United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
2016-CPA-0058

OCT 0 6 2016

Mr. Bob Peyton, Refuge Manager
Midway Atoll National Wildlife Refuge
U.S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, HI 96850

Re: Final Fish and Wildlife Coordination Act (FWCA) 2(b) Planning Aid Report (PAR) for the Midway Seawall Long-Term Maintenance project, Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial

Dear Mr. Peyton:

The U.S. Fish and Wildlife Service (Service) Pacific Islands Fish and Wildlife Office (PIFWO) has completed the Final FWCA 2(b) PAR for the Midway Seawall Long-Term Maintenance project, Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial, which is enclosed with this communication. The project is co-sponsored by the U.S. Fish and Wildlife Service National Wildife Refuge system (Refuges) and the Federal Aviation Administration (FAA). This report has been prepared in accordance with the requirements of section 2(b) of the FWCA of 1934 [16 U.S.C. 661 *et seq.*; 48 Stat. 401], as amended. The purpose of the biological survey was to document fish and wildlife resources at the proposed project site and to insure that fish and wildlife conservation receives equal consideration with the other proposed project objectives as required under the FWCA. The report includes both a qualitative and a quantitative assessment of the fish and wildlife resources at the proposed project site, an evaluation of potential impacts associated with the project design alternatives, and recommendations for fish and wildlife mitigation measures. All of the recommendations were proposed in cooperation with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA/NMFS), Pacific Islands Regional Office in Honolulu, Hawaii.

Specific coral mitigation actions are not recommended in the document. During the Draft FWCA comment period, an additional discussion was requested to occur between PIFWO, NOAA/NMFS, Refuges, and the FAA. The discussion was not initiated during that time, therefore specific recommendations could not be included in the Final FWCA. The Final FWCA includes additional comments and concerns from NOAA/NMFS in Appendix F. A discussion on mitigation options should occur before the completion of the Draft Environmental Assessment

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and the issuance of the Department of Army permit. Not doing so may delay the process for an issue that is time sensitive.

The Service appreciates the opportunity to coordinate with the U.S. Fish and Wildlife National Wildlife Refuge System and the Federal Aviation Administration on this project. If you have questions regarding the Final FWCA report, please contact Marine Biologist Nadiera Sukhraj (Nadiera_McCarthy@fws.gov) or the Aquatics Ecosystem Conservation Program. Office phone: (808) 792-9400.

Sincerely,

For Mary M. Abrams, Ph.D.
Field Supervisor

Enclosure
cc: NMFS-PIRO, Honolulu

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Phase 1 Marine Habitat Characterization and Phase 2 Marine Biological Assessment

Midway Seawall Long-Term Maintenance Midway Atoll National Wildlife Refuge & Battle of Midway National Memorial

Planning Aid Report - Fish & Wildlife Coordination Act

FINAL REPORT **October 2016**

Prepared for

U. S. Fish & Wildlife Service
Midway Atoll National Wildlife Refuge
abd
Federal Aviation Administration
Western Pacific Region

Prepared by

Nadiera Sukhraj and Gordon Smith
Pacific Islands Fish & Wildlife Office
Honolulu, Hawaii

FINAL
FISH AND WILDLIFE COORDINATION ACT
Planning Aid Report

Seawall Long Term Maintenance Project
Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial

Prepared by

Nadiera Sukhraj, Ph.D. and Gordon Smith
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Aquatic Ecosystem Conservation Program
Honolulu, HI

Prepared for

U.S. Fish and Wildlife Service
Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial
Papahānaumokuākea Marine National Monument
Honolulu, HI

and

Federal Aviation Administration
Western Pacific Region
Honolulu, HI

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INTRODUCTION

Authority, Purpose and Scope

This is the U.S. Fish and Wildlife Service's (Service), Pacific Islands Fish and Wildlife Office (PIFWO), final report on plans developed by the National Wildlife Refuge System (Refuges); the Federal Aviation Administration (FAA), Airports Western-Pacific Region; and PND Engineers, Inc., for modifications to the southern seawall on Sand Island, at Midway Atoll National Wildlife Refuge. The contents of the report apply to the 5,720-ft. (1,606 m) section of seawall that was proposed in the February 2016 Draft Environmental Assessment: Seawall Long Term Maintenance Project, Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial. The intent is to apply for a Programmatic General Permit with the U.S. Army Corps of Engineers Honolulu District in order to address any future repairs or modifications to the existing seawall in the time period 2016-2026. As funding becomes available, construction can take place along segments of the wall that require immediate attention from threats such as erosion and design failure. This report has been prepared under the authority of the Fish and Wildlife Coordination Act of 1934 [16 U.S.C. 661 *et seq.*; 48 Stat. 401] (FWCA), as amended, and other authorities mandating Department of the Interior (DOI) concern for environmental values. This report is also consistent with the National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 852] (NEPA), as amended, and the Endangered Species Act (ESA) of 1973 [16 USC 1531 *et seq.*; 87 Stat. 884], as amended. Data collected will also assist with Essential Fish Habitat consultations through the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA NMFS) under the Magnuson-Stevens Fishery Conservation and Management Act, as amended. The purpose of this report is to document existing fish and wildlife resources across the entire proposed project site and to make certain that fish and wildlife conservation receives equal consideration with other proposed project objectives as required under the FWCA. The report includes an assessment of conspicuous diurnal fish and wildlife resources at the proposed project site, an evaluation of potential impacts associated with the proposed alternative actions, and recommendations for fish and wildlife mitigation measures.

The overall purpose of the project is to modify sections, as needed, within a 5,750-ft. section of the existing seawall. Part of the seawall protects the FAA-designated Extended-range Twin Operations (ETOPS) emergency landing site, at Henderson Airfield, on Sand Island, in order to have continued use of the runway for flights over the Pacific Ocean, while the adjacent portion protects USFWS National Wildlife Refuge land. The proposed action would utilize funds from both the FAA and Refuges. The existing seawall protects the runway and coastline from erosion and over-wash, however the seawall is over sixty years old and the original sheet piling has disintegrated in multiple locations, diminishing the integrity of the structure and causing sections to become unstable and others to fail. Improvements to the seawall design will allow the

continued use of the airfield and uninterrupted transportation of people and goods to the atoll. Proposed modifications include fill 50-ft. (15.2 m) upland of the designated section of shoreline that has failed and washed into the ocean, as well as the construction of a rock revetment approximately 40-ft. (12.2 m) seaward from the existing sheet pile seawall in order to protect the shoreline and the runway from long-term erosion. One project alternative and a No Action alternative were evaluated in this investigation, as follows: Alternative 1 – Removal of steel sheet piles from the damaged section of wall and replacement with an armor rock revetment, with a potential 287,500 sq. ft. (6.6 acres) footprint on the marine side and a potential 287,500 sq. ft. (6.6 acres) footprint on the upland side. All activities will occur from the landside; and Alternative 2 – No Action.

The construction of the seawall occurred in 1957-1958 in order to artificially stabilize the fill material that had been deposited to create the new shoreline. Approximately 25,000 ft. of the shoreline was armored with Z-sheet steel piles and new bulkhead with tie-backs. Over time, the steel sheet piles have corroded due to the exposure to seawater, storms, and other natural elements. Above the water line, there is evidence that over the years concrete, asphalt, metal debris, and rock, have been used to temporarily fill in the breaches in the seawall.

PIFWO biologists have discussed the proposed project with staff of the NOAA NMFS Pacific Islands Regional Office (PIRO) in Honolulu. Due to the geographic location of the project, it was not necessary to coordinate with the State of Hawaii Department of Land and Natural Resources, because there are no designated State waters at Midway Atoll.

Prior Studies and Reports

In November 2011, PND Engineers, Inc. completed a preliminary report on existing facilities and erosion at Sand Island to provide context for the development of a seawall repair along the southern coastline adjacent to Henderson Field (PND 2011). The report was used to project costs, logistics, and provide preliminary descriptions of alternatives to be considered.

In February 2013, informal and exploratory inventories of natural resources were conducted at Sand Island in the marine environment along the length of the existing seawall, and including supratidal and intertidal portions within the project area. The observations were qualitative in nature and were not meant to be used for impact assessment purposes or for quantifying resources present. The 100-ft. proposed area was included in the overall inventory. (USFWS, September 2013)

U.S. Army Corps of Engineers (USACE) permitted construction-related activities for the Midway seawall breach repair, which was undertaken by Chugach Alaska in June 2014 and completed in July 2014. Personnel completed the rock revetment in the 100 ft. section of shoreline and placed 18 inch stone to fill voids in the repair and to stabilize the structure.

In February 2016, PND Engineers, Inc., circulated a working Draft Environmental Assessment for a Midway Seawall Long Term Maintenance project on behalf of Refuges and the FAA, in order to solicit informal comments from all agencies involved on the project design, footprint, and potential impacts. At the time of transmittal of this Final PAR, the Draft EA had not been formally completed.

In June 2016, the PIFWO, in coordination with NOAA NMFS PIRO, submitted a Draft PAR to Refuges and the FAA for a 60 day comment period. During that time, a discussion was also requested by PIFWO and NOAA NMFS PIRO on possible compensatory mitigation for coral.

DESCRIPTION OF THE PROJECT AREA

The proposed project area is located at Midway Atoll, designated as the Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial (Midway NWR), and located within the Papahānaumokuākea Marine National Monument (Monument) (Figure 1). Midway Atoll is located in the northwestern part of the Hawaiian archipelago at 28° 12’ North latitude and 177° 21’ West longitude. Midway NWR was designated as a National Wildlife Refuge in 1988 and became a part of the Monument in 2006. Historically, the atoll was under the control of the U.S. Navy, but jurisdiction and control was transferred to the Department of the Interior under Executive Order 13022: Administration of the Midway Islands (November 1, 1996).

The land area of Midway NWR consists of three islands, with Henderson Airfield being located on Sand Island, the largest land mass within the atoll at 4.86 km^2. The major runway is located along the southern coastline, extending from the island’s southwestern point and terminating near the harbor. The shoreline is completely man-made and includes fill likely dredged from the harbor to create the entrance channel. Multiple sections of the existing southern seawall have been identified as extremely corroded and in need of immediate repair (Appendix C). The structural integrity of the seawall has been compromised at multiple locations, therefore Refuges and FAA are approaching the entire section of southern seawall as a possible repair area for permitting purposes. This will allow them to address repair areas on a shorter timeline and to reduce financial costs that would be associated with applying for a series of individual permits. PIFWO and NOAA/NMFS had previously suggested in 2013 that the applicants assess the cumulative impacts along the entire seawall in order to more accurately evaluate the cumulative impacts to resources and to avoid segmentation.

The seawall maintenance improvements will be the second U.S. Army Corps of Engineers permitted action at Midway NWR since the creation of the Papahānaumokuākea Marine National Monument in 2006.

FISH AND WILDLIFE RESOURCE CONCERNS AND PLANNING OBJECTIVES

The PIFWO's primary concerns with the proposed project include potential impacts to endangered species and other fish and wildlife resources due to planned project construction, and fill-related activities to be conducted in the marine environment. Specific PIFWO planning objectives are to maintain and enhance the existing significant habitat values at the proposed project site by (1) obtaining basic biological data for the proposed project site, (2) evaluating and analyzing the impacts of proposed-project alternatives on fish and wildlife resources and their habitats, (3) identifying the proposed-project alternative least damaging to fish and wildlife resources, and (4) recommending mitigation for unavoidable project-related habitat losses consistent with the FWCA and the Service's Mitigation Policy (Service 1981, 2016 revision in progress).

Under the authority of the ESA, the DOI and the Department of Commerce (DOC) share responsibility for the conservation, protection, and recovery of federally listed endangered and threatened species. Authority to conduct consultations has been delegated by the DOI Secretary to the Director of the Service and by the DOC Secretary to the Assistant Administrator for Fisheries of the National Oceanic Atmospheric Administration. Section 7(a)(2) of the ESA requires federal agencies, in consultation with and with the assistance of the Service or NMFS, to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitats. The Biological Opinion is the document that states the opinion of the Service or NMFS as to whether the federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

The Service's Mitigation Policy (Service 1981) outlines internal guidance for evaluating project impacts affecting fish and wildlife resources. The Mitigation Policy complements the Service's participation under NEPA and the FWCA. The Service's Mitigation Policy was formulated with the intent of protecting and conserving the most important fish and wildlife resources while facilitating balanced development of this nation's natural resources. The policy focuses primarily on habitat values and identifies four resource categories and mitigation guidelines. The resource categories are the following:

a. Resource Category 1: Habitat to be impacted is of high value for the evaluation species and is unique and irreplaceable on a national basis or in the local region.

b. Resource Category 2: Habitat to be impacted is of high value for the evaluation species and is relatively scarce or becoming scarce on a national basis or in the local region.

c. Resource Category 3: Habitat to be impacted is of high to medium value for the

evaluation species and is relatively abundant on a national basis.

d. Resource Category 4: Habitat to be impacted is of medium to low value for the evaluation species.

The habitat of major concern evaluated at Midway NWR was "coral reef habitat". Coral reef habitat, including sub-habitats such as live rock, artificial structures, crevices, and depressions in the reef, comprises the biological community within the proposed project site. The institutional significance of U.S. coral reefs has been established through their designation as Special Aquatic Sites under the Clean Water Act (40 CFR Part 230 §230.44/45 FR 249) (CWA) and as a Federal Trust Resource (Executive Order [E.O.] 13089 on Coral Reef Protection). These areas possess special ecological characteristics of diversity, productivity, habitat, wildlife protection, and easily disrupted biological integrity, and contribute to the general overall environmental health or vitality of an entire ecosystem in a region. As of April 2016, there are no coral species in this region of the Pacific Ocean listed as endangered under the ESA [http://www.fpir.noaa.gov/PRD/prd_coral.html]. The April 2014 final listing determination by NOAA, lists 15 coral species as threatened in the Indo-Pacific, and none of those are known to exist at Midway Atoll NWR. (NOAA 2014)

Coral reefs are relatively scarce on a national basis and are currently in a world-wide state of decline (Wilkinson 2008). In 2008, The *State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States* reported that "coral reef ecosystem resources have continued to decline over the short- and long-term" (Waddell and Clark (eds.) 2008). In Hawaii, coral reefs have been subjected to extensive historical and recent adverse impacts, and the extent of healthy and productive coral reefs has declined, particularly around several of the main Hawaiian islands (*e.g.*, Oahu, Maui, and Molokai Islands) (Waddel 2005). The Service considers most coral reef habitat in the U.S. Pacific to fall under either the Resource Category 1 or 2 designations. The proposed project site is considered Resource Category 2 habitat due to the presence of live coral and coral reef associated organisms. The Service's resource goal for Category 2 habitat is no net loss of in-kind habitat values. Under this designation, PIFWO and NOAA/NMFS will recommend ways to mitigate losses, through measures to avoid or minimize significant adverse impacts. In the event losses are unavoidable, measures to immediately rectify, reduce, or eliminate losses commensurate with project permitting, licensing or implementation will be recommended under the FWCA as necessary compensation for the replacement of in-kind habitat values. An effective and verifiable mitigation program planned and executed by the project proponent is required under the CWA.

Corals were selected as the primary evaluation species for this analysis because coral colonies provide the basic foundation for habitat that supports other invertebrates and reef fishes. Corals contribute a large amount of the calcareous raw material that forms and maintains the basic structural framework of the reef, and add significantly to the submarine topographic relief in

which a large number of fish and invertebrate species find shelter and food. Coral polyps themselves are an important food source for some fishes and other marine life.

Reef fish, algae, and non-coral invertebrates were also selected as evaluation species for the analysis. The species assemblages selected for study are known to be sensitive to land and water use actions, play roles in nutrient cycling and energy flow, utilize common environmental resources, and may serve as "early warning" or indicator species for the affected fish and wildlife community at the proposed project site. Selection of a diverse assemblage of organisms allows an evaluation at the community level to provide a broader ecological perspective of the project site's relative contribution to the overall coral reef resources that occur adjacent to the seawall.

COMBINED FWCA EVALUATION

The proposed area for evaluation can be seen in Figures 2 and 3. The FWCA fieldwork is usually conducted in two separate phases, with Phase 1 guiding the design of the quantitative study in Phase 2. Due to the logistics challenges of conducting fieldwork at Midway Atoll NWR, budget constraints, and the timeline of the permit application, PIFWO offered to conduct both studies simultaneously. Adjustments were made to both phases in order to complete the tasks in the time given and with logistical constraints. These will be described in the relevant methodology sections. Phase 1 involves assessing the coastal community and mapping benthic marine resources within the nearshore marine environment. Phase 2 involves quantifying taxonomic groups within and adjacent to the project footprint, and includes both ESA and non-ESA species. The quantitative information also includes data necessary for NOAA NMFS to conduct their Essential Fish Habitat consultation and to estimate compensatory mitigation, if required.

Phase 1: Marine Habitat Characterization/Benthic Habitat Mapping

Phase 1 was a benthic mapping exercise that included a survey of the coastal and marine community and habitats within the Midway Seawall Long Term Maintenance proposed project area. Survey data were used to characterize habitats and substrate composition as well as to identify areas that could be negatively impacted by project construction and operational activities, and that may require mitigative measures if project impacts cannot be avoided. The results of this survey phase qualitatively identified the presence of coastal and marine species, and also identified unique habitat and sub-habitat features within and outside of the project area. Additionally, the results of this survey phase will include a description of the level of colonization and ecological functions of the community of marine life in the project area and identified depth gradients, turtle resting sites, and invasive species.

Phase 2: Quantitative Marine Biological Assessment

Phase 2 was a detailed quantitative marine survey, including the collection and analyses of the diversity, size, density, and biomass of coastal and marine species that exist at the project site, inside and outside of the project footprint. These data were used to identify and quantitatively analyze ecologically important functional groups that may possibly be affected by activities associated with a planned water resource development project. Furthermore, quantitative data are helpful in scaling appropriate compensatory mitigation, consistent with the Environmental Protection Agency and Department of the Army, Corps of Engineers Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (FR/Vol.73, No. 70, April 10 2008).

PHASE 1: Marine Habitat Characterization
EVALUATION METHODOLOGY

The Phase 1 data collection was conducted from April 14-18, 2016. For Phase 1, only the horizontal component was evaluated for the benthic habitat map modeling. This project is unique in that there is a vertical (sheet pile and previous fill) component and a horizontal component (benthic habitat). In addition, a roving survey was conducted along and adjacent to the existing seawall in order to capture species present in the project footprint, both vertical and horizontal. The species observed from the roving surveys and Phase 2 will compose the overall species lists by taxa for this area.

Phase 1 Survey Protocols

Field Data Collection

Two biologists (Nadiera Sukhraj, Gordon Smith, USFWS PIFWO) using snorkel gear, collected information on the habitat and biological community within the proposed project footprint and an adjacent buffer. SCUBA was not used due the remote location of the field site, no working compressors for air refills, and additional lack of resources that would violate national USFWS diving regulations and restrictions. This limited the survey activities of the biologists as they had to work with the tides in order to evaluate resources in places where the water column was up to 6m depth. The survey area was based upon a proposed footprint along the southern seawall received from PND Engineering before departure from Honolulu.

The biologists filled the roles of 1) a coral biologist and 2) an invertebrate/algae biologist and were equipped with digital cameras, dive watches, floated Global Positioning System (GPS) units, and datasheets attached to a clipboard to record data. The time on the digital camera was synchronized with the GPS units by photographing the time of the GPS unit before entering the water (actual synchronization occurs with processing the photos in geo-referencing software such as GPS Photolink© or GeoJot+ ©). In addition, the time difference between the dive watch and GPS unit was recorded. The team was familiar with the proposed project area and had pre-

determined starting points and areas for the initial survey transects. The amount of survey transects needed to cover an area of interest was based on environmental conditions in the field such as depth, water clarity, weather conditions, size of area of interest, and the complexity of habitat and biological community. A survey transect consisted of the team collecting habitat and biological information as described below along a walking path with a handheld GPS unit or a swim path while towing a floated GPS unit. Two GPS units were used to collect geo-positioning data by each team to help minimize possible gaps in the track log from a GPS malfunction, setting error, signal loss, or other problem. The floated GPS units were always maintained/aligned directly above the team, with the team remaining in close proximity to each other to minimize spatial error between biologists and GPS. All survey transects were also marked by a starting waypoint and an ending waypoint. GPS units were set to the local time and set to record a track log automatically at 5 second intervals. The GPS settings were verified at the start of each day before data collection.

Both biologists collected data on observed habitat zones and structures as well as their respective biological group. Data were recorded at a frequency of every 10 to 15 seconds depending on the habitat area and speed of swimming. This information was collected on a datasheet and each observation was recorded with a time of day. The time of day with the dive watch-GPS offset recorded at the beginning of the day determined the GPS time and subsequent GPS coordinates of the observation. The visual area was estimated individually by each biologist as the area that was qualitatively evaluated based on water clarity, rugosity of habitat, complexity of habitat, and other environmental conditions that limit visual distance. One biologist was assigned as the navigator and followed a pre-determined compass bearing, habitat boundary, or other criteria that determined the survey transect path. A second biologist was assigned the duty for towing the dive float with the GPS units.

Habitat photographs were taken approximately every 30 ft. (10 m) or as often as was practical to document habitat characteristics. Additional photos were taken when there was a change in benthic habitat type, a sub-habitat or unique feature, a rare or protected species, invasive or alien species, or when disease was observed. Digital photographs were taken at a 45º angle to the benthic substrate to document habitat features and at a 90º angle to capture the general landscape. All divers carried cameras and assisted in taking photographs of habitat and species observations.

Habitat Terminology and Characterization

Habitat terminology used was modified from Battista *et al.* (2007) and is summarized in the section called Habitat Zone Terms. Although the classification of Battista *et al.* (2007) was not developed specifically for impact assessments, the terminology and characterization framework was deemed generally appropriate for the purposes of characterizing habitats for this Phase 1 survey. The framework described in Battista *et al.* (2007) includes three data layers of habitat information, consisting of a classification of geographic zones, geomorphological structures, and

biological cover. The biologists used the geographic zone terms, geomorphological structures, major geomorphological structures, and biological cover. The geographic zone terms, geomorphological structures, and major geomorphological structures are used with slight modification. The "geographic zones" were subsequently called "habitat zones," the "geomorphological structures" were subsequently called "habitat structures," and "major geomorphological structures" were subsequently called "major habitat structures." The biological cover classification scheme of Battista *et al.* (2007), was not used. Instead, the biological cover classification scheme used was modified and expanded substantially from Battista *et al.* (2007), as described below in Biotic Characterization.

Habitat zones were generally determined prior to entering the water or after exit of the dive, since these terms are broad in nature. Habitat structures were determined in the water to the best ability of the biologist. Although water clarity and conditions can impact a diver's ability to determine the specific habitat structure, this information can be generally determined while in the water. Biologists, particularly the navigator, followed along a habitat structure boundary when appropriate in order to assist with further delineation between habitat structures. The boundaries between habitat structures was also evaluated and refined during the data processing phase (see Habitat Map Production methods). In addition to habitat structures, the types of unconsolidated sediments observed were also noted, being scored as present or absent. These include sand, mud, rubble, and cobble.

Habitat Zone Terms

Land – Terrestrial features above the spring high tide line.

Shoreline Intertidal – Area between the mean high water line (or landward edge of emergent vegetation when present) and lowest spring tide level (excluding emergent segments of barrier reefs).

Vertical Wall – Area with near-vertical slope from shore to shelf or shelf escarpment. This zone is typically narrow and may not be distinguishable in remotely sensed imagery, but is included because it is recognized as a biologically important feature.

Reef Flat – Shallow, semi-exposed area between the shoreline intertidal zone and the reef crest of a fringing reef. This zone is protected from the high-energy waves commonly experienced on the shelf and reef crest.

Lagoon – Shallow area (relative to the deeper water of the bank/shelf) between the shoreline intertidal zone and the back reef of a barrier island. This zone is relatively protected from the high-energy waves commonly experienced on the bank/shelf and reef crest. If no reef crest is present there is no lagoon zone.

Back Reef – Area between the seaward edge of a lagoon floor and the landward edge of a reef crest. This zone is present when a reef crest and lagoon exist.

Reef Crest – The flattened, emergent (especially during low tides) or nearly emergent segment of a reef. This zone lies between the back reef and fore reef zones. Breaking waves will often be visible in aerial images at the seaward edge of this zone.

Fore Reef – Area from the seaward edge of the reef crest that slopes into deeper water to the landward edge of the bank/shelf platform. Features not forming an emergent reef crest but still having a seaward-facing slope that is significantly greater than the slope of the bank/shelf are also designated as fore reef.

Bank/ Shelf – Deep water area (relative to the shallow water in a lagoon) extending offshore from the seaward edge of the fore reef to the beginning of the escarpment where the insular shelf drops off into deep, oceanic water. The bank/shelf is the flattened platform between the fore reef and deep open ocean waters or between the shoreline/intertidal zone and open ocean if no reef crest is present.

Bank/ Shelf Escarpment – The edge of the bank/shelf where depth increases rapidly into deep, oceanic water or to another bank/shelf.

Channel – Natural channels or reef passes that often cut across several other zones (does not include artificial channels for harbors).

Harbor – Area that is used for vessel mooring and is generally considered to be inside the outer points of the rock jetty at the mouth of the harbor entrance.

Habitat Structure Terms

Aggregate Reef – High vertical relief relative to pavement lacking sand/rubble channels of spur and groove. (Major Structure: Hard Bottom)

Spur and Groove – High vertical relief relative to pavement having alternating sand/rubble (groves) and reef (spurs) formations (greater than 1 meter). (Major Structure: Hard Bottom)

Patch Reef – Coral formations that are isolated from other coral reef formations by sand, seagrass, or other habitats and that have no organized structural axis relative to the contours of the shore or shelf edge. (Major Structure: Hard Bottom)

Rock/Boulder – Continuous rocks/boulders (carbonate or basalt greater than 25 cm) with coverage of macroalgae, corals, and other benthic invertebrates. (Major Structure: Hard Bottom)

Pavement – Flat, low-relief, and solid (carbonate or basalt substratum) bottom with coverage of macroalgae, coral, and other benthic invertebrates that are dense enough to begin to obscure the underlying surface. (Major Structure: Hard Bottom)

Pavement with Sand Channels – Habitats of pavement with alternating sand/rubble channel formations. The sand/rubble channels of this feature have low vertical relief relative to spur and groove formations (less than 1 meter). (Major Structure: Hard Bottom)

Reef Hole – An area where a depression exists from the surrounding reef area. These do not include large, expansive basin features, but smaller reef features. (Major Structure: Hard Bottom)

Scattered Coral/Rock in Unconsolidated Sediment – Primarily unconsolidated sediment bottom with scattered rocks/ boulders or small, isolated coral heads that are too small to be delineated individually (i.e. smaller than individual patch reef). (Major Structure: Unconsolidated Sediment)

Unconsolidated Sediment – Area comprising of sand, mud, rubble, or cobble without isolated scattered coral/ rocks or large corals. See definitions of sediment terms below for sand, mud, rubble, and cobble. (Major Structure: Unconsolidated Sediment)

Artificial – A structure that cannot the classified as any other structure that includes harbor pilings or other harbor, development structure. (Major Structure: Hard Bottom)

Sediment Terms

Sand – defined as sediment that has a visual grain size (estimated to be 0.0625 to 10 mm)

Mud – defined as sediment that is difficult or impossible to determine grain size

Rubble – limestone rubble or gravel that is comprised of limestone greater than sand, but less than 25 cm in diameter

Cobble – basalt rubble or gravel that is comprised of basalt or other non-limestone material greater than sand, but less than 25 cm in diameter (note if material is artificial).

Biotic Characterization

The biologists collected information on various biological groups/categories and conducted a species inventory along the horizontal (benthic) component only for the habitat mapping portion. Species observed on the vertical (artificial sheet pile and rip rap) components were recorded during the additional roving surveys and used for species lists only. The information on the various biological groups/ categories (as described below) were recorded at a frequency of every 10 to 15 seconds depending on the habitat area and speed of swimming. The biotic characterization includes three main survey components (coral, algae/invertebrate, and fish/protected species) and each main component has multiple data collection components. The inclusion, exclusion, or alteration of each main survey component or data collection component can be project specific and should be commensurate with the project and/ or regulatory needs. For this project, collection of reef fish data for habitat mapping was not a priority and therefore, no data was collected.

Coral Data

The coral surveyor collected information on up to six different components of the coral population within an area. These six components included the relative abundance of stony coral, stony coral growth forms observed, estimated stony coral sizes present, presence of non-stony corals, location of proposed ESA corals, and an overall coral species list (includes all anthozoan species). Details for each component are below. Each observation was collected with the specific time (hh:mm:ss) that was later converted to a GPS coordinate. The visual distance (in terms of a radius) in meters that was reasonably assessed for coral was recorded. The observer also carried an underwater camera to take photographs of representative habitats, representative coral communities, coral colonies for species identification, or any other notable feature of interest.

Component 1 – Relative abundance of coral was recorded utilizing a modified DACOR method. DACOR stands for dominant, abundant, common, occasional, and rare, and categories were recorded on a 1-5 scale with 1 being Rare and 5 being Dominant. Zero was used for coral absence. Each category was approximated to represent a broad range of percent coral cover such as: 1 – <1% (scattered corals), 2 – <10%, 3 – 10-50%, 4 – 50-80%, and 5 – >80%.

Component 2 – The stony coral growth forms include: 1) lobate/massive (lm), 2) conical (con), 3) small-branching (sb), 4) medium-branching (mb), 5) large-branching (lb), 6) digitate (d), 7) columnar (cm), 8) table (t), 9) plate (p), 10) foliaceous (f), 11) encrusting (e), 12) free-living (fl), and 13) mixed (mix). Mixed growth forms include forms like plates and column (p/l) and plates and branched (p/b), but other combinations exist and should be noted. The distinction between small and medium branching colonies was made by using the approximate diameter of a pencil (< 1 cm) while the distinction between medium and large branching colonies was made by using the approximate diameter of a small wrist (< 5 cm).

Component 3 – For each growth form observed, the sizes observed were recorded into broad size categories that included: 1) small (s) - included colonies estimated less than 50 centimeters, 2) large (l) - included colonies greater than 50 cm, 3) mixed (m) - included colonies of both small and large, and 4) extra-large (x) - included colonies greater than 2 meters.

Component 4 – Non-stony coral groups were recorded as present or absent and the groups included: 1) soft corals (sc), 2) zoanthids (z), gorgonians or sea fans (g), and black or wire corals (bc). Other groups (*e.g.*, hydrocorals) can be added if deemed important or included in the comment section.

Component 5 – Corals listed, proposed, or petitioned were recorded as well. These corals should be sized the same as the previously described coral morphologies. In Hawai'i, there are three currently proposed coral groups that are reasonable for a single coral observer to record. The

corals include *Acropora paniculata* (ap), *Monitpora dilitata*/ *flabelata*/ *turgescens* (m d/f/t), and *Montipora patula*/ *verrilli* (m p/v).

Component 6 – The final component conducted by the coral observer was to compile an overall species list for all anthozoan corals observed. Species were identified to the lowest taxonomic level possible, either *in situ* or by subsequent examination of photographs taken on-site. The species inventory should not be assumed to be a comprehensive list of all species and likely missed certain cryptic or hard to identify species. The inventory component was the lowest priority activity.

Algae/ Non-Coral Invertebrate Data

The algal/invertebrate observer collected information on up to eight different components. These components included relative abundances for seagrass, turf algae, coralline algae, filamentous algae, macroalgae, and several invertebrate groups. The observer also recorded observations of debris. Additionally, the observer developed an overall species list for algae and non-coral invertebrates. The details for each component are below. Each observation was collected with the specific time (hh:mm:ss) that was later converted to a GPS coordinate. The visual distance in meters that was reasonably assessed was recorded. The observer also carried an underwater camera to take photographs of representative habitats, representative algal and invertebrate communities, algae and invertebrates for species identification, or any other notable feature of interest.

Component 1 – Relative abundance for seagrass was recorded on a scale of 0-3. Zero was used for seagrass absence. Category one represented seagrass abundance that consisted of isolated patches and did not have continuous coverage within an area. Category two represented seagrass that had a semi-continuous or continuous coverage, but had a low density of blades. Category three represented seagrass with a continuous coverage and had a high density of blades or a tall canopy height.

Component 2 – Relative abundance for turf algae was recorded on a scale of 0-3. Zero was used for turf algae absence. Category one represented turf algae that had sparse or patchy coverage and/or low density of turf algae. Category two represented a moderate, semi-continuous coverage and a low to moderate density of turf algae. Category three represented a continuous coverage and a high density of turf algae. Turf algae for the purpose of this assessment were sparse to thick multi-specific assemblage of diminutive and juvenile algae less than 2-3 cm in canopy height.

Component 3 – Relative abundance for coralline algae was recorded on a scale of 0-3. Zero was used for coralline algae absence. Category one represented a sparse or patchy coverage of coralline algae. Category two represented a moderate or semi-continuous coverage of coralline

algae. Category three represented a continuous coverage of coralline algae. Coralline algae was assessed for readily visible corallines mostly that are red or pink on the reef surface. The observer did not look in holes or under rocks to assess the coralline algae abundance.

Component 4 – Relative abundance of filamentous algae and cyanobacteria was recorded on a scale of 0-3. Zero was used for absence of filamentous algae or cyanobacteria. Category one represented a sparse or patchy coverage of filamentous algae or cyanobacteria. Category two represented a moderate or semi-continuous coverage of filamentous algae or cyanobacteria. Category three represented a continuous coverage and a high density of filamentous algae or cyanobacteria. Filamentous algae for the purposes of this assessment was defined as hair-like plants that do not form a substantial thallus and not forming a coherent tissue (definition modified from Huisman *et al.* 2007, page 254).

Component 5 – Relative abundance of macroalgae was recorded on a scale of 0-3. Zero was used for macroalgae absence. Category one represents sparse or patchy (even individuals plants) and a low density of macroalgae. Category two represents moderate, semi-continuous coverage and a low to moderate density of macroalgae. Category three represents a continuous coverage with a high density of macroalgae. In addition to recording the relative abundance, four forms of macroalgae are recorded as being present or absent and include short frondose, tall frondose, Halimeda algae, or invasive macroalgae. Short frondose macroalgae is defined as having a maximum canopy height of 20 cm and tall frondose macroalgae is defined as a canopy minimum canopy height of 20 cm. Invasive macroalgae is specifically defined for six species groups in Hawai'i that include *Acanthophora spicifera*, *Gracilaria salicornia*, *Gracilaria tikvahiae*, *Avrainvillea amadelpha*, *Hypnea musciformis*, and *Euchuma*/ *Kappaphycus* complex. There may be invasive algal species in other jurisdictions, but they are not readily known to be invasive at this time.

Component 6 – Relative abundance for all non-coral invertebrates were recorded on a scale of 0-3. Zero was used for invertebrate absence. Category one represented an observation of 1-2 individuals. Category two represented the observation of 3-10 individuals. Category three represented the observation of greater than 10 individuals. If an aggregation of significantly more than 10 individuals was observed, this was recorded in the comments section. Any macro-invertebrate of interest can be targeted based on the project needs or the fulfillment of specific regulatory needs (particularly essential Fish Habitat species of concern, ESA listed species, or any species of concerns) within the local jurisdiction. The proposed invertebrate groups for Hilo Commercial Harbor included grazing sea urchins (urc), rock boring sea urchins (rb), crown-of-thorn starfish (ct), lobsters (lob), *Pinctada* spp. (pinc), giant clams (gc), anemones (an), and sea cucumbers (cuc). In addition, the presence and absence, but not relative abundance of sponges (sp) in all forms and shapes were recorded.

Component 7 – The observation of any marine debris (deb) of remnant structure underwater was recorded as present or absent and the type of structure or debris was noted.

Component 8 – The final component that was conducted by the algae/ invertebrate observer was to compile an overall species list for all algae and invertebrate species observed. Species were identified to the lowest taxonomic level possible, either *in situ* or by subsequent examination of photographs taken on-site. This species inventory should not be assumed to be a comprehensive list of all species, and likely missed certain cryptic or hard to identify species. The inventory component was the lowest priority activity.

Post-Field Work Data Processing

Data Preparation

At the end of each dive day, digital images and GPS information were downloaded using appropriate software. Images were placed into daily folders and GPS data downloaded using DNRGPS 6.0© as a tab-delimited or comma-delimited text file (.txt). Upon returning to the office, benthic data was entered into a Microsoft Access© database. Images were used as documentation of habitat and marine resources, and serve as a permanent archive of the area. These can be georeferenced if necessary with other software (GeoJot+ ©). The images were not used for habitat classification. Representative habitat images for Phase 1 are shown in Appendix A.

After all data were entered into the Access database, the GPS data, dive data, habitat-coral data, and algae-invertebrate data were validated for errors or anomalies in the data. All errors were corrected. When completed, the data were outputted using the lowest time interval to synchronize the habitat data with the GPS data. The total number of habitat-coral and algae-invertebrate points was compared to the final *.dbf output to verify there was no significant loss of data during synchronization. If significant data was lost, then use of a longer time interval to synchronize the data was evaluated.

Corals, algae and non-coral macro-invertebrates species encountered at each site were identified to the lowest taxonomic level possible, either *in situ* or by subsequent examination of photographs taken on-site. All species identifications, nomenclature, and taxonomy were confirmed by Hoover 1993, Randall 1996, Hoover 1999, Fenner 2005, Huisman *et al.* 2007, Froese and Pauly 2014, Van Soest *et al.* 2014, Appeltans *et al.* 2014, and Guiry and Guiry 2014, or by using the appropriate global species database such as International Commission on Zoological Nomenclature, Zoobank, Algaebase, World Register of Marine Species, Biogeoinformatics of Hexacorals, Global Biodiversity Information Facility, Fishbase, or any others deemed appropriate. The species observed were tabulated for presentation (Tables 2, 3,4, 5).

Data Processing

Habitat map data layers are produced with a custom built toolbox using Modelbuilder in ArcGIS© 10.1. The toolbox consists of three models. Model 1 conducts a series of geoprocessing steps which produces final data layers such as a habitat point shapefile, protected species point shapefile, debris point shapefile, project area shapefile, target area shapefile, observed area shapefile, and a draft habitat structure shapefile. Model 2 conducts a series of additional geoprocessing steps which produces final data layers such as coral point shapefile, algae point shapefile, invertebrate point shapefile, habitat zone shapefile, habitat major structure shapefile, and a final habitat structure shapefile. Model 3 conducts a series of interpolations for various biological groups as described previously. These biotic interpolations are created with the Inverse-Distance Weight (IDW) Interpolation tool in Spatial Analysts.

An area enclosure and target area shapefiles need to be prepared prior to running the model. The "target area" shapefile represents the anticipated direct impact area of the proposed action. The "area enclosure" shapefile represents the area that bounds the total project area. The model requires these two shapefiles as well as the two *.dbf outputs from the database. Manual processing of a Theissen polygon should occur between Models 1 and 2. The draft Theissen shapefile is manually edited to best characterize habitats (zones, major structure, structure, and sediment) and determine boundaries between various habitat structures. The boundaries of the habitat structures are determined by: 1) direct observation, 2) transects that were walked along or swum along habitat structure transition boundaries (i.e. scattered rock in unconsolidated sediment on one side and unconsolidated sediment-sand on the other side), 3) utilizing NOAA's Benthic Habitat Maps where deemed appropriate, or 4) any other data source that provides information on habitat structures. These boundaries may not represent the exact delineation between habitat structures, but serve as an estimate based on the available information. After the boundaries are drawn for each habitat character, the edited Theissen polygon should be validated to reassure all changes are correct and complete. Finally, Models 2 and 3 are run to complete habitat map data layer processing. The data layers should be added to a map to validate the layers are complete.

Habitat Map Production

Once the habitat map data layers were produced and verified, the final set of formatted maps were produced with a custom built Python© map production script. This script produces 28 final formatted maps that provide a complete characterization of the project. If needed, additional smaller scale maps can be produced to provide a fine scale characterization. For this project, there is a division of the area based on responsibility by agency.

DESCRIPTION OF FISH AND WILDLIFE RESOURCES

Project Area

The project area at Sand Island, Midway NWR includes a possible 6.6 acres of upland fill and a possible 6.6 acres of fill in the marine environment from the construction of rock revetment to replace the failing seawall structure. The project area is located along a 5,720-ft. (1,606 m) section of seawall (Figure 2). For the habitat mapping characterization activity, only the shoreline and submerged areas seaward of the existing sheet pile were included. The project area also included the silt curtain boundary, an additional area of impact, as depicted in Figure 3. The project area is very long and for the purpose of illustration, the project area has been divided into three different displays: the entire project area and SubMaps A and B (Figures 4 and 5). Since there is some overlap between the submaps, reporting habitat features and species observations may be to some extent redundant or otherwise contain similar descriptions. Figures 6a-c illustrate the areas observed versus not observed. Areas not observed were interpolated for both geomorphology and biological cover of key groups.

Geomorphology

General

The majority of the proposed project area habitat zone is designated as Reef Flat (Figure 7). This section of Sand Island was built with fill on top of an existing reef flat, resulting in a hardened shoreline. The small area that is characterized as shoreline intertidal is an area filled with rip rap and sediment. The sharp distinction between land and reef flat has been gone for years in most of this area. The sheet pile boundary is no longer present, as vegetation now grows where the seawall used to be and seabirds have created burrows. The combination of sediment and rip rap allows for a gradual slope down to the reef flat. Figure 8 illustrates the major habitat structures, Hard Bottom and Unconsolidated Sediment, for the project area as well as the area that was surveyed by the biologists. The “corner” of the seawall on the eastern portion of the map is an area where temporary debris and rip rap has been dropped over the years in an attempt to combat the erosion problem. There is no longer natural bottom in that section as it has been replaced by artificial cover (Appendix A). Figures 9a-c illustrate the various sediment types observed with the unconsolidated sediment areas. There is a large amount of sand in the project area. Figure 10 identifies the habitat structures observed within the surveyed project area. Figure 11 illustrates debris observed within the surveyed project area. It is an underrepresentation of the actual debris present, because debris and rip rap were observed throughout the majority of the benthic habitat adjacent to the sheet pile seawall. Marking every piece of debris would have been time consuming and detracted from the collection of the mapping and biological data that were the primary focus of this survey.

Table 1 identifies the areas of Habitat Zone, Major Structure, Sediment and Habitat Structure within the area surveyed as approximately 8.02 acres (32,441 meters squared (m^2)). The major habitat structures within the area surveyed consist of approximately 5 acres (20,289 m^2) of unconsolidated sediment and 3 acres (12,151 m^2) of hard bottom. Within the unconsolidated sediment major structure habitat layer, approximately 4.24 acres (17,176 m^2) was sand and rubble and 0.77 (3,112 m^2) acres was only sand. The areas that were classified as "Artificial" are the areas of shoreline represented in Figure 8. They are not recent additions and have colonization by multiple marine species.

Geomorphological and Biological Characterization

General

Within the project area the relative abundance of various biological groups was estimated. These groups included stony corals, soft corals, zoanthids, frondose algae, crustose coralline algae, turf algae, filamentous algae, herbivorous urchins, rock boring urchins, sea cucumbers, crown-of-thorns starfish (*Acanthaster planci*), lobsters, black lipped pearl oysters (*Pinctada margaritifera*), anenomes, octopus, and sponges. Sea grass was not observed within the project area and is therefore not discussed further in this report. Figures 13a-30 show the geomorphology and relative abundance of all of the above groups across the area surveyed.

Table 2 lists the ninety-seven reef fish species observed from twenty-seven families during the Phase 1 and Phase 2 surveys, including a manta ray (*Manta alfredi*). Table 3 lists the nine coral species that were observed within the project target area during the Phase 1 and Phase 2 surveys. Phase 1 does not include coral colonies on the vertical sheet pile seawall. The most commonly observed colonies were branching forms of *Pocillopora damicornis*, *Pocillopora meandrina*, and *Pocillopora ligulata*. *Porites lobata*, *Cyphastrea ocellina*, *Lesptastrea purpurea*, and *Montipora flabellata* were observed in encrusting form only. Coral colonies were observed growing on natural substrate, rip rap, and debris (Appendix A). No ESA-listed corals were found in or adjacent to the project area. Table 4 lists the non-coral macroinvertebrate species observed throughout the area during Phase 1 and Phase 2. A total of 32 species were observed with the most common phyla observations from Echinodermata and Mollusca. Unidentified infauna were observed throughout the range of the unconsolidated sediment. Table 5 summarizes the marine plant species observed in the project area during Phase 1 and Phase 2. An estimated total of 28 algae species were observed. The crustose coralline algae and turfs were not identified to species but are noted in the table. All four phyla were observed distributed throughout the project area, including on artificial structures and debris. The most abundant and common species observed was the red macroalgae *Aparagopsis taxiformis*. Sea grass was not observed during the survey period. No ESA-listed species were observed during Phase 1, resulting in a blank map (Figure 12) but their presence in the survey area was recorded during Phase 2.

Submap A

Submap Area A contains two of the Priority Repair Areas shown in Figure 31 and listed in Appendix C. There is a larger amount of debris on the benthic habitat than in Submap B. The area covered by Submap A was surveyed by a combination of shoreline walks along the rip rap and shore-based snorkeling. Water quality conditions were manageable, as both biologists paid attention to the current and the proximity to hard structures such as the seawall and rip rap shoreline, in order to prevent injury. The bottom was a combination of hard bottom and unconsolidated sediment. The majority of the hard bottom was on the western end of the project area where rip rap has been placed in the marine environment over time to prevent erosion of the coastline adjacent to the operational runway. Crustose coralline algae was dominant on the hard structures and debris. Coral colonies were observed mostly near the rip rap and will be summarized in Phase 2. No sponges or sea grass were observed in the Submap A area.

Submap B

Submap Area B contains one of the Priority Repair Areas shown in Figure 31 and listed in Appendix C. The area covered by Submap B was surveyed by shore-based snorkeling only and had areas with depth of greater than 5 m, especially around the “L”-shaped corner. The bottom was a combination of hard bottom and unconsolidated sediment, with the hard bottom occurring around the “L”-shaped corner and near the harbor channel groin. The hard bottom is where rip rap and other fill have been placed over time to prevent erosion of the coastline and are no longer natural benthic substrates. Encrusting and branching coral colonies were observed on both major structure types and will be summarized in Phase 2. No sponges or sea grass were observed in the Submap B area.

PHASE 2 – Quantitative Marine Biological Assessment

EVALUATION METHODOLOGY

The Phase 2 data collection was conducted from April 20-22, 2016. Two biologists (Nadiera Sukhraj, Gordon Smith, USFWS PIFWO) collected biological data within the proposed project footprint and an adjacent buffer. For Phase 2, both the horizontal (benthic) and vertical (sheet pile) components were evaluated for baseline data on coral and only the horizontal component was evaluated for reef fish data. Standard data collection methods were altered to accommodate both types of taxonomic collection, due to the unique circumstances, and are described below. Quantitative data were not collected for non-coral invertebrates or macroalgae based on the Phase 1 mapping surveys, logistics restrictions, reporting deadlines, and prioritizing data collection for NOAA NMFS data needs. If a new species of invertebrate or macroalgae was observed during the Phase 2 surveys it was recorded by the biologist to add to the Phase 1 list. All species observed in Phase 2 were added to those observed in Phase 1 for incorporation into the overall species lists (Tables 2,3,4,5). SCUBA was not used due to the unavailability of required safety equipment and air compressors. Both biologists collected all data using shore-based entry and snorkeling gear in water up to 5 m depth.

Phase 2 Survey Protocols

Field Data Collection: Survey Transects

Due to the size of the footprint, time limitation, and feasible water depths for observations without SCUBA, traditional transect methods were not used to evaluate resources and project impacts. All entry and exit occurred from the seawall via a temporarily secured ladder or from the deteriorating platform at the “L”-shaped corner of the seawall. Data on the benthic habitat collected in Phase 1 were used to create sampling strata for Phase 2. Due to time and logistic limitations, baseline species data was collected from only 26 random survey sites (Tables 6 and 7). A single 25-m transect line was used by all taxonomic groups for data collection, instead of 2, in order to increase the number of possible survey sites. The number of survey transects needed to cover the project survey area was based on environmental conditions in the field such as water depth, water clarity, weather conditions, size of area of interest, and the complexity of habitats and biological communities.

Two handheld GPS units enclosed in waterproof cases were attached to a surface dive float in order to collect start and end waypoints and a track log for the extent of the area surveyed (Appendix B). Two GPS units were attached to the dive float to ensure geo-positioning data was collected throughout the dive and to avoid possible gaps in the data from a GPS malfunction, setting error, signal loss, or other problems. The GPS units were used to collect the survey transect starting point, 0-m mark, and ending point, 25-m mark and these data will illustrate the location of each survey transect for reporting purposes. The surface dive float served as a

reference point for the Refuge and FAA staff in case of emergency in order to alert them of the location of the snorkelers in the water. Due to the amount of surge, the close proximity to the damaged seawall, and the amount of debris in the water column depth, the biologists had to swim in and out of the area in order make observations and take measurements.

The survey team was equipped with digital cameras, dive watches, floated GPS units, and datasheets attached to a clipboard to record data. The time on the digital camera was synchronized with the GPS units by photographing the time displayed on the GPS before entering the water (actual synchronization occurs with processing the photos in geo-referencing software such as GPS Photolink© or GeoJot+©). In addition, the time difference between the dive watch and GPS unit was recorded.

Reef fish

A belt transect protocol that is used in a variety of marine environments, particularly coral reef habitats (Maragos and Gulko 2000, Friedlander *et al*. 2003, Sandin et al. 2008, Minton et al. 2009, Sukhraj et al. 2010, Sukhraj 2014, Coral Reef Assessment and Monitoring Program (CRAMP)) was used to collect reef fish data. One biologist performed all fish surveys in order to minimize observer variability.

Fish observations were made by swimming along a single 25m x 4m belt transect. This was the same line being used for the coral data collection, therefore the start and end marks are the same. The biologist recorded both the number of fish by species and the size of all individuals encountered.

A weight was randomly dropped to mark the beginning of the transect line. The start and end of each belt transect was marked by a surface towed GPS unit. During the deployment leg of the transect line, the observer recorded size-class-specific (total length, TL) counts of all fishes greater than 5 cm within visually estimated but defined belt widths (2 m on each side of the line). On a normal transect, smaller (and more cryptic) fish (i.e., less than 5 cm long) would be counted during the “swim-back” leg. These observations were limited because the biologist not able to employ SCUBA. On most transects, new fishes larger than 5 cm were also counted on the swim-back leg. The vertical water column component (depth) of the belt survey areas was recorded for each survey attempt. Each fish was identified to species *in situ* to the lowest taxonomic level possible. In the case where a fish could not be identified to species, the genus was identified. The result was that the observer obtained a density estimate of all fishes > 5 cm total length (TL) within a 25-m long x 4-m wide (100 m^2) area.

In addition, observations of protected resources such as sea turtles and monk seals were recorded by the biologists.

Size class distribution

All individual reef fish observations were collected in centimeters of total length (cm TL). Each individual was assigned to a designated bin for determination of the current average TL for that species: 0 < 2 cm, 2 < 5 cm, 5 < 10 cm, 10 < 20 cm, 20 < 30 cm, 30 < 40 cm, 40 < 50 cm, 50 < 60 cm, 60 < 70 cm, 70+ cm. The bins are small so that they can be combined in multiple ways for comparison to other studies. Larger bins would have limited the data manipulation and increased error in the biomass calculation. Size class information was presented at the species level, not grouped at the family level, in order to identify the current length for those species at Sand Island.

Estimate of biomass

In order to calculate estimates of the biomass of herbivorous fishes per unit area for each fish species, a length-weight conversion, $W = a*(SL)^b$, was used to estimate the weight of all fish present at a site (where parameters *a* and *b* are constants, (*SL)* is standard length in millimeters, and *W* is the estimated weight in grams). This biomass estimate (expressed as metric tons per hectare) is a combined representation of both fish numbers and fish size per unit area and is widely used in fishery science. These results are useful for comparison with studies of coral reef habitat elsewhere in the western and central Pacific. Weight and length (total length or TL) information for over 150 Hawaiian fish species were obtained from a variety of literature and agency sources (FishBase; DAR pers. comm.; USFWS pers. comm). The database also contains conversion ratios from TL to SL. Total length is the straight-line length from the tip of the snout to the tip of the longer lobe of the caudal fin. Standard length excludes the length of the caudal fin. Due to the skill set of the observer, TL was measured. In cases where length-weight conversions were not readily available for a given species, values were used from a proxy species of the same genus with similar morphological characteristics.

Corals

Quantitative surveys were conducted within the proposed project construction site, with silt curtain buffer, and separated into 3 areas: 1) vertical sheet pile, 2) benthic (bottom) – unconsolidated sediment, and 3) benthic – hard bottom/artificial. On the western end of the project area near the Bulky Dump, the deteriorating sheet pile is no longer exposed, so coral colonies could not be counted on sheet pile in that area or at the “L”- shaped area towards the east. Transects were not placed in the “L”- shaped area due to safety concerns, as both biologists were snorkeling and the current was switching in both directions at the point.

The coral surveys were conducted along one 25m transect line at each random survey site. Only one transect line was used in order to increase the number of survey sites and due to limitations associated with time and not using SCUBA. Coral colonies were counted and measured using

the center-point rule where only colonies of which the center of the colony falls within the belt width are counted. All coral colonies within one 10 m x 1m belt transects, along the benthic transect lines, and within one variable transect on the sheet pile, were identified to the lowest possible taxonomic level (generally species), and the longest dimension of each colony was measured and recorded using a flexible tailor's tape. One biologist performed all coral count surveys in order to minimize observer variability.

Unattached coral fragments were identified and considered as separate individuals, while coral colonies exhibiting tissue mortality resulting in subdivision (fission) were identified and considered to be one individual. Fission is partial mortality of a coral colony that results in separation of a colony into pieces that are genetically identical (*i.e.*, ramets) and remain attached to the substratum. For colonies subdivided by fission, the proportion of tissue mortality within each coral colony was determined by visually estimating the percentage of the entire original colony composed of live coral tissue. Gross growth anomalies and/or anomalous patterns of tissue loss by taxa were photographed if encountered.

The biologist made note of any coral species currently considered for listing under the ESA by the NOAA/NMFS as of April 2016. In addition, observations of protected resources such as sea turtles and monk seals were recorded by the biologists.

Horizontal component: Benthic transects

Random quantitative transects occurred on the natural benthic substrate or on the artificial areas determined in Phase 1. The data collection occurred on the first 10m of the transect laid out as described in the Reef Fish section. Coral colonies were counted and measured using the center-point rule where only colonies of which the center of the colony falls within the belt width are counted. All coral colonies within one 10m x 1m belt transect was identified to the lowest possible taxonomic level (generally species), and the longest dimension of each colony was measured and recorded using a flexible tailor's tape.

Vertical component: Sheet Pile

Random colony counts occurred on the existing sheet pile structure by modifying the benthic transect method. A location was randomly selected by dropping a weight at the base of the seawall. From that point, the benthic transect line was laid out for 5 m against the base of the seawall. A distance of 5 m was decided on by both biologists before starting Phase 2, not knowing how long it would take to accomplish the task, and also in an attempt to use a total survey area that was comparable to the benthic coral transects. The biologist then used another tape to measure the height of the water column from the base of the seawall to the water surface. For this vertical polygon (5 m base length x submerged portion of seawall) the biologist counted every colony of which the center point was within the boundary. All coral colonies were

identified to the lowest possible taxonomic level (generally species), and the longest dimension of each colony was measured and recorded using a flexible tailor's tape. The base of every polygon was 5m while the water column depth differed by location.

Size class distribution

Stony corals were identified to the species level and were measured and assigned to one of eight size class categories (0 to <2 cm, 2 to <5 cm, 5 to <10 cm, 10 to <20 cm, 20 to <40 cm, 40 to <80 cm, 80 to <160 cm, and >160 cm in greatest diameter).

Non-coral macroinvertebrates

Due to the time and water depth limitations, density data for non-coral macroinvertebrates were not collected. A species list was compiled of all non-coral macroinvertebrates encountered during a swim over the proposed project footprint and a buffer zone around the perimeter of the footprint in both Phase 1 and Phase 2. All invertebrate species observed within the survey area were identified to the lowest possible taxonomic level. A belt transect or quadrat method was not used.

Algae

Due to the time and water depth limitations, density data for macroalgae were not collected. A species list was compiled of all macroalgae encountered during a swim over the proposed project footprint and a buffer zone around the perimeter of the footprint in both Phase 1 and Phase 2. All algal species observed within the survey area were identified to the lowest possible taxonomic level. A belt transect or quadrat method was not used.

Protected Species

Both biologists recorded observations of protected species, such as the green sea turtle (*Chelonia mydas*) and the Hawaiian monk seal (*Neomonachus schauinslandi*).

DESCRIPTION OF FISH AND WILDLIFE RESOURCES

Existing Marine Resources

Existing resources for coral and reef fish were evaluated on 26 random data transects (Table 7, Figures 32a-c). The 26 random transects were divided as follows: vertical component = 8 sheet pile transects, horizontal component = 14 natural benthic transects, horizontal component = 4 artificial benthic transects. Coral data were collected on every transect line, while reef fish data were only collected on the benthic transect lines. Resources are reported by species and survey station in the Tables section (Tables 9-14).

Reef Fish

Twenty-six total quantitative transects were completed in Phase 2 and reef fish data were collected on 18 of those (Table 6). All reef fish data were collected from the benthic (horizontal) component only. The benthic transects were randomly split into two categories, natural and artificial as described in the methods. Fourteen were on natural benthic substrate and four on artificial substrate. Total counts of reef fish species per size class, estimates of density by species, and estimates of biomass by species are presented in Tables 9, 10, 11, and 12. *Kyphosus hawaiiensis* and *K. sandwicensis* were often combined for reporting due the large schools swimming through the transect belt. Due to using single transects, figures for averages and standard deviation are not provided. As noted in the methods, the data collection underestimates observations of benthic-associated species due to the water depth, which in some cases inhibited observations while snorkeling.

Table 2 lists all 97 reef fish species observed from 27 families in the project area for both Phase 1 and Phase 2. None of those species would be considered rare for the Monument. For Phase 2, 39 species were recorded along the belt transects and the most common families observed were Acanthuridae, Labridae, Kuhliidae, Kyphosidae, Mulliidae, Chaetodontidae, and Pomacentridae. The estimated density of reef fish by species is presented in Table 10. Because there were a number of transects where no fish observations occurred, averaging the density of each species across all transects gave a better estimate for what the population could be along the southern seawall project area. The number in the final column is the average density by species as the number of individuals per hectare. Fish species observed in the highest densities included *Acanthurus leucopareius*, *Acanthurus triostegus*, *Neoniphon samara*, *Kuhlia xenura*, *Kyphosus* spp., and *Mulloidichthys flavolineatus*.

The estimates of biomass by reef fish species is summarized in Table 11. As with density, there were a number of transects where no fish observations occurred, so averaging the biomass across all transects gives a better estimate of what biomass could be in the project area. The number in the final column is the average estimate of biomass per species shown as kilograms per hectare. The largest estimates of biomass were for the mixed *Kyphosus* spp. (129.42 kg/ha) and *Mulloidichthys flavolineatus* (127.85 kg/ha). Both of those species were commonly observed in the project area, especially around areas with artificial structure.

For the observed fish, a summary of individuals per size class is given in Table 12. The information is presented by transect. Areas with structure, debris or artificial bottom, had more individuals. These included Transects 13, 20, 22, 25, and 26.

Corals

Twenty-six total quantitative transects were completed in Phase 2 and coral data were collected on all 26 of those (Table 7). Coral data were collected on both the horizontal (benthic) and vertical (sheet pile) components within the project area. Eighteen were on benthic substrate and eight were on sheet pile. Ten of the coral transects did not contain coral colonies as shown in Table 13. All of those were benthic transects. The area calculation for each sheet pile polygon transect is listed in Table 8 and this number was used in density calculations. It is a very small observation area when compared to the surface area of the existing seawall. The coral numbers are presented in square meters, because this represents a better scale for use with each future individual repair area under a programmatic permit. Total counts of coral colonies per size class, density by species, and total counts of coral colonies with partial mortality are presented for the area (Tables 13 and 14). They are not summarized in the text by transect, because the estimates should be averaged across the entire area for future use, due to the overall small surface area that was achieved. There were no fragments observed in any of the survey transects. Due to the use of single transects, figures for averages and standard deviation were not provided.

Colonies in the three smallest size classes were binned (0 to <2 cm, 2 to <5 cm, 5 to <10 cm) into a single size class. Colonies in these size classes were present but may have been underrepresented due to the visibility in the surge environment, fouling on the sheet pile, and the limitations on visibility from not using SCUBA. Representative coral colonies and habitat are located in Appendix B.

A total of 9 coral species was observed in the project area (Table 3). Four were counted on the horizontal benthic components and all 9 were counted on the vertical sheet pile. A total of 373 colonies were used for the data summary. Table 13 summarizes coral density by species and coral density by transect. The majority of the 8 sheet pile coral densities are higher than those of the 8 benthic transects where coral species were recorded. The most common species recorded were *Pocillopora meandrina* (41% of all colonies observed), *Pocillopora damicornis* (39%), and *Pocillopora ligulata* (11%), all these species having a branching morphology. Encrusting morphologies of species were observed on both the benthic transects and sheet pile and additional observations are illustrated in Figures 14a-c from Phase 1. For the observed colonies, approximately 9.5% (36 colonies) showed signs of partial mortality (Table 14) across the project area.

Coral colonies counted along the transects did not have a wide range of size classes. Almost half (~43%) of all colonies were less than 10cm in diameter (Table 13 and Table 15). Twenty-eight percent were in the range of 10 < 20cm diameter, for a total of 72% colonies with a diameter smaller than 20cm. Most of the colonies in the 20 < 40cm diameter range (27%) were *P. meandrina*. Only 1% (4 colonies) had a diameter greater than 40 cm. The largest colony observation was on the sheet pile at Transect 17, a *P. meandrina* colony with a maximum

diameter of 48cm and no visible mortality.

Tables 15 and 16 separate the size class distribution for all colonies observed and those observed on the sheet pile only. The distribution does not change significantly for the first three size classes for coral on the the sheet pile only [44%, 25%, 29%] versus all corals observed [43%, 28%, 27%]. In addition, the size class distribution of the three most common corals are provided by species in Tables 17 (*P. meandrina*), 18 (*P. damicornis*), and 19 (*P. ligulata*).

Protected coral species were not observed during the data collection. No paling, partially bleached, or bleached colonies were observed, on the transects or in the project area.

Protected Species

The green sea turtle (*Chelonia myda*s) and the Hawaiian monk seal (*Neomonachus schauinslandi*) were observed in the project area during Phase 2. Table 20 lists those observations. A single adult monk seal swam into the area twice on the same day. The turtles were represented by 2 separate swimming adults, differing in size, and observed on separate days.

Additional Comments on Coral Resources

The absence of coral on the surveyed bottom in the area of the footprint beyond the sheet pile and submerged rip rap is best explained by the lack of appropriate hard substrate for coral planula to recruit on (i.e. settle and survive). The limited number of live corals encountered may also be due to wave energy, turbidity, and a limited amount of coral planula available for settlement, given that the nearest natural reef is located far away. Additional sedimentation stress from fine sediment coating the rip rap, rocks, and steel sheet piles is caused by continuous re-suspension of particulates by wave action and changes in the tidal heights. The higher abundance of coral colonies growing on the steel sheet piles is likely due to the reduced sedimentation stress due to vertical orientation. Factors such as greater water movement along the steel sheet piles, and colonization by crustose coralline algae, may also promote coral recruitment and/or survival along these structures.

Beyond the low abundance of coral colonies, the species composition and morphology of corals present on and along the seawall, as well as the presence of colonies with partial mortality, indicate an environment exposed to a moderate level of wave energy and relatively levels of sedimentation. There were also a large number of dead colonies throughout the project area, but it is unknown how many of the dead colonies were mortalities caused by the 2014 global bleaching event.

The size class structure of the coral colonies observed, specifically the absence of large-sized

colonies, indicates that corals may have been continuously present adjacent to the seawall, but that reef-building species are not a dominant component of the community. Corals have recruited to the previous repair area, and *P. meandrina* and *P. pocillopora* were observed on the submerged portion of the 2014 rock revetment. The presence of small colonies (>5 cm in greatest diameter) indicates that corals continue to recruit to the project area, and the medium sized colonies (20 > 40 cm) indicate that despite the high sedimentation environment, corals survive and continue growth beyond initial recruitment.

DESCRIPTION OF ALTERNATIVES EVALUATED

The objective of the planning alternatives is to minimize impacts to the natural environment while improving necessary structures for the continued operation of the Henderson Airfield and protecting seabird nesting habitat at Midway Atoll NWR. The alternatives that were presented to the federal resource agencies before fieldwork began were in draft form, and if they are subsequently altered (i.e. adding work from a barge, expanding the project footprint for seawall repair, changing the construction design), the resource agencies will need to evaluate the changes as new alternatives. The following two alternatives from the February 2016 Draft Environmental Assessment were used to plan the field survey and were assumed to be the most up-to-date information.

Alternative 1: Removal of existing steel sheet piles and buildout of rock revetment

In Alternative 1, repairs to the seawall would be made over a 10-year period by partially removing damaged sheet pile and replacing it with an armor rock revetment. The rock revetment method consists of large (2 to 3 ft. diameter) rock placed over smaller rocks, forming an interlocking, continuous sloping surface that dissipates and breaks wave energy. Repairs would take place in an annual cycle. To avoid impacts to breeding birds, construction would generally occur from mid-August through October of any given year, depending on consultations with refuge staff and necessary agencies.

The cumulative footprint of the “Maximum Construction Scenario” includes the footprint of all rock revetment that could be installed along the 5,720 linear feet seawall (6.6 acres) as well as a 50-foot construction footprint on uplands adjacent to the seawall (6.6 acres) for a total Corps permit area of 13.2 acres. The rock revetment would extend approximately 40 ft. from the current mean high water mark (MHW).

The revetment would consist of three layers:

1) A base layer of granular fill will be placed to fill in existing eroded areas landward of the existing wall. Geotextile fabric may be placed over the base layer and the entire footprint of the revetment to keep the finer materials in place.

2) An approximate 2-foot-thick layer of underlayer rock (approximately 150 pounds each) would be placed directly on the geotextile fabric.
3) An approximate 4-foot-thick layer of larger armor rock (approximately 1,500 pounds each and roughly two feet square) would be placed over the medium-sized rock layer.

The revetment would have a design-life of approximately 50 years, with minor maintenance required approximately every 10 years or after major storm and tsunami events.

Demolition of the existing sheet piles within the project footprint would be completed by land-based equipment. During the construction of the revetment, proposed repairs would be land-based only. This report assumes that there will be no use of a barge or any anchored vessel in the project area. Repairs would be made using conventional construction equipment such as an excavator and crane. Current plans are for using equipment already on the island, though additional equipment may need to be barged in.

Materials may be barged to the island early, requiring storage for several weeks or even months prior to construction, depending on construction windows established to protect birds and on the logistics of getting construction crews to the island. If barged early, the rock and other construction materials would be unloaded onto trucks and driven to a temporary stockpile area void of any environmental concerns, as confirmed and approved by Refuge staff. All stockpile areas will be on existing paved surfaces and all haul routes will be on existing roads and runway access routes.

The remains of the failed seawall and other obstructing debris would be cleared with crane and excavator and removed via truck or barge to the existing USFWS-approved disposal site on the Sand Island or, if no room is available, then barged off-island. Some rock, rubble and sand on the site may be reused in place as backfill after the armor rock has been installed.

Armor rock would be offloaded in the harbor and moved by truck to the stockpile area or directly to the repair site. Armor rock and other construction materials would be transported by truck from temporary storage area to the work area via specified route determined by USFWS Refuge staff. Armor rock would be loaded and unloaded from trucks using an excavator/front-end loader and then temporarily stockpiled at a designated staging area near the work site.

Demobilization would involve additional truck traffic to remove any remaining post-construction debris to a USFWS-Refuges designated disposal site.

Alternative 2: No Action

No action would be performed to modify the existing environment at the southern Sand Island seawall.

PROJECT IMPACTS

As described in the *Existing Marine Resources* sections of this report, coral colonies and associated coral reef organisms were observed along all surveyed structures.

Portions of the existing coral habitat will be permanently lost as a result of proposed improvement activities to the seawall breach repair under the Midway Seawall Long Term Maintenance permit. Project related impacts would likely include direct impacts to coral resources within the individual breach repair sections and indirect impacts to coral reef resources that occur along the seawall adjacent to the proposed construction. Impacts to existing coral (which negatively effects associated organisms) would involve whole mortality of colonies resulting from a) mechanical breakage due to the movement of the existing sheet piles, rocks, and rip rap, b) suffocation of colonies due to overlay of fill materials and larger armor stones, or c) sedimentation stress due to project related activities, suspending marine sediments in the water column during and after construction. Impacts to coral will also include increased interference, through sedimentation, with coral larval settlement, and also with three stages of coral reproduction (*e.g.* gamete fertilization, larval competence, and metamorphosis/settlement to a new juvenile coral) (Richmond 1997).

Methods for estimating project impacts

The surveys were designed with knowledge of the proposed alternatives in the incomplete Draft EA, and as a result, resources were recorded in the appropriate proposed construction areas. Estimates of coral density by species were obtained throughout the project area on both vertical and horizontal structures, and size classes summarized for use in future mitigation discussions. Only a small portion of the surface area was surveyed due to time and logistics limitations. The habitat was mostly homogeneous, therefore our estimates can be applied across the structure type as a whole. Additional statistical analyses were not performed due to the absence of replicate "transects". The biologists decided on spreading the quantitative data collection to a large area instead of performing replicate transects in a smaller area, in order to allow for more comprehensive spatial coverage.

The comments below describe impacts based on the February 2016 alternatives. Because the alternative to replace the existing seawall with new steel sheet piles was rejected, the impacts associated with that alternative were not included in the survey.

Alternative 1: Removal of existing steel sheet piles and buildout of rock revetment

The action will cause loss of all coral colonies located within the individual project repair segments due to the overlay of fill material and placement armor stones. Loss of corals and sessile invertebrates present will also occur by removal of the existing rocks, rip rap, and debris before construction. Sedimentation stress could also occur to corals located directly adjacent to the repair area.

Reef fish will temporarily lose current habitat and foraging areas, but they can move to either side of the construction footprint, so no direct mortality is anticipated.

Cumulative impacts

There is potential for cumulative and permanent loss of coral reef habitat, essential fish habitat, and infaunal habitat along the entire southern coastline as additional sections of the seawall are selected for repair with the new rock revetment design. When a majority of the proposed new repair segments are completed along the length of the seawall, cumulative impacts to coral may decrease because the new construction design may reduce turbidity and wave energy along the permanently armored coastline.

The risk of introduction or spread of invasive species also increases with multiple construction periods and events, all requiring the shipment of materials and equipment to Midway.

Alternative 2: No Action

No change in impact.

RECOMMENDATIONS

The following recommendations are provided by PIFWO in coordination with NOAA NMFS. The agencies are concerned that live corals, as well as other native marine fauna and flora located within the proposed construction areas (described in the *Description of Fish and Wildlife Resources* sections), will be lost due to the construction-related activities that are proposed, and that activities may facilitate the spread of invasive species. We recommend that every effort should be made to avoid damage and loss of this coral habitat and to prevent the spread of introduced and invasive species.

Before any transplantation or compensatory mitigation project is undertaken, the goals of the restoration work should be carefully considered and described as precisely as possible. Advanced planning before the start of construction will reduce the likelihood that the project may be ecologically or logistically unrealistic. Without goals or measureable criteria it is also not possible to evaluate success. The targets need to be feasible and fairly easily assessed, and the timeframe in which they are to be achieved should be defined. A timeframe with milestones allows the progress of the restoration to be monitored over time and corrective actions (adaptive management) to be undertaken if appropriate. Indicators may be measurable items, such as percentage of live colonies, percentage of live coral cover, percentage of coral recruitment, etc.

A control area may also need to be assessed to compare areas where assisted restoration occurs and what happens in adjacent areas where natural growth is occurring.

Recommended Alternative

We anticipate that project construction activities will result in varying degrees of impact from planned Alternative 1. There is no alternative design to compare except for a No Action alternative.

Recommended Avoidance and Minimization Measures

To avoid and minimize impacts to fish and wildlife resources, we recommend implementing a range of measures, including standard Best Management Practices (BMPs), as listed at the end of this *Recommendations* section. Additional impacts to resources outside of the permitted footprint may occur from mechanical abrasion due to construction activities and from stress to the affected species.

Recommended Post-Construction Monitoring

Both agencies anticipate that implementation of Alternative 1 will result in a permanent loss of habitat and coral reef resources, but with the implementation of the recommended avoidance and minimization measures, the resulting loss of coral-associated resources in each individual repair segment less than 100 ft. in linear length would be minimized. However, the impacts to coral reef resources significantly increase along a distance of 5,720 ft. A greater loss of coral resources and habitat is anticipated as future sections of the seawall are selected for the new rock revetment design. Thus we recommend that a post-construction marine biological survey be conducted after the construction of each seawall breach repair segment to determine the actual project-related impact and the need for compensatory mitigation. Lost ecological function associated with any project impact should be mitigated through compensatory mitigation.

The post-construction survey should compare the status and condition of coral resources post-construction in the areas adjacent to the repair area with the status and condition of resources prior to construction, and include the quantity of coral and other marine resources lost and their sizes, if practicable. If Refuges and the FAA are limited by staff expertise in their ability to complete the survey as described, then arrangements should to be made to fill that deficiency.

We recommend that the survey occur within 6 months after project completion, and that the survey plan be developed prior to start of construction. The Plan should outline valid scientific methods by which impact will be assessed, and should at the least involve comparison of coral counts, coral size class structure, counts of coral fragments and fission. If construction occurs

within 3 years of the date of the quantitative surveys contained in this report, then the current data can be used as a pre-construction baseline.

Recommended Coral Transplantation

We recommend the relocation of coral colonies and macroinvertebrates present within the project area that will be damaged or lost by construction, both in the footprint of the repair segment and along the vertical sheet piles, to an area outside of the project footprint. This includes the corals attached to rip-rap and temporary fill materials in the project footprint. The coral colonies, and if necessary, the rip-rap colonized by coral, should be relocated prior to the start of construction. Appendix D is a sample of previous transplantation guidelines. These are very general but could be adjusted to suit the habitat at Midway Island, including information such as including success criteria. When selecting a relocation site, the FAA and Refuges should consider a site away from the length of the seawall since it is likely that segments along the rest of the seawall will require repair in the next several years, and should consult with PIFWO and NOAA NMFS on selecting the appropriate location. We also recommend establishing a monitoring protocol for corals post-move to determine the effects of transplantation on the survival, growth and fecundity of the transplanted organisms. Both PIFWO and NOAA NMFS can assist in developing a practicable transplantation plan.

A site visit was made to the previous coral translocation site at Reef Hotel (Appendix E). It does not appear that the methodology employed in translocation of the coral colonies was effective in providing the transplants a reasonable opportunity to survive the move. The PIFWO biologists did not have an opportunity to look for possible alternative mitigation sites on this trip. PIFWO, NOAA NMFS, Refuges, and the FAA should have a discussion on alternative methodologies for all future translocation efforts. This plan should be agreed upon prior to the start of any future permitted repairs along the southern seawall.

Post-construction, we recommend the FAA and Refuges provide information on the species, size and the total amount of any corals impacted from the construction operations. If the overall unavoidable loss is minimal, it may be possible to offset for future sections of seawall repair by removing long-standing uncolonized debris in areas adjacent to the project footprint in order to reduce future damage to the corals and marine resources in the area. Other compensatory mitigation alternatives may also be appropriate.

Any colonized rip-rap or fill material should not be used for any reconstruction or future construction purposes.

Recommended Compensatory Mitigation

The Corps requires a compensatory mitigation plan be submitted as part of the supporting documentation for the permit application process, therefore it needs to be completed prior to construction. Since compensatory mitigation will only be necessary should it be determined that there is in fact unanticipated impact to coral habitat, we recommend that the Mitigation Plan clarify this, i.e. that the need for compensatory mitigation will be determined after evaluating the results of the pre-construction survey. We recommend that, should compensatory mitigation be deemed necessary from resulting impacts to ecological function, a mitigation project be developed in coordination with all involved agencies (FAA, USFWS Refuges, USFWS PIFWO, NOAA NMFS, and EPA).

During the 60-day review period of the Draft FWCA report, both USFWS PIFWO and NOAA NMFS requested the USFWS Refuges and FAA have a discussion on potential compensatory mitigation, coral mitigation options, and the start of a draft mitigation plan, as these should be completed prior to any construction. No comments were received on the Draft FWCA document and a discussion on compensatory mitigation never occurred with the applicants. USFWS PIFWO and NOAA NMFS are still available for this discussion, but cannot include any mitigation recommendations in this Final FWCA report due to the non-response from both applicants. The co-applicants have specific financial and geographic responsibilities and constraints in the project area which complicates pre-construction activities and follow-up monitoring.

Recommendations for Endangered and Protected Species

The federally endangered Hawksbill sea turtle (*Eretmochelys imbricata*), and the threatened green sea turtle (*Chelonia mydas*) (collectively referred to as sea turtles), and the Hawaiian monk seal (*Neomonachus schauinslandi*) may occur within the vicinity of the proposed project site. Seabird species that are protected under the Migratory Bird Treaty Act [16 U.S.C. 703-712], including, but not limited to, the wedge-tailed shearwater (*Puffinus pacificus chlorhynchus*) and Laysan Albatross (*Phoebastria immutabilis*) (collectively referred to as Hawaiian seabirds), may also be impacted by project lighting and the destruction of nests. By contrast, the proposed seawall repair project may be a benefit to species that are currently impacted due to the entrapment hazard.

Sea turtles

The Service has jurisdiction of sea turtles and their use of terrestrial habitats (beaches where nesting and/or basking is known to occur), whereas the NOAA NMFS has jurisdiction of sea turtles and their use of off-shore and open ocean habitats. Therefore, the proposed project was reviewed for potential impacts to turtles in their terrestrial habitats only. Due to the armored shoreline adjacent to the proposed footprint, sea turtles are not known to bask or nest in the area. We recommend that the NOAA NMFS Pacific Islands Regional Office, Protected Resources Division, be contacted regarding the potential for the proposed project to affect sea turtles and any other federally listed species under NOAA NMFS's jurisdiction. In order to facilitate early

resolution of any potential conflicts between the proposed project activities and endangered and threatened species, we recommend that interagency consultation in accordance with section 7 of the Endangered Species Act be completed prior to the issuance of a USACE permit.

Beach nourishment and hardening projects, including the placement of seawalls, jetties, sandbags, and other hardened structures, are known to reduce the suitability of on-shore habitat for sea turtles. Construction activities for this project may increase the risk of entrapment within the site. We recommend daily monitoring within the project site to ensure turtles are not likely to be adversely impacted by construction debris, structures, and other entrapment hazards. Additionally, we recommend no night-time work during the sea turtle nesting season. Sea turtles in transit may become disoriented by artificial lighting, leading to exhaustion, possible placement of a nest in an inappropriate location (such as at or below the high tide line where nests are unlikely to be successful).

Hawaiian monk seal

NOAA/NMFS has jurisdiction over Hawaiian monk seals. We recommend that the NOAA/NMFS Pacific Islands Regional Office, Protected Resources Division, be contacted regarding the potential for the proposed project to affect monk seals. In order to facilitate early resolution of any potential conflicts between the proposed project activities and endangered and threatened species, we recommend that interagency consultation in accordance with section 7 of the Endangered Species Act be completed prior to the issuance of a USACE permit.

Hawaiian seabirds

Laysan albatross arrive at nesting colonies starting in November 1 and begin to depart in mid-June. Most eggs are laid between mid-November to mid-December. If construction work with machinery is proposed during the nesting season, there is a likelihood that eggs and chicks could be killed. We recommend conducting surveys immediately prior to any construction work. If any nests are documented within the project area, including adjacent to the harbor or the staging areas, work should not begin until the chick has fledged.

Outdoor lighting, used for night time work, can adversely impact listed and migratory seabird species protected under the Migratory Bird Treaty Act. Night lighting poses a significant threat to protected fledgling seabirds. Seabirds fly at night and are attracted to artificially-lighted areas, which can result in disorientation and subsequent fallout due to exhaustion or collision with objects that protrude above the vegetation layer. Any increase in the use of night-time lighting, particularly during each year's peak fallout period (September 15 through December 15), could result in seabird injury or mortality. Once grounded, they can be struck by vehicles. We recommend avoiding night-time work, and providing all project staff with information about seabird fallout.

Invasive species

The Service considers the spread of non-native invasive species to be a major threat to threatened and endangered species and other trust resources because of their potential to become established and thereby alter existing terrestrial or aquatic ecosystems. Construction activities and the transportation of equipment and materials for the proposed actions at the Midway seawall are potential pathways for the introduction and expansion of terrestrial and aquatic non-native invasive species (i.e., microbes, plants, vertebrates, and invertebrates). Pathways for the introduction and spread of non-native invasive species via the proposed action could be, but are not limited to, construction equipment and materials, personal protective equipment, vehicles/vessels and their contents, shipping material, and other sources that provide conditions for transport of non-native invasive species. Project planning should include an evaluation of the potential for movement and dispersal of invasive species due to planned activities, and provide measures to prevent or reduce impacts from invasive species.

Recommended Best Management Practices

To Avoid and Minimize project impacts to the maximum extent possible, we recommend that the following best management practices to minimize the degradation of the coastal water quality and impacts to fish and wildlife resources and habitats be incorporated into the project:

a. If there is a protected species in the area prior to performing any component of the permitted activity (including stockpiling of materials at the staging area, etc.), that activity should not commence until the animal(s) voluntarily departs the area; if the protected species is in the area when that activity is already underway, that activity should cease until the animal voluntarily departs the area,

b. Armor rocks and fill materials should be placed in a manner that will not pose an entrapment hazard to fish and wildlife;

c. Transport of construction materials across the island and project construction should avoid the Hawaiian seabird nesting season, with the peak at approximately mid-November to mid-December;

d. Minimize the amount of in-water work (*e.g.*, buildout the rock revetment and underlying support layers from land);

e. Construction materials or sediments should not be stockpiled in the marine environment;

f. Construction-related materials should be placed or stored in ways to avoid or minimize disturbance to marine resources;

g. A qualified inspector should check the ship's hull for invasives and shipments of equipment, cargo, and construction materials before departure to Midway Atoll. The inspection, except for hull invasives, should be conducted again upon arrival at Midway NWR. In the event of a failure to pass inspection, the vessel should not be allowed to leave for or unload cargo at Midway NWR;

h. All construction-related materials and equipment (*e.g.*, dredges, barges, pilings, cranes, etc.) to be placed in the water should be cleaned of pollutants prior to use. When in service, if pollutants are found to be leaking from any equipment, that piece of equipment should be removed from service until the cause of the leak has been fixed;

i. Construction activities should not cause contamination (*e.g.*, trash or debris disposal, alien species introductions, etc.) of the marine or terrestrial environments;

j. Fueling of construction related equipment should occur away from the seawall construction site at a designated location with the ability to handle and accidental spill on Sand Island;

k. A contingency plan to control the accidental spills of petroleum products at the construction site should be developed. Absorbent pads and containment booms should be stored on-site to facilitate the clean-up of petroleum spills;

l. Turbidity and siltation from the removal of existing sheet piles should be minimized and confined to the immediate vicinity of the removal and discharge through the use of effective silt containment devices (*e.g.*, silt curtains) and the curtailment of debris removal during adverse sea conditions;

m. Avoid conducting construction during coral spawning season from May- September, specifically avoiding the week before and the week after the full moon during these months (Gulko 2001, Kolinski and Cox 2003); and

n. Dispose all debris removed from the seawall construction site at an approved upland site.

SUMMARY OF POSITION

The summary of position is provided jointly by the U.S. Fish and Wildlife Service, Ecological Services, and the National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

The substrates on which coral reef resources have been observed are the habitats of concern for the proposed project. The institutional significance of U.S. coral reefs has been established through their designation as Special Aquatic Sites [40 CFR Part 230 §230.44/FR v.45n.249] and as a Federal Trust Resource [Executive Order (E.O.) 13089]. Coral reef ecosystem organisms (*e.g*., corals, reef fishes, macroinvertebrates, algae and sea turtles) that occur at these locations provide a set of ecological functions and services including: shoreline protection from oceanic swells and storm events; significant sources of larvae/juveniles to promote species replenishment; prey items for federally protected migratory birds; and opportunities for human activities such as subsistence harvest/fishing, recreation, tourism and cultural practices. The coral resources in the surveyed project area along the 5,720 ft. section of the seawall, while occupying some artificial substrate, provide important functions and services, including, but not limited to, habitat for reef organisms, a source of larvae/juveniles, and filtration of the water column.

Substrate and coral reef communities within the project footprint are anticipated to be negatively impacted by experiencing a total loss due to the buildout of multiple seawall breach segments in order to armor the shoreline. That loss could potentially be up to 6.6 acres of marine habitat. From a resource conservation perspective, Alternative 1 would result in permanent loss of coral colonies, and temporary loss of habitat to other fish and wildlife resources. Because there was only one Action alternative and one No Action alternative, we are not recommending a selection. The sole action alternative would be the project design approved or disapproved by the U.S. Army Corps of Engineers.

To further avoid and minimize project impacts to fish and wildlife resources that may result from project construction, we have recommended implementation of a variety of avoidance and minimization measures including standard Best Management Practices. We have recommended among other things that construction activities avoid seabird nesting season and coral spawning season (if possible), and that attention is given to minimizing the introduction of invasive species.

The cumulative impacts of repairing each section of seawall will have a greater negative impact to fish and wildlife resources than each section individually. If Alternative 1 is chosen and all recommended actions are completed to avoid and minimize impact, we anticipate that impact to fish and wildlife resources in each individual seawall repair area will be minimal. The impact to

resources increases as more segments are repaired and built out. We recommend that a post-construction marine biological survey be conducted after the first repair area is completed in order to determine the actual level of impact to coral reef habitat, and the need for compensatory mitigation. We have not provided prescriptive language for compensatory mitigation in this report, and instead have recommended that a plan be developed in coordination with PIFWO and NOAA NMFS after post-construction impacts are analyzed.

The resource agencies maintain that implementation of the proposed project, including the conservation recommendations and compensatory mitigation suggested in this report, would minimize unavoidable impacts and avoid unnecessary impacts to biological resources. Any changes to the proposed project plan or to the recommendations in this report will require additional coordination with the PIFWO and NOAA NMFS. For example, Alternative 1 states that a barge may be used in the project construction area for removal of construction debris, however this Final FWCA PAR was prepared under the assumption that a barge would not be used.

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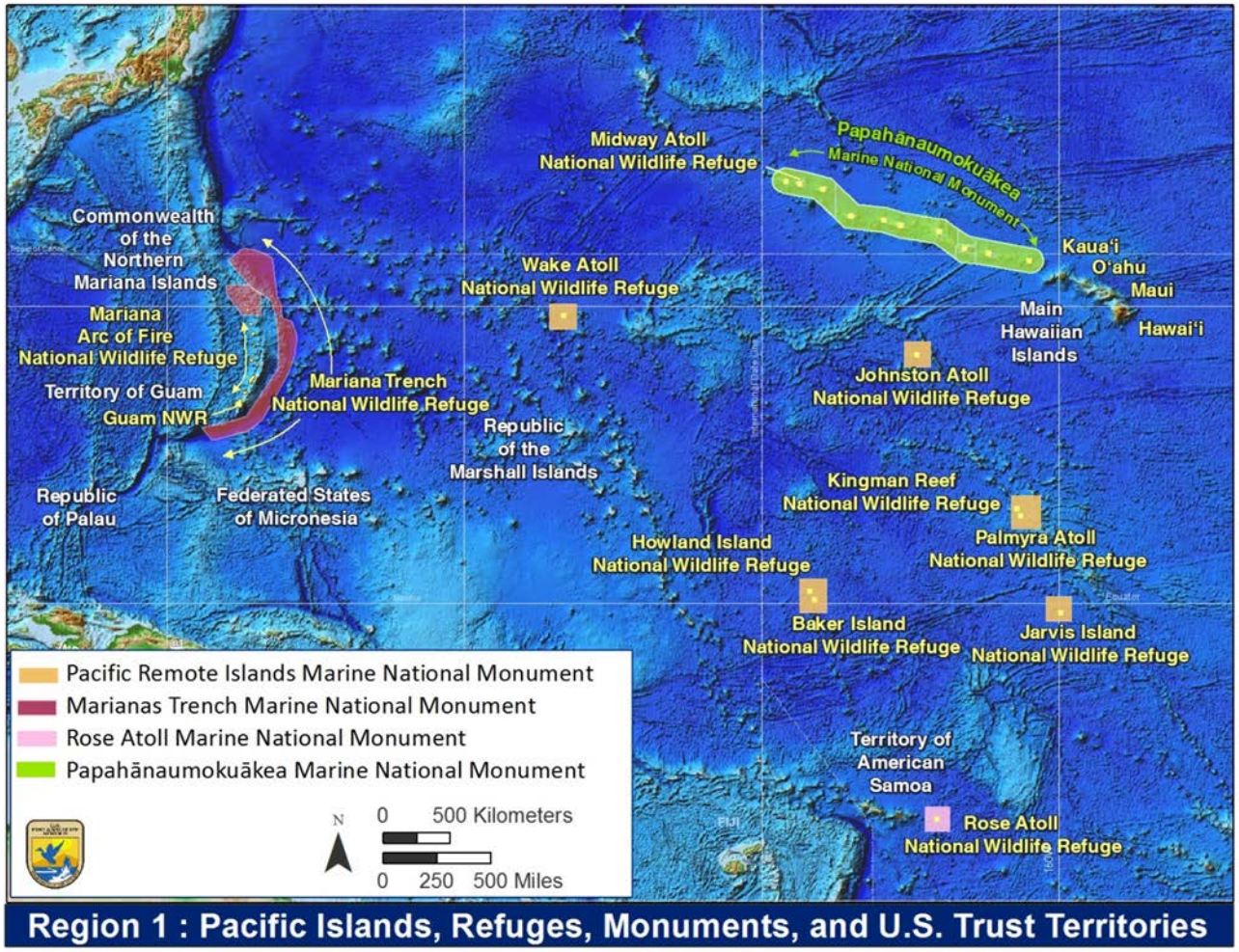


Figure 1. Location of Midway Atoll National Wildlife Refuge in the Pacific Ocean. (2011, USFWS)

Figure 2. Estimated seawall repair area at Sand Island to be covered under programmatic U.S. Army Corps Permit.

Figure 3. Potential footrpint of project impacts, including silt curtain boundary (yellow line). Sand Island, Midway Atoll NWR

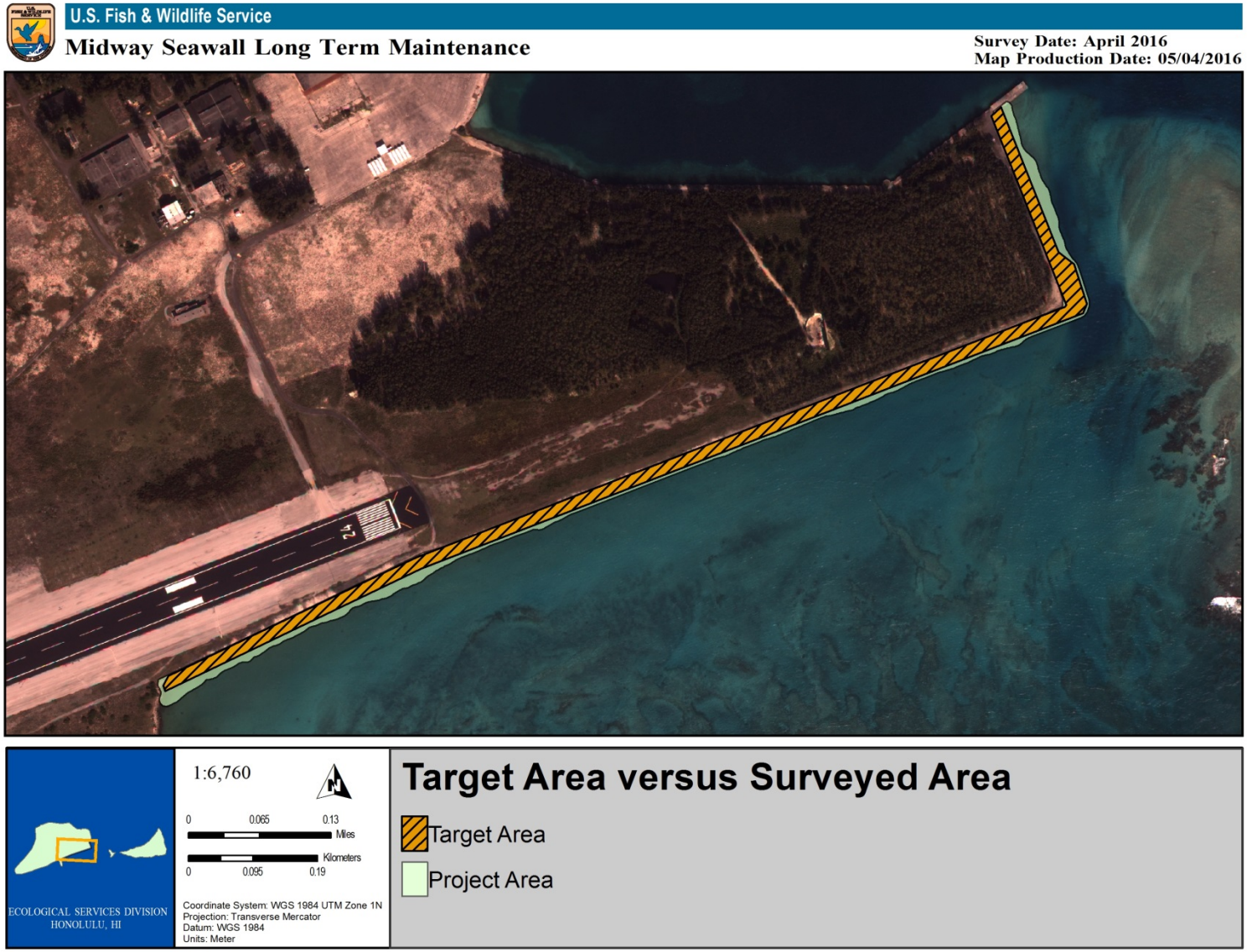


Figure 4. Project Area: Target Area versus Surveyed Area

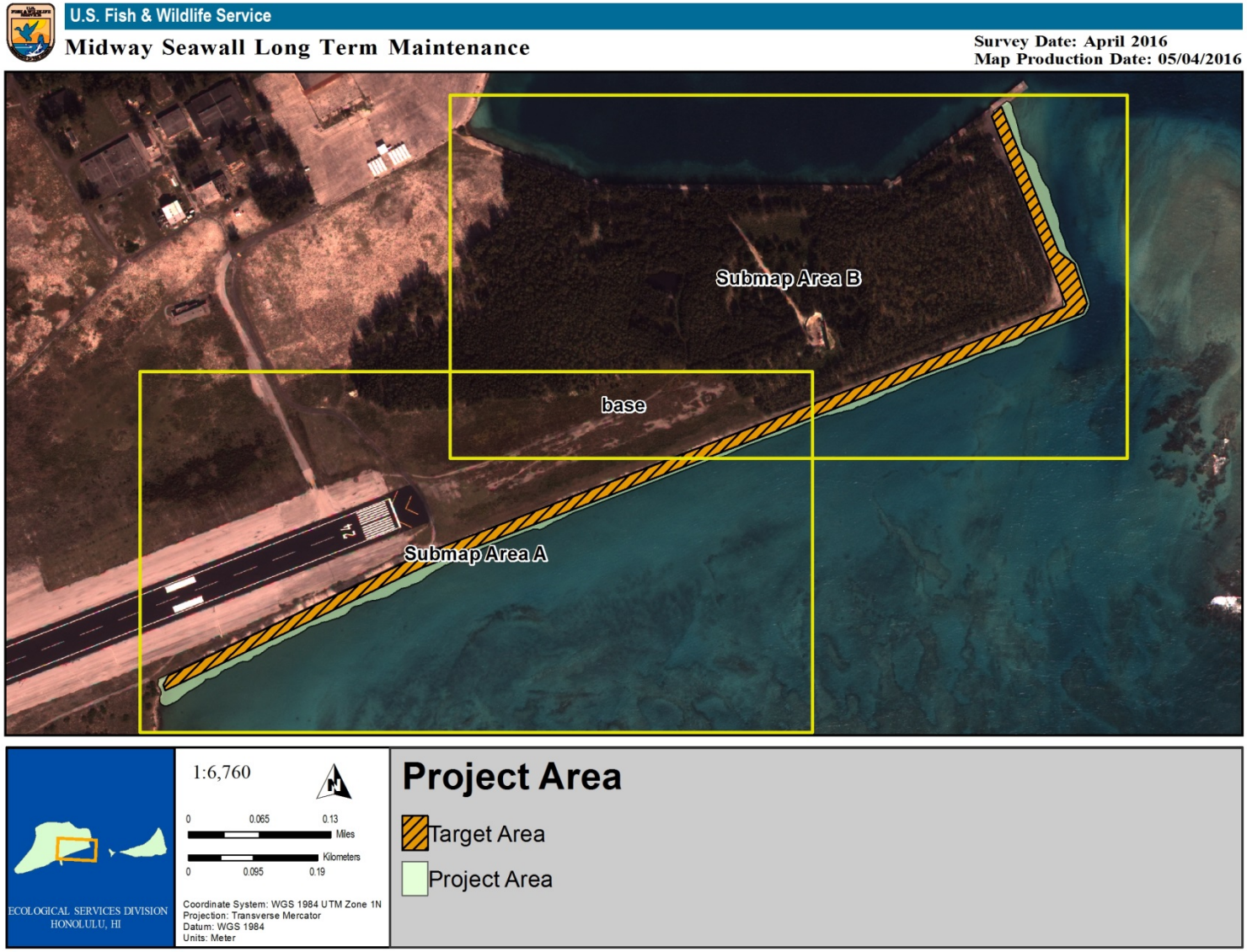


Figure 5. Project Area detail maps: Sub-map A and Sub-map B

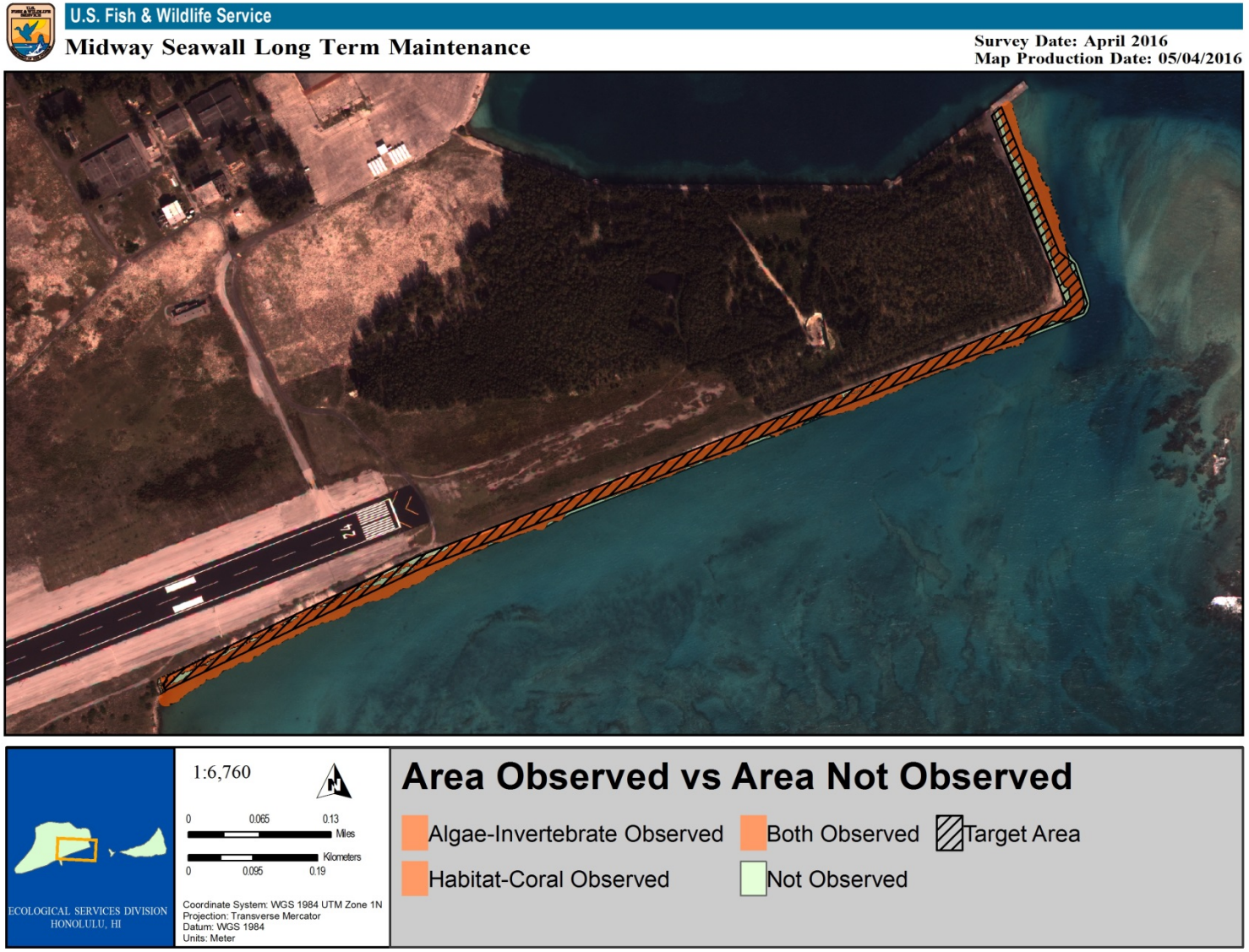


Figure 6a. Area Observed for data collection versus the Area Not Observed.

Figure 6b. Sub-map A. Area Observed for data collection versus the Area Not Observed.

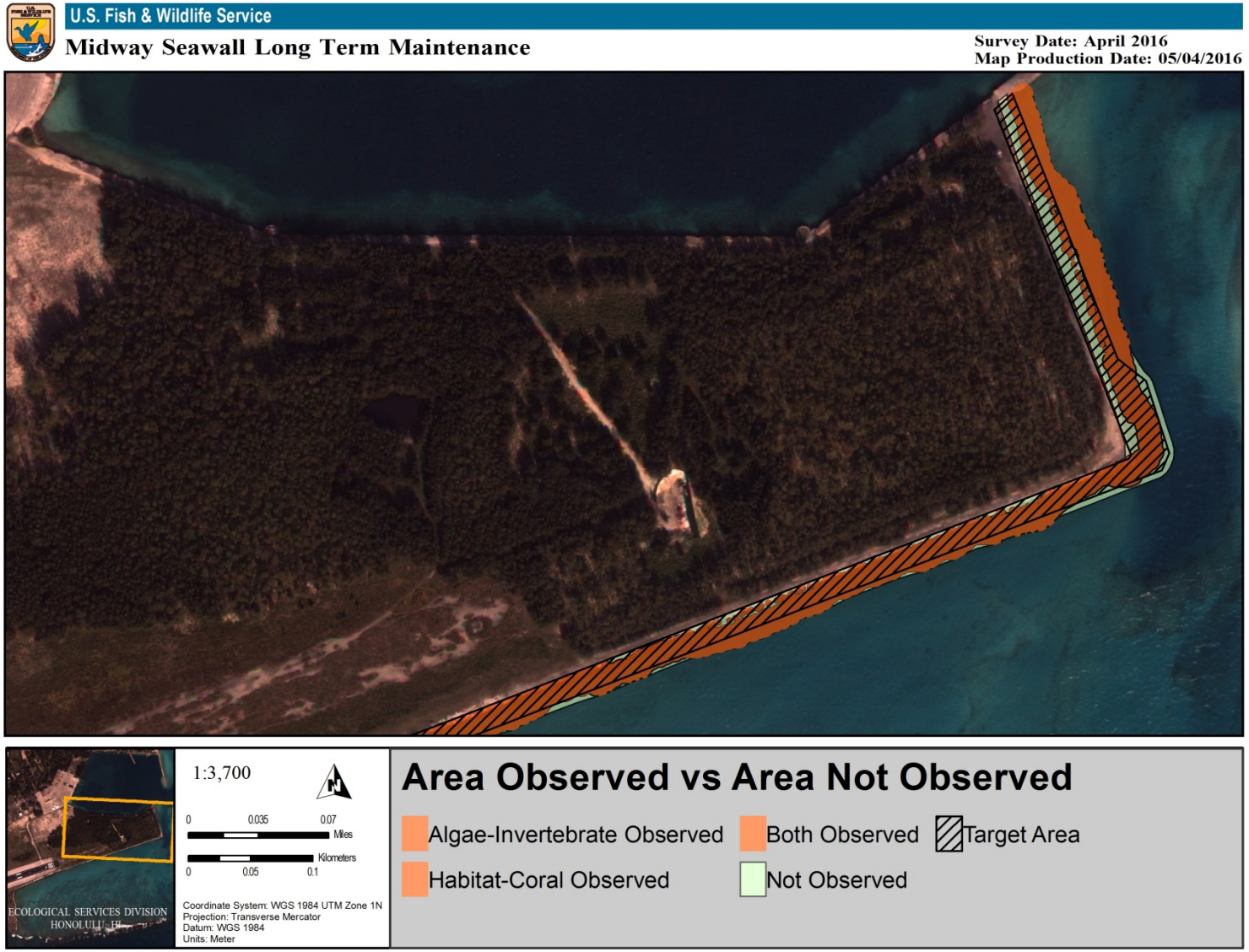


Figure 6c. Sub-map B. Area Observed for data collection versus the Area Not Observed.

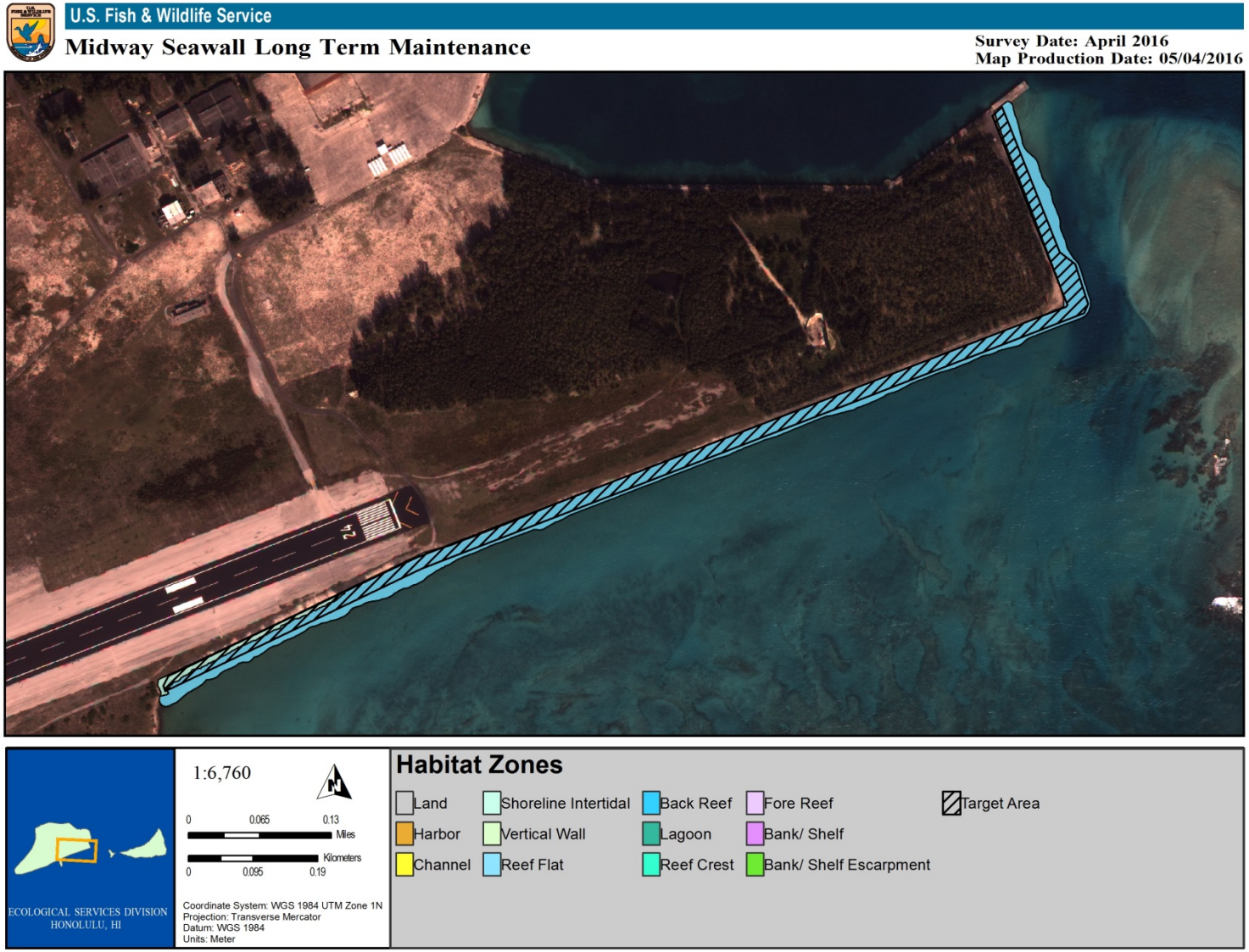


Figure 7. Habitat zones within the project area.

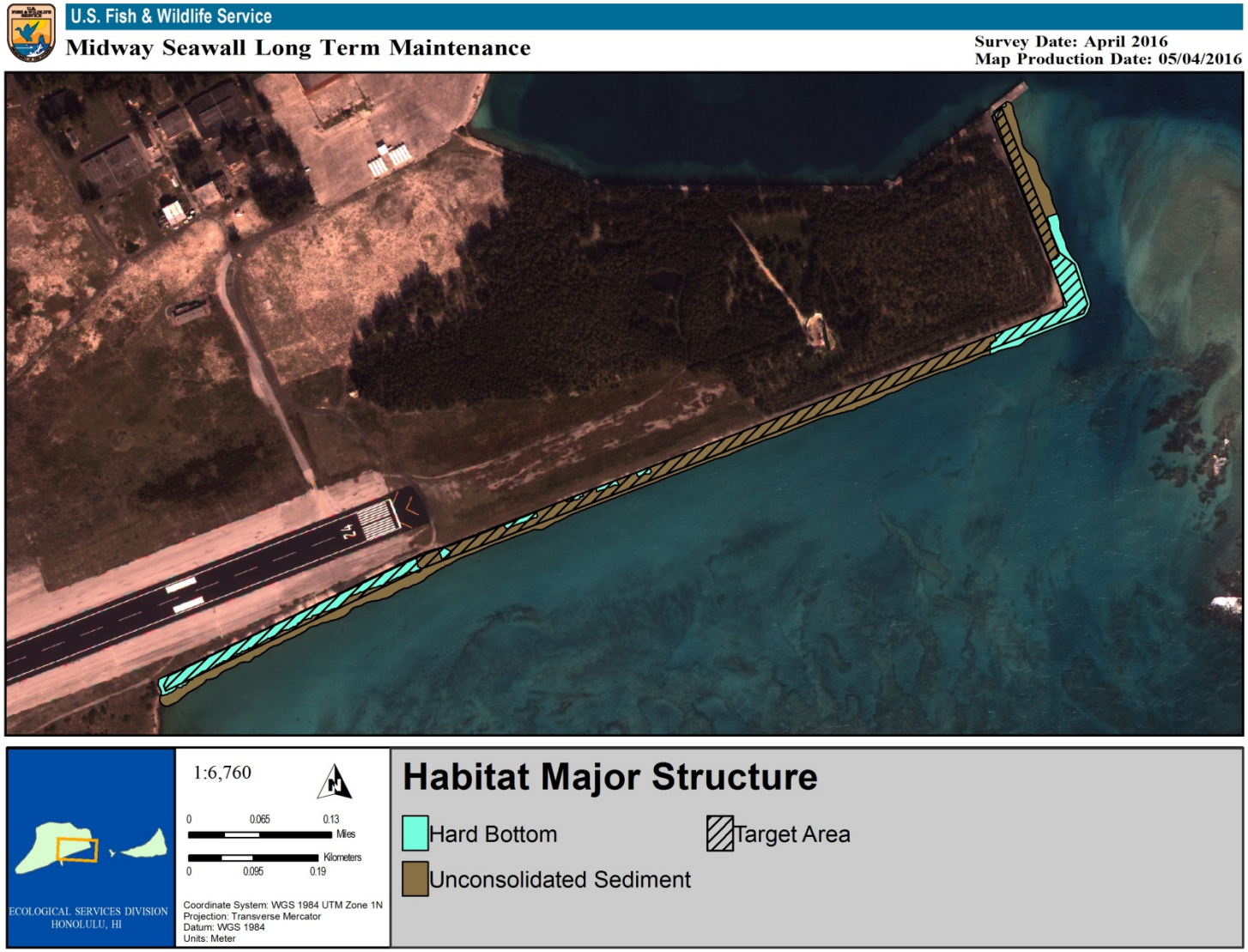


Figure 8. Major habitat structures within the project area.

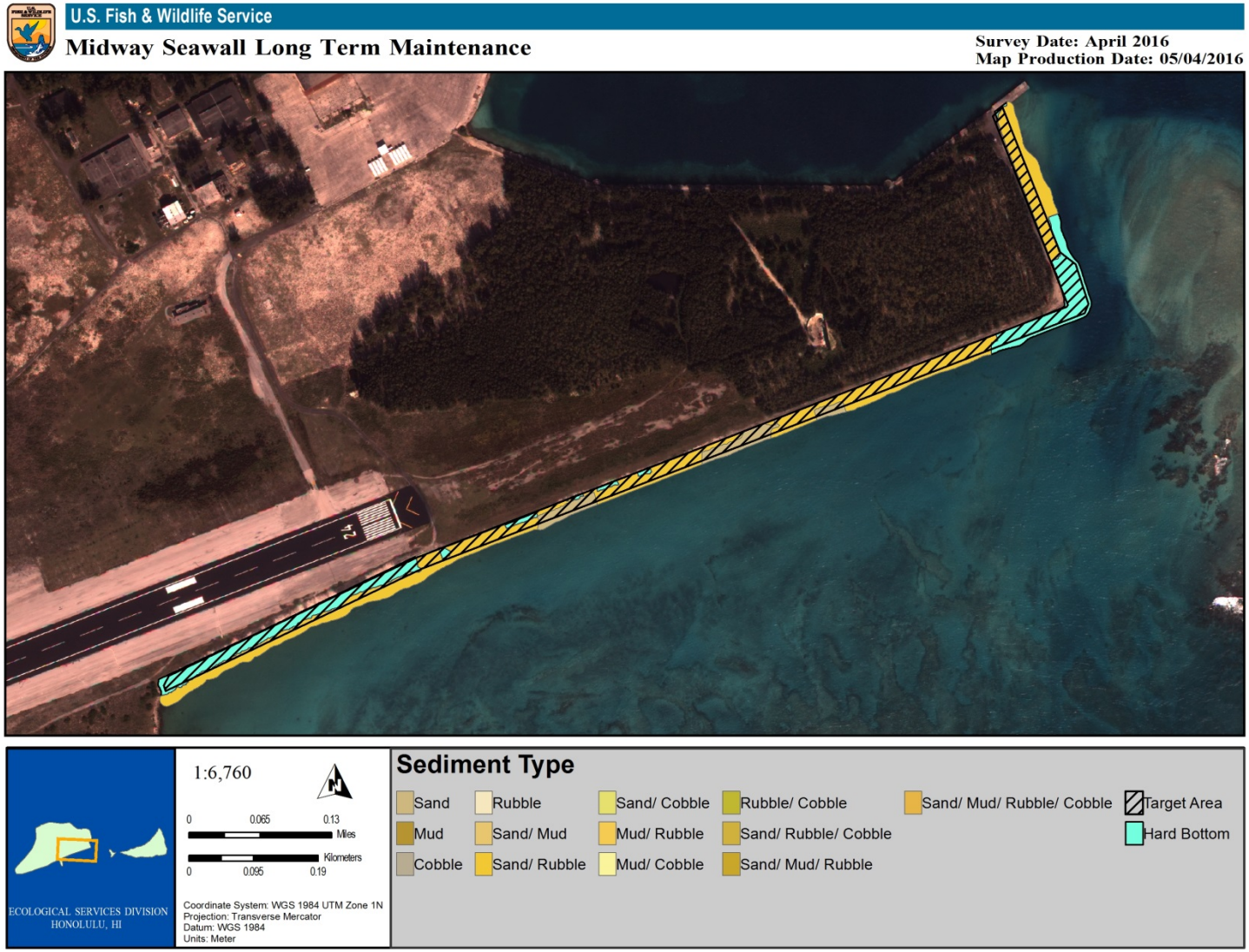


Figure 9a. Sediment types within the unconsolidated sediment major habitat structure.

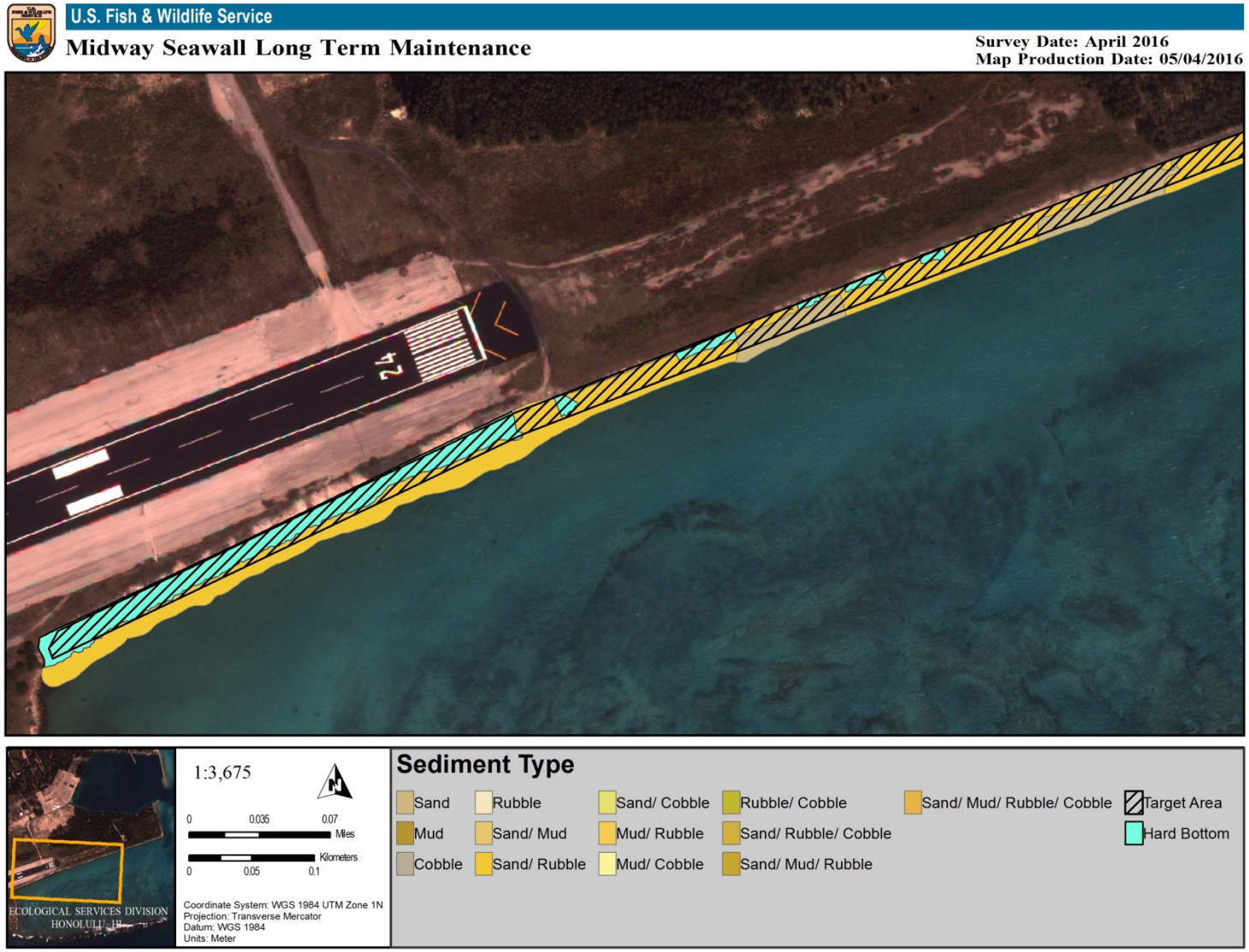


Figure 9b. Sub-map A. Sediment types within the unconsolidated sediment major habitat structure.

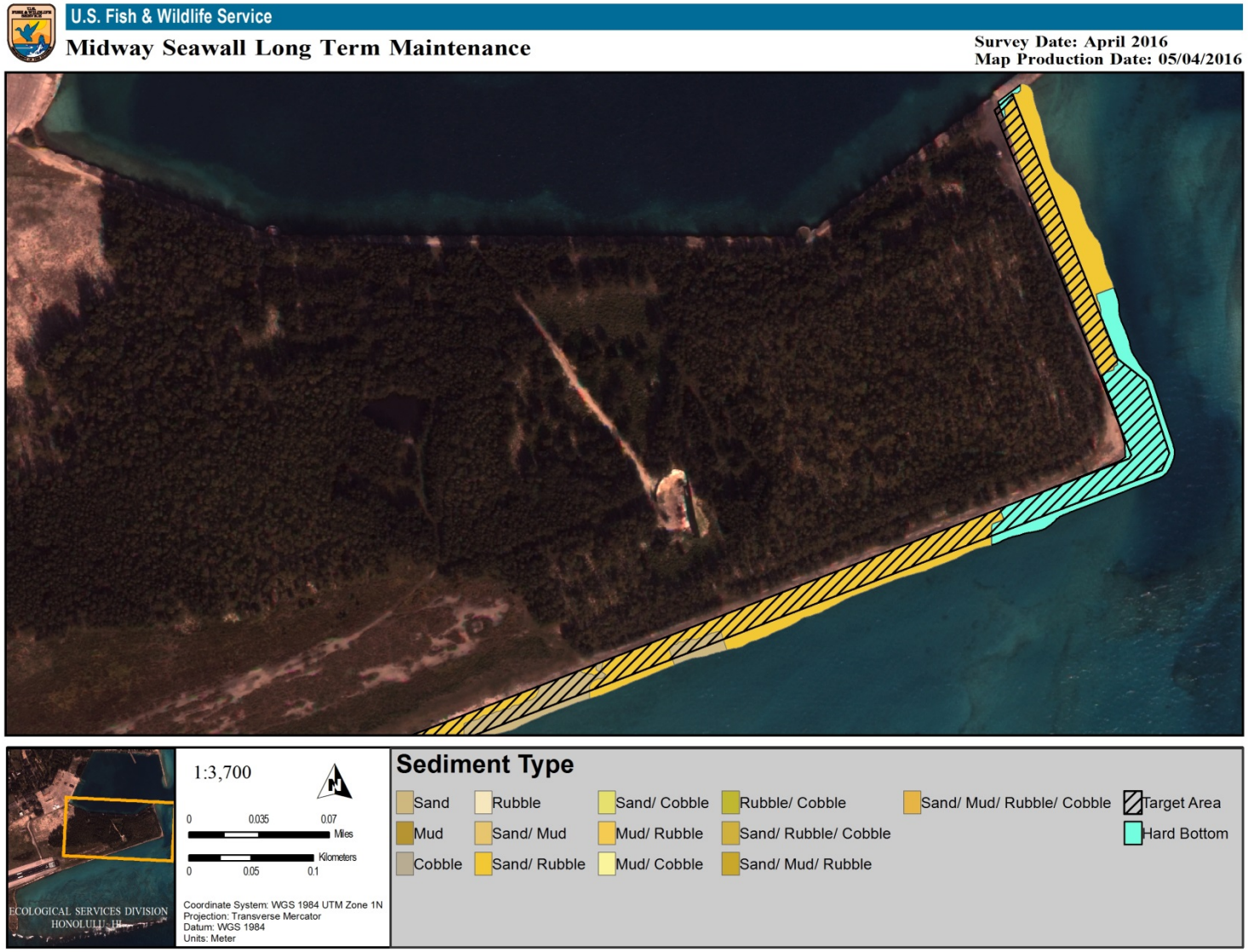


Figure 9c. Sub-map B. Sediment types within the unconsolidated sediment major habitat structure.

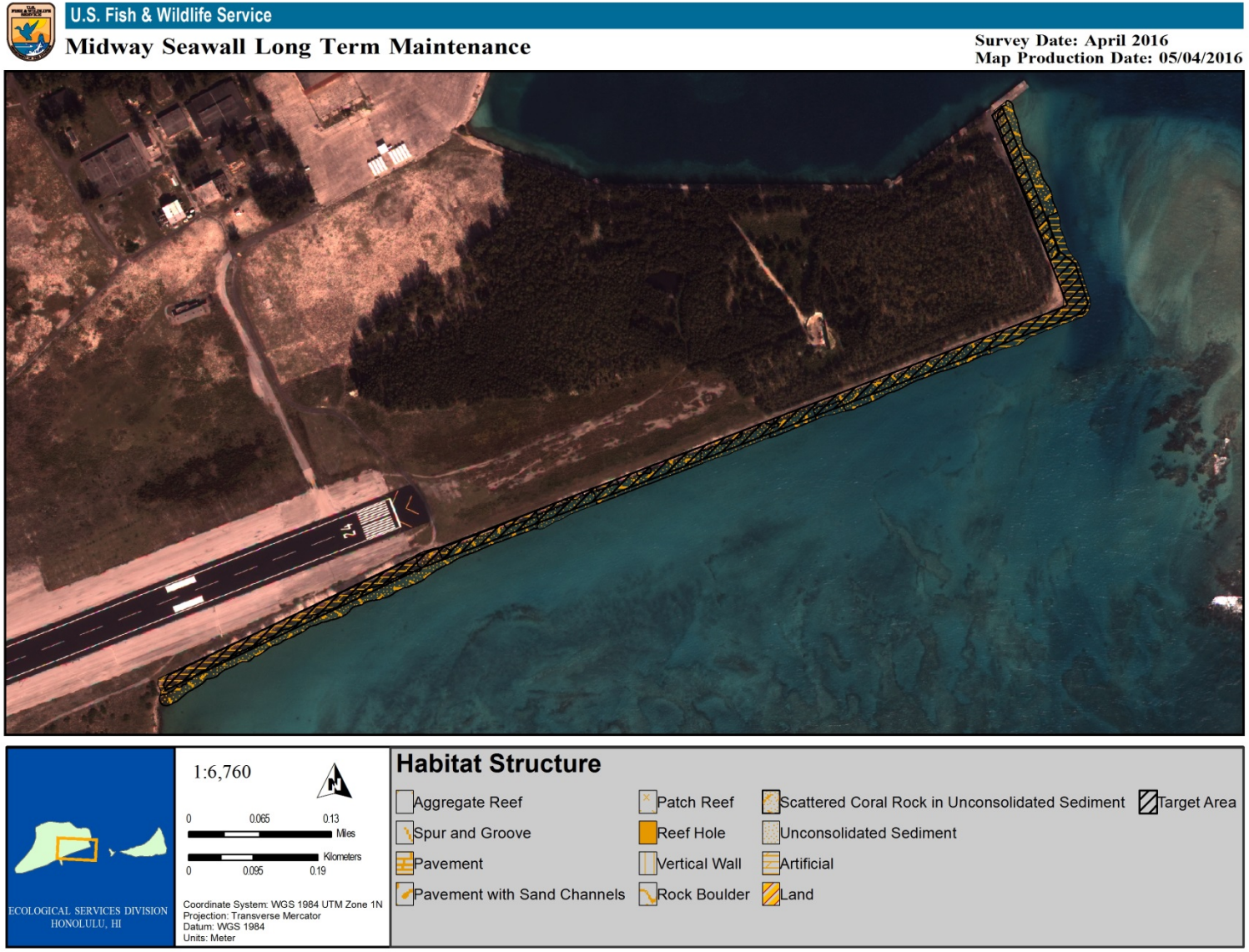


Figure 10. Habitat structures within the project area.

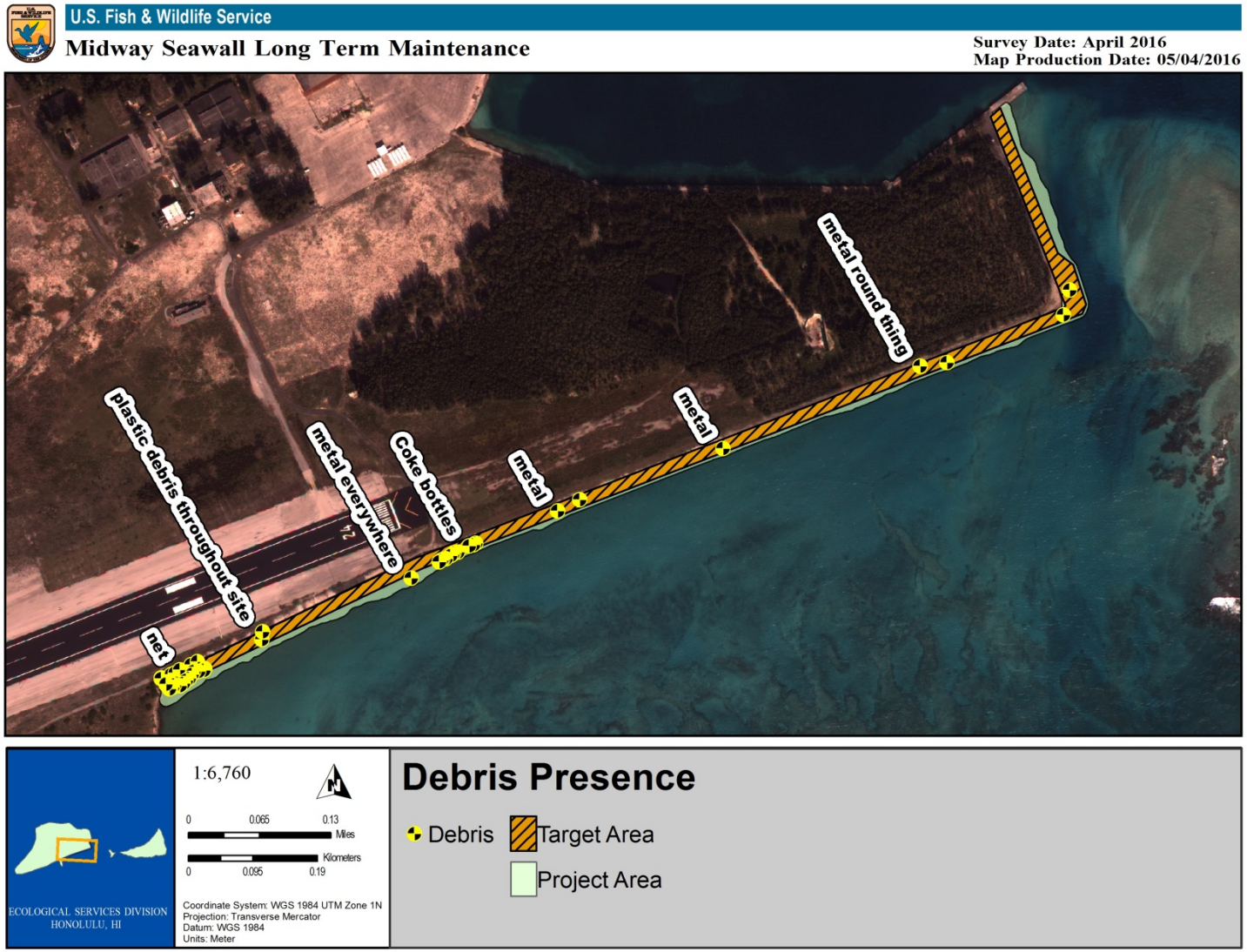


Figure 11. Location of observed debris within the proposed dredge area. Underestimate – debris was located along entire shoreline.

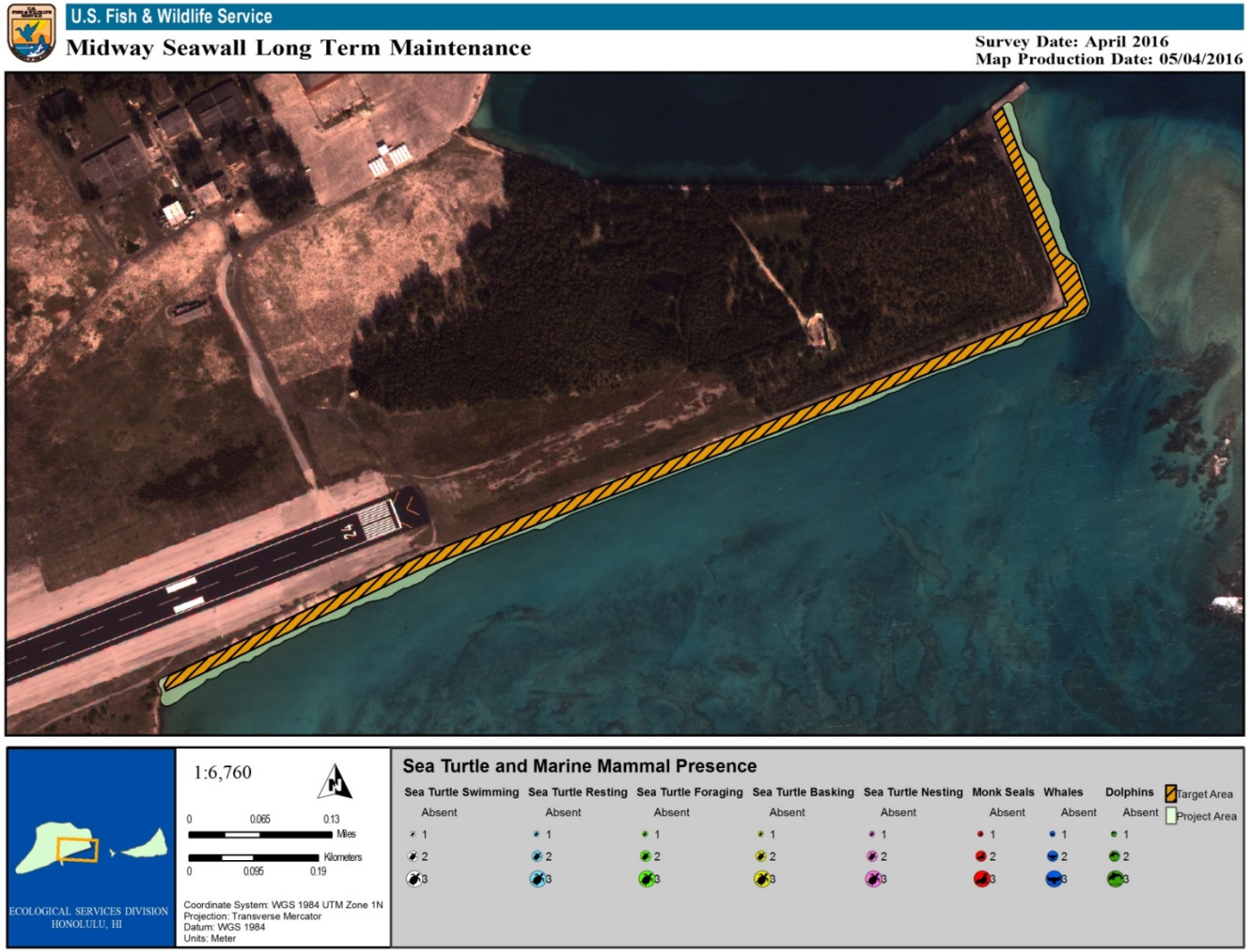


Figure 12. Protected resources observed during mapping activities. No ESA species were recorded during Phase 1 qualitative surveys. ESA species were recorded during the Phase 2 quantitative surveys.

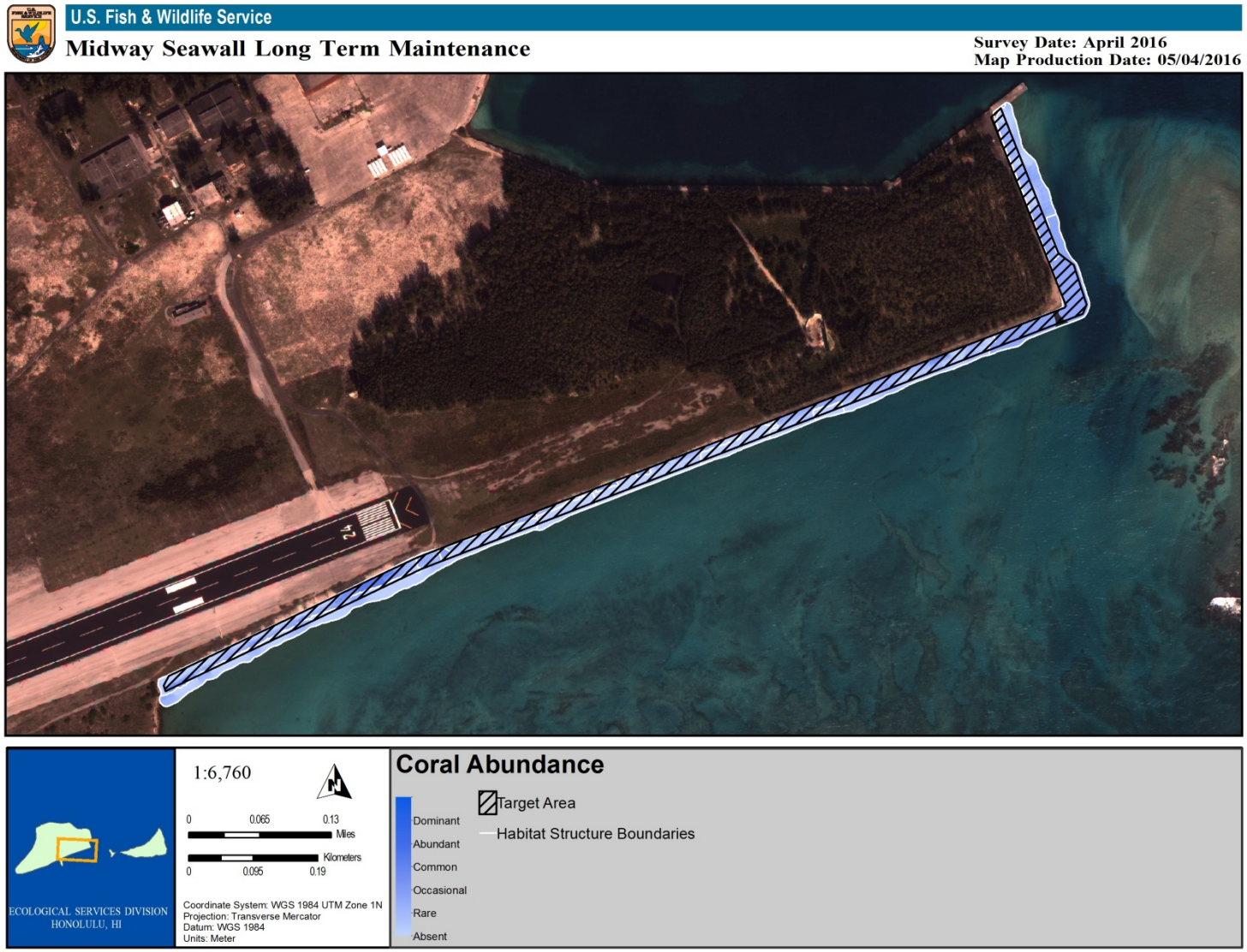


Figure 13a. Relative Abundance of Corals

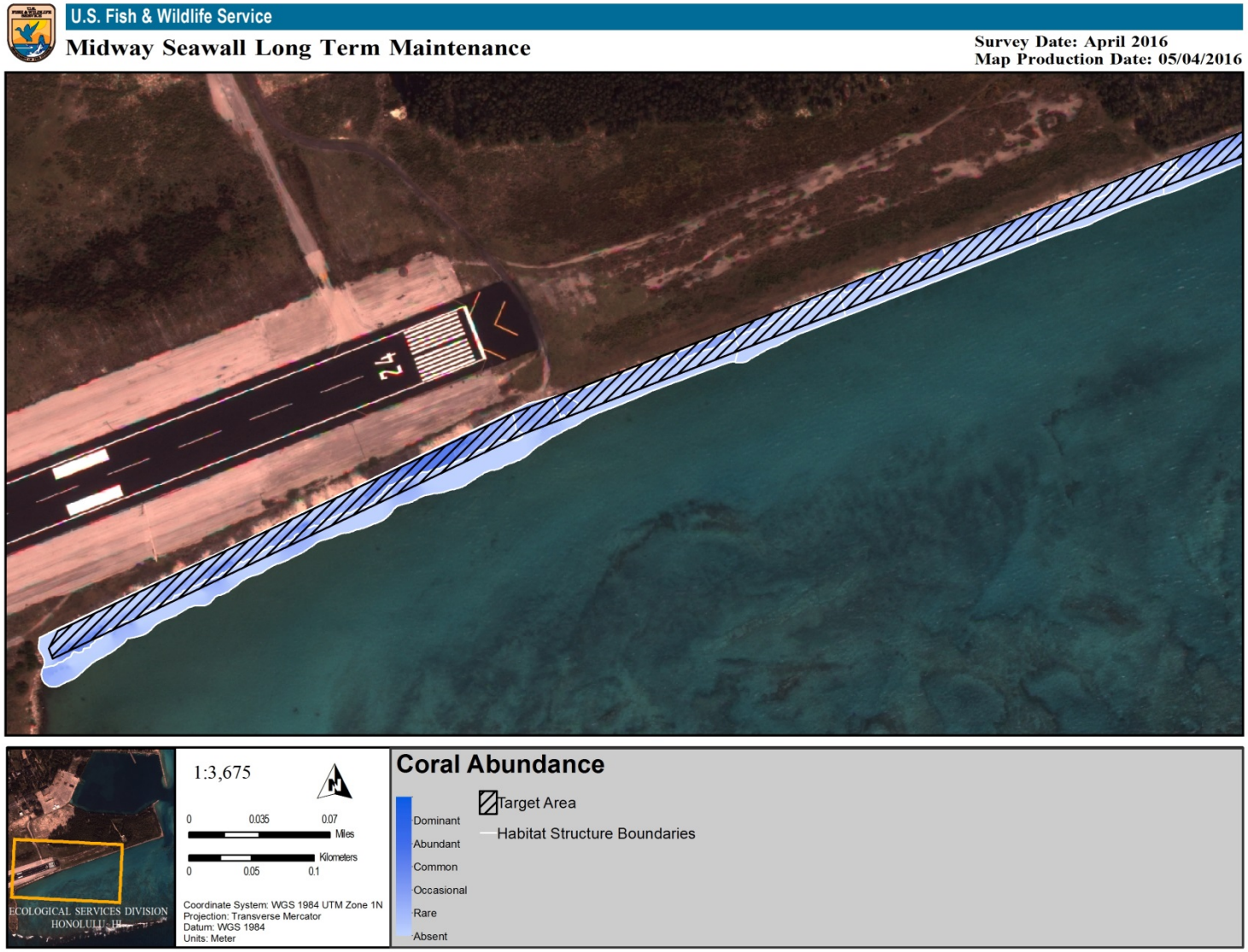


Figure 13b. Sub-map A. Relative Abundance of Corals

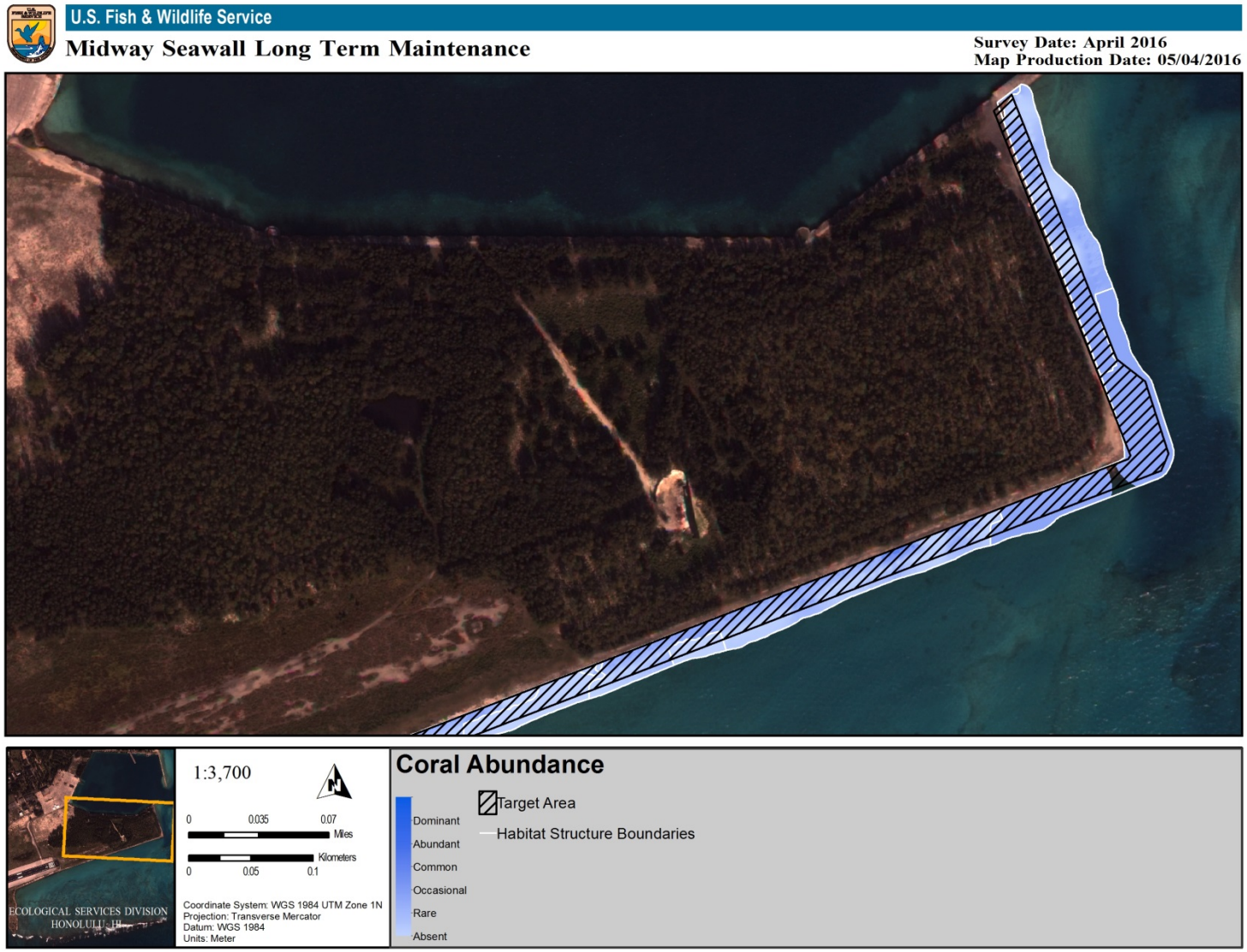


Figure 13c. Sub-map B. Relative Abundance of Corals

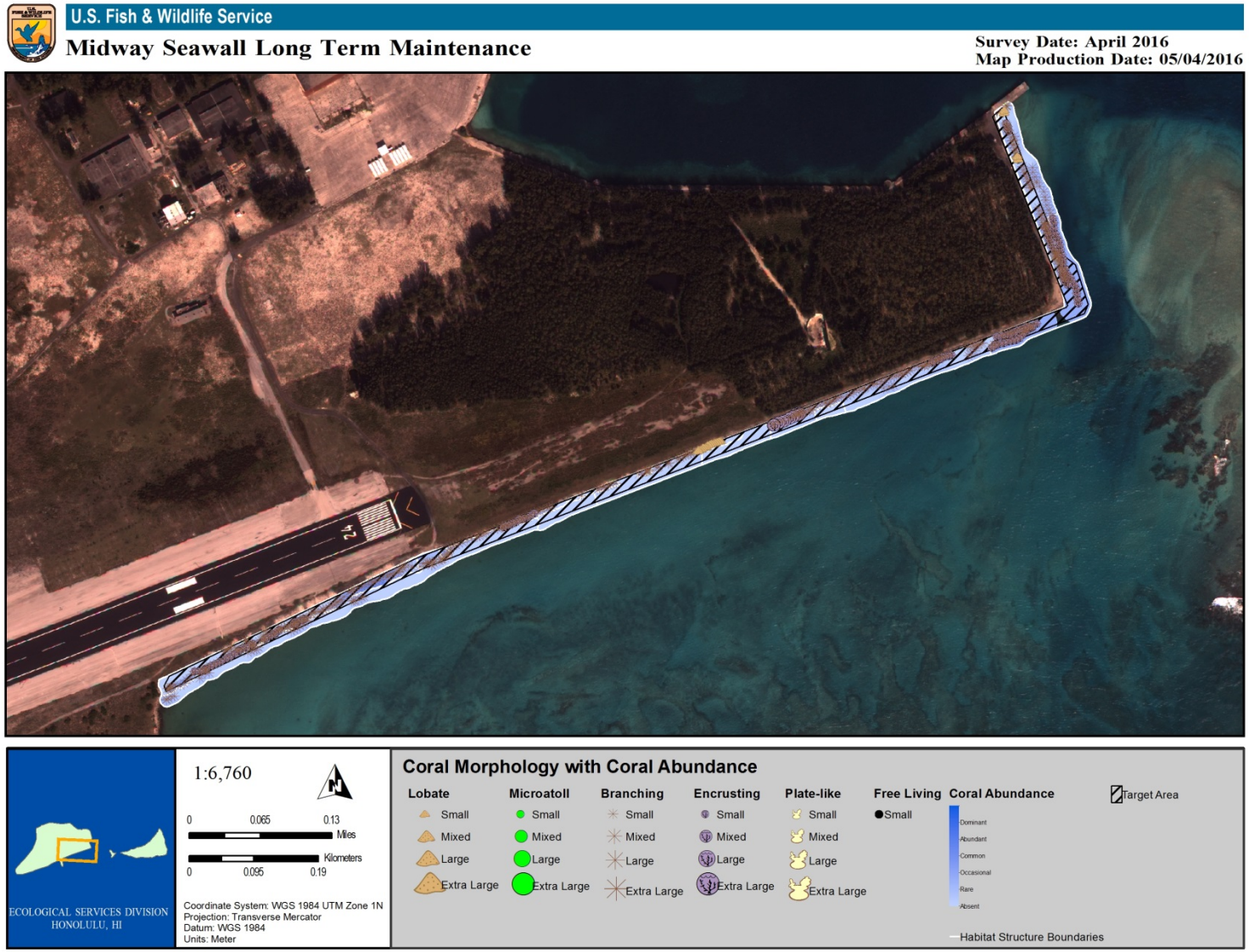


Figure 14a. Coral Morphology with Coral Abundance. Benthic/horizontal component only.

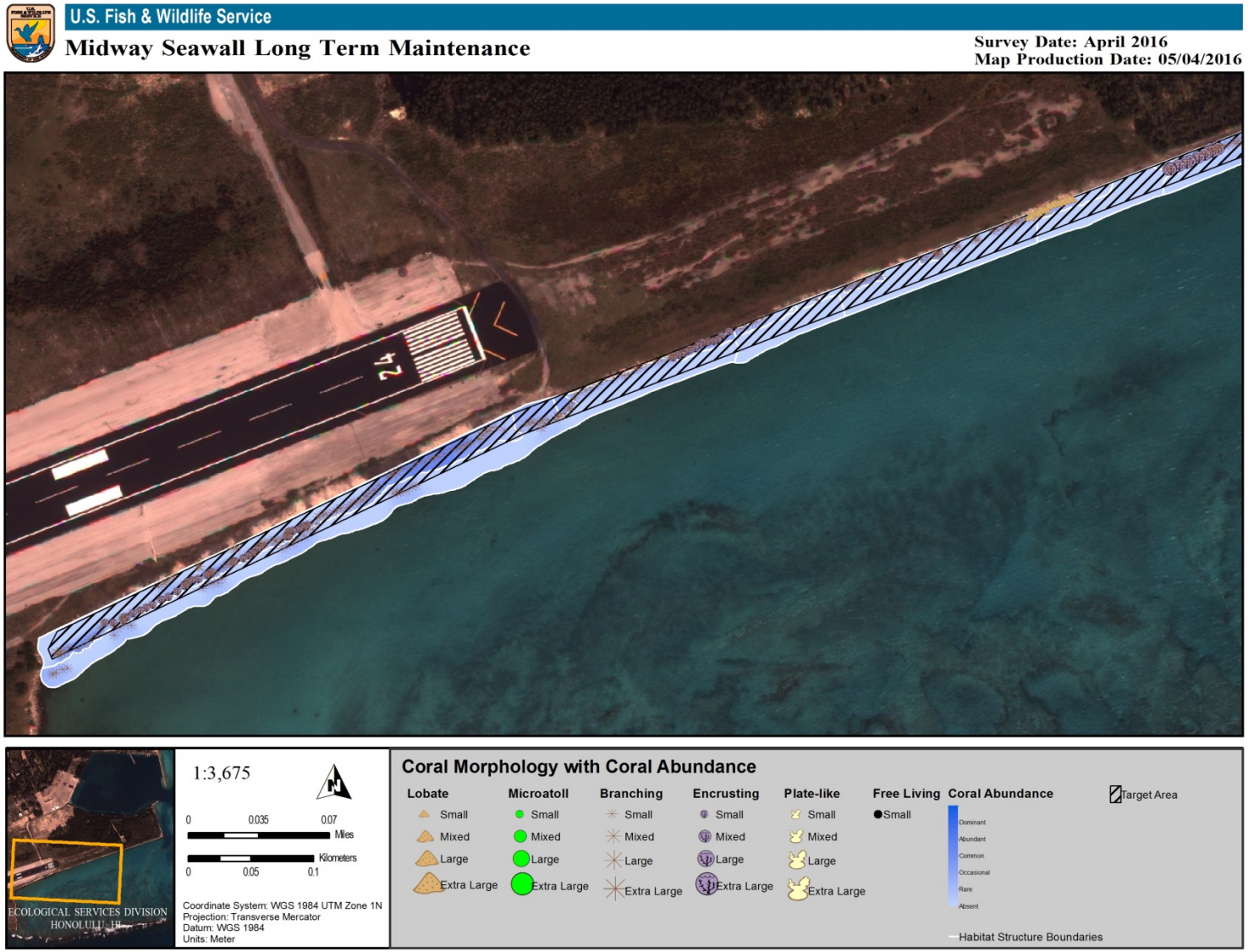


Figure 14b. Sub-map A. Coral Morphology with Coral Abundance. Benthic/vertical component only.

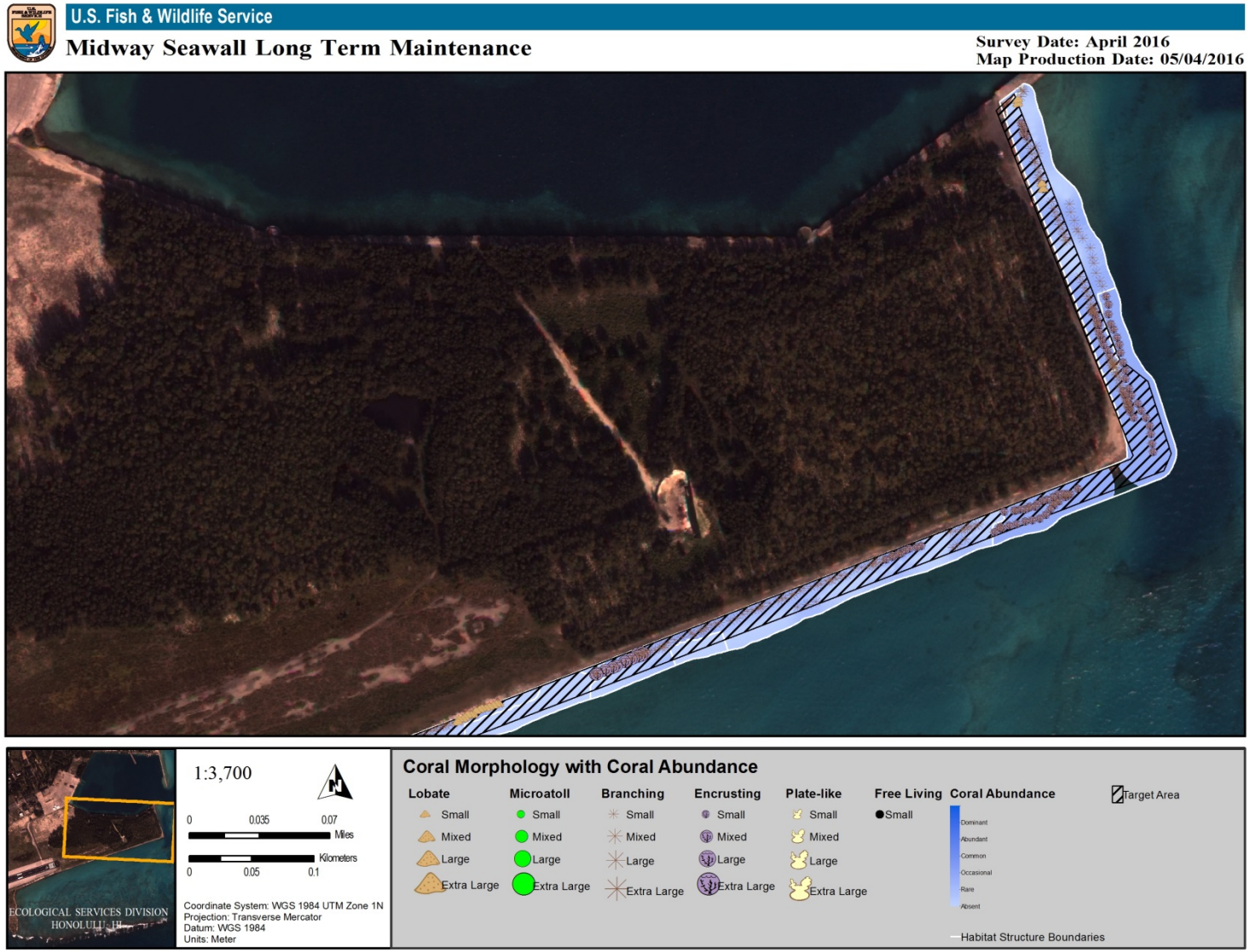


Figure 14c. Sub-map B. Coral Morphology with Coral Abundance. Benthic/horizontal component only.

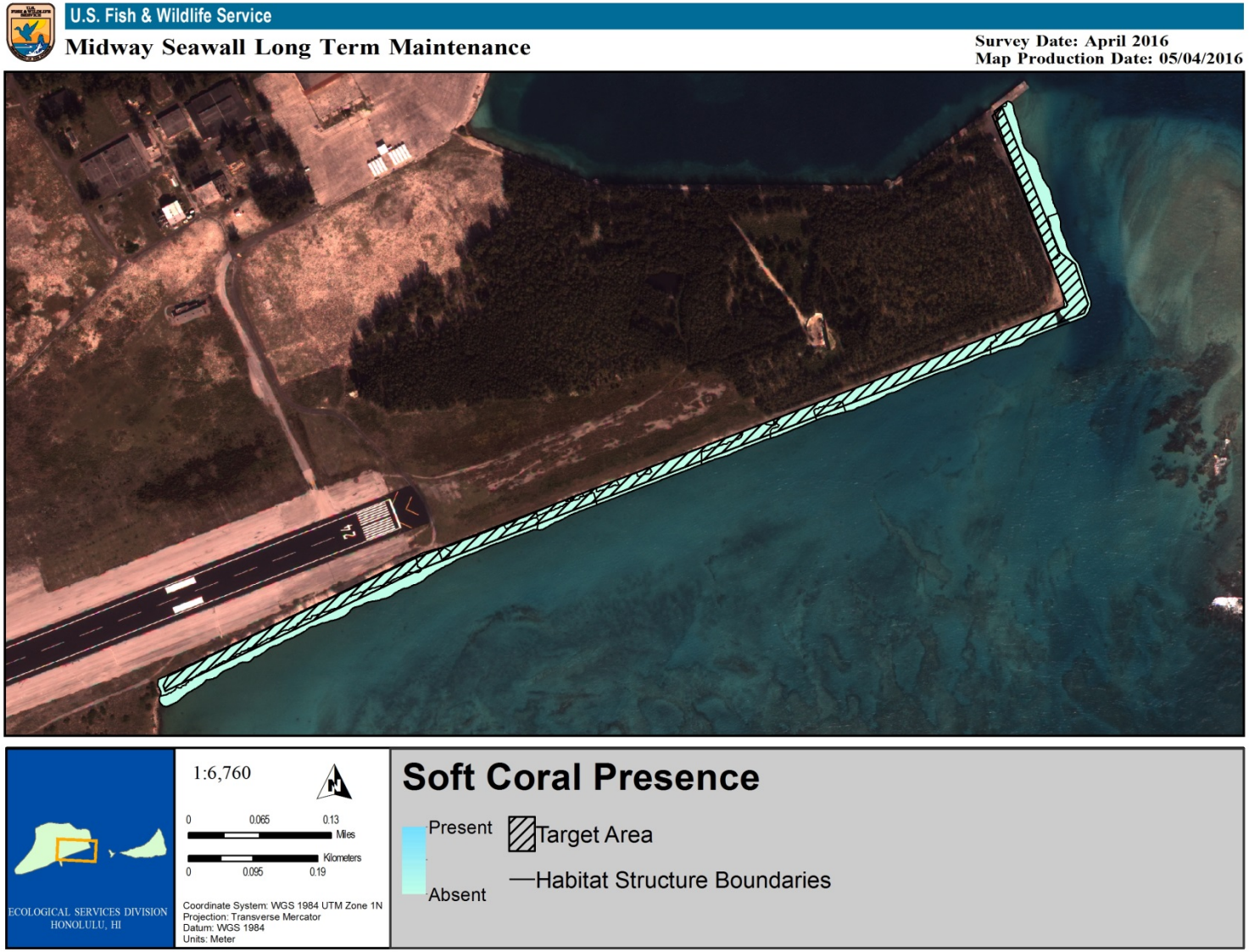


Figure 15. Presence of Soft Corals. None observed.

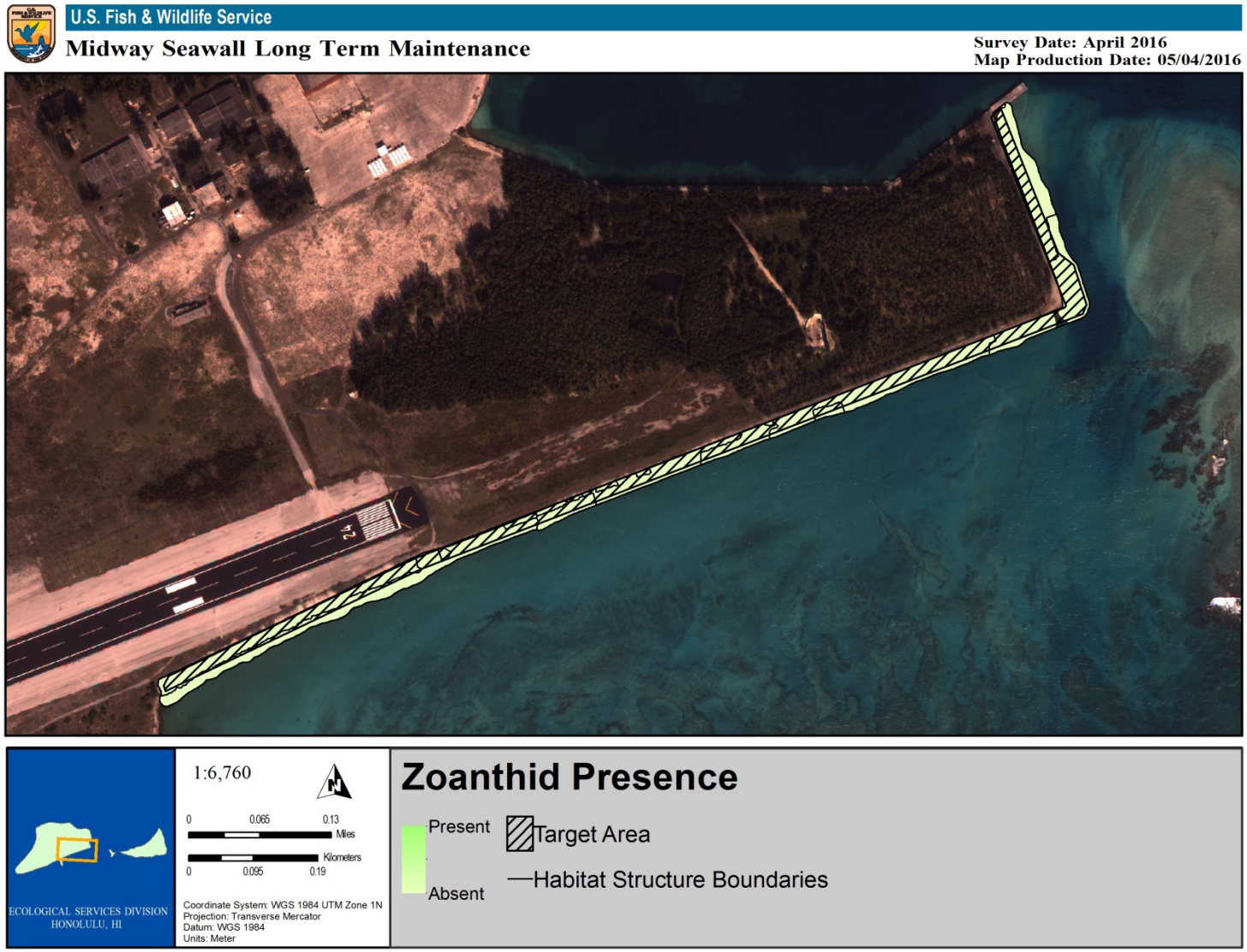


Figure 16. Presence of Zoanthids. None observed.

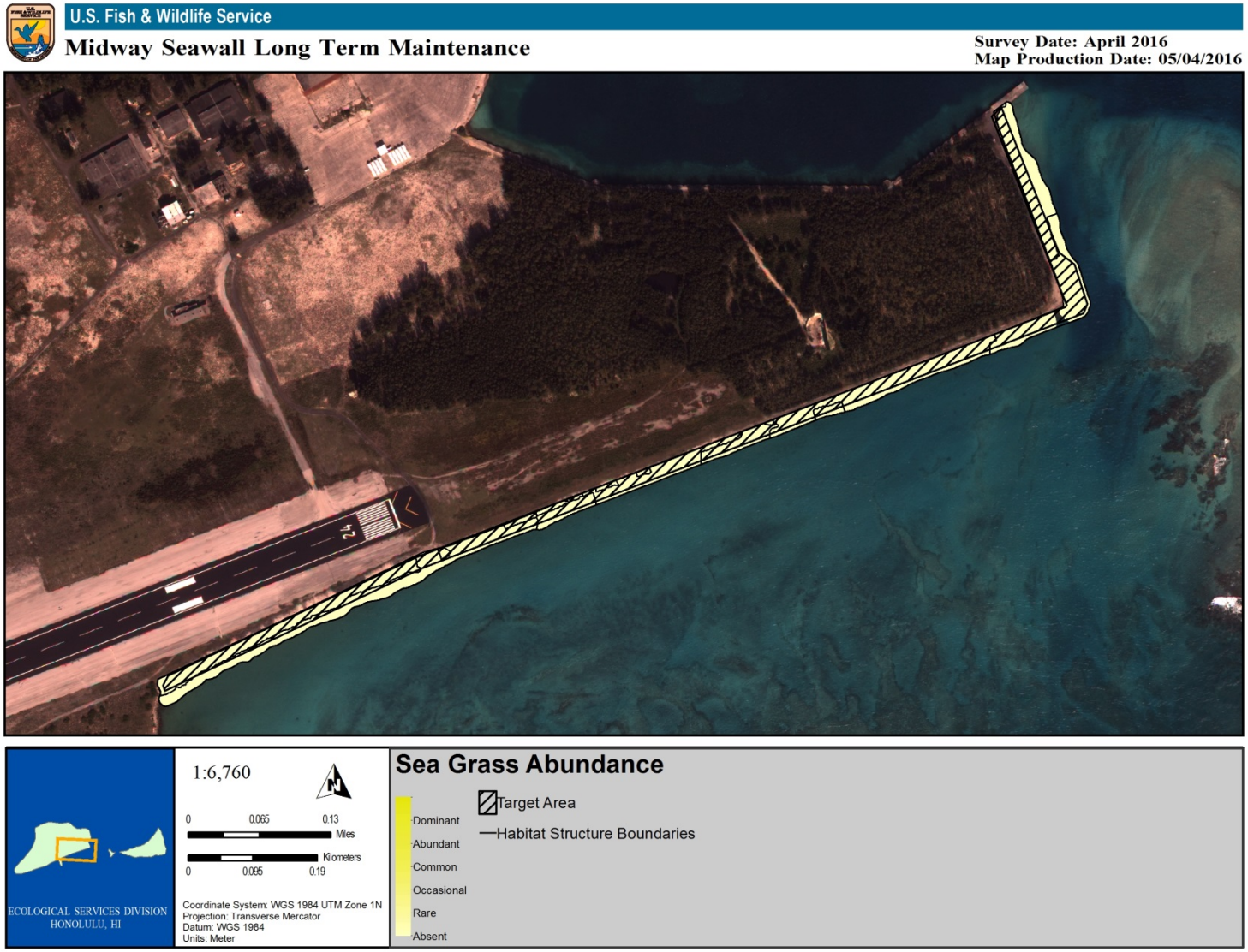


Figure 17. Relative Abundance of Sea Grass. None observed.

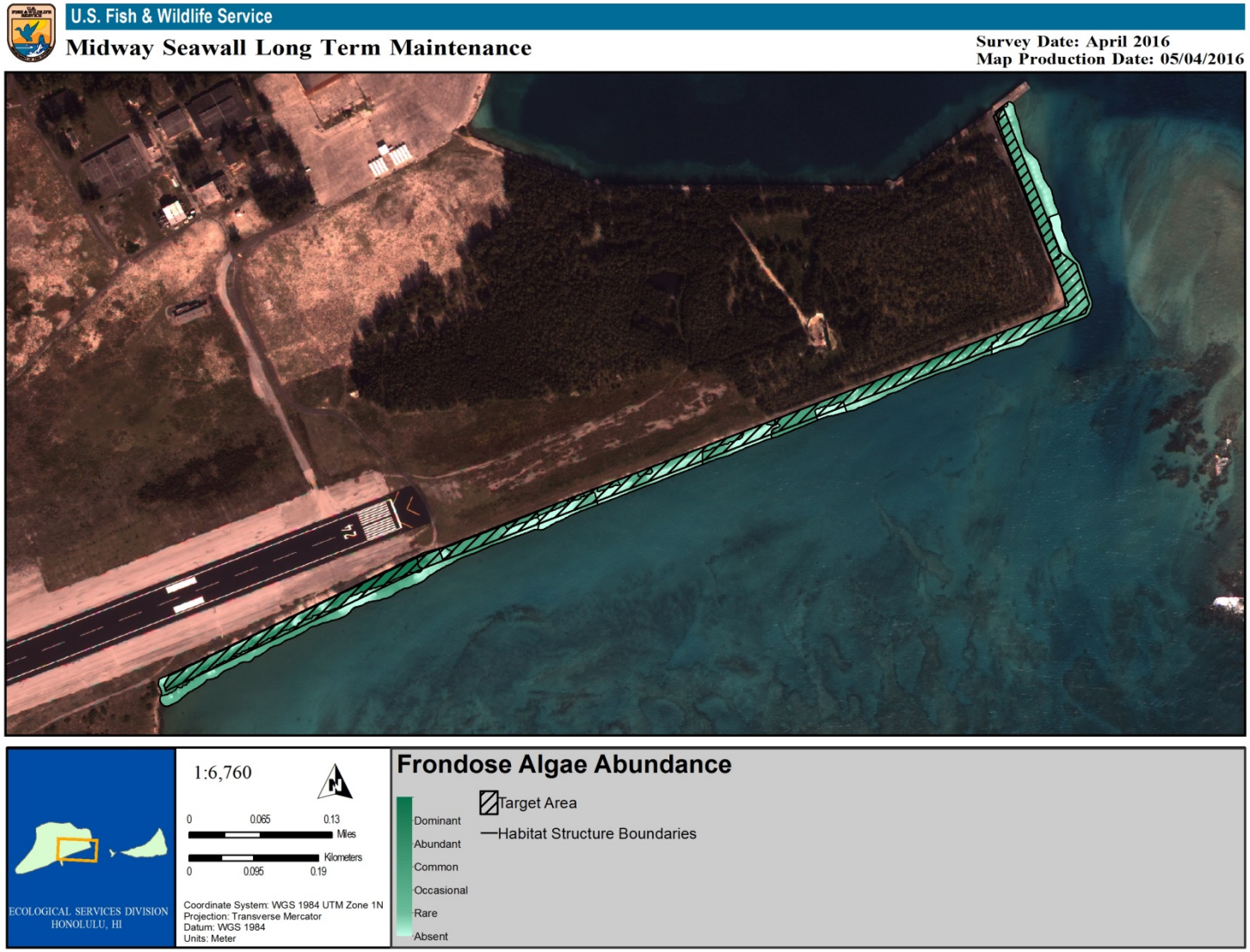


Figure 18. Relative abundance of Frondose Algae.

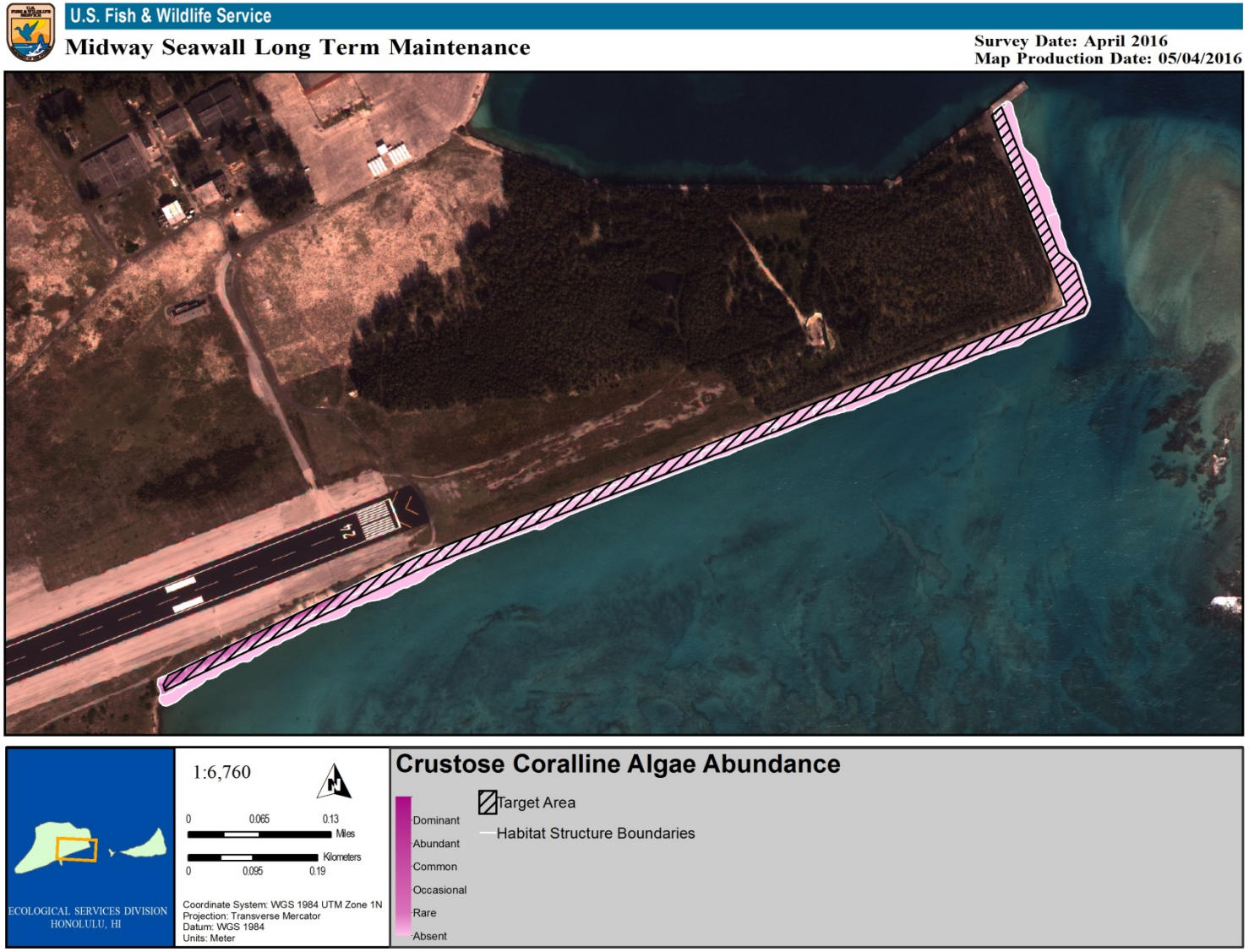


Figure 19a. Relative abundance of Crustose Coralline Algae.

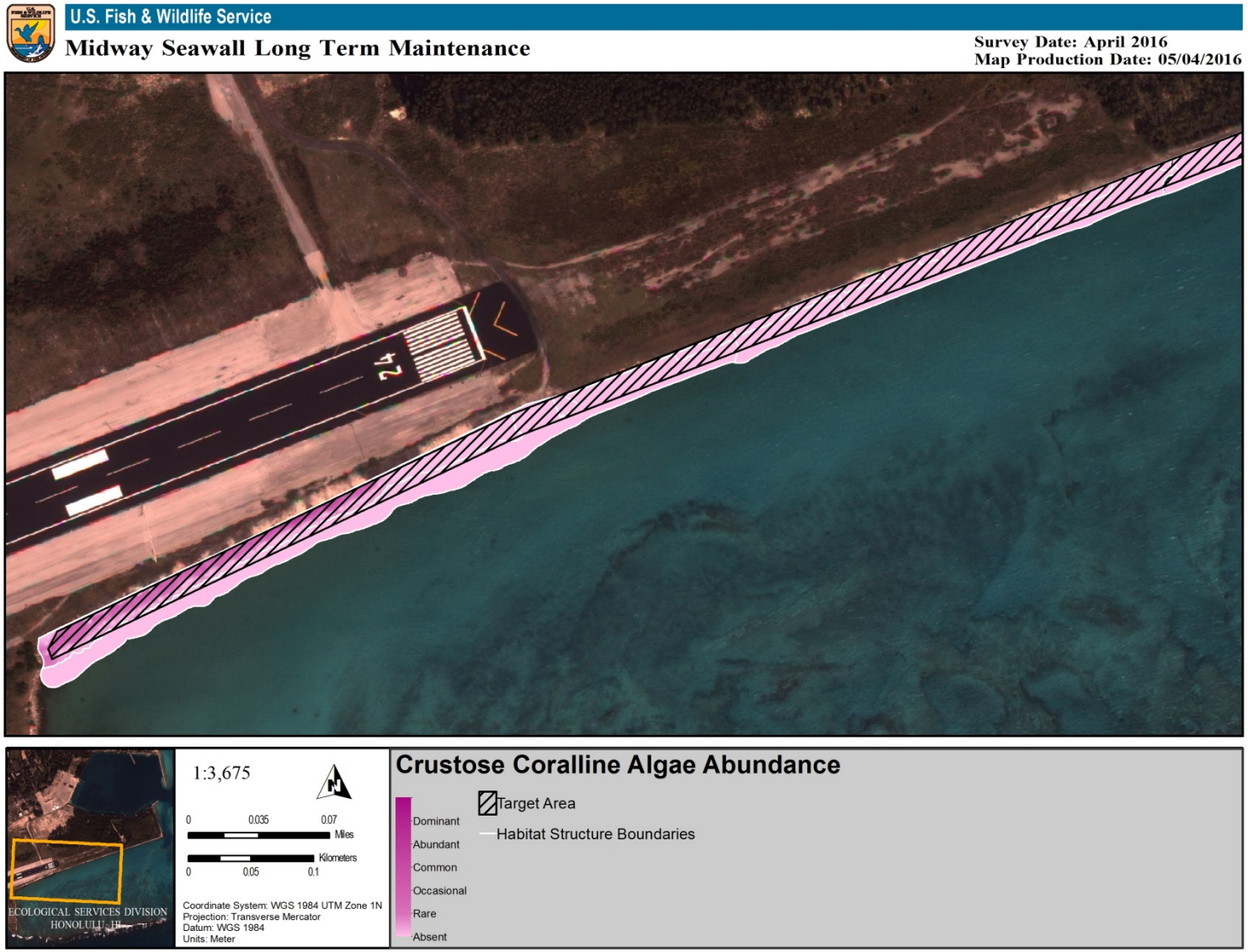


Figure 19b. Sub-map A. Relative abundance of Crustose Coralline Algae.

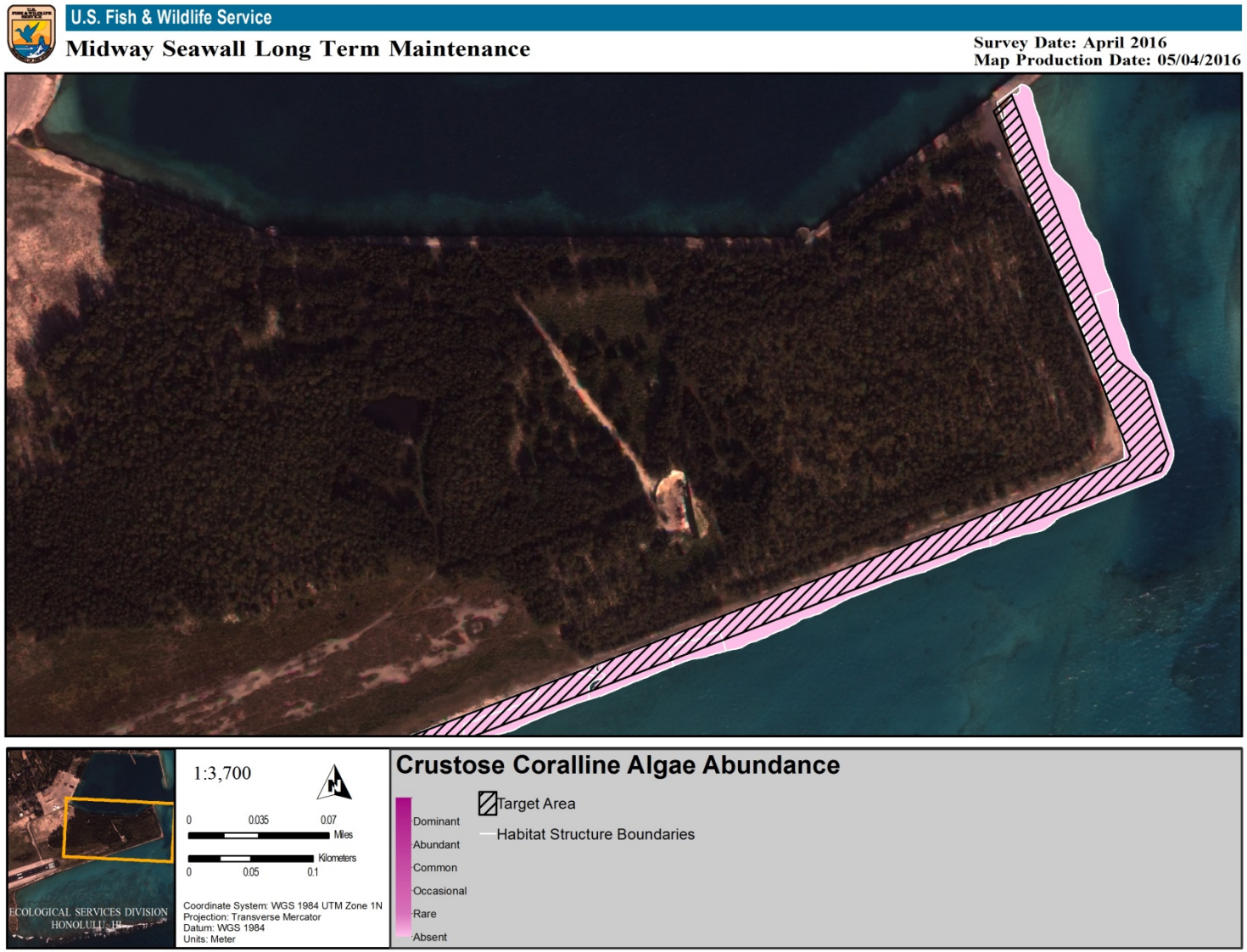


Figure 19c. Sub-map B. Relative abundance of Crustose Coralline Algae.

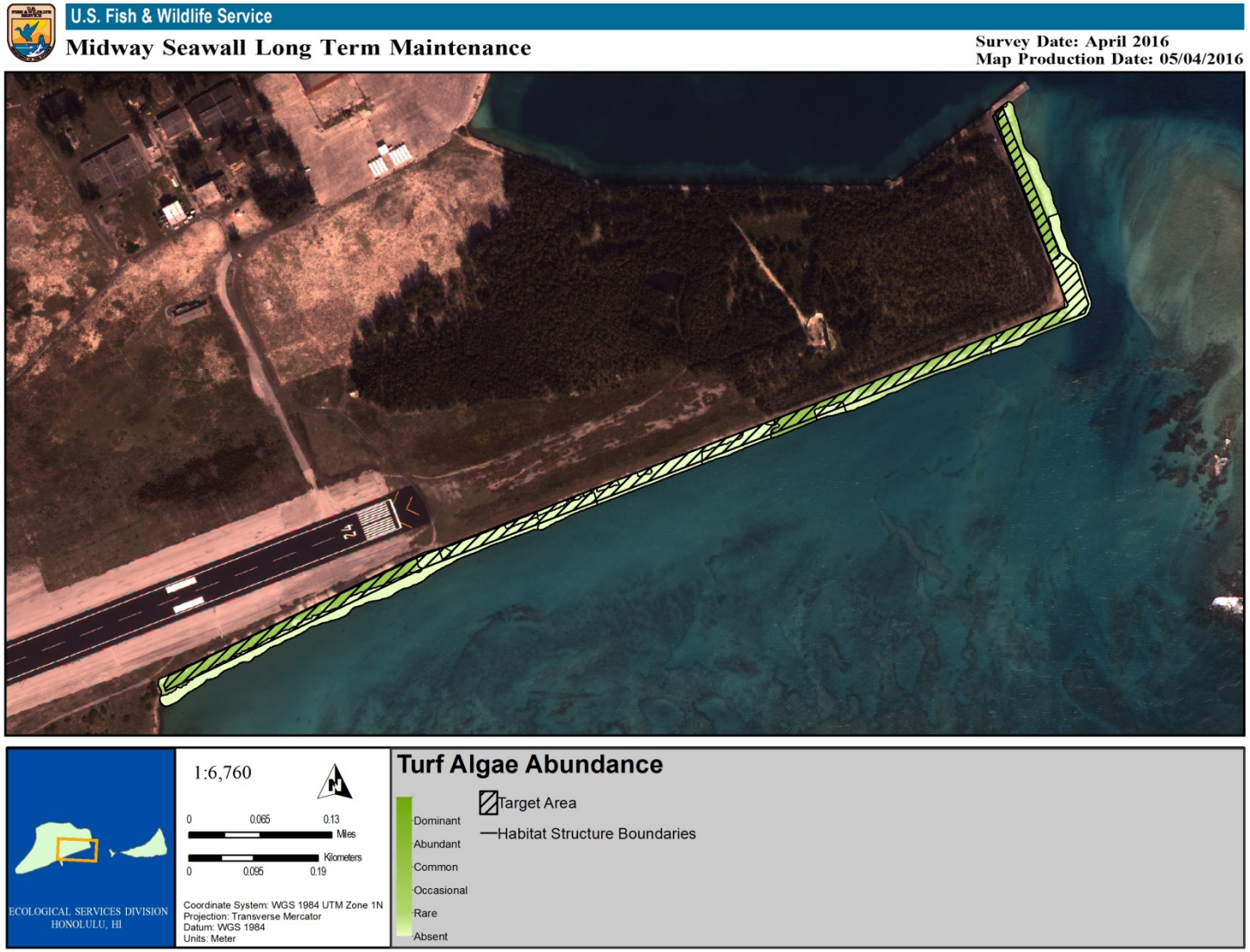


Figure 20. Relative abundance of Turf Algae.

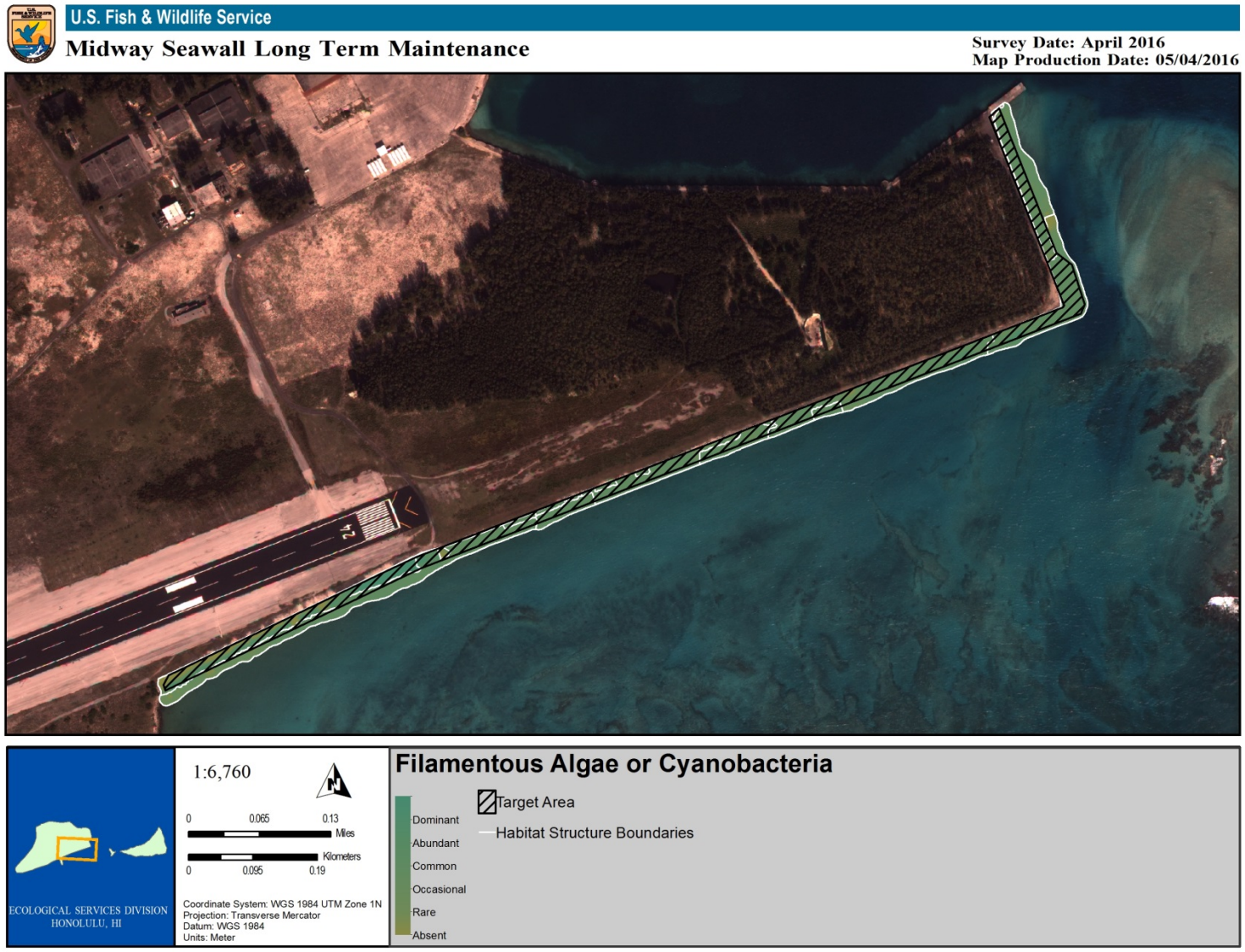


Figure 21. Relative abundance of Filamentous Algae.

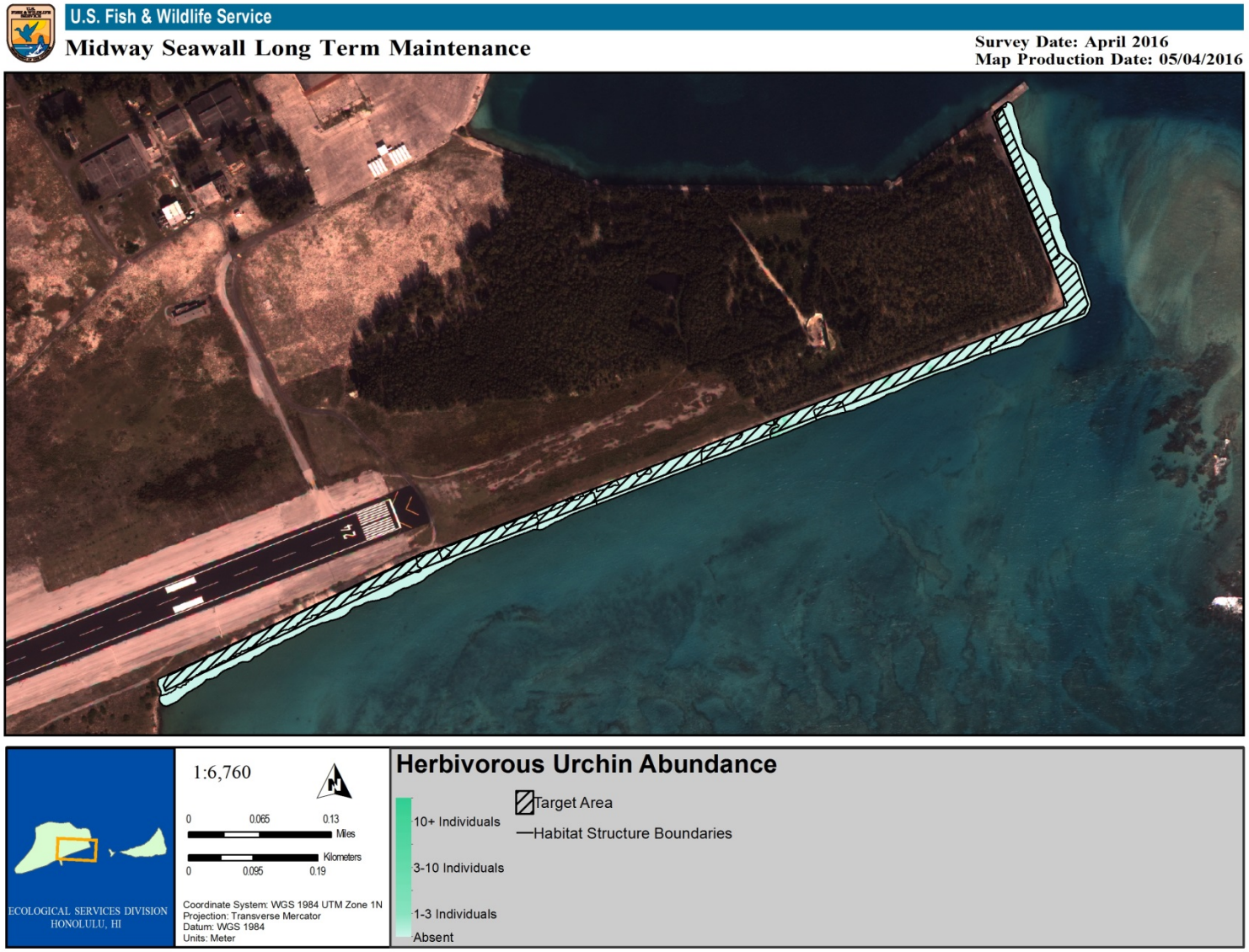


Figure 22a. Relative Abundance of Herbivorous Urchins

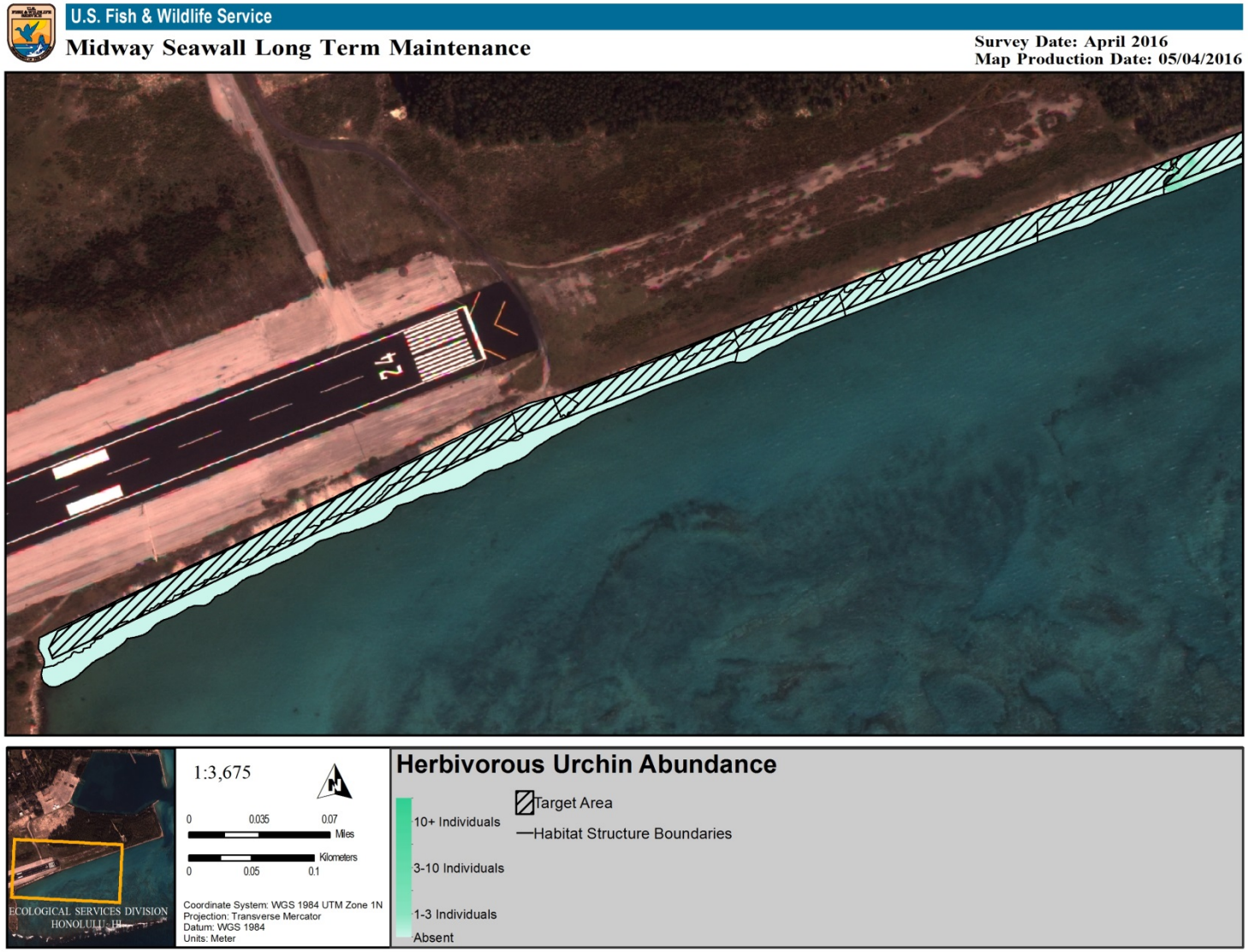


Figure 22b. Sub-map A. Relative Abundance of Herbivorous Urchins

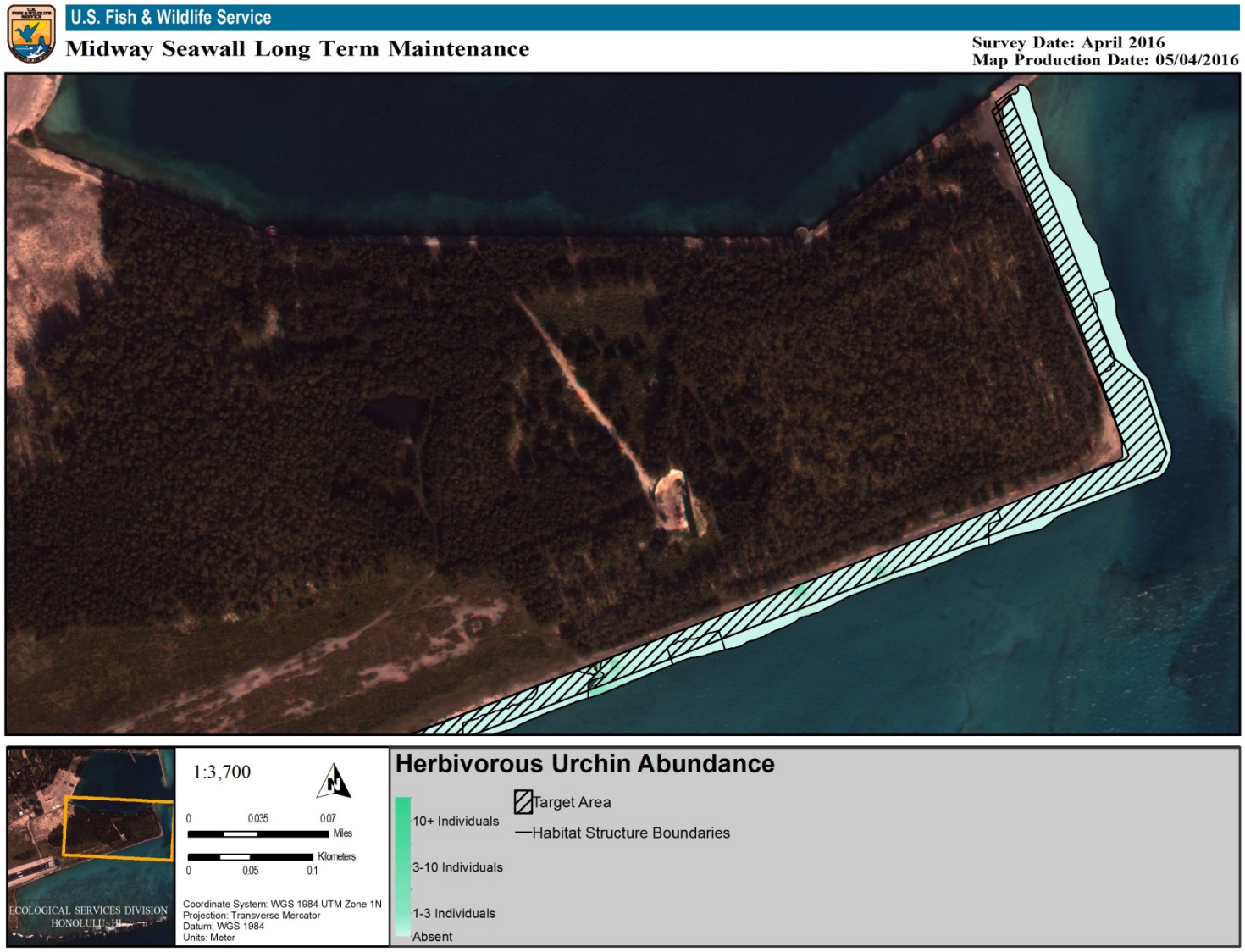


Figure 22c. Sub-map B. Relative Abundance of Herbivorous Urchins

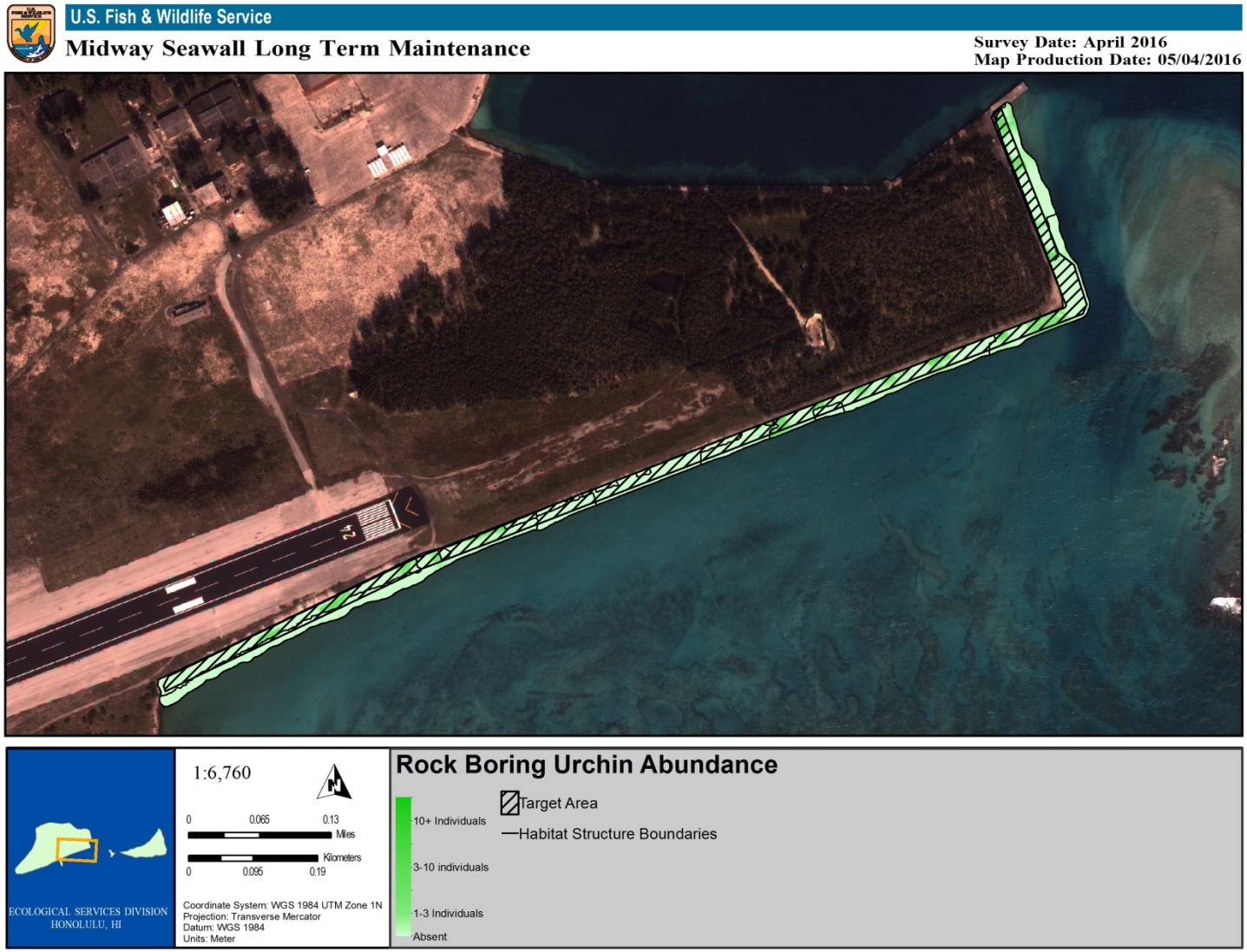


Figure 23a. Relative abundance of Rock Boring Urchins.

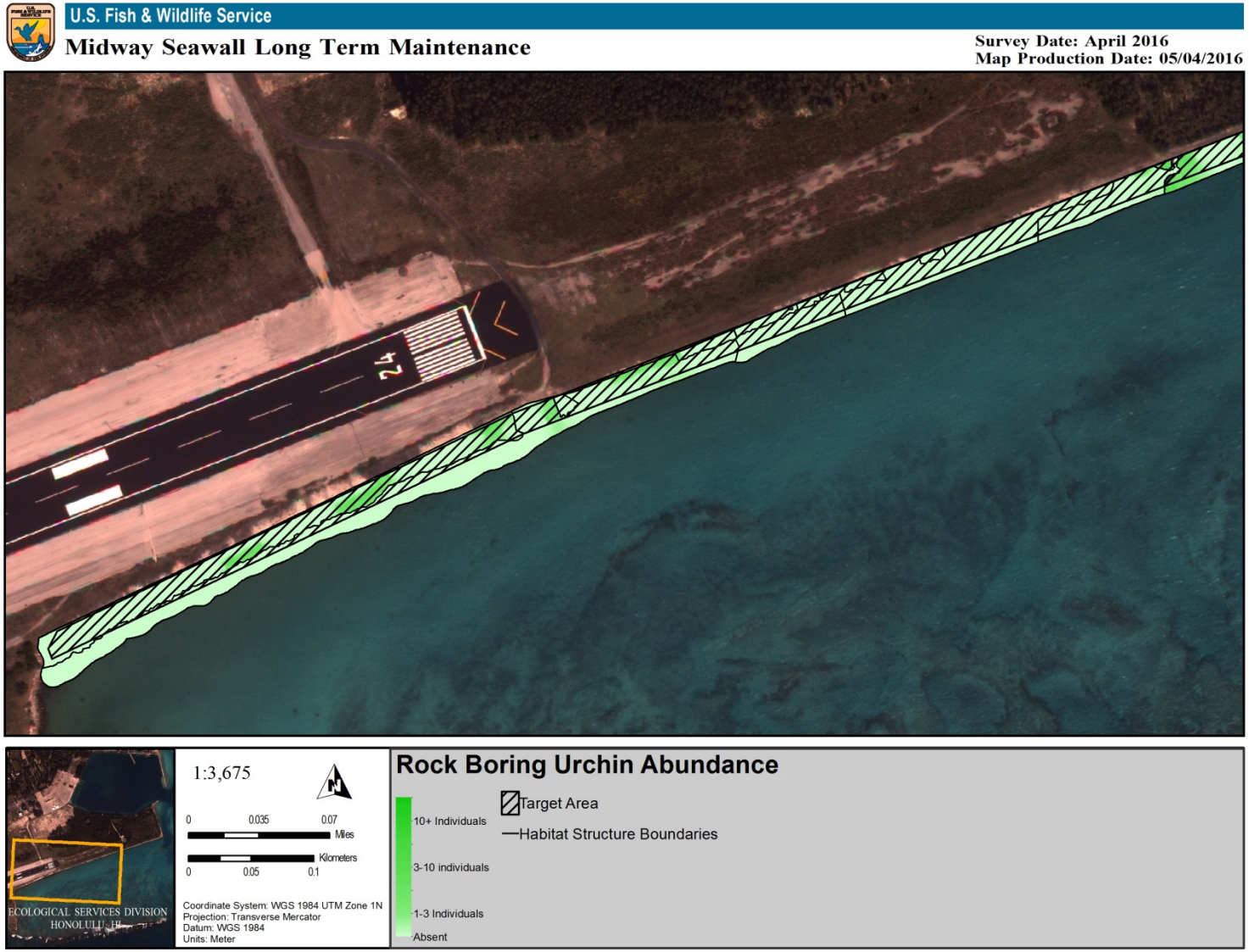


Figure 23b. Sub-map A. Relative abundance of Rock Boring Urchins.

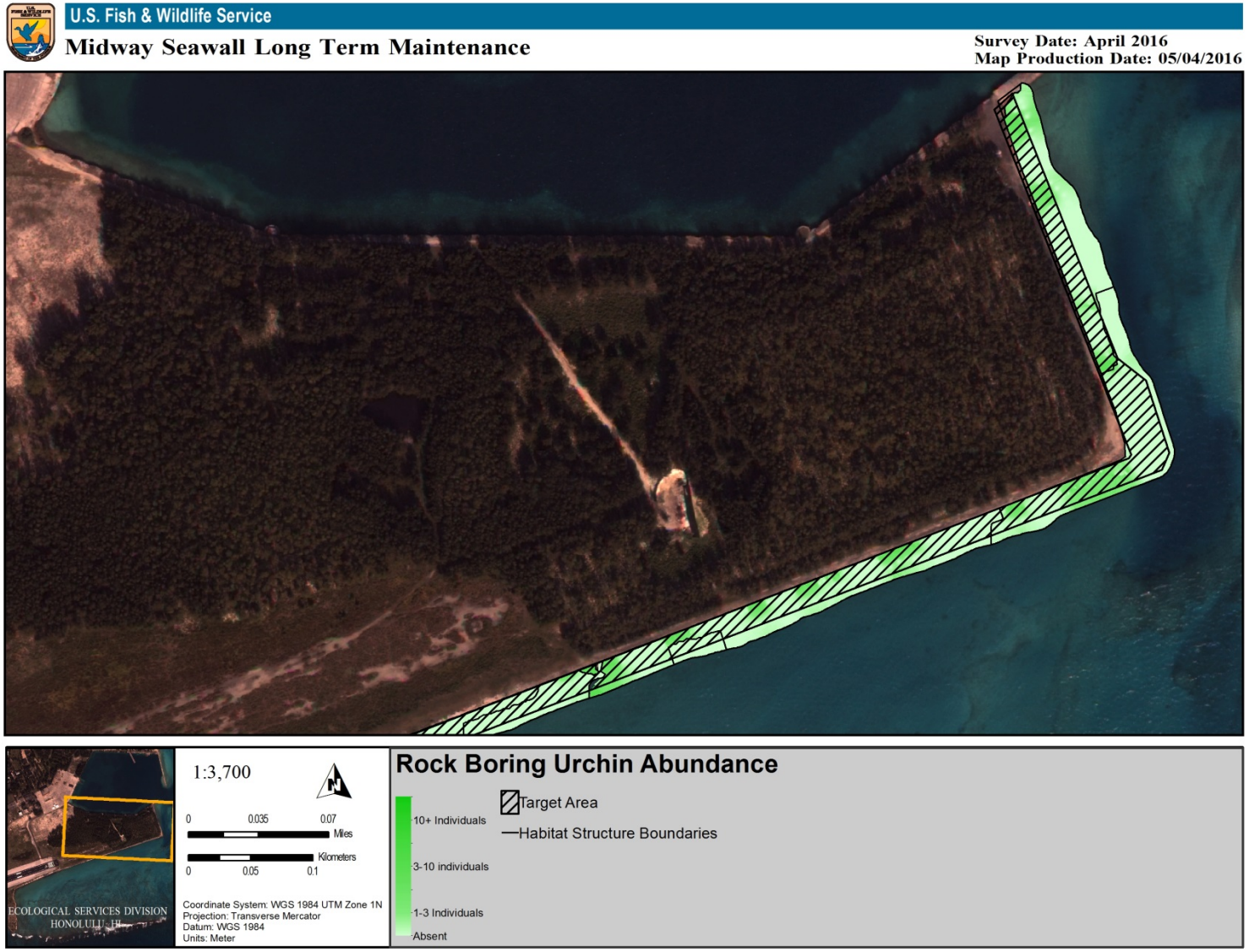


Figure 23c. Sub-map B. Relative abundance of Rock Boring Urchins.

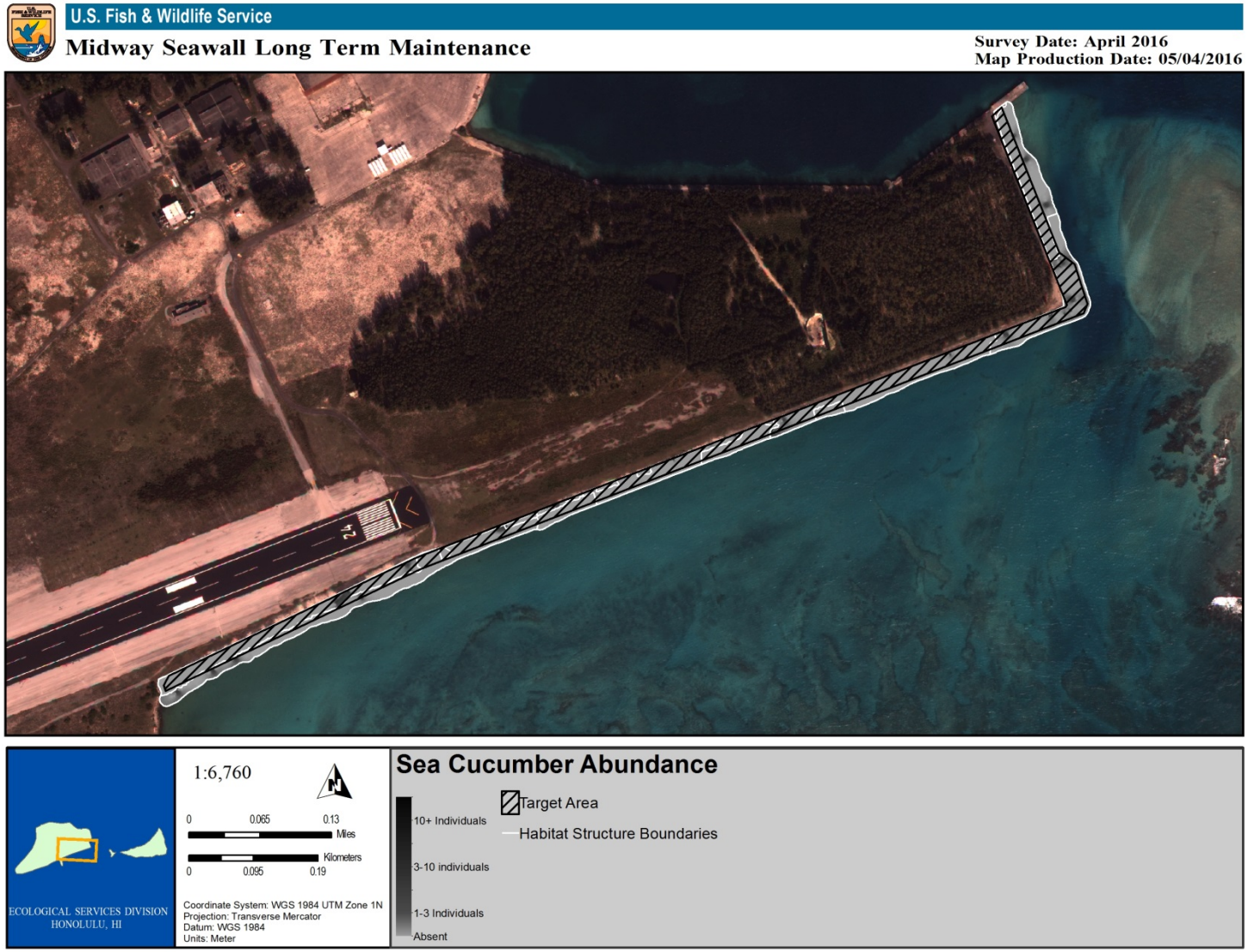


Figure 24. Relative abundance of Sea Cucumbers.

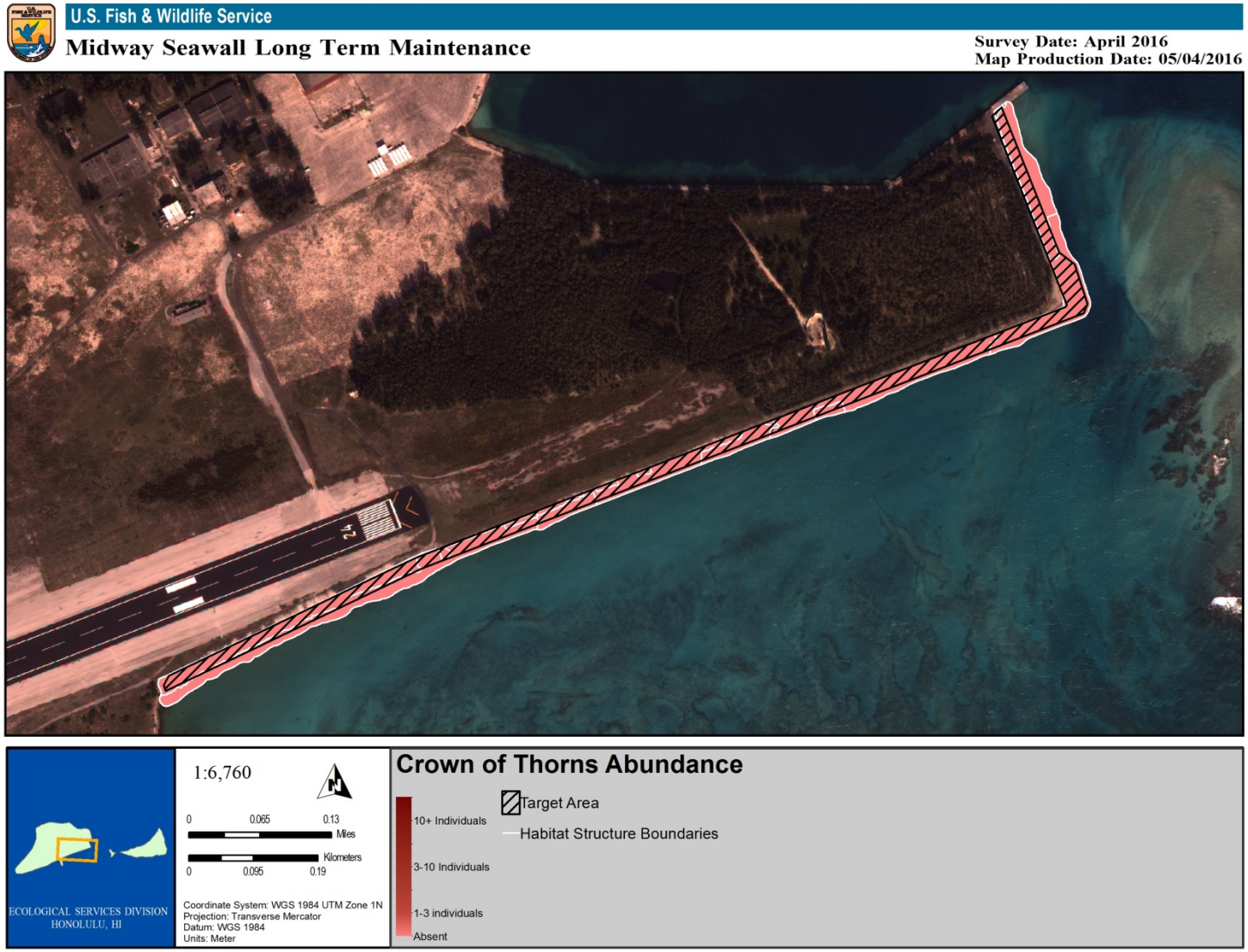


Figure 25. Relative abundance of Crown of Thorns Starfish (*Acanthaster planci*). None observed.

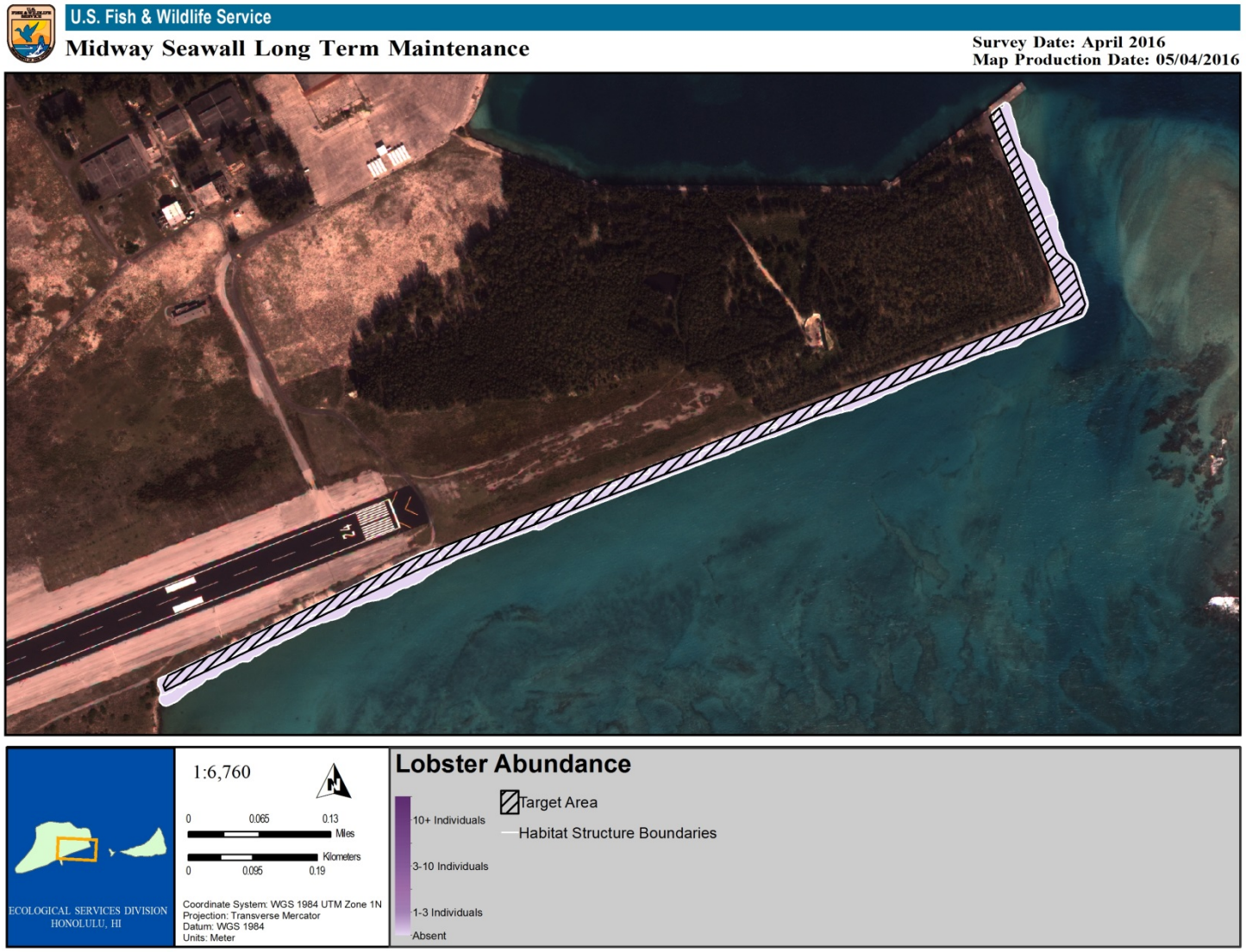


Figure 26. Relative abundance of Lobsters. Benthic/horizontal component only. None observed.

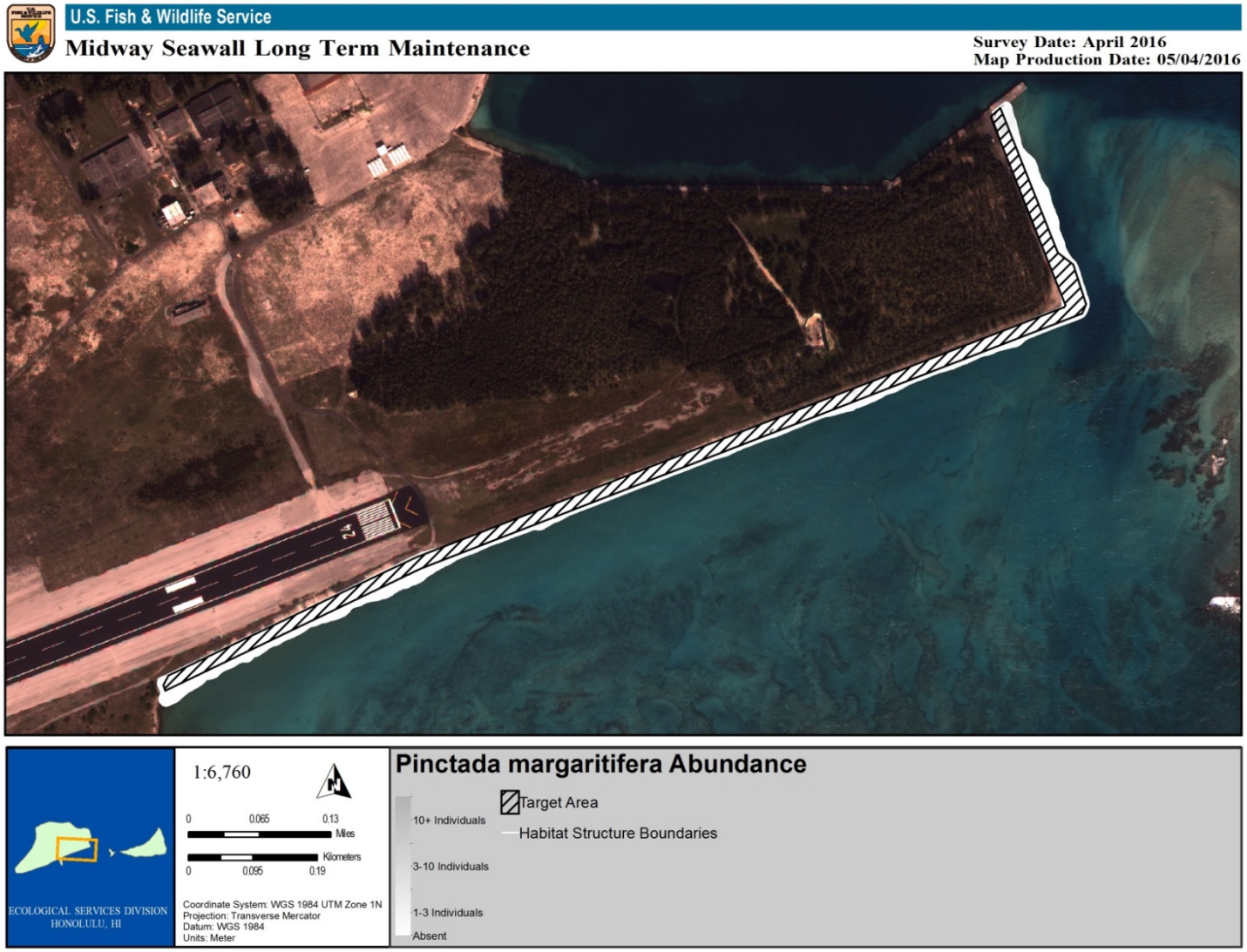


Figure 27. Relative abundance of *Pinctada margarifiera* (Black-lipped pearl oyster). Benthic/horizontal component only. None observed

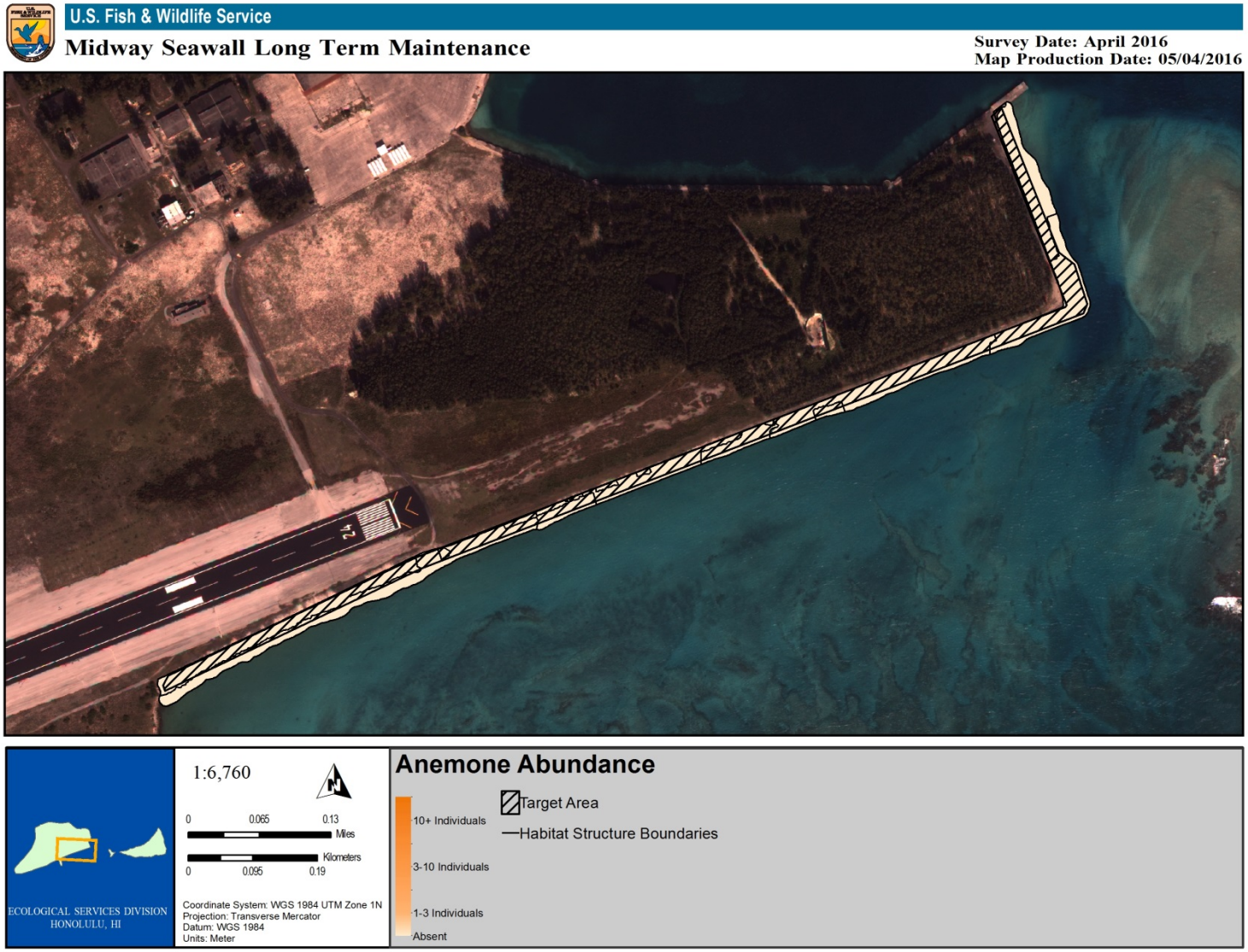


Figure 28. Relative abundance of Anemones. None observed

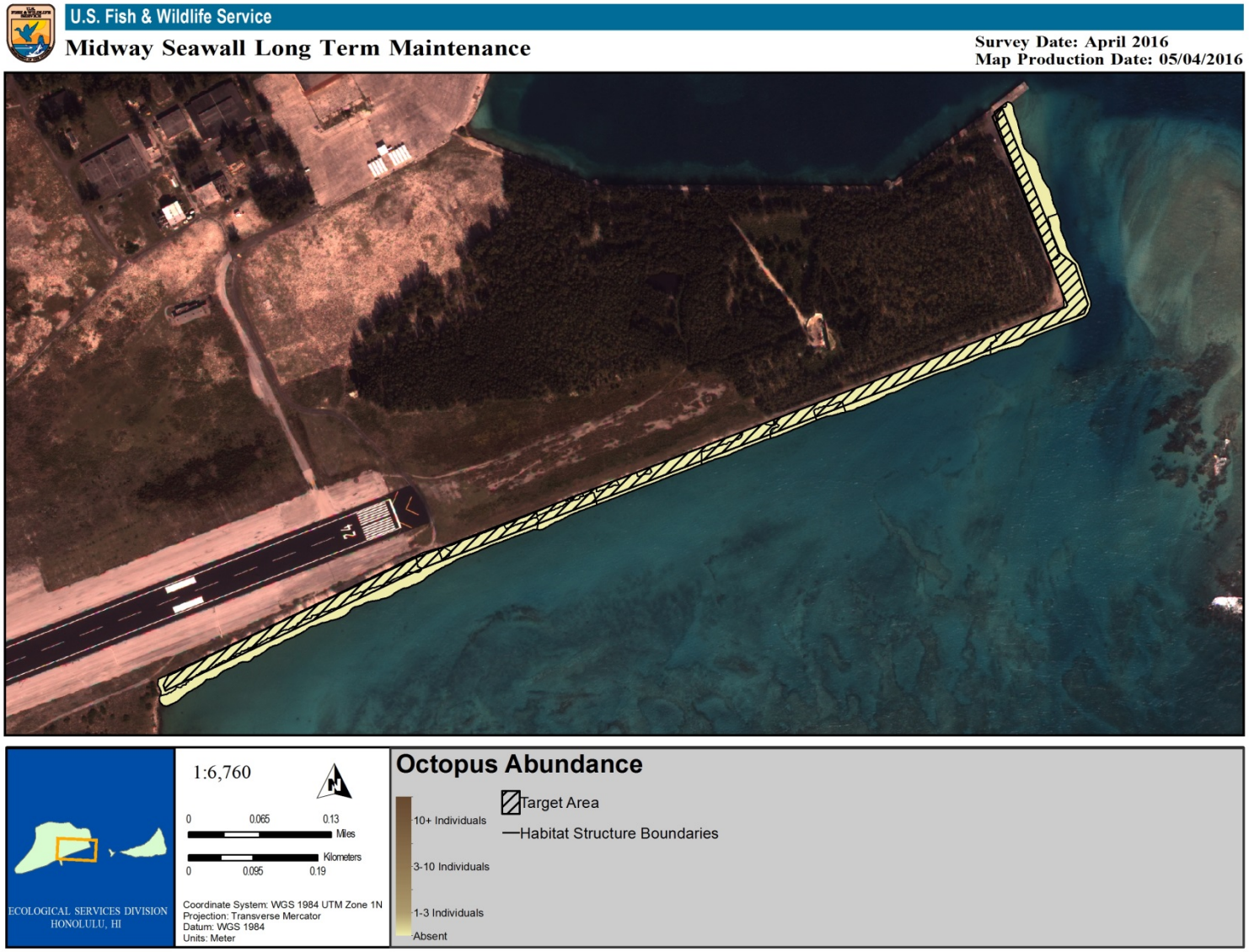


Figure 29. Relative abundance of Octopus. None observed.

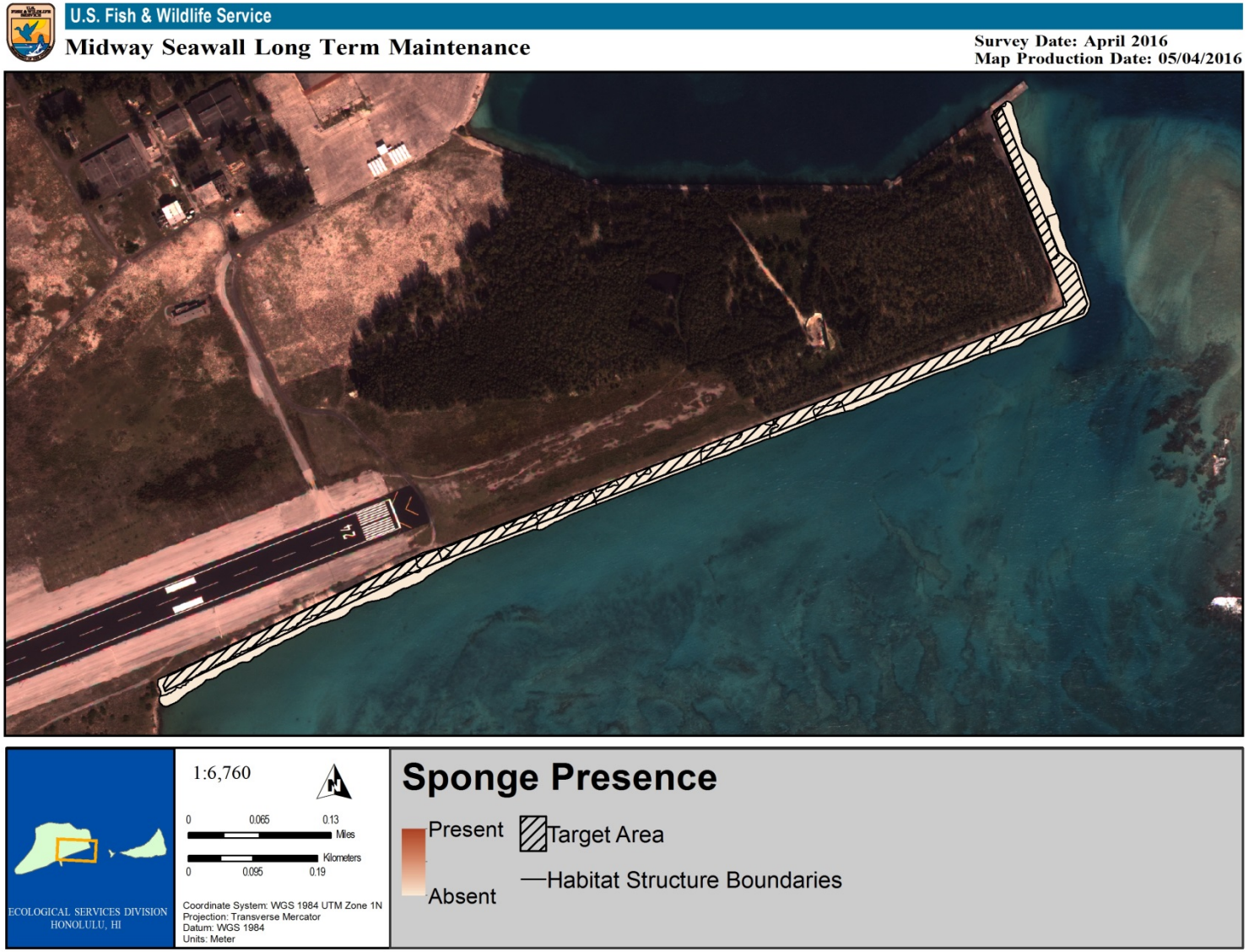


Figure 30. Presence of Sponges. Benthic/horizontal component only. None observed

Figure 31. Priority Repair Locations A, B, and C. (Map date: March 5, 2015)

Figure 32a. Location of 26 data survey transects, horizontal and vertical, in project area.

Figure 32b. Sub-map A. Location of data survey transects, horizontal and vertical, in project area.

Figure 32c. Sub-map B. Location of data survey transects, horizontal and vertical, in project area.

Table 1. Area calculation for the proposed project area by habitat zone, major substrate type, sediment types, and habitat structure type.

Habitat Zone Types	**Acres**	**Square Meters**	**Percent (%)**
Reef Flat	7.47	30,223	93
Shoreline Intertidal	0.55	2,218	7
Total	8.02	32,441	
Major Structure Types	**Acres**	**Square Meters**	**Percent (%)**
Hard Bottom	3.00	12,151	37
Unconsolidated Sediment	5.01	20,289	63
Total	8.02	32,440	
Sediment Types			
Sand	0.77	3,112	15
Sand/ Rubble	4.24	17,176	85
Total	5.01	20,288	
Habitat Structure Types	**Acres**	**Square Meters**	**Percent (%)**
Artificial	3.00	12,151	37
Scattered Coral Rock Unconsolidated Sediment	4.24	17,176	53
Unconsolidated Sediment	0.77	3,112	10
Total	8.02	32,440	

Table 2. Reef fish species observed along the southern coastline of Sand Island. Phase 1 and Phase 2. All observations made during daylight hours.
Midway Seawall Long Term Maintenance, Sand Island, Midway Atoll. April 14-22, 2016

Phylum-Class-Order-Family-*Genus-species*	
Phylum Chordata	
Class Actinopterygii	
Order Perciformes	
Family Mobulidae	
Manta alfredi	x
Family Acanthuridae	
Acanthurus blochii	x
A. leucopareus	x
A. nigrofuscus	x
A. nigroris	x
A. triostegus	x
A. xanthopterus	x
Ctenochaetus strigosus	x
Naso unicornis	x
Zebrasoma veliferum	x
Family Atherinidae	
Atherinomorus insularum	x
Family Belonidae	
Platybelone argalus	x
Family Bleniidae	
Plagiotremus ewaenisis	x
Family Carangidae	
Caranx ignobilis	x
C. melampygus	x
Elagatis bipinnulata	x
Scomberoides laysan	x
Seriola dumerili	x
Family Chaetodontidae	
Chaetodon auriga	x
C. citrinellus	x
C. fremblii	x
C. lunula	x
C. miliaris	x
C. unimaculatus	x

Table 2. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Chordata (continued)	
Class Actinopterygii	
Order Perciformes	
Family Cheilodactylidae	
Cheilodactylus vittatus	x
Family Cirrhitidae	
Cirrhites pinnulatus	x
Parachirrhites arcatus	x
P. forsteri	x
Family Diodontidae	
Diodon hystrix	x
Family Fistulariidae	
Fistularia commersonii	x
Family Holocentridae	
Myripristis amaena	x
M. kuntee	x
Neoniphon sammara	x
Family Kuhliidae	
Kuhlia sandwicensis	x
K. xenura	x
Family Kyphosidae	
Kyphosus hawaiiensis	x
K. sandwicensis	x
Family Labridae	
Anampses chrysocephalus	x
Bodianus albotaeniatus	x
Cheilio inermis	x
Coris flavovittata	x
C. gaimard	x
C. venusta	x
Iniistius pavo	x
I. umbrilatus	x
Labroides phthirophagus	x
Macropharyngodon geoffrey	x
Novaculichthys taeniourus	x
Pseudocheilinus tetrataenia	x

Table 2. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Chordata (continued)	
Class Actinopterygii	
Order Perciformes	
Family Labridae (continued)	
Stethojulis balteata	x
Thalassoma ballieui	x
T. duperrey	x
T. purpureum	x
T. quinquevittatum	x
T. trilobatum	x
Family Lutjanidae	
Aprion virescens	x
Family Mulliidae	
Mulloidichthys flavolineatus	x
M. vanicolensis	x
Parupeneus cyclostomus	x
P. insularis	x
P. multifasciatus	x
P. porphyreus	x
Family Oplegnathidae	
Oplegnathus fasciatus	x
O. punctatus	x
Family Ostraciidae	
Lactoria fornasini	x
Ostracion meleagris	x
Family Polynemidae	
Polydactylus sexfilis	x
Family Pocilloporidae	
Abudefduf abdominalis	x
A. sordidus	x
Chromis hanui	x
Dascyllus albisella	x
Plectroglyphidodon imparipennis	x
P. johnstonianus	x
P. sindonis	x
Stegastes marginatus	x
Family Pteronidae	
Pterois sphex	x

Table 2. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Chordata (continued)	
Class Actinopterygii	
Order Perciformes	
Family Priacanthidae	
Priacanthus meeki	x
Family Scaridae	
Chlororus perspicullatus	x
C. spilurus	x
Scarus rubroviolaceus	x
Family Synodontidae	
Saurida flamma	x
S. gracilis	x
Synodus dermatogenys	x
Family Tetraodontidae	
Canthigaster amboinensis	x
C. epilampra	x
C. jactator	x
Family Zanclidae	
Zanclus cornutus	x
Total Number of Families	**27**
Total Species Observed	**97**

Table 3. Coral species observed along the southern coastline of Sand Island during Phase 1 and Phase 2.
All observations made during daylight hours.
Midway Seawall Long Term Maintenance, Sand Island, Midway Atoll NWR. April 14-22, 2016

Phylum-Class-Order-Family-*Genus-species*	Structure	
	Benthic	Artificial
Phylum Cnidaria		
Class Anthozoa		
Order Scleractinia		
Family Acroporidae		
Montipora flabellata		x
Family Faviidae		
Cyphastrea ocellina		x
Leptastrea purpurea		x
Family Pocilloporidae		
Pocillopora damicornis	x	x
Pocillopora ligulata	x	x
Pocillopora meandrina	x	x
Family Poritidae		
Porites compressa		x
Porites evermanni		x
Porites lobata	x	x
Total Species per Phylum	4	9
TOTAL species per structure type	4	9

Table 4. Non-coral macroinvertebrate species observed along the southern coastline of Sand Island during Phase 1 and Phase 2. .
All observations made during daylight hours.
Midway Seawall Long Term Maintenance. Sand Island, Midway Atoll NWR. April 14-22, 2016

Phylum-Class-Order-Family-*Genus-species*	
Phylum Annelida	
Class Polychaeta	
Order Sabellida	
Family Sabellidae	
Sabellastarte sanctijosephi	x
Family Serpulidae	
Spirobranchus corniculatus	x
Order Terebellida	
Family Terrebellidae	
Loimia medusa	x
Total Species per Phylum	**3**
Phylum Mollusca	
Class Gastropoda	
Order Littorinimorpha	
Family Littorinidae	
Littoraria pintado	x
Family Vermetidae	
Thylacodes sp.	x
Order Neogastropoda	
Family Muricidae	
Drupa ricinus alolabris	x
Morula uva	x
Family Terebridae	
Oxymeris maculata	x

Table 4. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Mollusca (continued)	
Class Gastropoda	
Order Neogastropoda	
Family Conidae	
Conus spp.	x
Clade Neritomorpha	
Superfamily Neritoidea	
Family Neritidae	
Nerita picea	x
Class Bivalvia	
Order Pectinida	
Family Spondylidae	
Spondylus candidus	x
Order Pterioida	
Family Pteriidae	
Pinctada margaritifera	x
Total Species per Phylum	**9**
Phylum Arthopoda	
Class Crustacea	
Order Decapoda	
Family Diogenidae	
Unidentified species	x
Family Grapsidae	
Grapsus tenuicrustatus	x
Family Trapeziidae	
Trapezia ferruginea	x
Class Malacostraca	
Order Decapoda	
Family Alpheidae	
Alpheus deuteropus	x
Family Palinuridae	
Paniluris pencillatus	x
Total Species per Phylum	**5**

Table 4. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Echinodermata	
Class Echinoidea	
Order Camarodonta	
Family Echinometridae	
Echinometra mathaei	x
Echinometra oblonga	x
Echinostrephus aciculatus	x
Heterocentrotus mammillatus	x
Family Toxopneustidae	
Tripneustes gratilla	x
Pseudoboletia indiana	x
Order Camarodonta	
Family Diadematidae	
Diadema paucispinum	x
Echinothrix calamaris	x
Order Spatangoida	
Family Brissidae	
Brissus latecarinatus	x
Class Holothuroidea	
Order Aspidochirotida	
Family Holothuriidae	
Actinopyga obesa	x
Holothuria atra	x
H. whitmaei	x
Class Ophiuroidea	
Order Ophiurida	
Family Ophiocomidae	
Unidentified Ophiuroidea spp.	x
Total Species per Phylum	**13**
Phylum Chordata	
Order Phlebobranchia	
Family Ascidiidae	
Phallusia nigra	x
Total Species per Phylum	**1**
Unidentified Infauna	x
Total Species Observed	**32**

Table 5. Marine plant species observed along the southern coastline of Sand Island during Phase 1 and Phase 2. All observations made during daylight hours.
Midway Seawall Long Term Maintenance. Sand Island, Midway Atoll NWR
April 14-22, 2016

Phylum-Class-Order-Family-*Genus-species*	
Phylum Cyanobacteria	
Class Cyanophyceae	
Order Ocsillatoriales	
Family Oscillatoriaceae	
Lyngbya majuscula	x
Total Species per Phylum	**1**
Phylum Rhodophyta	
Class Florideophyceae	
Order Bonnemaisoniales	
Family Bonnemaisoniaceae	
Asparagopsis taxiformis	x
Order Corallinales	
Family Corallinaceae	
Hydrolithon spp.	x
Jania pumila	x
Order Ceramiales	
Family Dasyaceae	
Dasya iridescens	x
Family Delesseriaceae	
Martensia fragilis	x
Family Rhodomelaceae	
Laurencia sp.	x
Family Wrangelieae	
Wrangelia elegantissima	x
Order Halymeniales	
Family Halymeniaceae	
Grateloupia phuquocensis	x
Order Nemaliales	
Family Galaxauraceae	
Galaxaura sp.	x
Family Liagoraceae	
Trichogloea requienii	x

Table 5. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Rhodophyta (continued)	
Class Florideophyceae	
Order Peyssonneliales	
Family Peysonneliaceae	
Peyssonellia spp.	x
Total Species per Phylum	**11**
Phylum Chlorophyta	
Class Ulvophyceae	
Order Bryopsidales	
Family Bryopsidaceae	
Bryopsis pennata	x
Family Codiaceae	
Codium arabicum	x
Codium edule	x
Family Halimedaceae	
Halimeda discoidea	x
Order Cladophorales	
Family Anadyomenaceae	
Microdictyon setchellianum	x
Family Cladophoraceae	
Chaetomorpha antennina	x
Cladophora laetevirens	x
Family Siphonocladaceae	
Dictyosphaeria cavernosa	x
Order Dascycladales	
Family Dasycladaceae	
Neomeris annulata	x
Order Siphonocladales	
Family Boodleaceae	
Boodlea composita	x
Order Ulvales	
Family Ulvaceae	
Ulva fasciata	x
Total Species per Phylum	**11**

Table 5. Continued

Phylum-Class-Order-Family-*Genus-species*	
Phylum Ochrophyta	
Class Phaeophyceae	
Order Dictyotales	
Family Dictyotaceae	
Padina japonica	x
Padina sanctae-crucis	x
Order Ectocarpales	
Family Scytosiphonaceae	
Hydroclathrus clathratus	x
Order Ralfsiales	
Family Ralfsiaceae	
Ralfsia expansa	x
Order Scytosiphonales	
Family Scytosiphonaceae	
Colpomenia sinuosa	x
Total Species per Phylum	**5**
Unidentified Crustose Coralline Algae	x
Unidentified Turf Algae	x
TOTAL Phylum	**4**
Estimated Species Observed	**28**

Table 6. List of 18 random quantitative reef fish data transects, Phase 2.
All data collected along the same 25m line used for coral.
Midway Seawall Long Term Maintenance, Midway NWR. April 20-22, 2016

Date	Transect	Type	Horizontal Survey Length (m)	Survey Area (m^2)
4/20/2016	1	bottom	25	100
4/20/2016	3	bottom	25	100
4/20/2016	4	bottom	25	100
4/20/2016	6	bottom	25	100
4/20/2016	7	bottom	25	100
4/20/2016	9	bottom	25	100
4/20/2016	10	bottom	25	100
4/20/2016	12	bottom	25	100
4/21/2016	13	bottom	25	100
4/21/2016	15	bottom	25	100
4/21/2016	16	bottom	25	100
4/21/2016	18	bottom	25	100
4/22/2016	20	bottom - artificial	25	100
4/22/2016	21	bottom	25	100
4/22/2016	22	bottom - artificial	25	100
4/22/2016	24	bottom	25	100
4/22/2016	25	bottom - artificial	25	100
4/22/2016	26	bottom - artificial	25	100
			Total Area Surveyed	**1400**

Table 7. List of 26 random quantitative coral data transects, Phase 2.
All conducted along the same 25m line used for reef fish.
Midway Seawall Long Term Maintenance, Midway NWR
April 20-22, 2016

Date	Transect	Type	Vertical Survey Length (m)	Horizontal Survey Length (m)	Survey Area (m^2)
4/20/2016	1	bottom	0	10	20
4/20/2016	2	sheet pile	4.5	5	22.5
4/20/2016	3	bottom	0	10	20
4/20/2016	4	bottom	0	10	20
4/20/2016	5	sheet pile	4.5	5	22.5
4/20/2016	6	bottom	0	10	20
4/20/2016	7	bottom	0	10	20
4/20/2016	8	sheet pile	4.3	5	21.5
4/20/2016	9	bottom	0	10	20
4/20/2016	10	bottom	0	10	20
4/20/2016	11	sheet pile	2.5	5	12.5
4/20/2016	12	bottom	0	10	20
4/21/2016	13	bottom	0	10	20
4/21/2016	14	sheet pile	4.2	5	21
4/21/2016	15	bottom	0	10	20
4/21/2016	16	bottom	0	10	20
4/21/2016	17	sheet pile	4.2	5	21
4/21/2016	18	bottom	0	10	20
4/21/2016	19	sheet pile	3	5	15
4/22/2016	20	bottom - artificial	0	10	20
4/22/2016	21	bottom	0	10	20
4/22/2016	22	bottom - artificial	0	10	20
4/22/2016	23	sheet pile	3	5	15
4/22/2016	24	bottom	0	10	20
4/22/2016	25	bottom - artificial	0	10	20
4/22/2016	26	bottom - artificial	0	10	20
				Total Area Surveyed	**431**

Table 8. Area calculations for sheet pile transects, Phase 2. Submerged portion of sheet pile was surveyed.
All data collected along the same 25m line used for reef fish.
Midway Seawall Long Term Maintenance, Midway NWR. April 20-22, 2016

Date	Transect	Vertical Survey Length (m)	Horizontal Survey Length (m)	Survey Area (m^2)
4/20/2016	2	4.5	5	22.5
4/20/2016	5	4.5	5	22.5
4/20/2016	8	4.3	5	21.5
4/20/2016	11	2.5	5	12.5
4/21/2016	14	4.2	5	21
4/21/2016	17	4.2	5	21
4/21/2016	19	3	5	15
4/22/2016	23	3	5	15
			Total Area Surveyed (m^2)	**151**
			Average Sheet Pile Vertical survey height (m)	**3.775**

Table 9. Reef fish species observed by transect along southern coastline of Sand Island. Phase 2 only
All observations made during daylight hours. Horizontal component only, excludes vertical sheet pile transects
Midway Seawall Long Term Maintenance, Sand Island, Midway Atoll. April 20-22, 2016

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																	
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26
Phylum Chordata																		
Class Actinopterygii																		
Order Perciformes																		
Family Acanthuridae																		
Acanthurus leucopareius	x		x						x				x		x		x	x
A. nigroris																	x	
A. triostegus	x		x						x	x	x		x	x	x		x	x
Ctenochaetus strigosus																	x	
Naso unicornis												x	x					
Family Carangidae																		
Caranx melampygus																	x	
Family Chaetodontidae																		
Chaetodon auriga									x									x
C. fremblii									x				x	x	x		x	
C. miliaris	x				x						x		x					
Family Cheilodactylidae																		
Cheilodactylus vittatus															x			
Family Cirrhitidae																		
Cirrhites pinnulatus									x									
Parachirrhites arcatus			x															
P. forsteri	x		x															
Family Holocentridae																		
Neoniphon sammara									x						x		x	x

Table 9. Continued

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																	
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26
Phylum Chordata																		
Class Actinopterygii																		
Order Perciformes																		
Family Kuhliidae																		
Kuhlia xenura													x					x
Family Kyphosidae																		
Kyphosus hawaiiensis													x		x		x	x
K. sandwicensis													x		x		x	x
Family Labridae																		
Anampses chrysocephalus									x				x		x			x
Coris flavovittata									x		x		x	x	x			x
C. venusta						x	x				x					x		
Labroides phthirophagus									x						x			
Macropharyngodon geoffrey													x					
Stethojulis balteata									x				x		x		x	x
Thalassoma ballieui	x		x						x		x		x		x		x	x
T. duperrey	x		x		x		x		x		x		x		x		x	x
Family Mulliidae																		
Mulloidichthys flavolineatus														x				
M. vanicolensis															x			
Parupeneus multifasciatus	x				x				x				x				x	
P. porphyreus									x									
Family Pomacentridae																		
Abudefduf abdominalis																	x	
A. sordidus					x										x		x	

Table 9. Continued

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																	
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26
Phylum Chordata																		
Class Actinopterygii																		
Order Perciformes																		
Family Pomacentridae (continued)																		
Chromis hanui									x						x			
Dascyllus albisella	x		x															
Plectroglyphidodon johnstonianus									x									
Stegastes marginatus	x		x						x				x		x		x	
Family Priacanthidae																		
Priacanthus meeki															x			
Family Scaridae																		
Chlororus perspicullatus						x							x		x		x	
Family Tetraodontidae																		
Canthigaster jactator	x		x															
Family Zanclidae																		
Zanclus cornutus													x					
Total Number of Families	**7**	**0**	**5**	**0**	**4**	**2**	**1**	**0**	**7**	**1**	**3**	**1**	**9**	**4**	**10**	**1**	**9**	**6**
Total Species Observed	**10**	**0**	**9**	**0**	**4**	**2**	**2**	**0**	**17**	**1**	**6**	**1**	**18**	**4**	**19**	**1**	**17**	**12**

Table 10. Estimated density of reef fish species (individuals/hectare) observed along southern coastline of Sand Island. 1 hectare = 10,000 m^2. All observations made during daylight hours. Horizontal component only, excludes vertical sheet pile transects. Eacg Survey Transect area = $100m^2$
Midway Seawall Long Term Maintenance, Sand Island, Midway Atoll. April 20-22, 2016

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																		Avg. by species
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26	
Phylum Chordata																			
Class Actinopterygii																			
Order Perciformes																			
Family Acanthuridae																			
Acanthurus leucopareius	300		400						200				1700		200		1500	2600	383.33
A. nigroris																	300		16.67
A. triostegus	700		800						1900	500	100		2700	2600	1200		2100	4200	933.33
Ctenochaetus strigosus																	100		5.56
Naso unicornis												300	200						27.78
Family Carangidae																			
Caranx melampygus																	200		11.11
Family Chaetodontidae																			
Chaetodon auriga									100									300	22.22
C. fremblii									200				100	100	100		100		33.33
C. miliaris	1800				100						300		100						127.78
Family Cheilodactylidae																			
Cheilodactylus vittatus															100				5.56
Family Cirrhitidae																			
Cirrhites pinnulatus									200										11.11
Parachirrhites arcatus			200																11.11
P. forsteri	700		200																50
Family Holocentridae																			
Neoniphon sammara									100						4200		600	1800	372.22

Table 10. Continued

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																		Avg. by species
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26	
Phylum Chordata																			
Class Actinopterygii																			
Order Perciformes																			
Family Kuhliidae																			
Kuhlia xenura													12400					300	705.56
Family Kyphosidae																			
*Kyphosus hawaiiensis**																			*
*K. sandwicensis**																			*
**Mixed school*													3800		700		900	2800	455.56
Family Labridae																			
Anampses chrysocephalus									100				100		100			100	22.22
Coris flavovittata									100		100		200	100	100			200	44.44
C. venusta						100	100				400					200			44.44
Labroides phthirophagus									100						300				22.22
Macropharyngodon geoffrey													100						5.56
Stethojulis balteata									200				400		100		600	100	77.78
Thalassoma ballieui	100		1100						400		100		800		700		200	900	238.89
T. duperrey	200		800		100		100		500		200		600		200		200	200	172.22
Family Mulliidae																			
Mulloidichthys flavolineatus														20100					1116.67
M. vanicolensis															7200				400
Parupeneus multifasciatus	2500				100				200				200				100		172.22
P. porphyreus									200										11.11
Family Pomacentridae																			
Abudefduf abdominalis																	300		16.67
A. sordidus					100										100		200		22.22

Table 10. Continued

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																		Avg. by species
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26	
Phylum Chordata																			
Class Actinopterygii																			
Order Perciformes																			
Family Pomacentridae (continued)																			
Chromis hanui									100						300				22.22
Dascyllus albisella	1500		500																111.11
Plectroglyphidodon johnstonianus									200										11.11
Stegastes marginatus	1900		500						1000				400		1000		800		311.11
Family Priacanthidae																			
Priacanthus meeki															100				5.56
Family Scaridae																			
Chlororus perspicullatus						100							300		100		300		44.44
Family Tetraodontidae																			
Canthigaster jactator	400		500																50
Family Zanclidae																			
Zanclus cornutus													100						5.56

Table 11. Estimated biomass of reef fish species (kilograms/hectare) observed along southern coastline of Sand Island. 1 hectare = 10,000 m^2. All observations made during daylight hours. Horizontal component only, excludes vertical sheet pile transects. Each Survey Transect area = $100m^2$
Midway Seawall Long Term Maintenance, Sand Island, Midway Atoll NWR. April 20-22, 2016

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																		Avg. by species
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26	
Phylum Chordata																			
Class Actinopterygii																			
Order Perciformes																			
Family Acanthuridae																			
Acanthurus leucopareius	3.47		4.5						2.06				198.04		6.47		157.3	301.3	37.39
A. nigroris																	26.43		1.47
A. triostegus	7.3		16.2						32.26	40.97	6.46		91.65	574.8	62.61		172.1	344.2	74.92
Ctenochaetus strigosus																	0.008		0.00
Naso unicornis												752.8	454.73						67.08
Family Carangidae																			
Caranx melampygus																	47.54		2.64
Family Chaetodontidae																			
Chaetodon auriga									3.8									53.42	3.18
C. fremblii									5.36				2.68	8.47	2.68		4.49		1.32
C. miliaris	22.7				1.47						8.56		1.47						1.90
Family Cheilodactylidae																			
Cheilodactylus vittatus															12				0.67
Family Cirrhitidae																			
Cirrhites pinnulatus									35.33										1.96
Parachirrhites arcatus			0.27																0.02
P. forsteri	4.81		2.97																0.43
Family Holocentridae																			
Neoniphon sammara									7.95						233.9		56.08	178.2	26.45

Table 11. Continued

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																		Avg. by species
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26	
Phylum Chordata																			
Class Actinopterygii																			
Order Perciformes																			
Family Kuhliidae																			
Kuhlia xenura													1386.6					33.55	78.90
Family Kyphosidae																			
*Kyphosus hawaiiensis**																			*
*K. sandwicensis**																			*
**Mixed school*													1169.5		184.6		237.3	738.3	129.42
Family Labridae																			
Anampses chrysocephalus									10.04				22.55		10.04			14.22	3.16
Coris flavovittata									36.25		45.49		36.95	24.97	4.65			49.93	11.01
C. venusta						3.19	15.2				20.82					10.13			2.74
Labroides phthirophagus									0.039						62.61				3.48
Macropharyngodon geoffrey													1.69						0.09
Stethojulis balteata									0.004				0.0077		0.004		0.02	0.009	0.00
Thalassoma ballieui	1.46		21.6						110.1		78.57		100.67		109.7		28.74	127.7	32.13
T. duperrey	2.05		4.32		8.78		0.69		9.96		4.47		12.2		9.26		11.05	26.41	4.96
Family Mulliidae																			
Mulloidichthys flavolineatus														2301					127.85
M. vanicolensis															928.8				51.60
Parupeneus multifasciatus	115				13.2				20.68				14.83				9.47		9.60
P. porphyreus									25.06										1.39
Family Pomacentridae																			
Abudefduf abdominalis																	32.79		1.82
A. sordidus					0.02										0.019		0.048		0.01

Table 11. Continued

Phylum-Class-Order-Family-*Genus-species*	**Survey Transect Number**																		Avg. by species
	1	3	4	6	7	9	10	12	13	15	16	18	20	21	22	24	25	26	
Phylum Chordata																			
Class Actinopterygii																			
Order Perciformes																			
Family Pomacentridae (continued)																			
Chromis hanui									12.56						1.48				0.78
Dascyllus albisella	6.51		1.7																0.46
Plectroglyphidodon johnstonianus									6.03										0.34
Stegastes marginatus	11.4		2.12						14.47				7.37		13.76		84.79		7.44
Family Priacanthidae																			
Priacanthus meeki															13.97				0.78
Family Scaridae																			
Chlororus perspicullatus						23.39							70.17		124		231.3		24.94
Family Tetraodontidae																			
Canthigaster jactator	1		0.96																0.11
Family Zanclidae																			
Zanclus cornutus													10.48						0.58

Table 12. Number of reef fish observed by size class and species during Phase 2. Size classes are centimeters Total Length (cm TL). Each transect area is $100m^2$ (25m x 4m belt).
Midway Seawall Long Term Maintenance, Sand Island, Midway Atoll NWR. April 20-22, 2016

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 1											
Family Acanthuridae											
Acanthurus leucopareius			3								3
A. triostegus			6	1							7
Family Chaetodontidae											
Chaetodon miliaris			18								18
Family Cirrhitidae											
Parachirrhites forsteri		1	6								7
Family Labridae											
Thalassoma ballieui				1							1
T. duperrey			1	1							2
Family Mulliidae											
Parupeneus multifasciatus			4	21							25
Family Pomacentridae											
Dascyllus albisella			15								15
Stegastes marginatus		2	17								19
Family Tetraodontidae											
Canthigaster jactator		4									4
TRANSECT 3	**** No fish observed***										0

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 4											
Family Acanthuridae											
Acanthurus leucopareius			3	1							4
A. triostegus				8							8
Family Cirrhitidae											
Parachirrhites arcatus		1	1								2
P. forsteri			2								2
Family Labridae											
Thalassoma ballieui			5	6							11
T. duperrey		1	6	1							8
Family Pomacentridae											
Dascyllus albisella			5								5
Stegastes marginatus		1	4								5
Family Tetraodontidae											
Canthigaster jactator		5									5
TRANSECT 6	**** No fish observed***										0
TRANSECT 7											
Family Chaetodontidae											
Chaetodon miliaris			1								1
Family Labridae											
Thalassoma duperrey				1							1
Family Mulliidae											
Parupeneus multifasciatus					1						1
Family Pomacentridae											
Abudefduf sordidus				1							1

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 9											
Family Labridae											
Coris venusta				1							1
Family Scaridae											
Chlororus perspicullatus					1						1
TRANSECT 10											
Family Labridae											
Coris venusta				3							3
Thalassoma duperrey			1								1
TRANSECT 12	**** No fish observed***										0

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 13											
Family Acanthuridae											
Acanthurus leucopareius			2								2
A. triostegus			4	14							18
Family Chaetodontidae											
Chaetodon auriga				1							1
C. fremblii				2							2
Family Cirrhitidae											
Cirrhites pinnulatus				2							2
Family Holocentridae											
Neoniphon sammara				1							1
Family Labridae											
Anampses chrysocephalus				1							1
Coris flavovittata					1						1
Labroides phthirophagus		1									1
Stethojulis balteata				2							2
Thalassoma ballieui				2	1	1					4
T. duperrey			1	4							5
Family Mulliidae											
Parupeneus multifasciatus				2							2
P. porphyreus				2							2
Family Pomacentridae											
Chromis hanui		1									1
Plectroglyphidodon johnstonianus			2								2
Stegastes marginatus			10								10

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 15											
Family Acanthuridae											
Acanthurus triostegus				5							5
TRANSECT 16											
Family Acanthuridae											
Acanthurus triostegus				1							1
Family Chaetodontidae											
Chaetodon miliaris			1	2							3
Family Labridae											
Coris flavovittata						1					1
C. venusta			1	3							4
Thalassoma ballieui						1					1
T. duperrey			1	1							2
TRANSECT 18											
Family Acanthuridae											
Naso unicornis								3			3

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 20											
Family Acanthuridae											
Acanthurus leucopareius					17						17
A. triostegus				27							27
Naso unicornis								2			2
Family Chaetodontidae											
C. fremblii				1							1
C. miliaris			1								1
Family Kuhliidae											
Kuhlia xenura					124						124
Family Kyphosidae											
*Kyphosus hawaiiensis**											*
*K. sandwicensis**											*
**Mixed school*					22	16					38
Family Labridae											
Anampses chrysocephalus					1						1
Coris flavovittata					2						2
Macropharyngodon geoffrey			1								1
Stethojulis balteata				4							4
Thalassoma ballieui				5	3						8
T. duperrey			1	5							6
Family Mulliidae											
Parupeneus multifasciatus				2							2
Family Pomacentridae											
Stegastes marginatus			4								4
Family Scaridae											
Chlororus perspicullatus					3						3
Family Zanclidae											
Zanclus cornutus				1							1

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 21											
Family Acanthuridae											
Acanthurus triostegus					26						26
Family Chaetodontidae											
Chaetodon fremblii				1							1
Family Labridae											
Coris flavovittata					1						1
Family Mulliidae											
Mulloidichthys flavolineatus					201						201

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 22											
Family Acanthuridae											
Acanthurus leucopareius				2							2
A. triostegus				12							12
Family Chaetodontidae											
Chaetodon fremblii				1							1
Family Cheilodactylidae											
Cheilodactylus vittatus				1							1
Family Holocentridae											
Neoniphon sammara				42							42
Family Kyphosidae											
*Kyphosus hawaiiensis**											*
*K. sandwicensis**											*
**Mixed school*					7						7
Family Labridae											
Anampses chrysocephalus				1							1
Coris flavovittata				1							1
Labroides phthirophagus			3								3
Stethojulis balteata				1							1
Thalassoma ballieui				5	2						7
T. duperrey				2							2
Family Mulliidae											
Mulloidichthys vanicolensis					72						72
Family Pomacentridae											
Abudefduf sordidus				1							1
Chromis hanui			3								3
Stegastes marginatus		1	9								10
Family Priacanthidae											
Priacanthus meeki					1						1
Family Scaridae											
Chlororus perspicullatus						1					1

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 24											
Family Labridae											
Coris venusta				2							2

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 25											
Family Acanthuridae											
Acanthurus leucopareius				15							15
A. nigroris				3							3
A. triostegus				21							21
Ctenochaetus strigosus				1							1
Family Carangidae											
Caranx melampygus					2						2
Family Chaetodontidae											
Chaetodon fremblii				1							1
Family Holocentridae											
Neoniphon sammara				6							6
Family Kyphosidae											
*Kyphosus hawaiiensis**											
*K. sandwicensis**											
**Mixed school*					9						9
Family Labridae											
Stethojulis balteata				6							6
Thalassoma ballieui					2						2
T. duperrey				2							2
Family Mulliidae											
Parupeneus multifasciatus				1							1
Family Pomacentridae											
Abudefduf abdominalis				3							3
A. sordidus				2							2
Stegastes marginatus				8							8
Family Scaridae											
Chlororus perspicullatus					2	1					3

Table 12. Continued

SPECIES	0 < 2	2 < 5	5 < 10	10 < 20	20 < 30	30<40	40 < 50	50 < 60	60 <70	70+	Total by Species
TRANSECT 26											
Family Acanthuridae											
Acanthurus leucopareius				26							26
A. triostegus				42							42
Family Chaetodontidae											
Chaetodon auriga				3							3
Family Holocentridae											
Neoniphon sammara				16	2						18
Family Kuhliidae											
Kuhlia xenura					3						3
Family Kyphosidae											
*Kyphosus hawaiiensis**											*
*K. sandwicensis**											*
**Mixed school*					28						28
Family Labridae											
Anampses chrysocephalus					1						1
Coris flavovittata					2						2
Stethojulis balteata					1						1
Thalassoma ballieui				4	5						9
T. duperrey					2						2

Table 13. Count of coral colonies per modified size class category (cm) for 26 transects, Phase 2. Midway Seawall Long Term Maintenance, Midway NWR. April 20-22, 2016

			Coral colony diameter (cm)										
	Substrate type	*Genus species*	0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	No. of colonies per site	Area of survey (m^2)	Density by species (#/m^2)	Total coral density by site (#/m^2)
1	bottom/ natural	*Pocillopora ligulata*	1	2					3		20	0.15	
		Pocillopora meandrina		1	2				3	6	20	0.15	0.3
2	sheet pile	*Pocillopora damicornis*	8						8		22.5	0.36	
		Pocillopora ligulata	9	5	1				15		22.5	0.67	
		Pocillopora meandrina	4	7	8				19	42	22.5	0.84	1.87
3	bottom/ natural	No colonies observed							0	0	20	0	0
4	bottom/ natural	*Pocillopora damicornis*	5						5		20	0.25	
		Pocillopora meandrina		1	3				4	9	20	0.2	0.45
5	sheet pile	*Pocillopora damicornis*	10	1					11		22.5	0.49	
		Pocillopora ligulata	1	4					5		22.5	0.22	
		Pocillopora meandrina		2	8				10	26	22.5	0.44	1.16
6	bottom/ natural	No colonies observed							0	0	20	0	0
7	bottom/ natural	No colonies observed							0	0	20	0	0
8	sheet pile	*Pocillopora damicornis*	10						10		21.5	0.47	
		Pocillopora ligulata	2	2	1				5		21.5	0.23	
		Pocillopora meandrina		4	8	1			13		21.5	0.60	
		Porites compressa		1					1		21.5	0.05	
		Porites lobata		2	4				6		21.5	0.28	
		Cyphastrea ocellina		2					2	37	21.5	0.09	1.72

Table 13. Continued

Site	Substrate type	*Genus species*	0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	No. of colonies per site	Area of survey (m^2)	Density by species (#/m^2)	Total coral density by site (#/m^2)
9	bottom/ natural	No colonies observed							0	0	20	0	0
10	bottom/ natural	No colonies observed							0	0	20	0	0
11	sheet pile	*Pocillopora damicornis*	25						25		12.5	2	
		Pocillopora ligulata		1					1		12.5	0.08	
		Pocillopora meandrina		3	4				7		12.5	0.56	
		Porites compressa			2				2		12.5	0.16	
		Porites lobata		1					1		12.5	0.08	
		Cyphastrea ocellina		1					1	37	12.5	0.08	2.96
12	bottom/ natural	No colonies observed							0	0	20	0	0
13	bottom/ natural	*Pocillopora damicornis*		1	1				2		20	0.1	
		Pocillopora meandrina		1	2				3		20	0.15	
		Cyphastrea ocellina	1	2					3	8	20	0.15	0.4
14	sheet pile	*Pocillopora damicornis*	12						12		21	0.57	
		Pocillopora ligulata		2					2		21	0.10	
		Pocillopora meandrina		5	6				11	25	21	0.52	1.19
15	bottom/ natural	No colonies observed							0	0	20	0	0
16	bottom/ natural	*Pocillopora damicornis*	3						3		20	0.15	
		Pocillopora meandrina		1					1	4	20	0.05	0.2

Table 13. Continued

Site	Substrate type	*Genus species*	0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	No. of colonies per site	Area of survey (m^2)	Density by species (#/m^2)	Total coral density by site (#/m^2)
17	sheet pile	*Pocillopora damicornis*	17						17		21	0.81	
		Pocillopora ligulata		3					3		21	0.14	
		Pocillopora meandrina		2	8	2			12		21	0.57	
		Porites lobata			1				1	33	21	0.05	1.57
18	bottom/ natural	No colonies observed							0	0	20	0	0
19	sheet pile	*Pocillopora damicornis*	12	3					15		15	1.0	
		Pocillopora ligulata	2	3					5		15	0.33	
		Pocillopora meandrina	2	9	10	1			22		15	1.47	
		Cyphastrea ocellina	3						3	45	15	0.2	3.0
20	bottom/ artificial	*Pocillopora damicornis*	5						5		20	0.25	
		Pocillopora ligulata	1						1		20	0.05	
		Pocillopora meandrina	1	3					4	10	20	0.2	0.5
21	bottom/ natural	No colonies observed							0	0	20	0	0
22	bottom/ artificial	*Pocillopora damicornis*	5	2					7		20	0.35	
		Pocillopora ligulata		2					2		20	0.1	
		Pocillopora meandrina		5	7				12	21	20	0.6	1.05
23	sheet pile	*Pocillopora damicornis*		3	3				6		15	0.4	
		Pocillopora meandrina		1	12				13	19	15	0.87	1.27
24	bottom/ natural	No colonies observed							0	0	20	0	0

Table 13 . Continued

Site	Substrate type	*Genus species*	Coral colony diameter (cm) 0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	No. of colonies per site	Area of survey (m^2)	Density by species (#/m^2)	Total coral density by site (#/m^2)
25	bottom/ artificial	*Pocillopora damicornis*	2	2					4		20	0.2	
		Pocillopora meandrina		6	3				9		20	0.45	
		Cyphastrea ocellina	3	2					5	18	20	0.25	0.9
26	bottom/ artificial	*Pocillopora damicornis*	14	1					15		20	0.75	
		Pocillopora ligulata		1					1		20	0.05	
		Pocillopora meandrina	1	4	7				12		20	0.6	
		Cyphastrea ocellina	3	2					5	33	20	0.25	1.65

Table14. Count of coral colonies with visible mortality of <50% per size class category (cm), Phase 2 Midway Seawall Long Term Maintenance, Midway NWR. April 20-22, 2016

		Coral colony diameter (cm)							
Survey Station	*Genus species*	0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Number of colonies per site	% of colonies per site
1	*Pocillopora ligulata*								
	Pocillopora meandrina							0	0
2	*Pocillopora damicornis*								
	Pocillopora ligulata			1					
	Pocillopora meandrina		1	1				3	7.14
3	No colonies observed								
								0	
4	*Pocillopora damicornis*	1							
	Pocillopora meandrina			1				2	22.22
5	*Pocillopora damicornis*		1						
	Pocillopora ligulata		1						
	Pocillopora meandrina			2				4	15.38
6	No colonies observed								
								0	
7	No colonies observed								
								0	
8	*Pocillopora damicornis*								
	Pocillopora ligulata								
	Pocillopora meandrina								
	Porites compressa								
	Porites lobata								
	Cyphastrea ocellina							0	0

Table 14. Continued

Survey Station	*Genus species*	Coral colony diameter (cm) 0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	% of colonies per site
9	No colonies observed							0	0
10	No colonies observed							0	0
11	*Pocillopora damicornis*	4							
	Pocillopora ligulata								
	Pocillopora meandrina		1						
	Porites compressa								
	Porites lobata								
	Cyphastrea ocellina							5	13.51
12	No colonies observed							0	0
13	*Pocillopora damicornis*								
	Pocillopora meandrina								
	Cyphastrea ocellina							0	0
14	*Pocillopora damicornis*	1							
	Pocillopora ligulata								
	Pocillopora meandrina		1					2	8.00
15	No colonies observed							0	0
16	*Pocillopora damicornis*	1							
	Pocillopora meandrina							1	25.00

Table 14. Continued

Survey Station	*Genus species*	Coral colony diameter (cm) 0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	% of colonies per site
17	*Pocillopora damicornis*	2							
	Pocillopora ligulata		1						
	Pocillopora meandrina			2					
	Porites lobata							5	15.15
18	No colonies observed							0	0
19	*Pocillopora damicornis*	1							
	Pocillopora ligulata		1						
	Pocillopora meandrina			2					
	Cyphastrea ocellina							4	8.89
20	*Pocillopora damicornis*								
	Pocillopora ligulata								
	Pocillopora meandrina		1					1	10.00
21	No colonies observed							0	0
22	*Pocillopora damicornis*		1						
	Pocillopora ligulata								
	Pocillopora meandrina	1						2	9.52
23	*Pocillopora damicornis*								
	Pocillopora meandrina			1				1	5.26
24	No colonies observed							0	0

Table 14. Continued

Survey Station	*Genus species*	Coral colony diameter (cm) 0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	No. of colonies per species	% of colonies per site
25	*Pocillopora damicornis*								
	Pocillopora meandrina		2						
	Cyphastrea ocellina	1						3	16.67
26	*Pocillopora damicornis*	2							
	Pocillopora ligulata								
	Pocillopora meandrina		1						
	Cyphastrea ocellina							3	9.09

Est. size class distribution

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total Colonies with Mortality	% Mortality, All Colonies
14	12	10	0	0	0	36	9.65

Table 15. Estimated size class distribution (cm) for all coral colonies observed

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total All Colonies
162	106	101	4	0	0	373

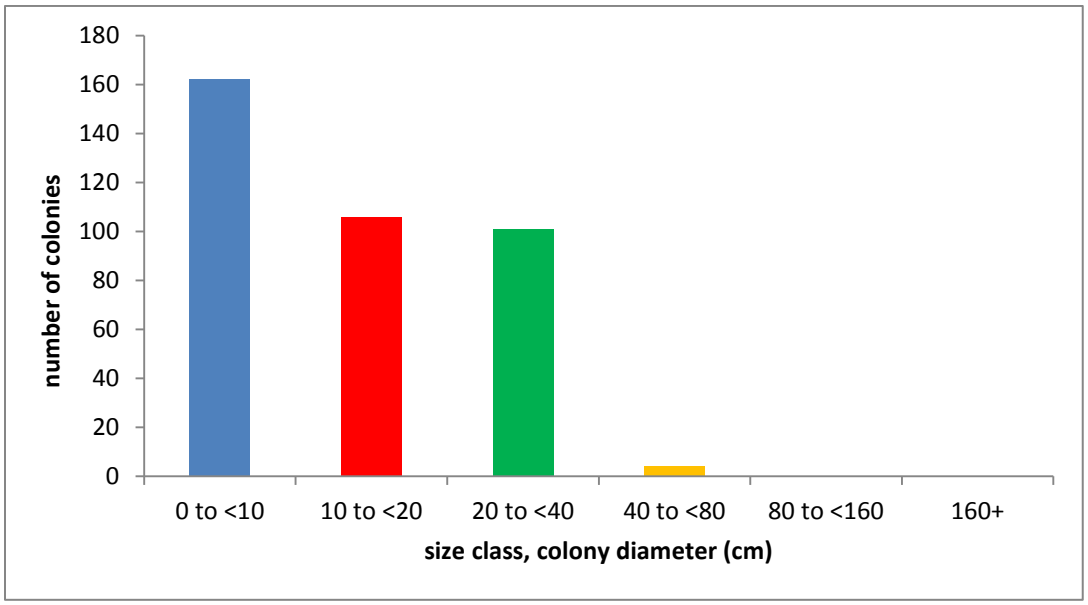


Table 16. Estimated size class distribution (cm) for coral colonies observed on sheet pile

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total All Colonies
117	67	76	4	0	0	264

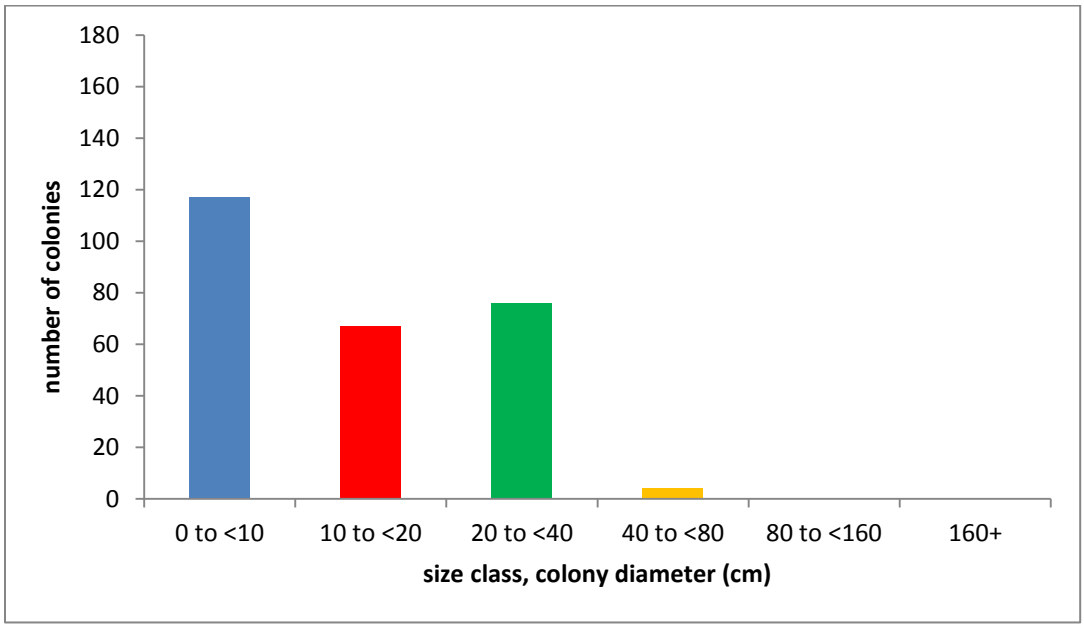


Table 17. Estimated size class distribution (cm) for all *P. meandrina* colonies observed

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total All Colonies
8	55	88	4	0	0	155

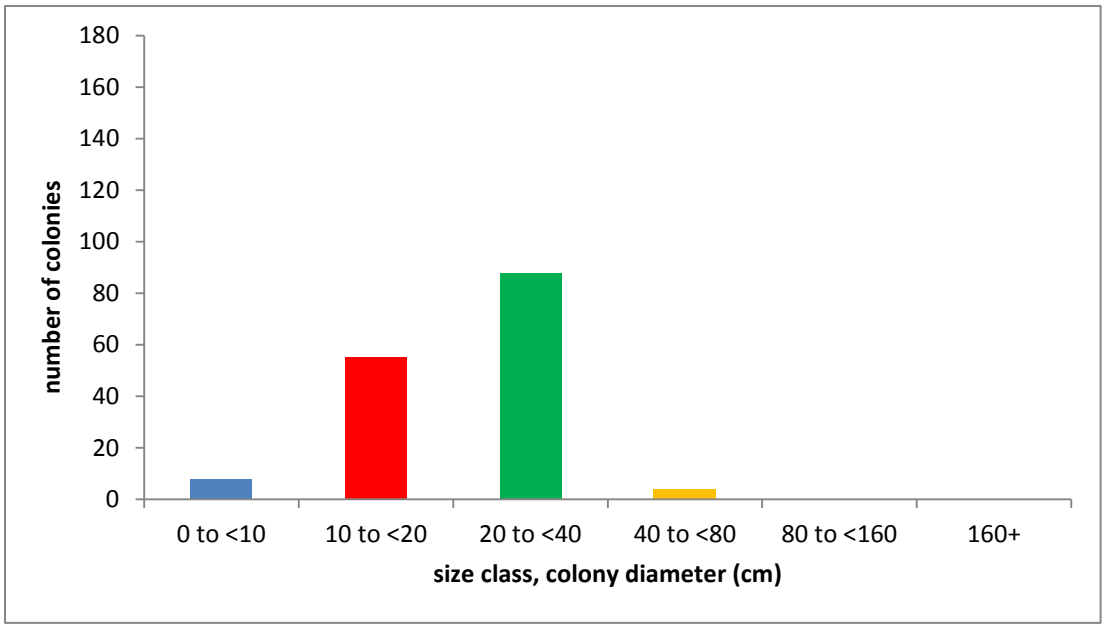


Table 18. Estimated size class distribution (cm) for all *P. damicornis* colonies observed

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total All Colonies
128	13	4	0	0	0	145

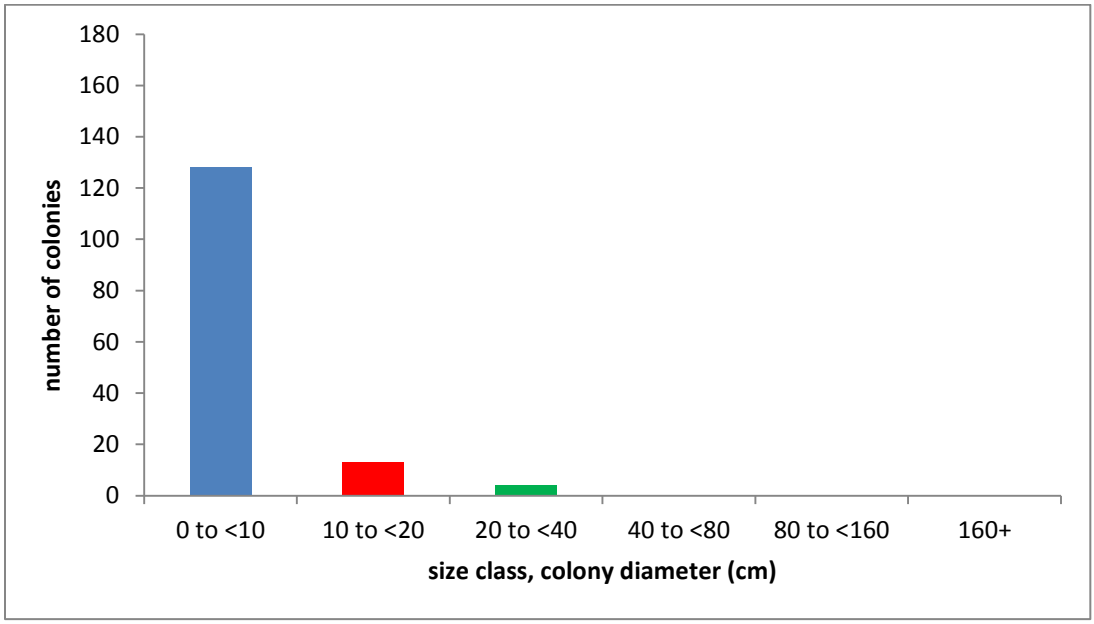


Table 19. Estimated size class distribution (cm) for all *P. ligulata* colonies observed

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total All Colonies
16	25	2	0	0	0	43

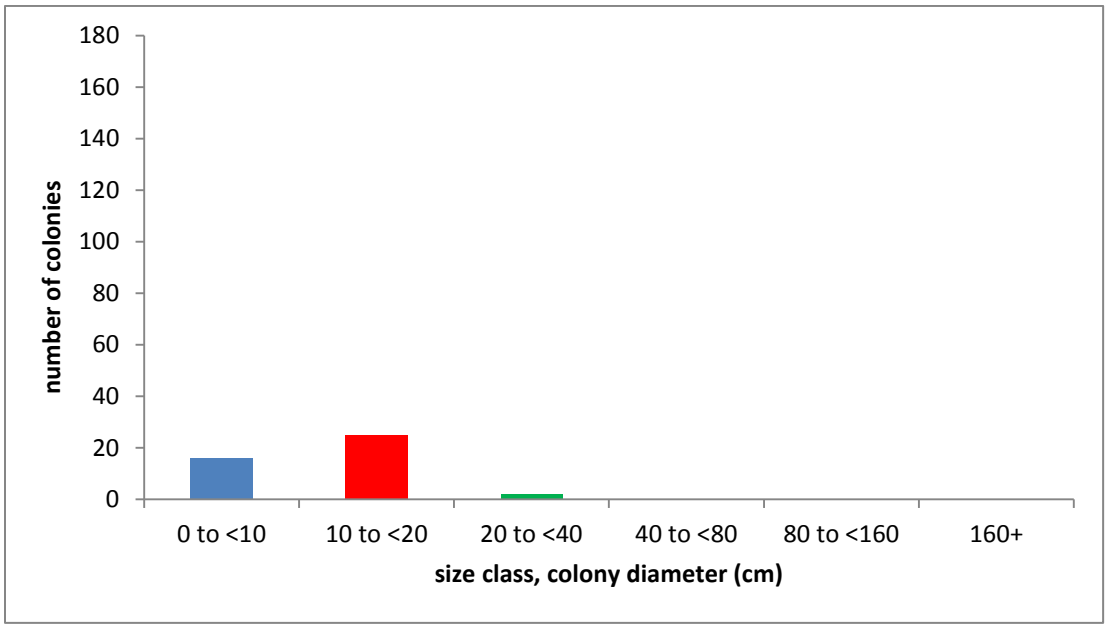


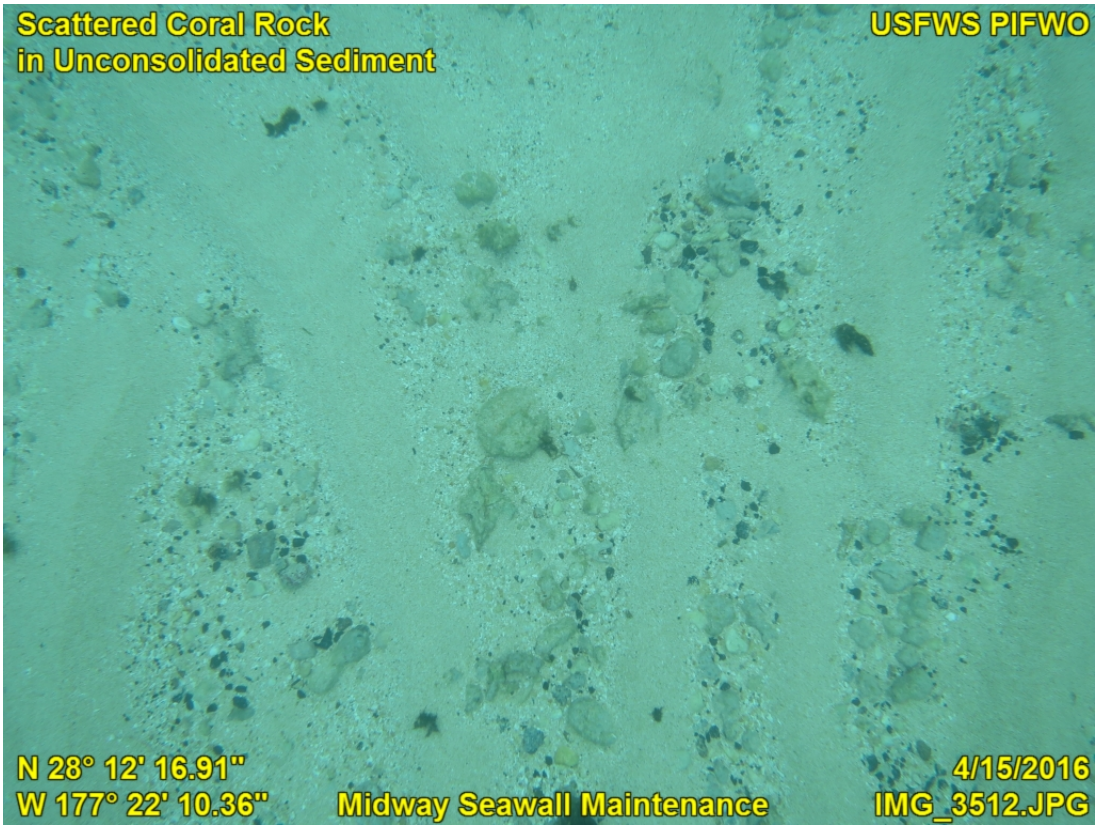
Table 20. Protected species observed at 26 survey stations at Sand Island, Phase 2.
All observations made during daylight hours.
Midway Seawall Long Term Maintenance, Midway NWR, April 20-22, 2016

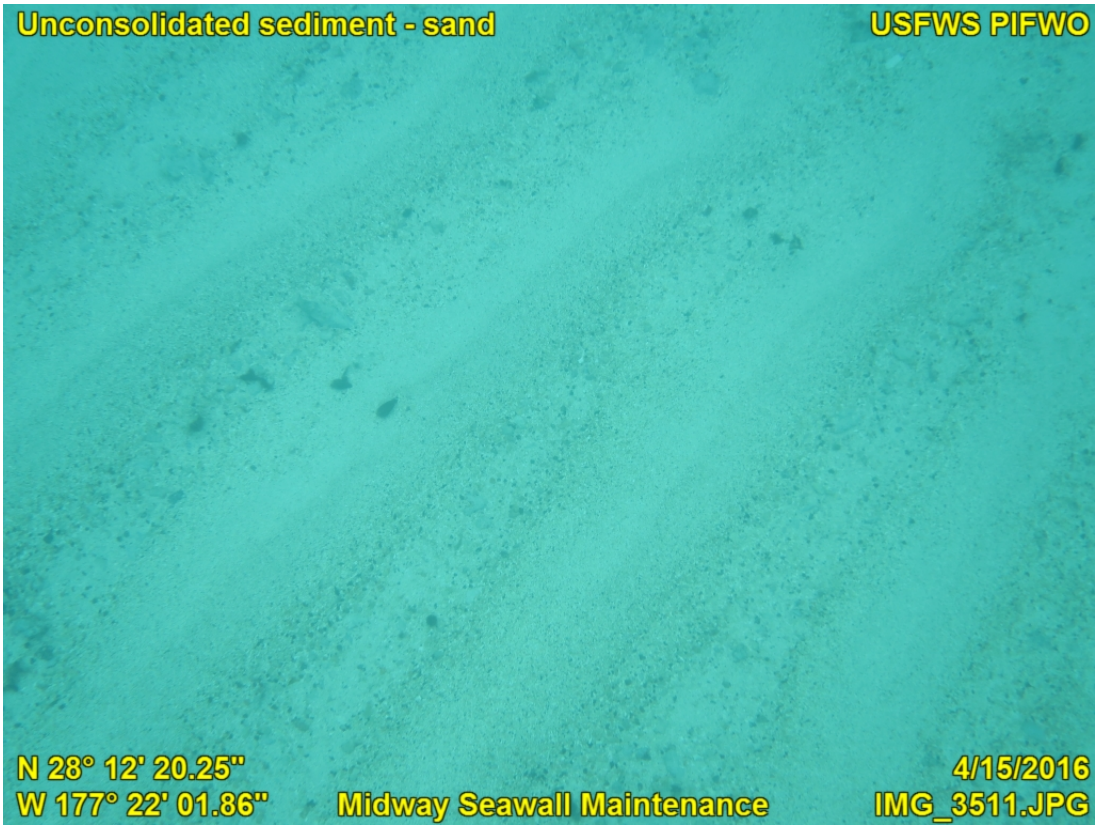
Phylum-Class-Order-Family-*Genus-species*	Survey Stations																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Phylum Chordata																										
Class Mammalia																										
Order Carnivora																										
Family Phocidae																										
Neomonachus schauinslandi																1		1								
Class Reptilia																										
Order Testudines																										
Family Cheloniidae																										
Chelonia mydas									1											1						
Total Species per Phylum	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL species per site	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**

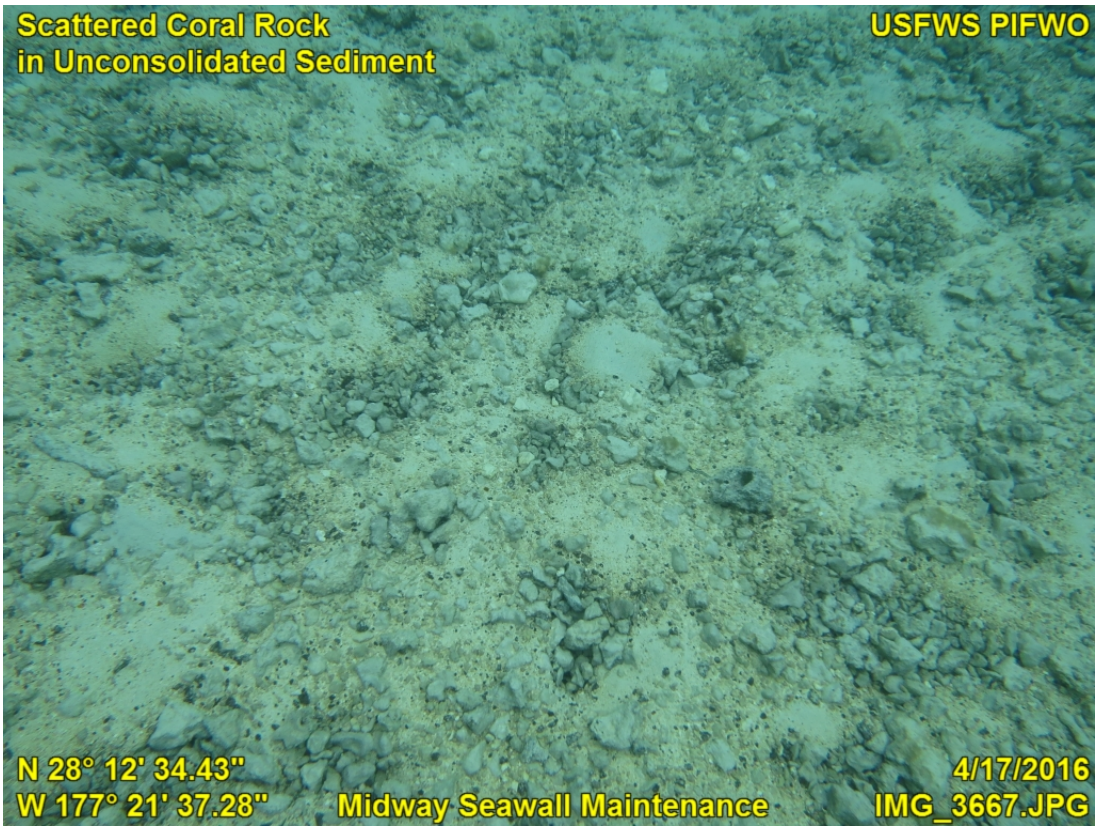
APPENDIX A.

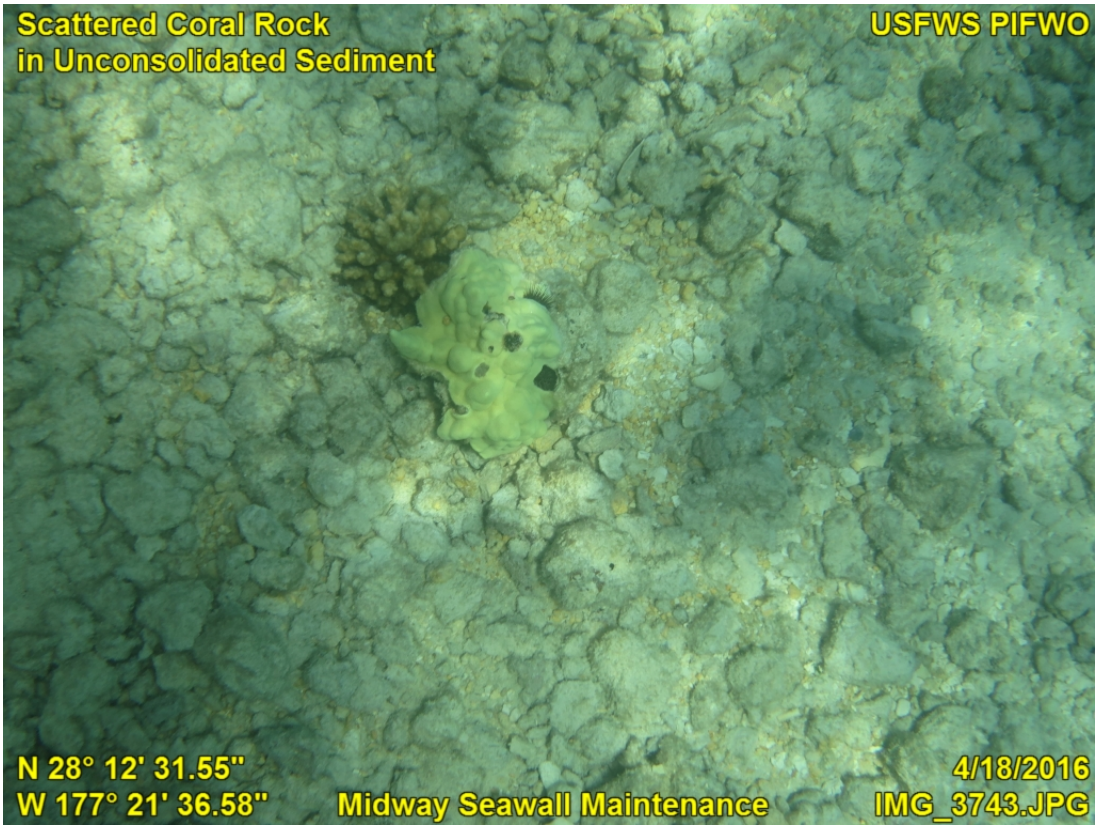
Representative photos from FWCA Phase 1 Benthic Habitat Mapping Surveys

Artificial fill
USFWS PIFWO
N 28° 12' 11.64"
W 177° 22' 24.47"
Midway Seawall Maintenance
4/14/2016
IMG_3235.JPG

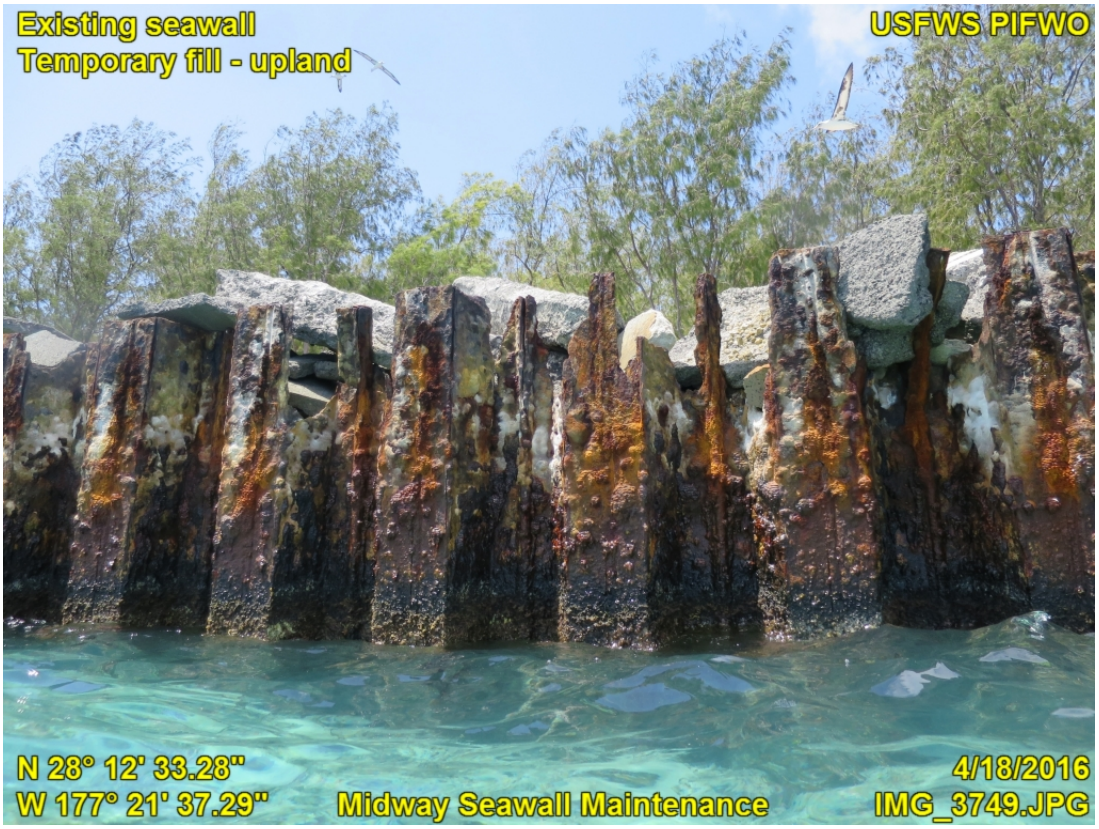

Scattered Coral Rock
in Unconsolidated Sediment
USFWS PIFWO
N 28° 12' 16.91"
W 177° 22' 10.36"
Midway Seawall Maintenance
4/15/2016
IMG_3512.JPG

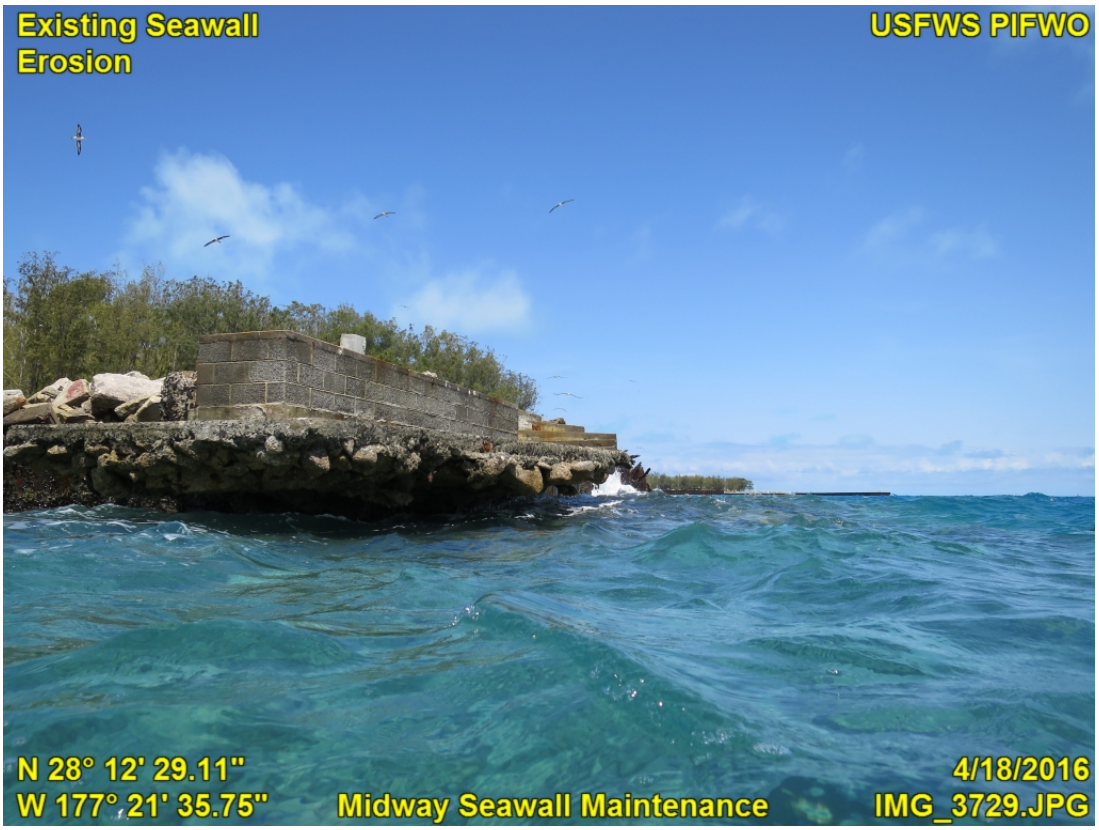

Unconsolidated sediment - sand
USFWS PIFWO
N 28° 12' 20.25"
W 177° 22' 01.86"
Midway Seawall Maintenance
4/15/2016
IMG_3511.JPG


Scattered Coral Rock
in Unconsolidated Sediment
USFWS PIFWO
N 28° 12' 34.43"
W 177° 21' 37.28"
Midway Seawall Maintenance
4/17/2016
IMG_3667.JPG


Scattered Coral Rock
in Unconsolidated Sediment
USFWS PIFWO
N 28° 12' 31.55"
W 177° 21' 36.58"
Midway Seawall Maintenance
4/18/2016
IMG_3743.JPG

Existing Seawall
Fill - Upland and marine
USFWS PIFWO
Midway Seawall Maintenance
IMG_3727.JPG

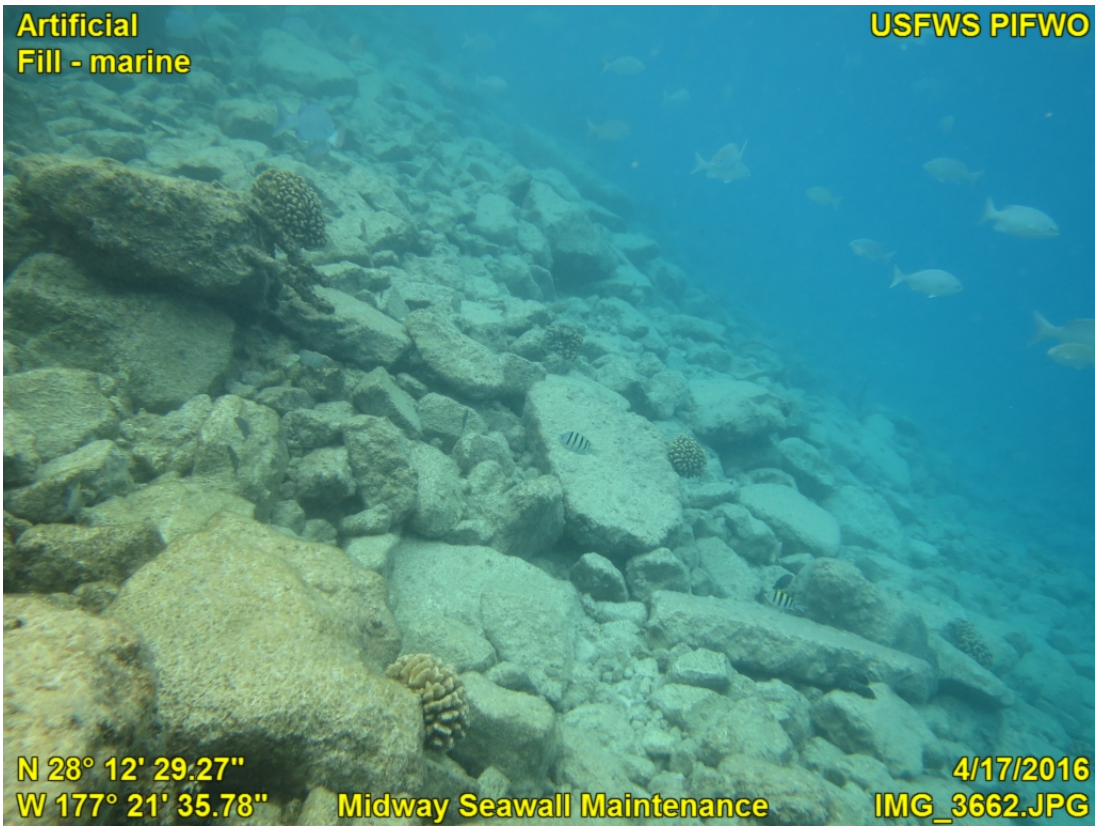

Existing seawall
Temporary fill - upland
USFWS PIFWO
N 28° 12' 33.28"
W 177° 21' 37.29"
Midway Seawall Maintenance
4/18/2016
IMG_3749.JPG


Existing Seawall
Erosion
USFWS PIFWO
N 28° 12' 29.11"
W 177° 21' 35.75"
Midway Seawall Maintenance
4/18/2016
IMG_3729.JPG

Green sea turtle
USFWS PIFWO
N 28° 12' 16.77"
W 177° 22' 11.98"
Midway Seawall Maintenance
4/17/2016
IMG_3639.JPG

Debris
USFWS PIFWO
N 28° 12' 19.15"
W 177° 22' 05.42"
Midway Seawall Maintenance
4/17/2016
IMG_3613.JPG

Debris
USFWS PIFWO
N 28° 12' 16.89"
W 177° 22' 11.68"
Midway Seawall Maintenance
4/17/2016
IMG_3638.JPG

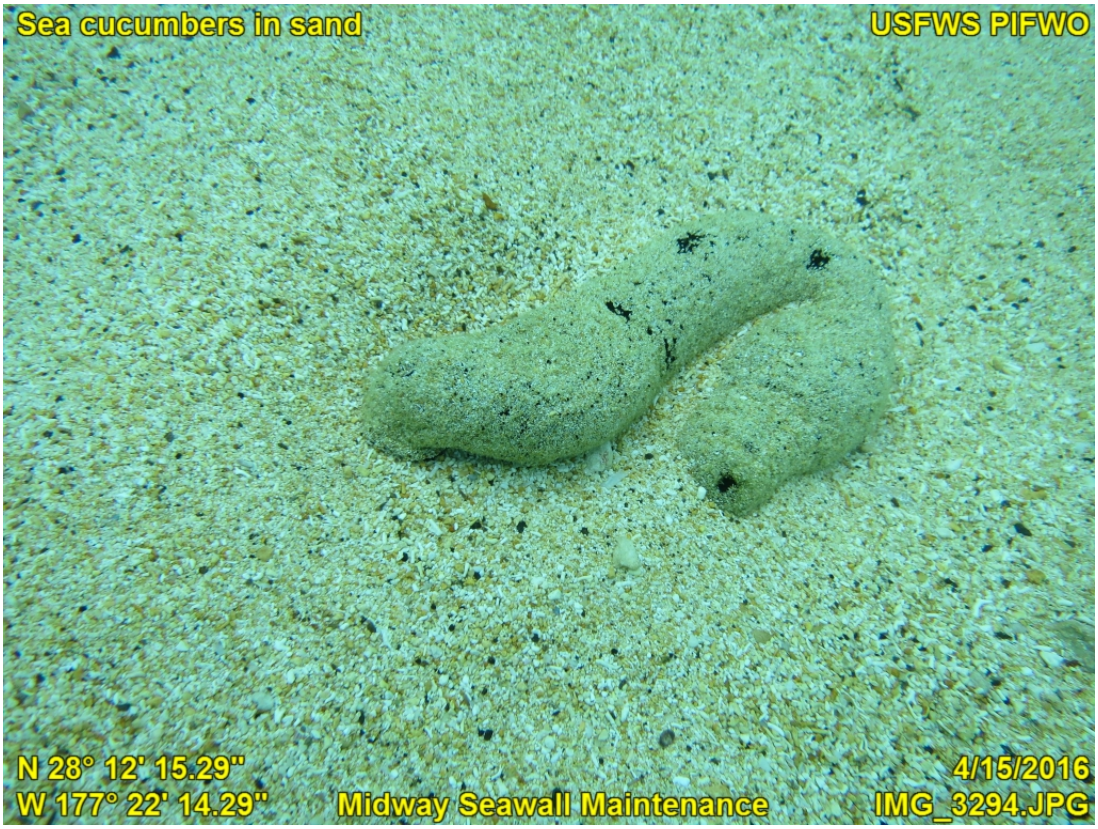

Artificial
Fill - marine
USFWS PIFWO
N 28° 12' 29.27"
W 177° 21' 35.78"
Midway Seawall Maintenance
4/17/2016
IMG_3662.JPG

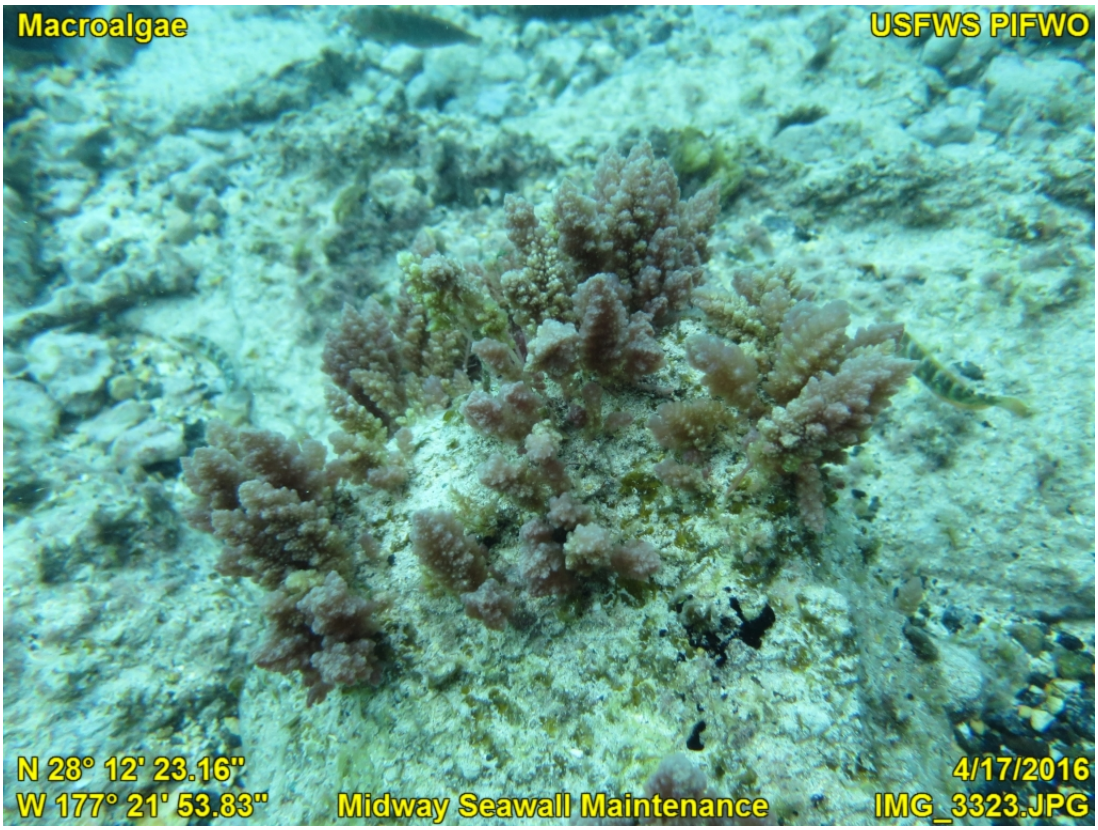
Habitat mapping in fill area
USFWS PIFWO
N 28° 12' 14.64"
W 177° 22' 17.38"
Midway Seawall Maintenance
4/14/2016
IMG_3254.JPG

Benthic habitat mapping
USFWS PIFWO
N 28° 12' 23.68"
W 177° 21' 52.06"
Midway Seawall Maintenance
4/17/2016
IMG_3583.JPG

Flora and fauna in fill area
USFWS PIFWO
N 28° 12' 13.55"
W 177° 22' 19.67"
Midway Seawall Maintenance
4/14/2016
IMG_3279.JPG

Flora and fauna in fill area
USFWS PIFWO
N 28° 12' 13.17"
W 177° 22' 20.67"
Midway Seawall Maintenance
4/14/2016
IMG_3280.JPG

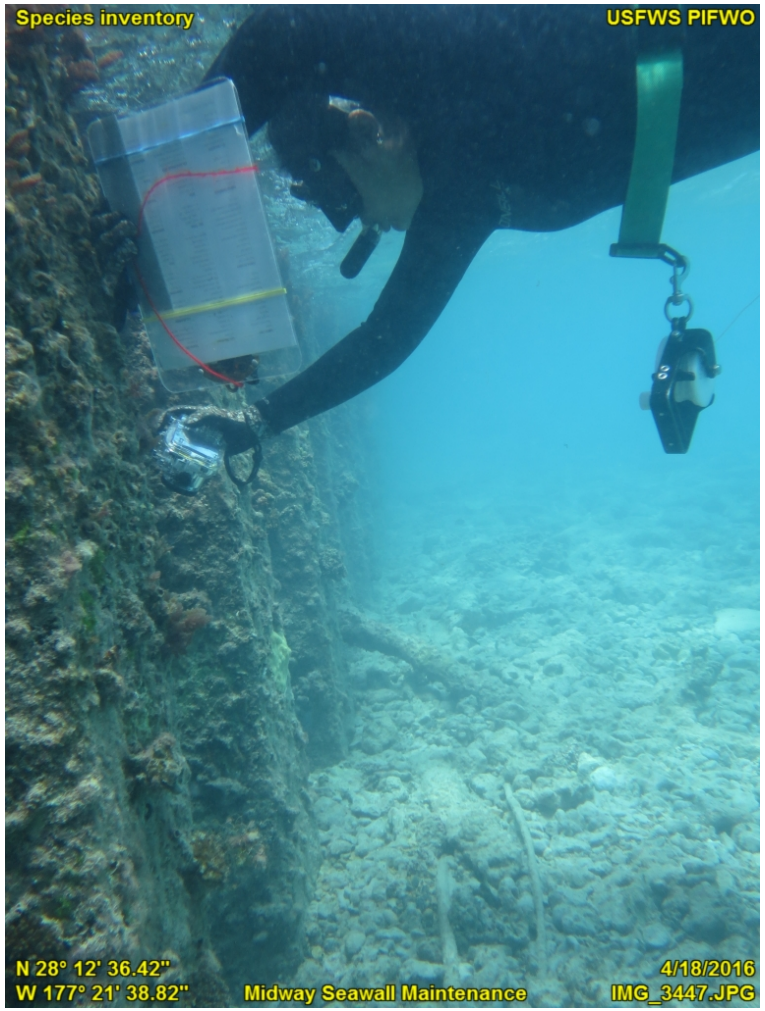

Sea cucumbers in sand
USFWS PIFWO
N 28° 12' 15.29"
W 177° 22' 14.29"
Midway Seawall Maintenance
4/15/2016
IMG_3294.JPG

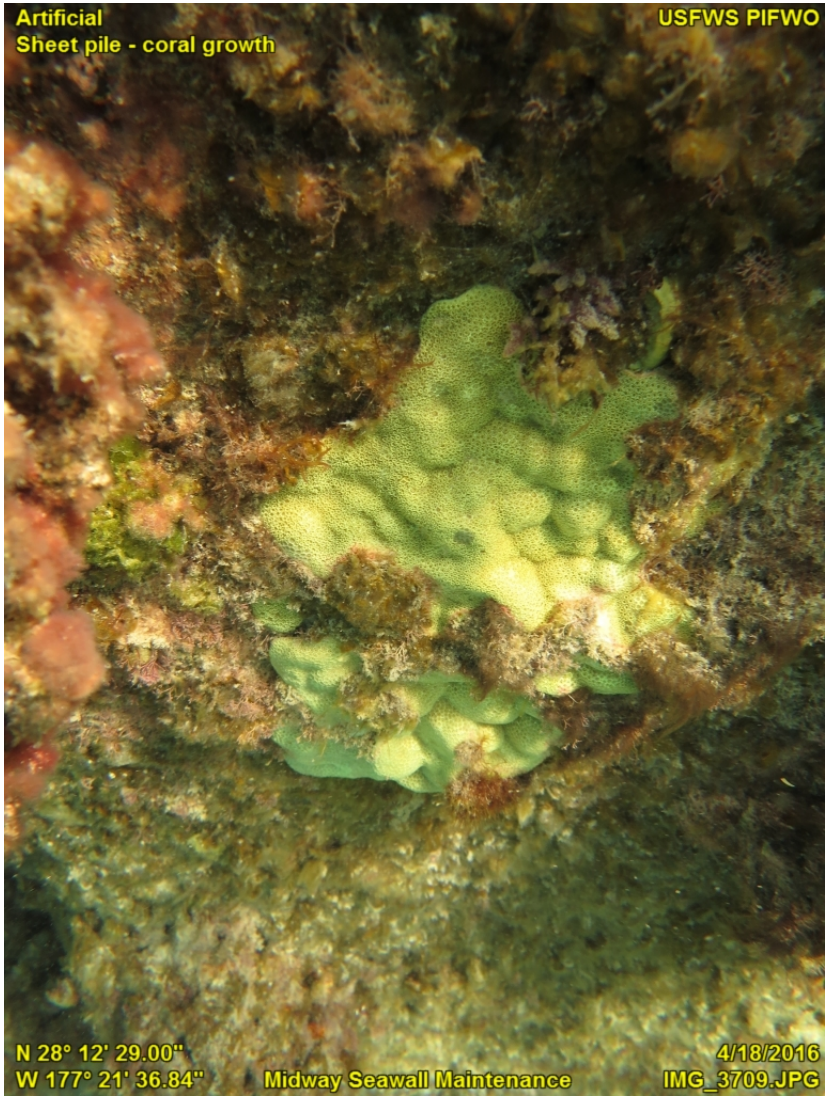

Macroalgae
USFWS PIFWO
N 28° 12' 23.16"
W 177° 21' 53.83"
Midway Seawall Maintenance
4/17/2016
IMG_3323.JPG

Reef fish inventory
USFWS PIFWO
N 28° 12' 15.16"
W 177° 22' 15.39"
Midway Seawall Maintenance
4/17/2016
IMG_3349.JPG

USFWS PIFWO
N 28° 12' 15.14"
W 177° 22' 15.44"
Midway Seawall Maintenance
4/17/2016
IMG_3350.JPG

Species inventory
Lobster on sheet pile
USFWS PIFWO
N 28° 12' 24.21"
W 177° 21' 50.47"
Midway Seawall Maintenance
4/18/2016
IMG_3422.JPG


Species inventory
USFWS PIFWO
N 28° 12' 36.42"
W 177° 21' 38.82"
Midway Seawall Maintenance
4/18/2016
IMG_3447.JPG


Artificial
Sheet pile - coral growth
USFWS PIFWO
N 28° 12' 29.00"
W 177° 21' 36.84"
Midway Seawall Maintenance
4/18/2016
IMG_3709.JPG

Artificial
Species inventory
USFWS PIFWO
N 28° 12' 20.79"
W 177° 22' 00.75"
Midway Seawall Maintenance
4/17/2016
IMG_3604.JPG

Artificial fill
At Bulky Dump facing east
USFWS PIFWO
N 28° 12' 10.97"
W 177° 22' 24.72"
Midway Seawall Maintenance
4/14/2016
IMG_3474.JPG

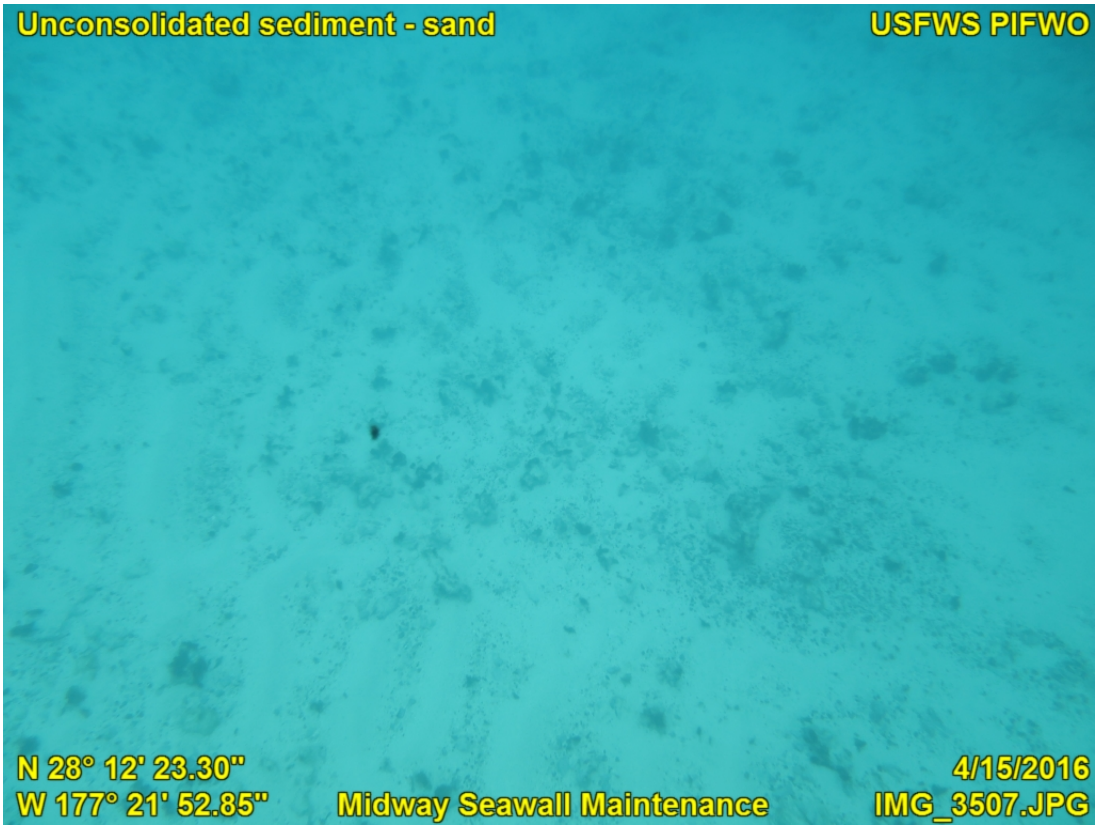
Artificial fill
USFWS PIFWO
N 28° 12' 10.98"
W 177° 22' 24.72"
Midway Seawall Maintenance
4/14/2016
IMG_3476.JPG

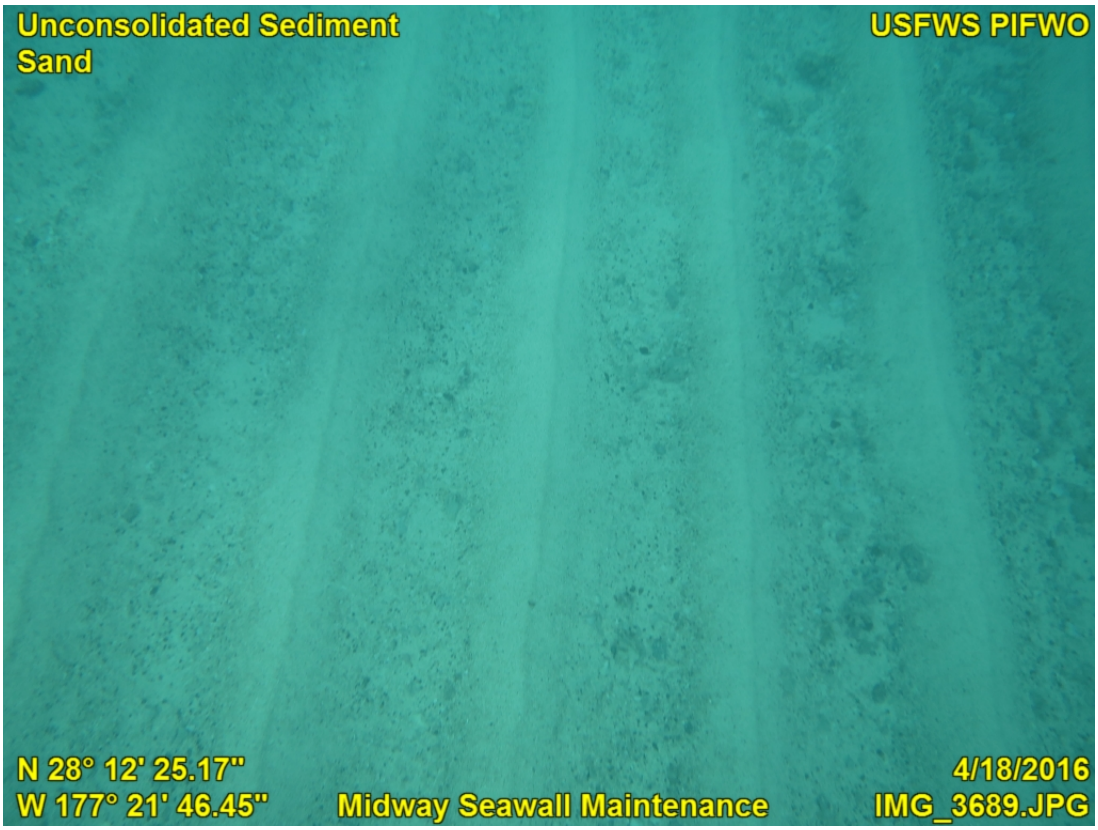
Sheet pile and artificial fill
USFWS PIFWO
N 28° 12' 12.15"
W 177° 22' 23.17"
Midway Seawall Maintenance
4/14/2016
IMG_3479.JPG

Sheet pile with artificial fill
USFWS PIFWO
N 28° 12' 15.23"
W 177° 22' 15.67"
Midway Seawall Maintenance
4/14/2016
IMG_3484.JPG

Sheet pile with artificial fill
USFWS PIFWO
N 28° 12' 15.25"
W 177° 22' 15.70"
Midway Seawall Maintenance
4/14/2016
IMG_3485.JPG

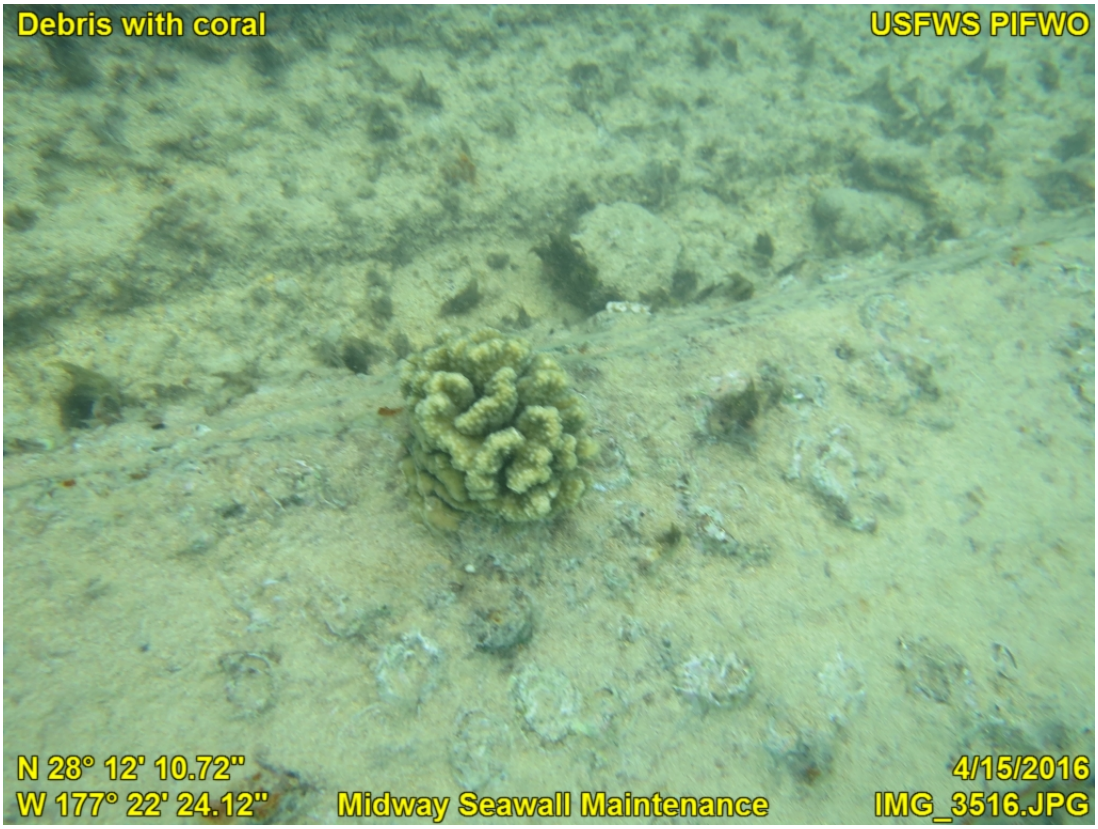
Artificial
Temporary fill
USFWS PIFWO
Midway Seawall Maintenance
IMG_3669.JPG

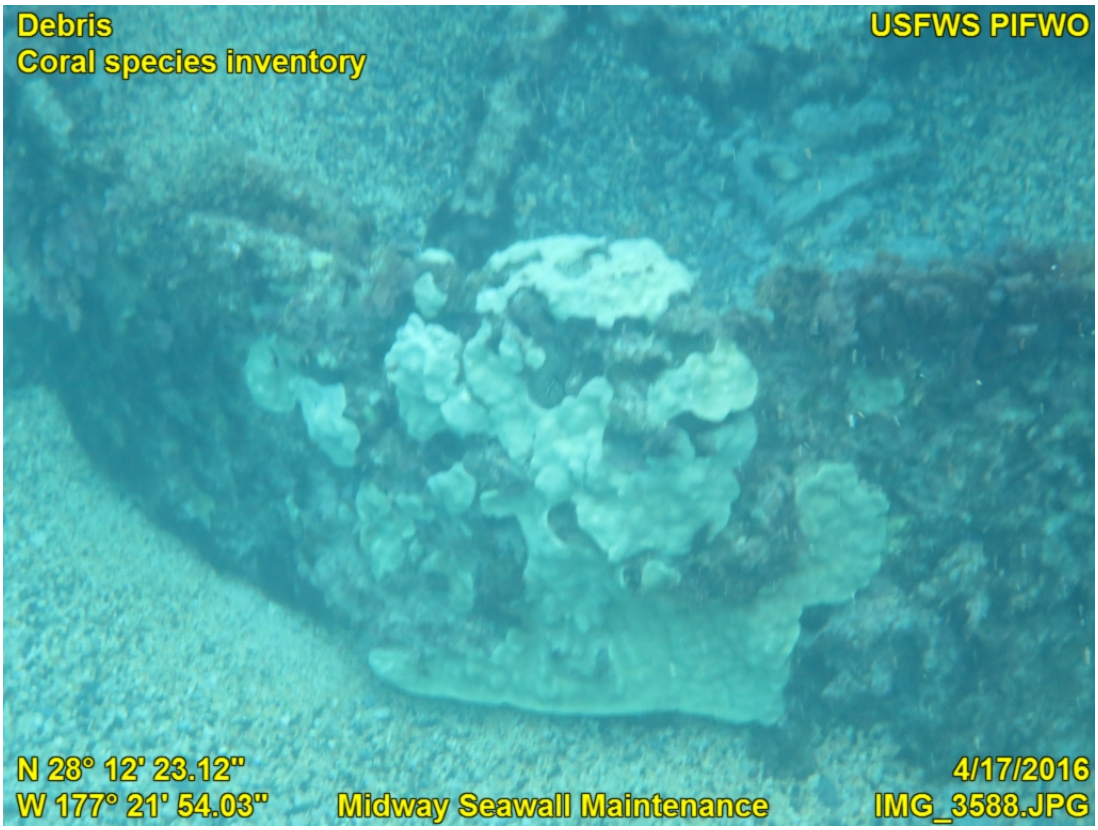

Unconsolidated sediment - sand
USFWS PIFWO
N 28° 12' 23.30"
W 177° 21' 52.85"
Midway Seawall Maintenance
4/15/2016
IMG_3507.JPG

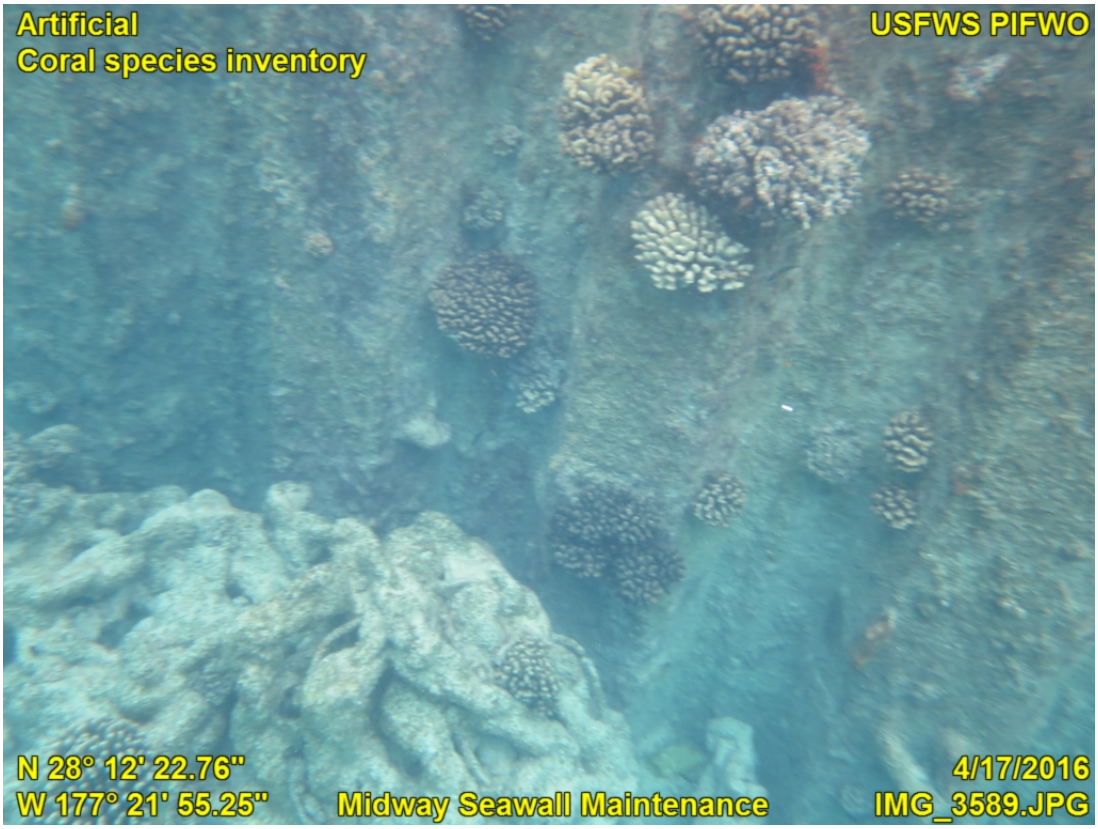

Unconsolidated Sediment
Sand
USFWS PIFWO
N 28° 12' 25.17"
W 177° 21' 46.45"
Midway Seawall Maintenance
4/18/2016
IMG_3689.JPG

Debris
USFWS PIFWO
N 28° 12' 21.35"
W 177° 21' 58.31"
Midway Seawall Maintenance
4/15/2016
IMG_3508.JPG

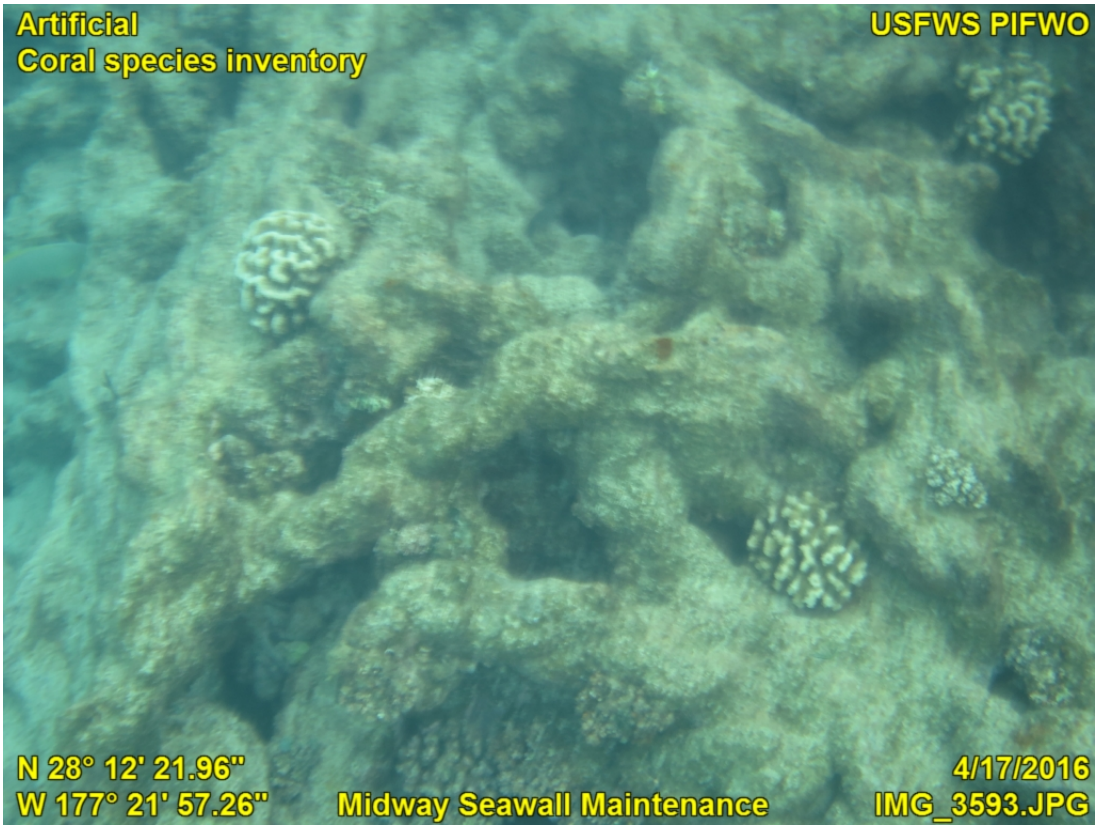
Debris
USFWS PIFWO
N 28° 12' 10.87"
W 177° 22' 24.04"
Midway Seawall Maintenance
4/15/2016
IMG_3515.JPG

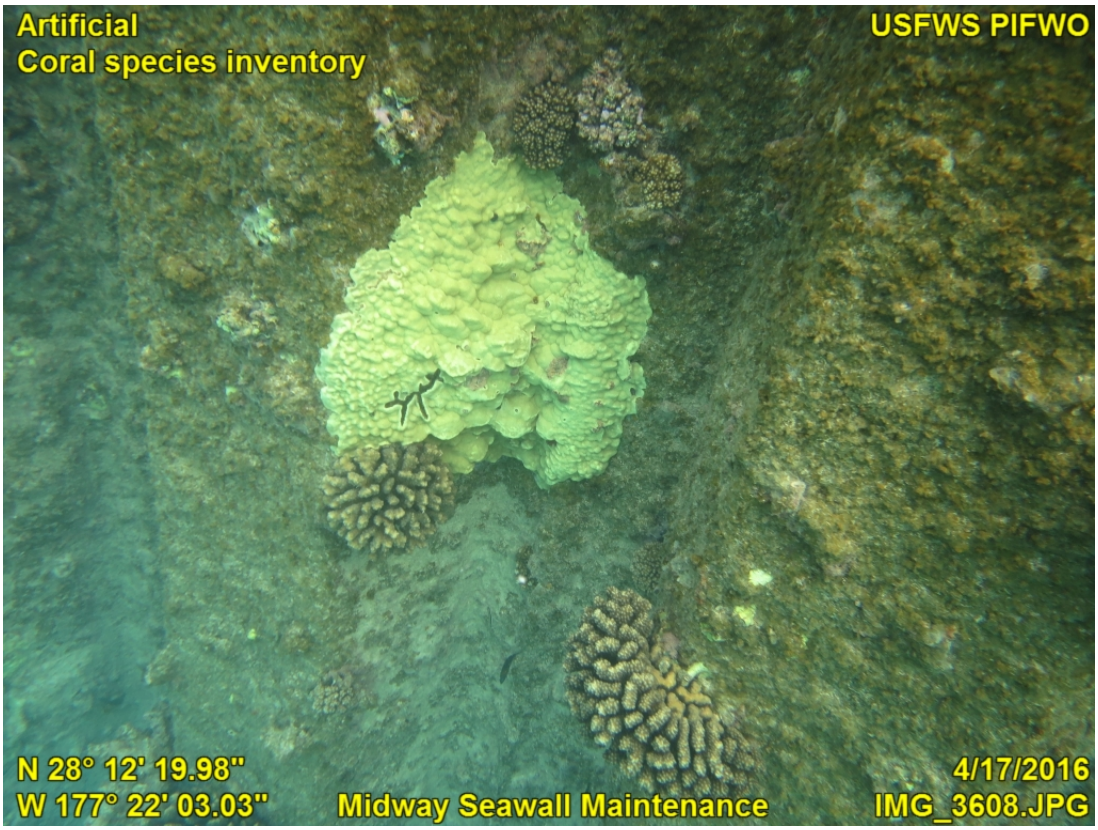

Debris with coral
USFWS PIFWO
N 28° 12' 10.72"
W 177° 22' 24.12"
Midway Seawall Maintenance
4/15/2016
IMG_3516.JPG


Debris
Coral species inventory
USFWS PIFWO
N 28° 12' 23.12"
W 177° 21' 54.03"
Midway Seawall Maintenance
4/17/2016
IMG_3588.JPG


Artificial
Coral species inventory
USFWS PIFWO
N 28° 12' 22.76"
W 177° 21' 55.25"
Midway Seawall Maintenance
4/17/2016
IMG_3589.JPG

USFWS PIFWO
N 28° 12' 22.03"
W 177° 21' 57.11"
Midway Seawall Maintenance
4/17/2016
IMG_3591.JPG


Artificial
Coral species inventory
USFWS PIFWO
N 28° 12' 21.96"
W 177° 21' 57.26"
Midway Seawall Maintenance
4/17/2016
IMG_3593.JPG


Artificial
Coral species inventory
USFWS PIFWO
N 28° 12' 19.98"
W 177° 22' 03.03"
Midway Seawall Maintenance
4/17/2016
IMG_3608.JPG

Debris
USFWS PIFWO
N 28° 12' 20.01"
W 177° 22' 03.03"
Midway Seawall Maintenance
4/17/2016
IMG_3609.JPG

Debris
USFWS PIFWO
N 28° 12' 19.23"
W 177° 22' 05.15"
Midway Seawall Maintenance
4/17/2016
IMG_3610.JPG

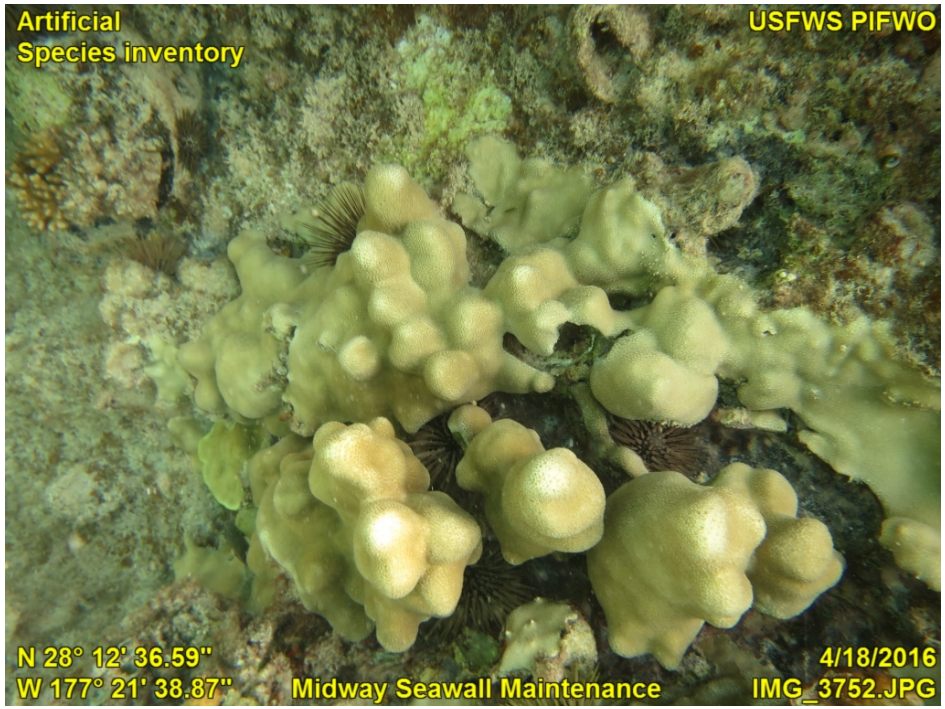
Debris
Coral growth
USFWS PIFWO
N 28° 12' 19.17"
W 177° 22' 05.29"
Midway Seawall Maintenance
4/17/2016
IMG_3612.JPG

Debris
Coral growth
USFWS PIFWO
N 28° 12' 19.14"
W 177° 22' 05.59"
Midway Seawall Maintenance
4/17/2016
IMG_3615.JPG

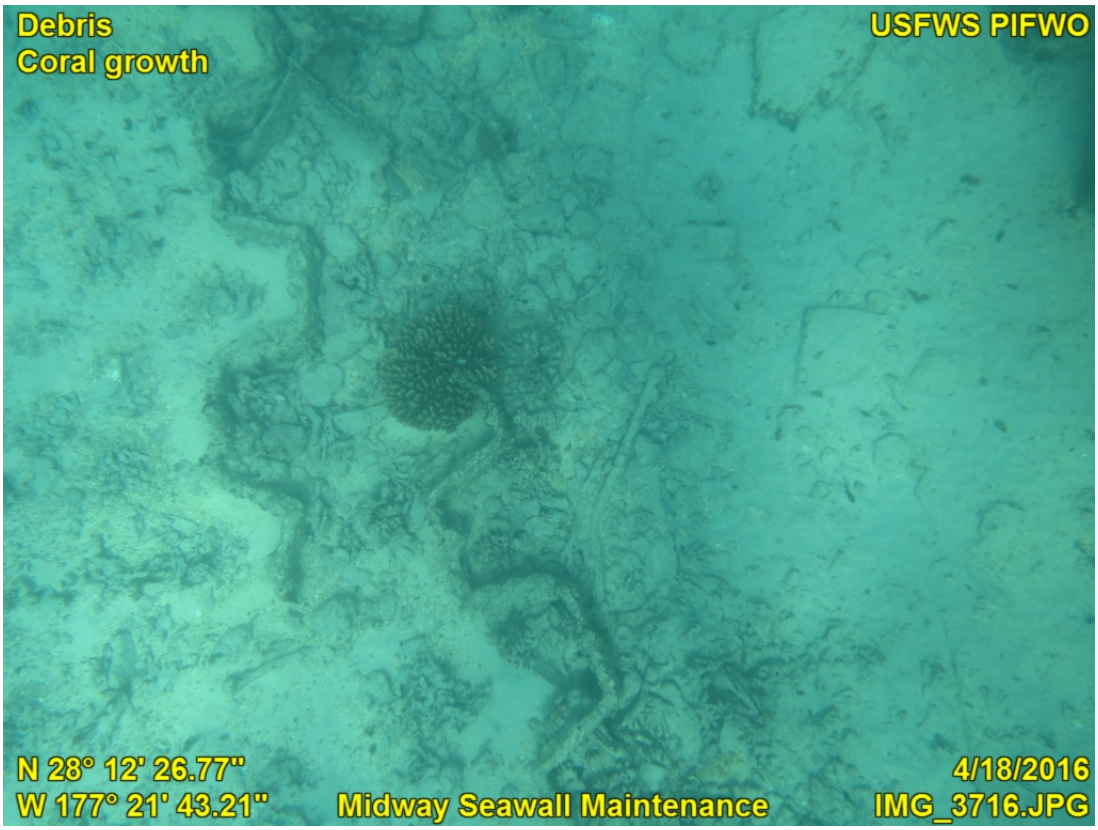
Artificial
Temporary fill
USFWS PIFWO
Midway Seawall Maintenance
IMG_3758.JPG

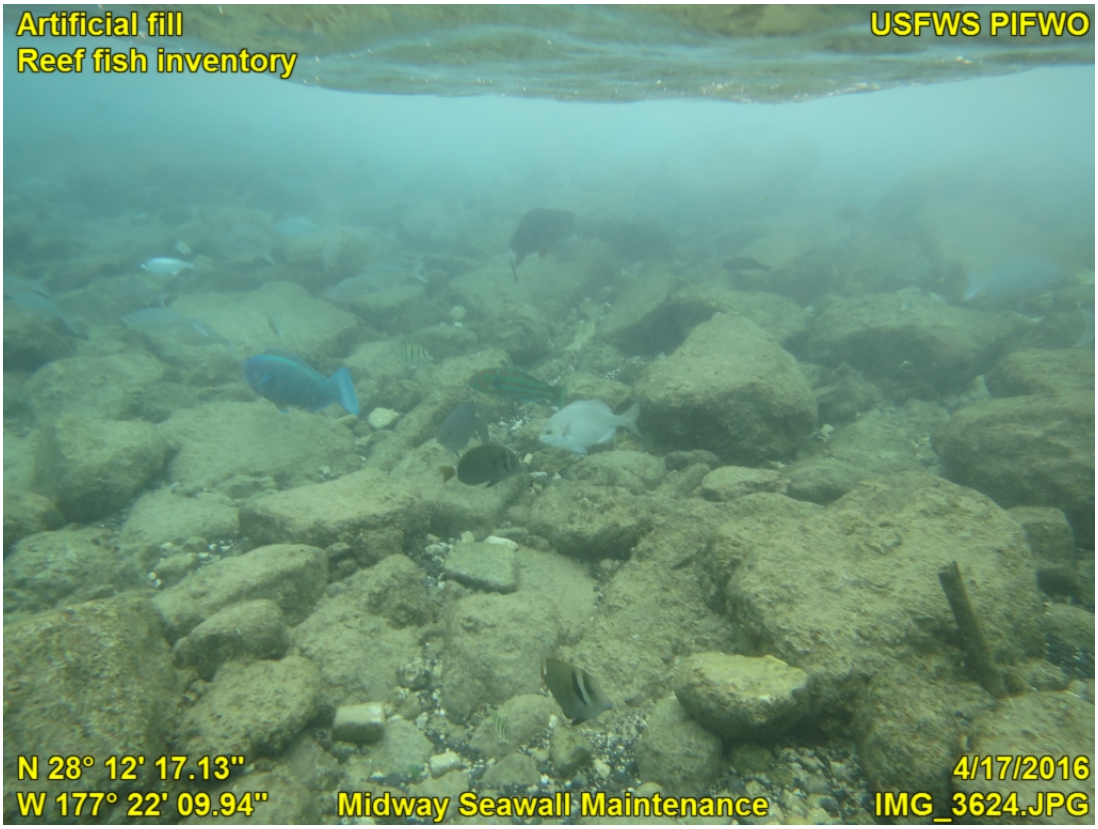
Existing seawall
Temporary fill - upland
USFWS PIFWO
Midway Seawall Maintenance
IMG_3658.JPG

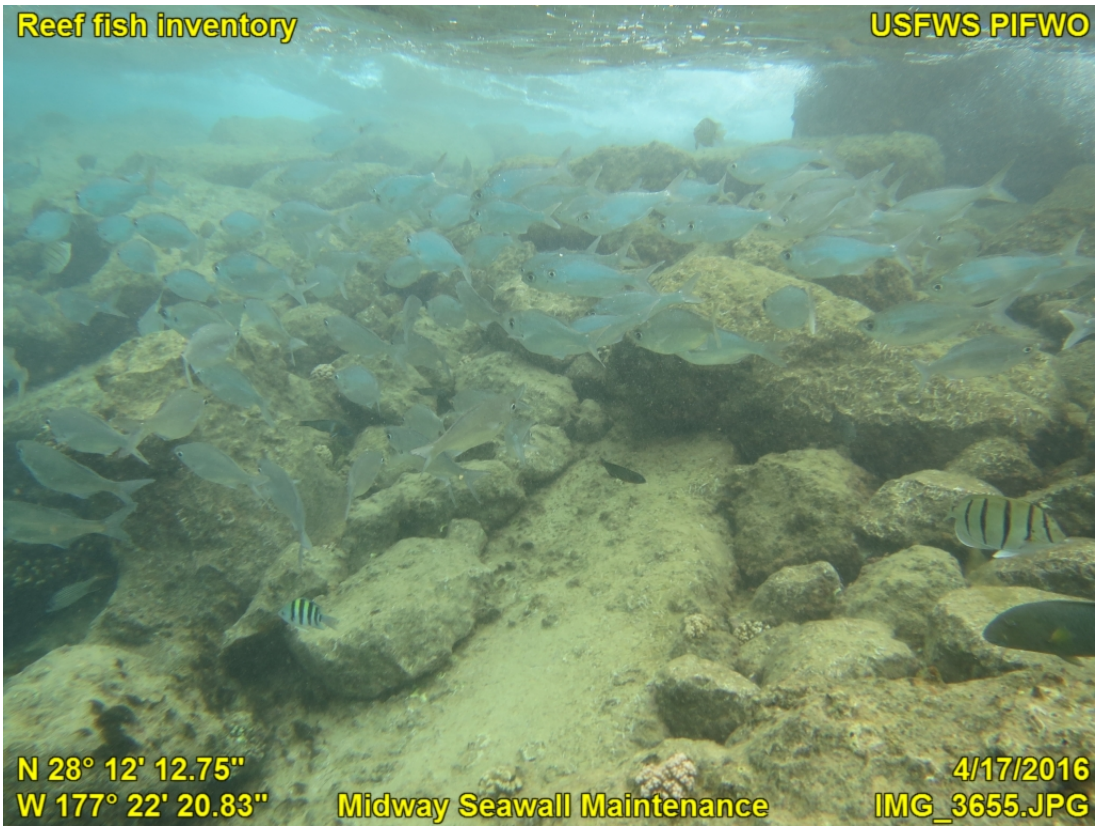
Rock boring urchins
USFWS PIFWO
N 28° 12' 33.13"
W 177° 21' 37.31"
Midway Seawall Maintenance
4/18/2016
IMG_3747.JPG

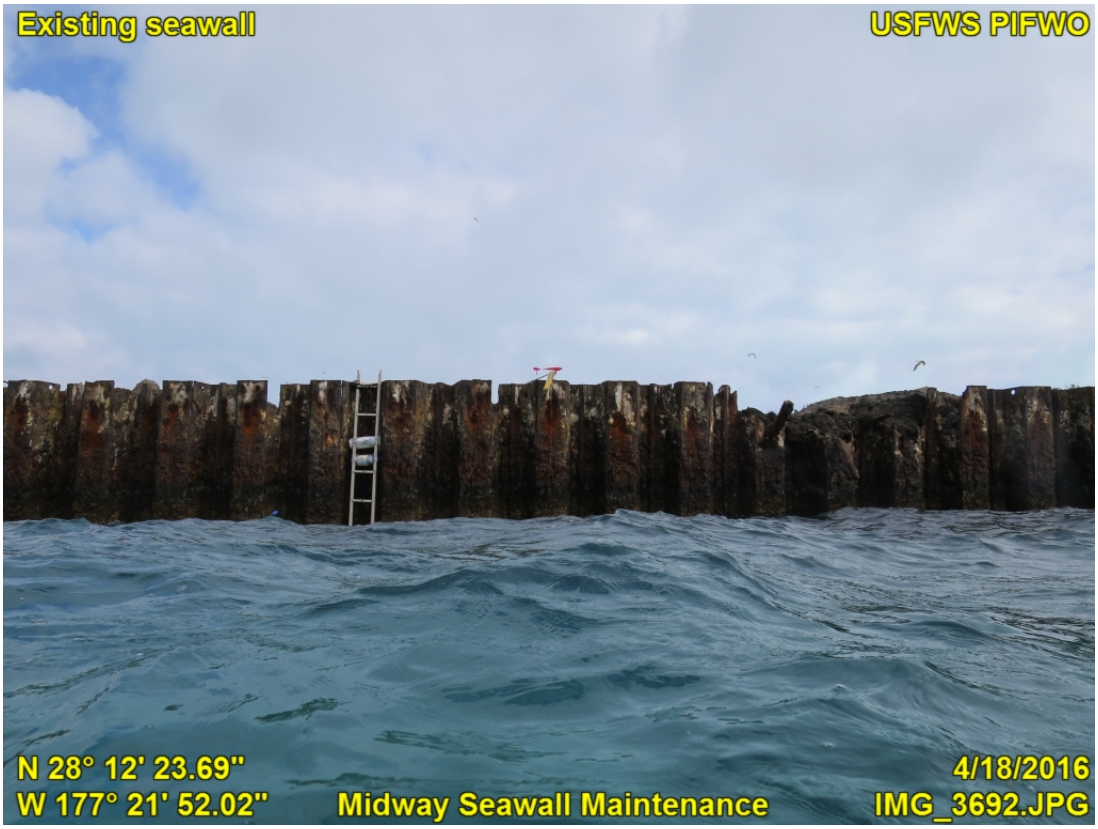

Artificial
Species inventory
USFWS PIFWO
N 28° 12' 36.59"
W 177° 21' 38.87"
Midway Seawall Maintenance
4/18/2016
IMG_3752.JPG

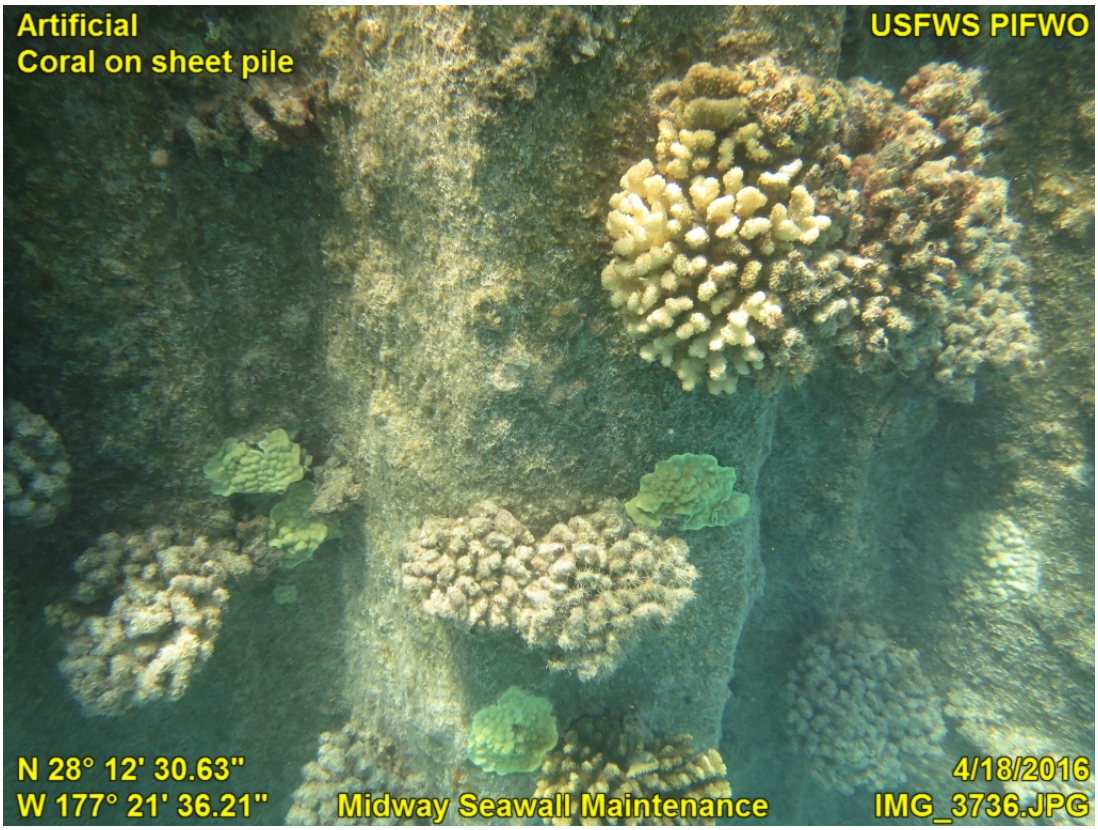
Debris
Coral growth
USFWS PIFWO
N 28° 12' 26.63"
W 177° 21' 43.53"
Midway Seawall Maintenance
4/18/2016
IMG_3718.JPG


Debris
Coral growth
USFWS PIFWO
N 28° 12' 26.77"
W 177° 21' 43.21"
Midway Seawall Maintenance
4/18/2016
IMG_3716.JPG

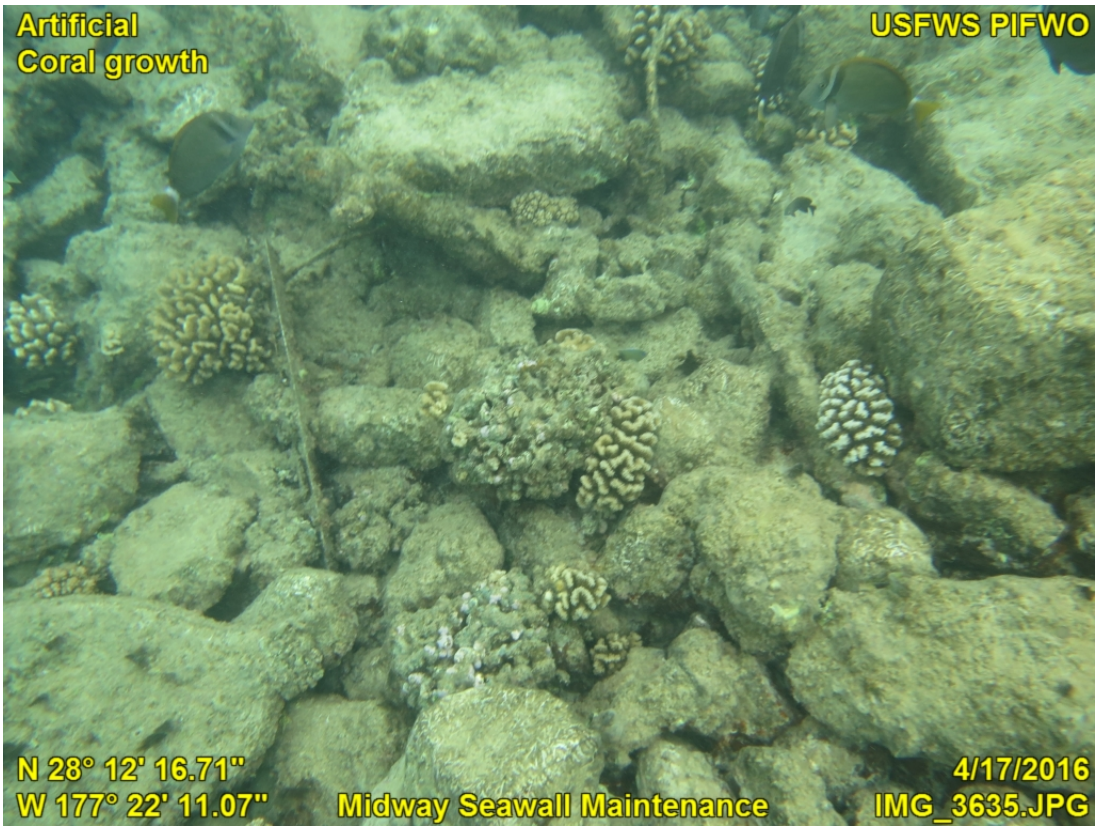

Artificial fill
Reef fish inventory
USFWS PIFWO
N 28° 12' 17.13"
W 177° 22' 09.94"
Midway Seawall Maintenance
4/17/2016
IMG_3624.JPG

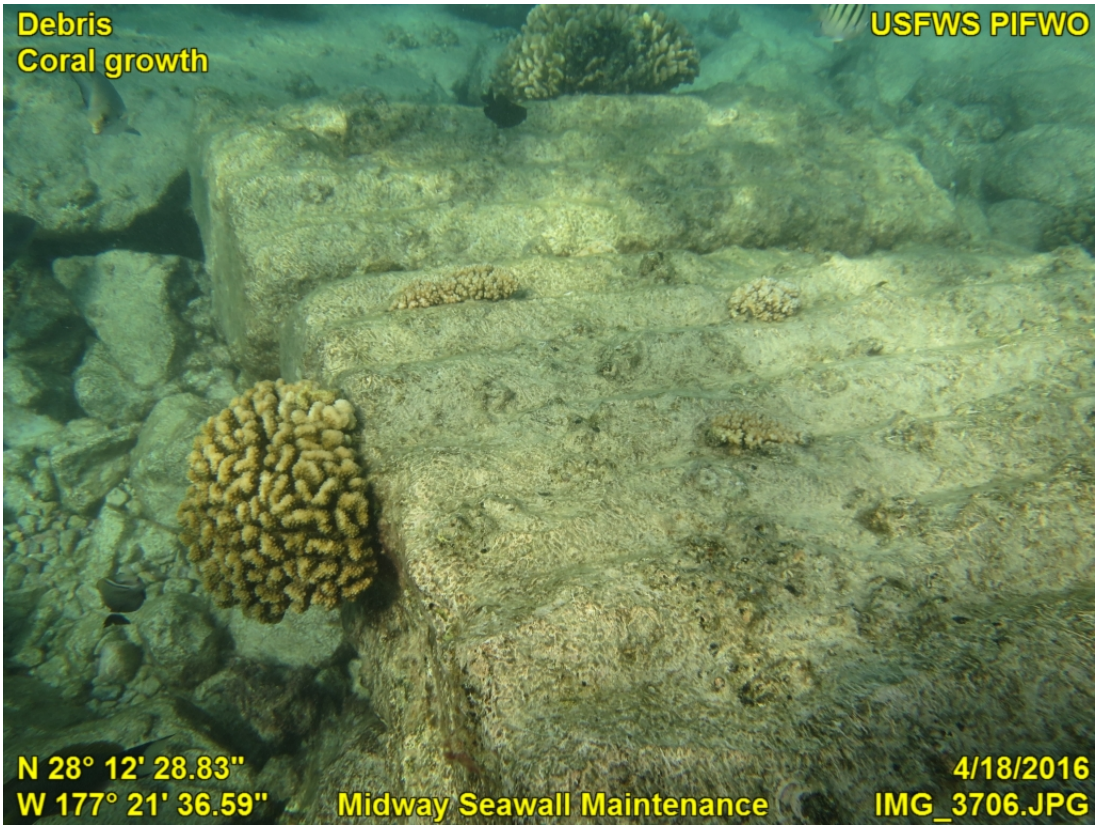

Reef fish inventory
USFWS PIFWO
N 28° 12' 12.75"
W 177° 22' 20.83"
Midway Seawall Maintenance
4/17/2016
IMG_3655.JPG

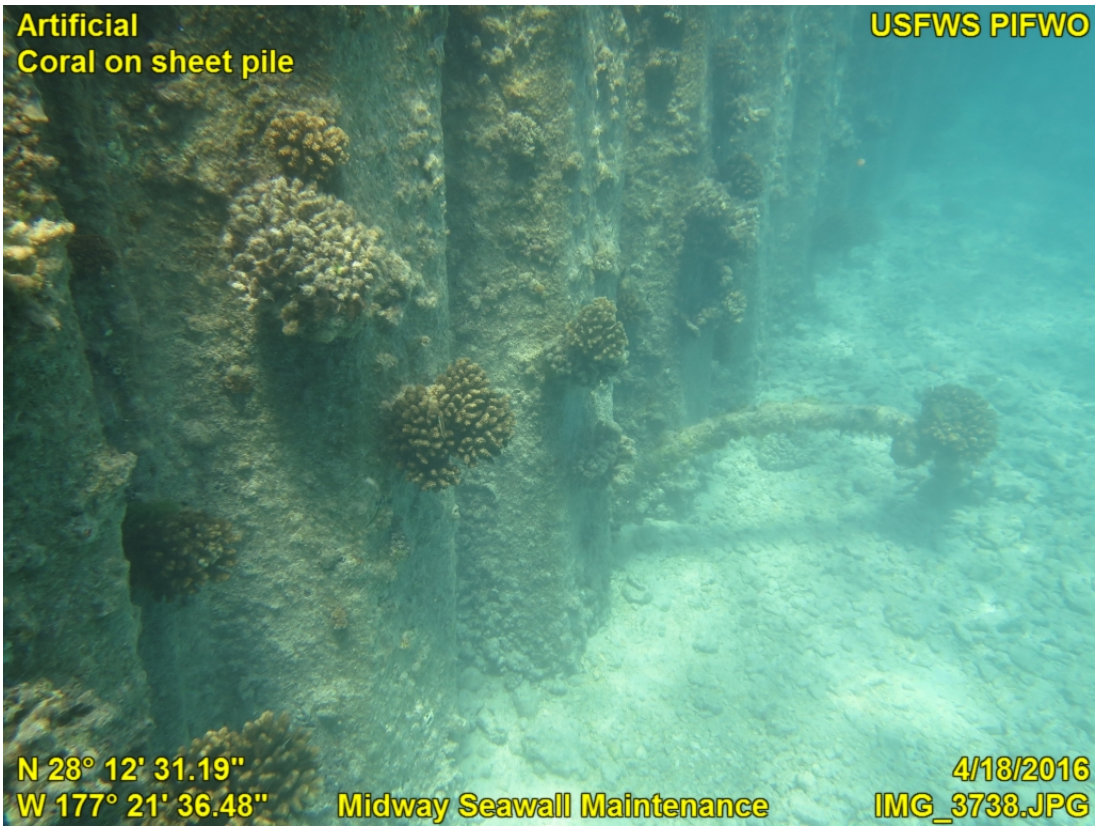

Existing seawall
USFWS PIFWO
N 28° 12' 23.69"
W 177° 21' 52.02"
Midway Seawall Maintenance
4/18/2016
IMG_3692.JPG

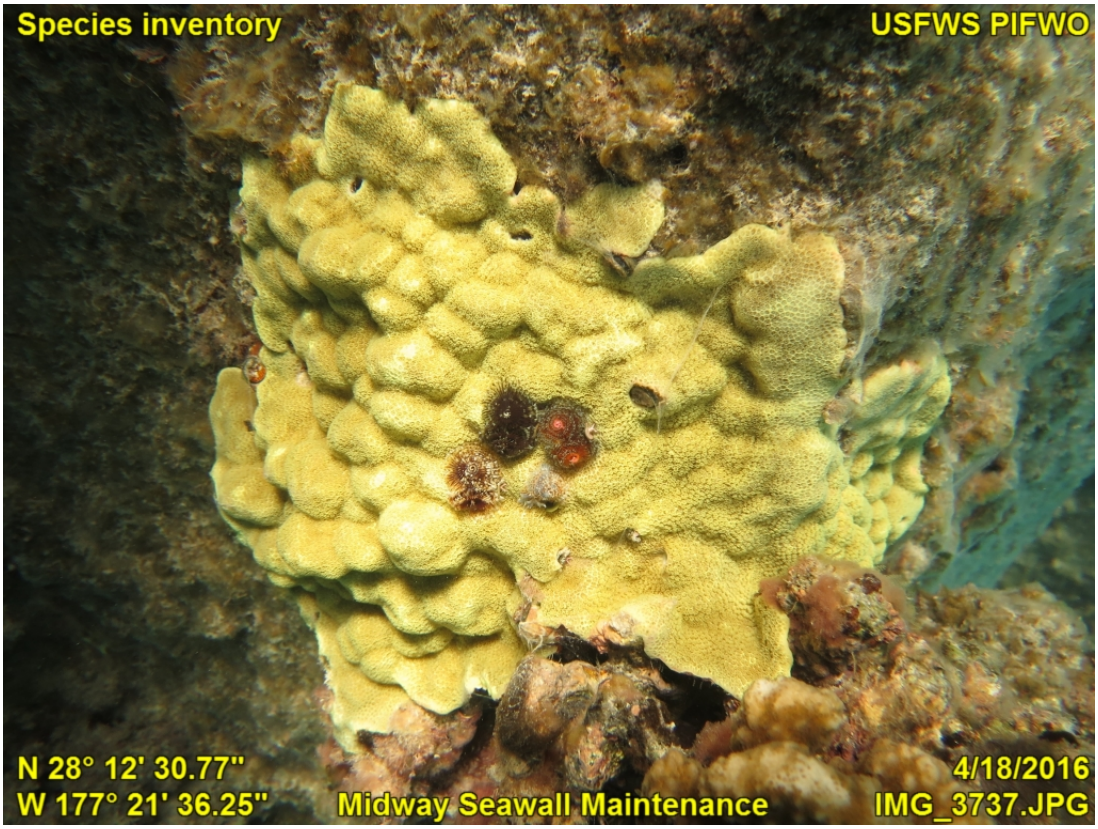

Artificial
Coral on sheet pile
USFWS PIFWO
N 28° 12' 30.63"
W 177° 21' 36.21"
Midway Seawall Maintenance
4/18/2016
IMG_3736.JPG

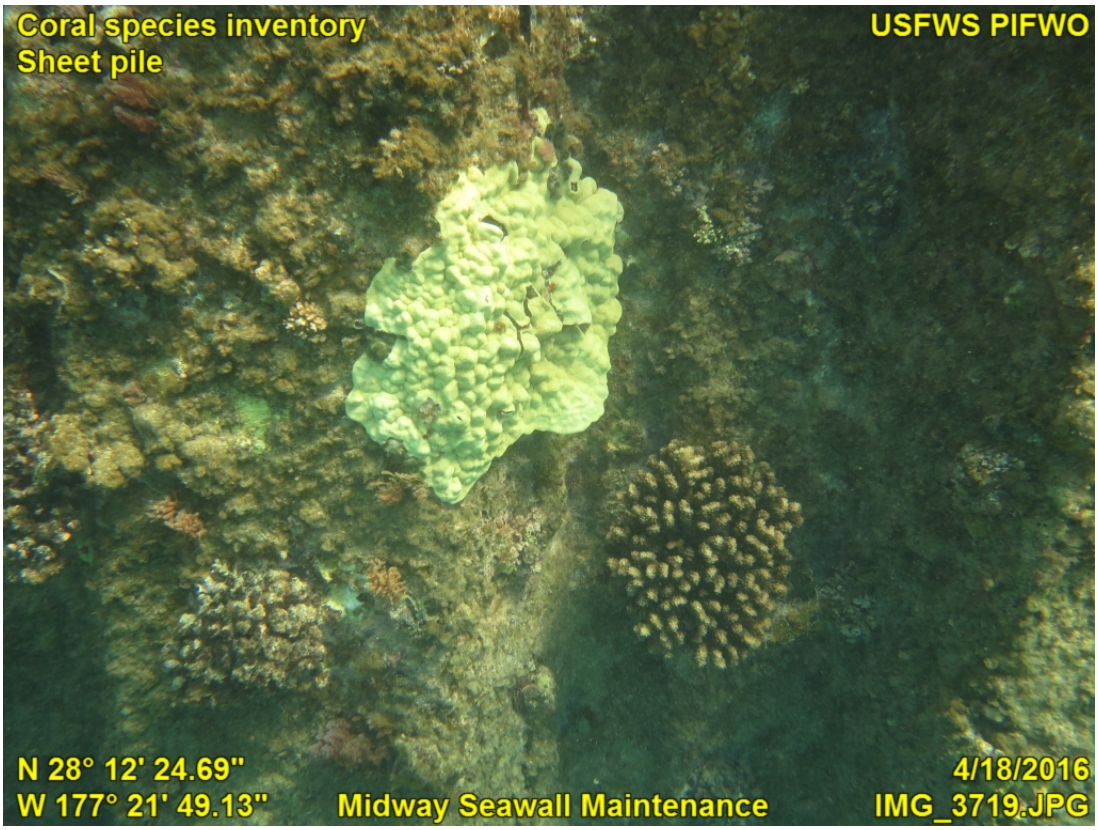
Debris
USFWS PIFWO
N 28° 12' 16.35"
W 177° 22' 12.82"
Midway Seawall Maintenance
4/17/2016
IMG_3642.JPG

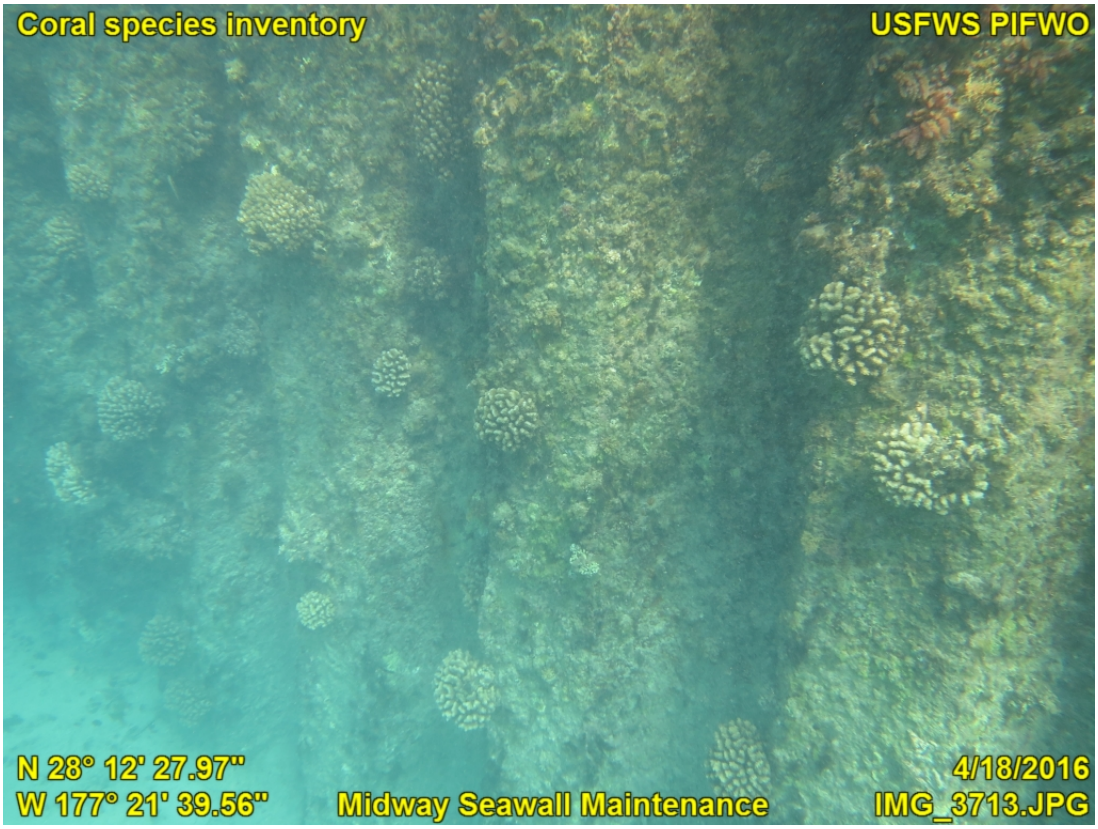

Artificial
Coral growth
USFWS PIFWO
N 28° 12' 16.71"
W 177° 22' 11.07"
Midway Seawall Maintenance
4/17/2016
IMG_3635.JPG

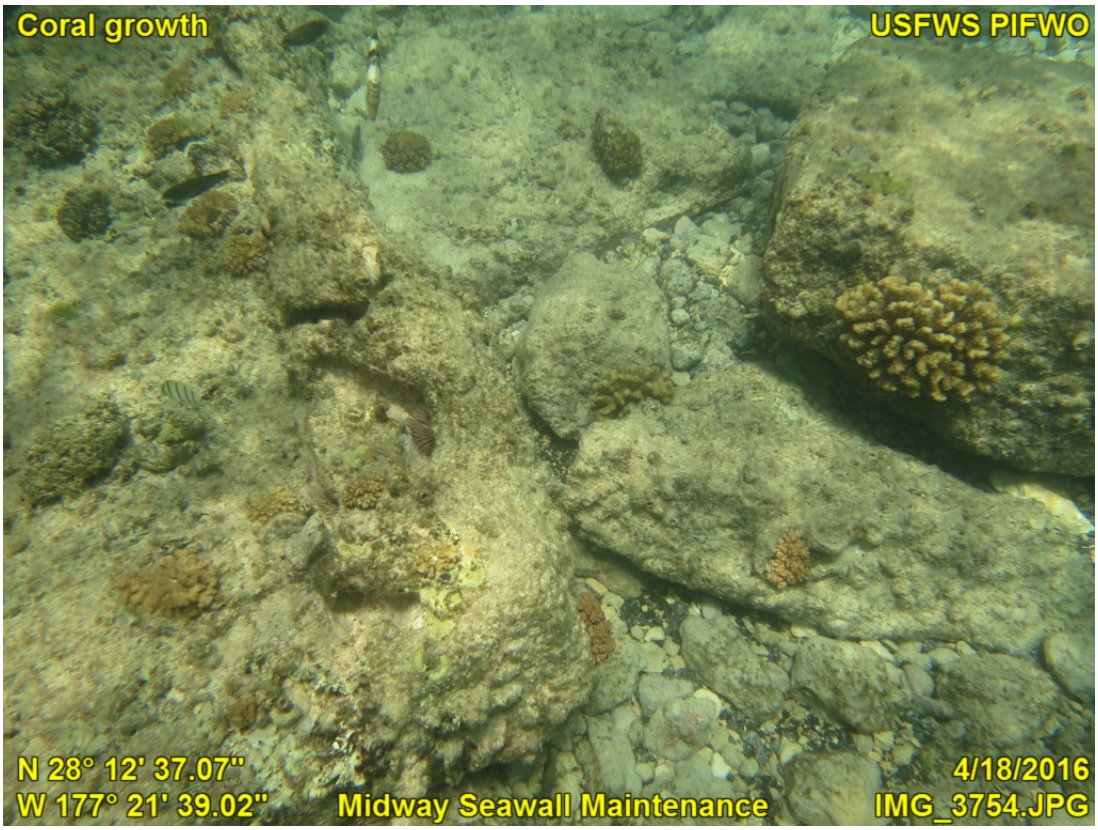

Debris
Coral growth
USFWS PIFWO
N 28° 12' 28.83"
W 177° 21' 36.59"
Midway Seawall Maintenance
4/18/2016
IMG_3706.JPG

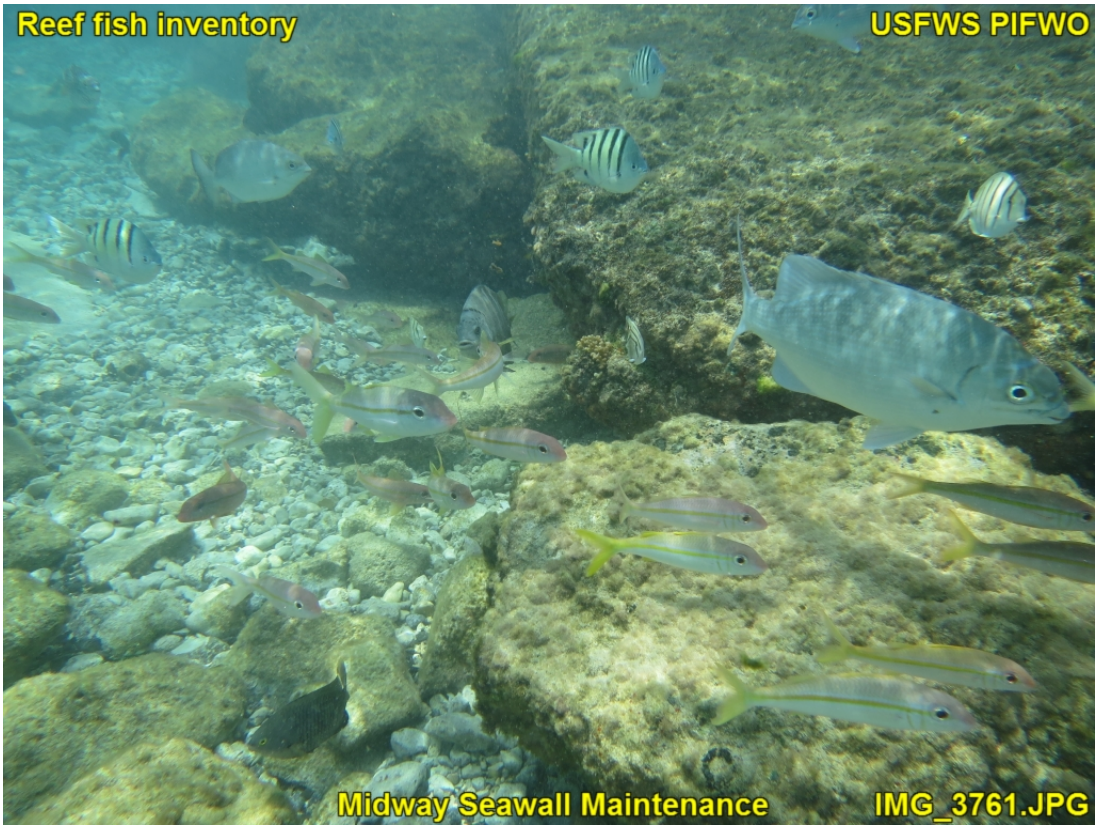

Artificial
Coral on sheet pile
USFWS PIFWO
N 28° 12' 31.19"
W 177° 21' 36.48"
Midway Seawall Maintenance
4/18/2016
IMG_3738.JPG

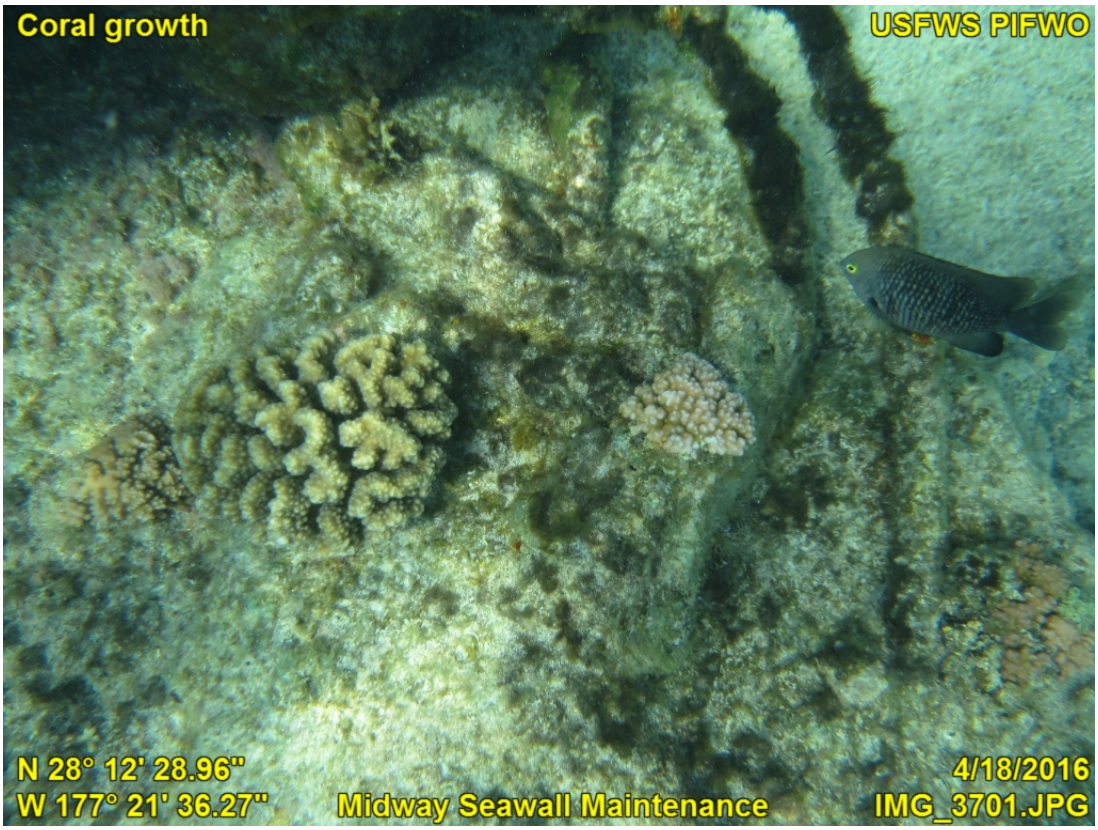

Species inventory
USFWS PIFWO
N 28° 12' 30.77"
W 177° 21' 36.25"
Midway Seawall Maintenance
4/18/2016
IMG_3737.JPG


Coral species inventory
Sheet pile
USFWS PIFWO
N 28° 12' 24.69"
W 177° 21' 49.13"
Midway Seawall Maintenance
4/18/2016
IMG_3719.JPG


Coral species inventory
USFWS PIFWO
N 28° 12' 27.97"
W 177° 21' 39.56"
Midway Seawall Maintenance
4/18/2016
IMG_3713.JPG

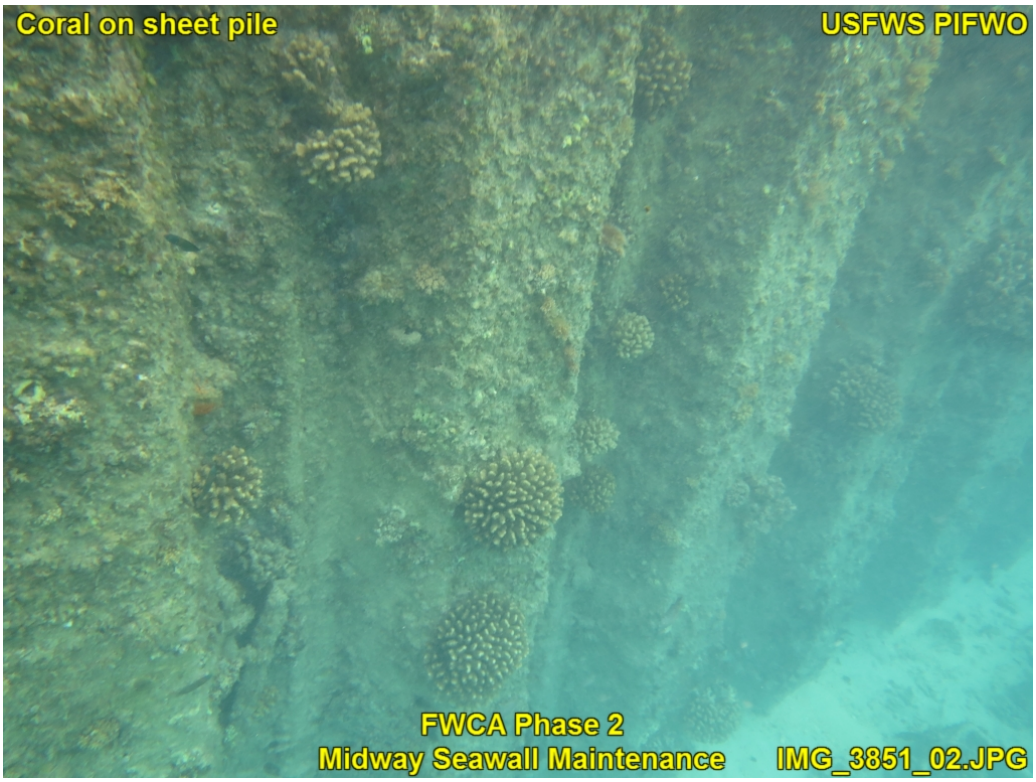

Coral growth
USFWS PIFWO
N 28° 12' 37.07"
W 177° 21' 39.02"
Midway Seawall Maintenance
4/18/2016
IMG_3754.JPG


Reef fish inventory
USFWS PIFWO
Midway Seawall Maintenance
IMG_3761.JPG

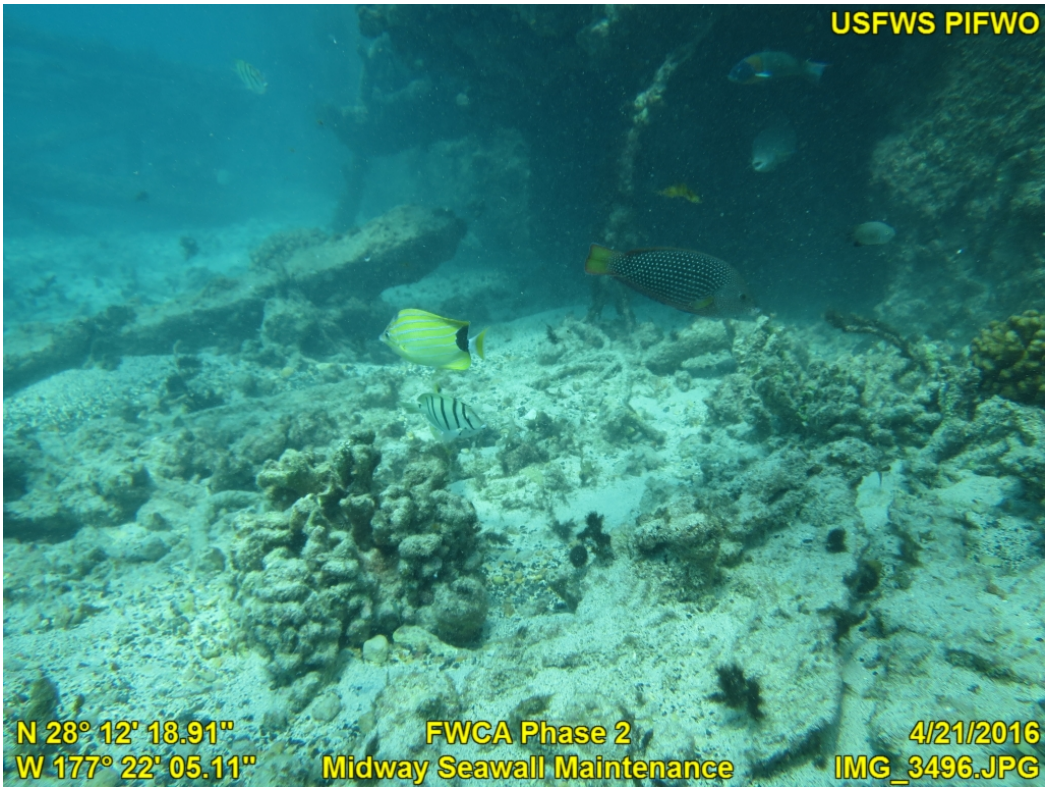

Coral growth
USFWS PIFWO
N 28° 12' 28.96"
W 177° 21' 36.27"
Midway Seawall Maintenance
4/18/2016
IMG_3701.JPG

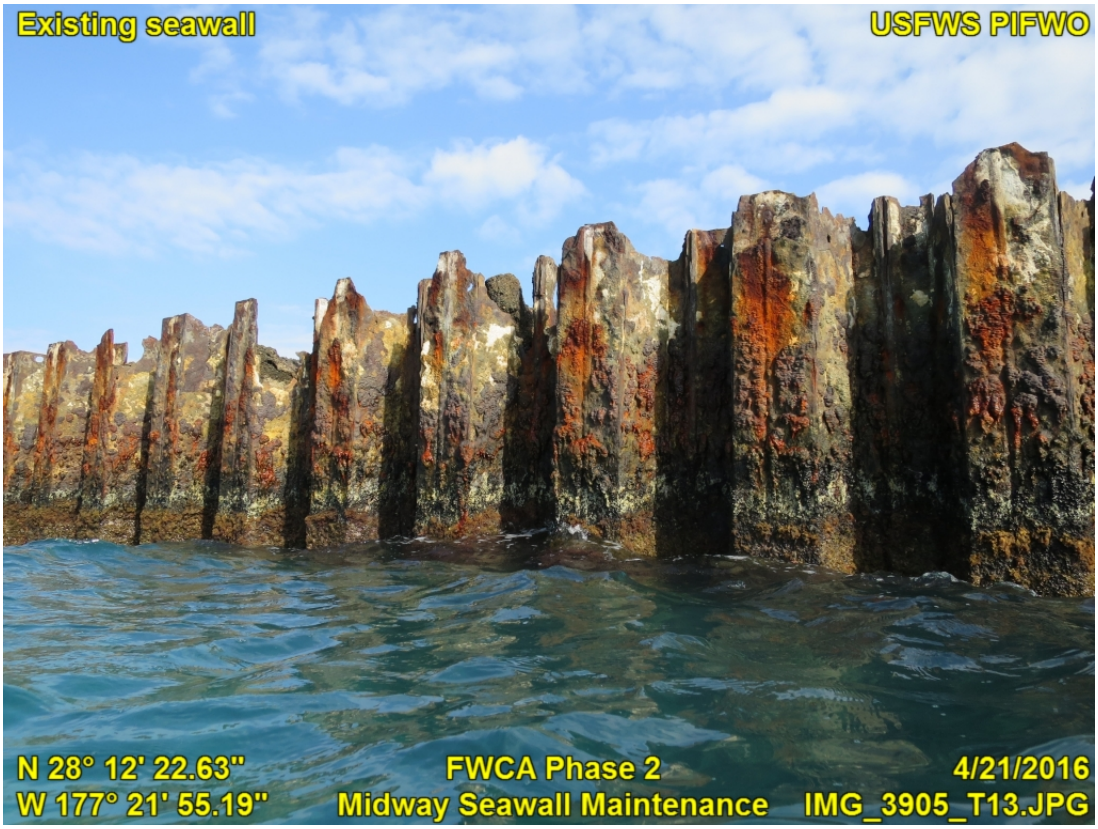
APPENDIX B.

Representative photos from FWCA Phase 2 Quantitative Surveys

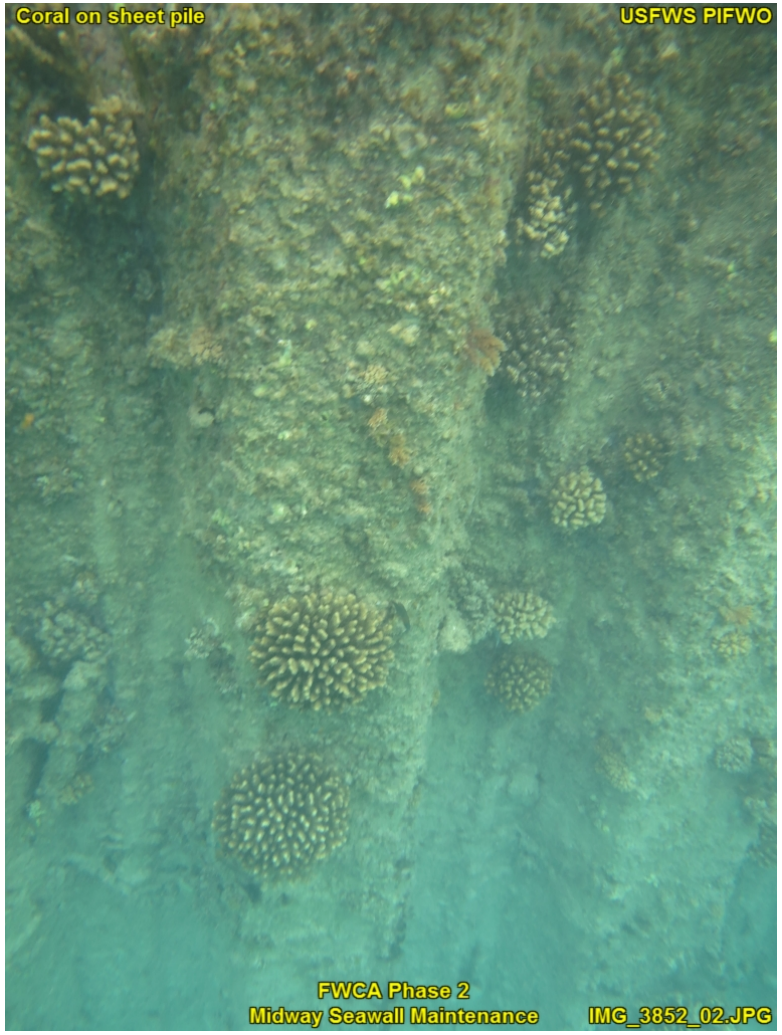


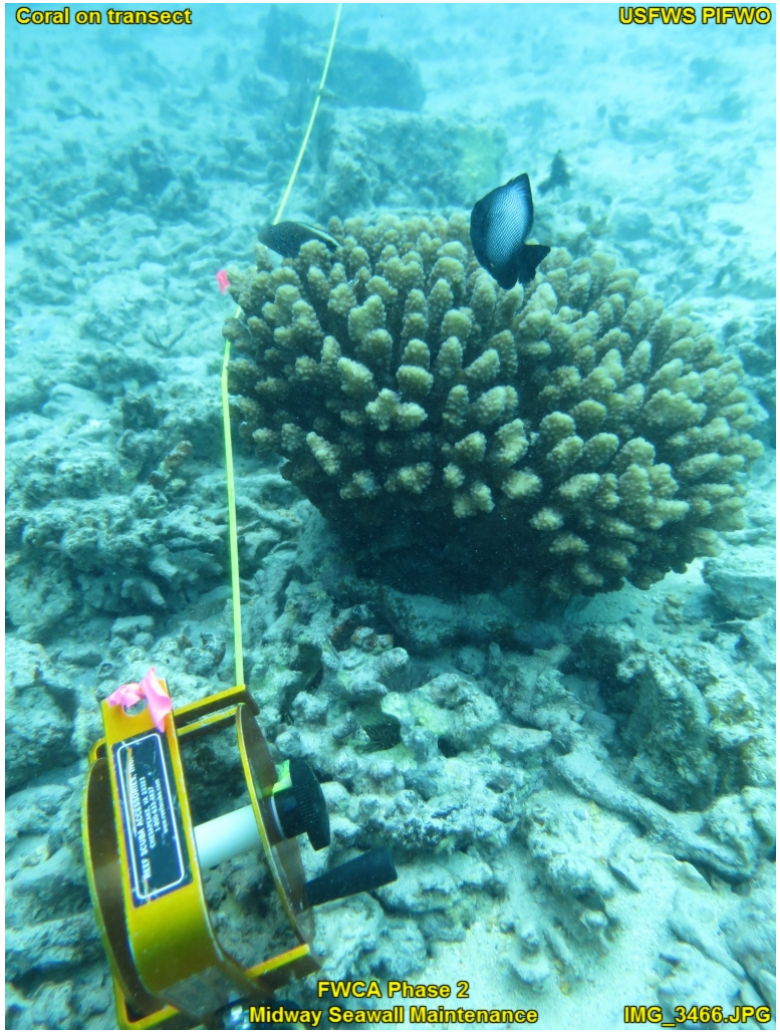
Transect 2 (above)



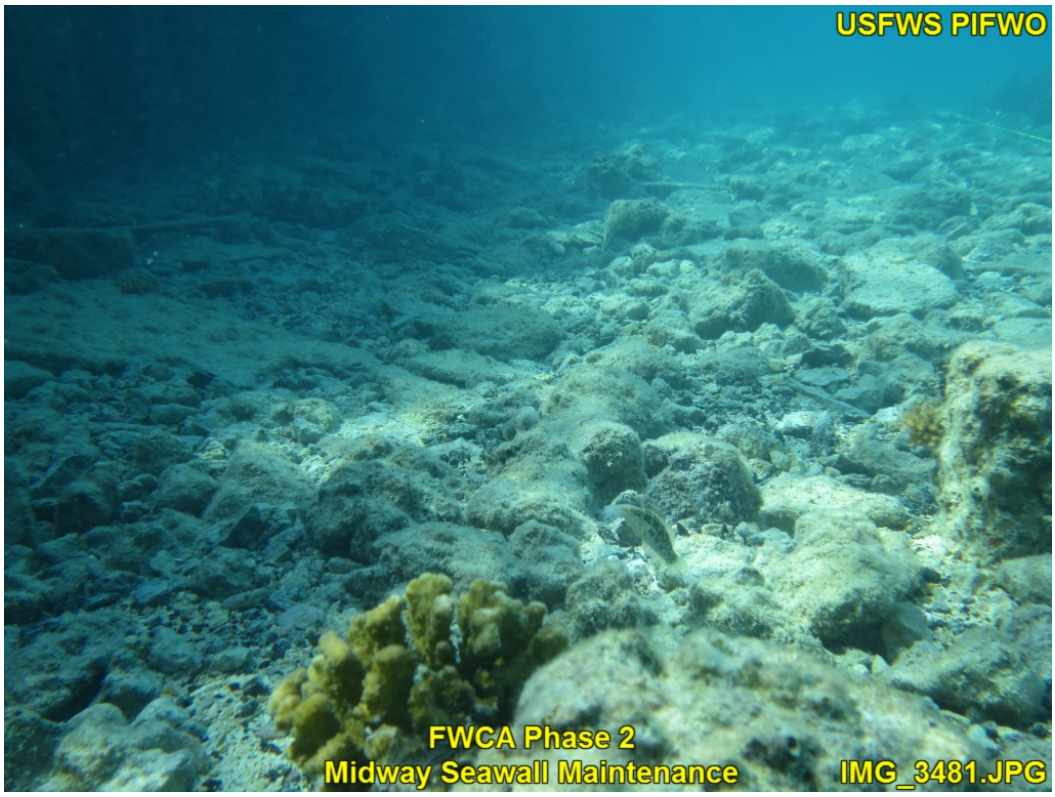

Existing seawall
USFWS PIFWO
N 28° 12' 22.63"
W 177° 21' 55.19"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3905_T13.JPG

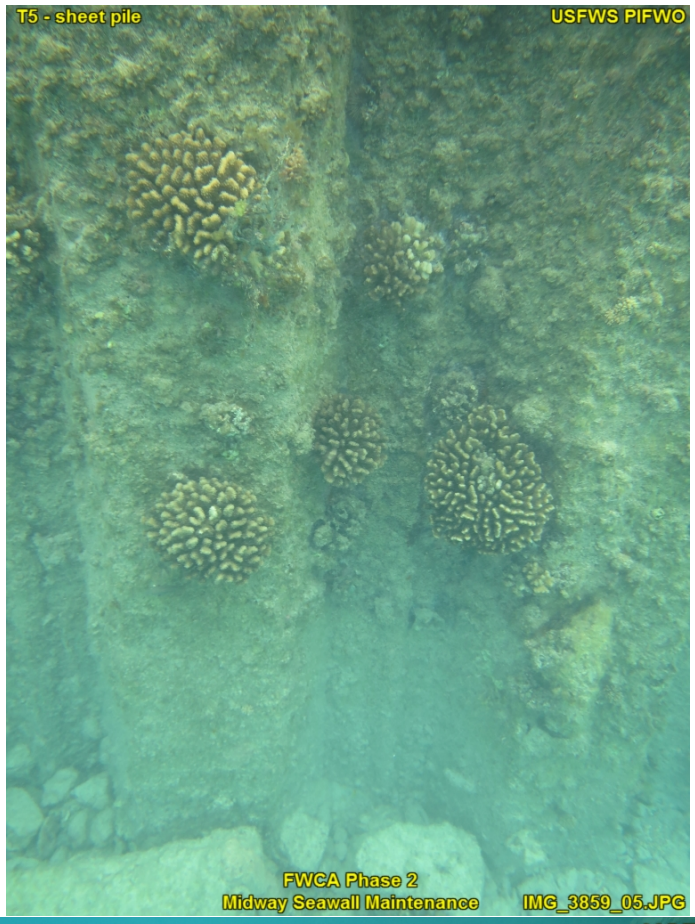
Temporary solution
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3889.JPG

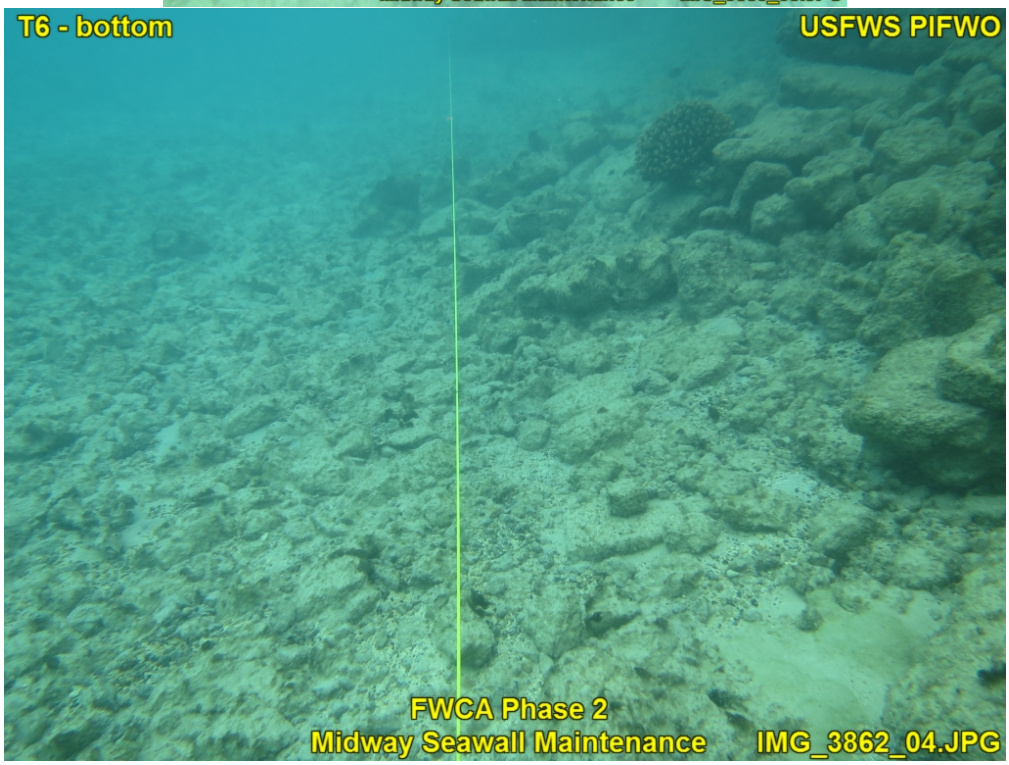

Coral on sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3852_02.JPG

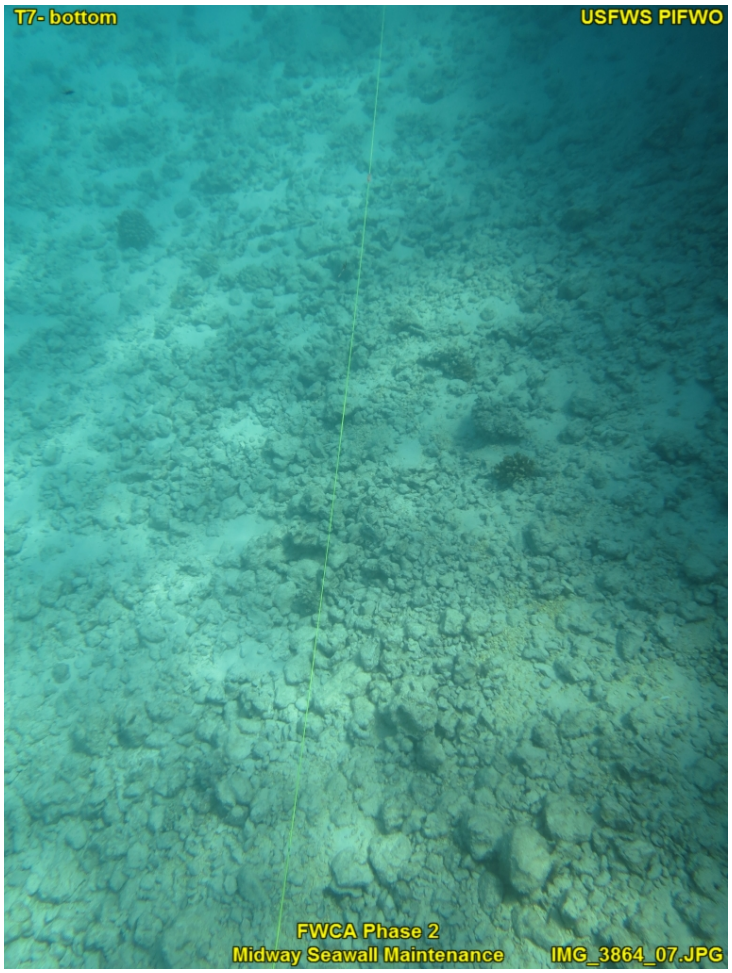

Coral on transect
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3466.JPG

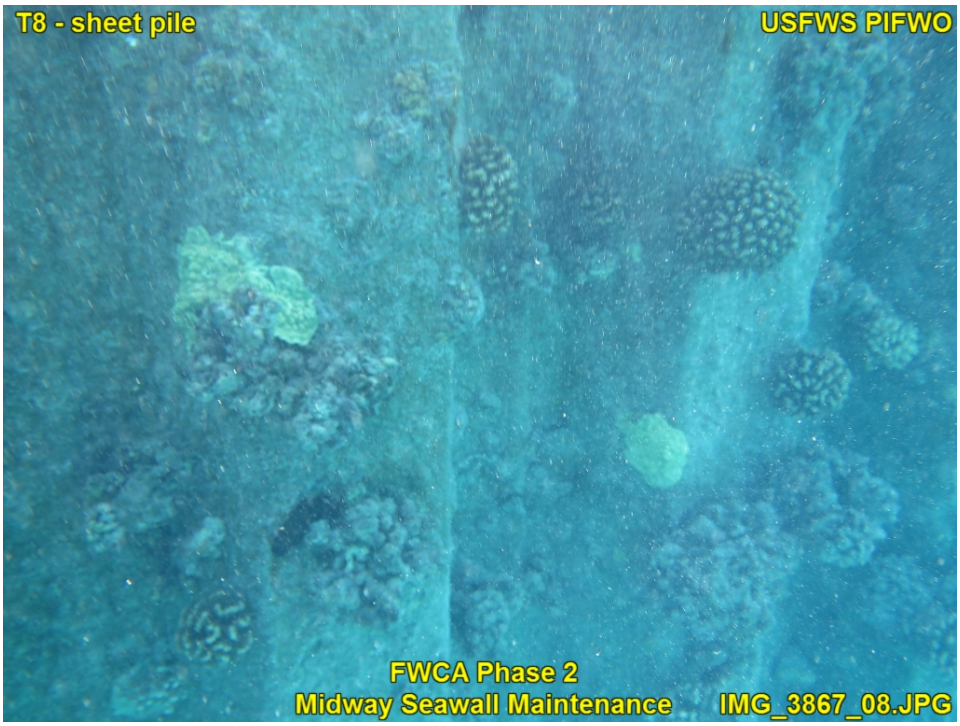
T4 - bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3857_05.JPG

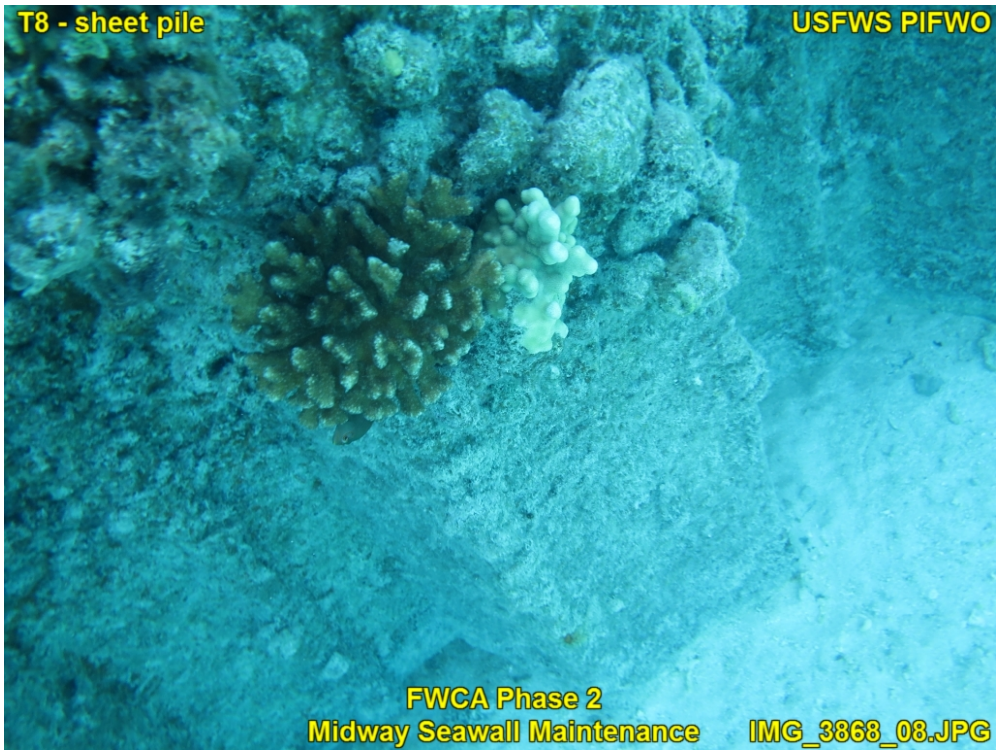

USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3481.JPG

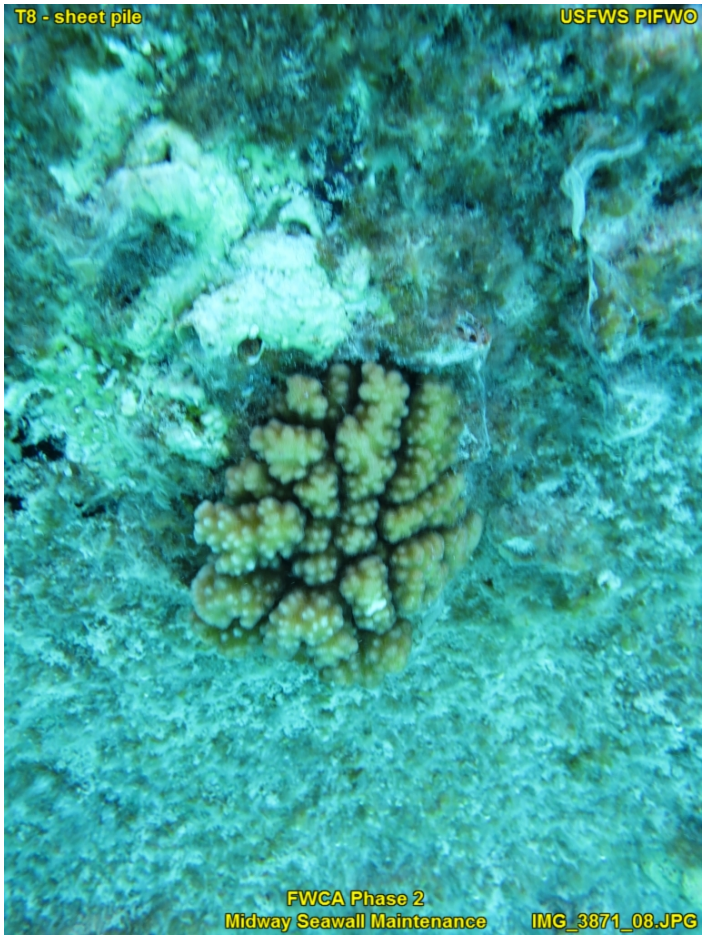

T5 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3859_05.JPG

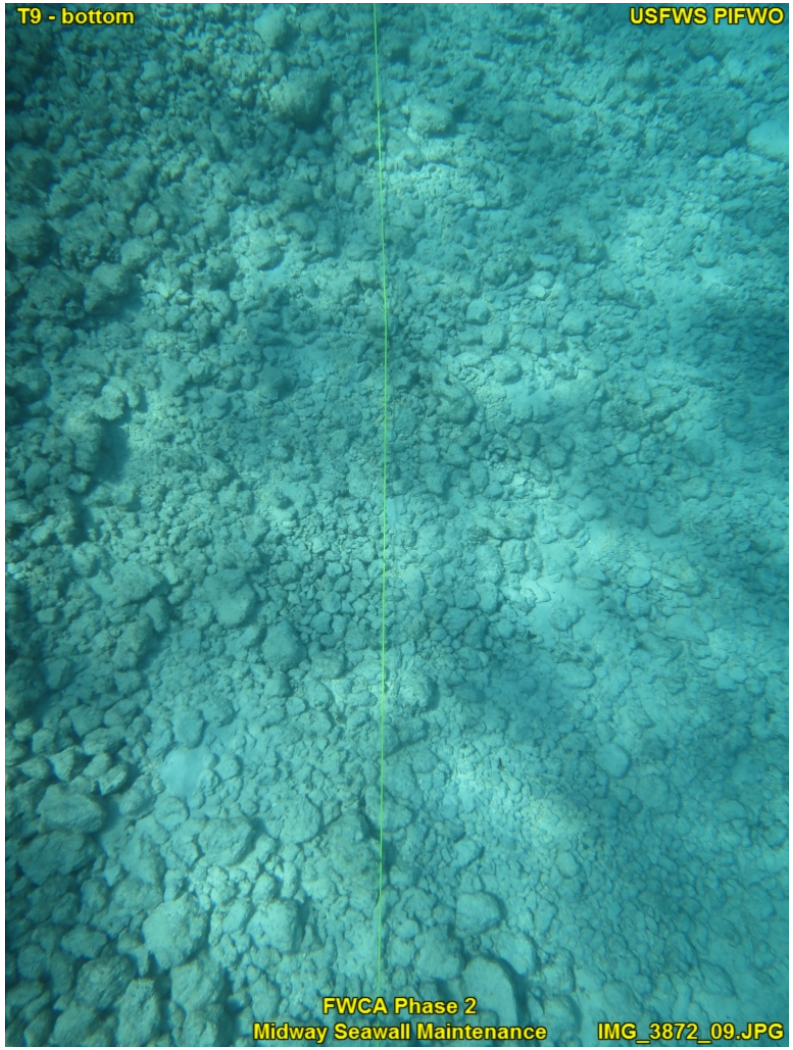

T6 - bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3862_04.JPG

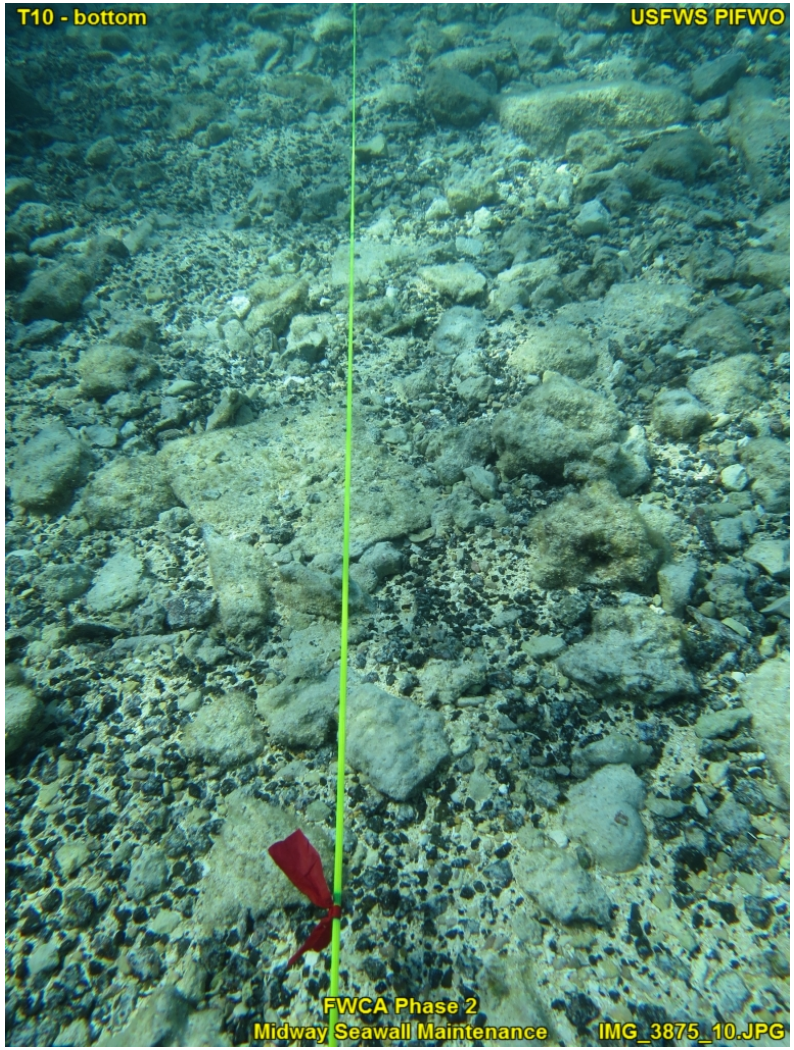

T7- bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3864_07.JPG

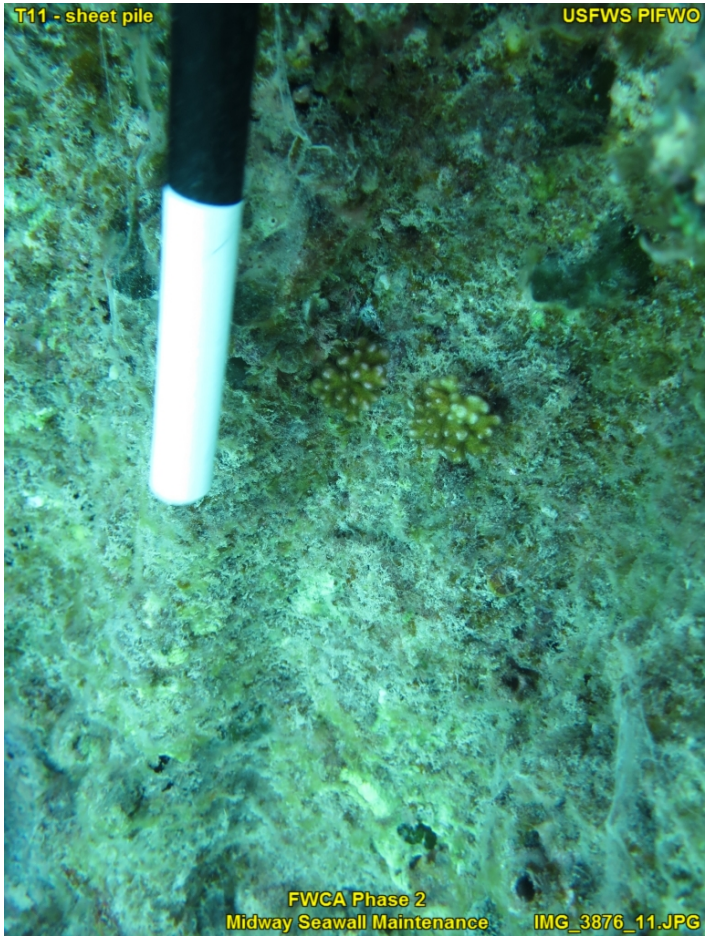

T8 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3867_08.JPG

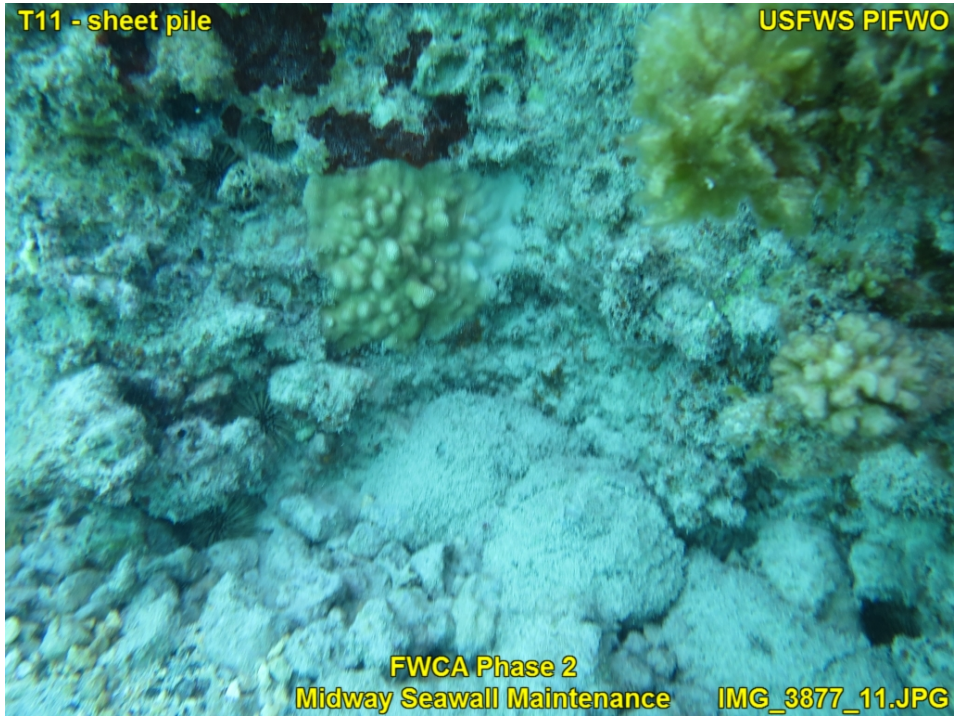

T8 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3868_08.JPG

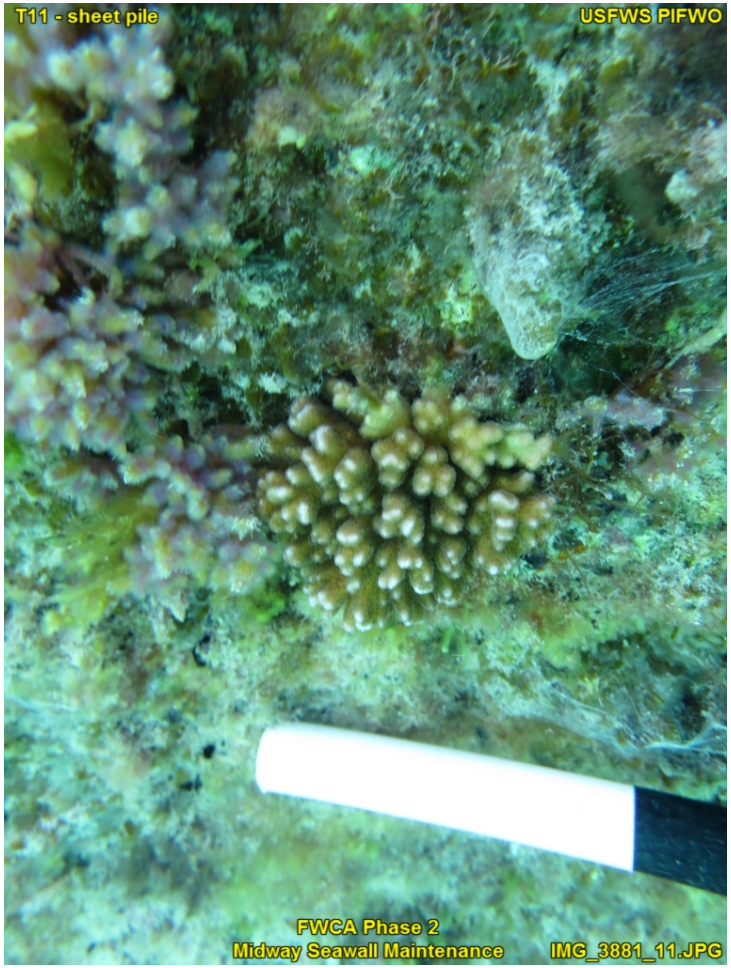

T8 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3871_08.JPG


T9 - bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3872_09.JPG

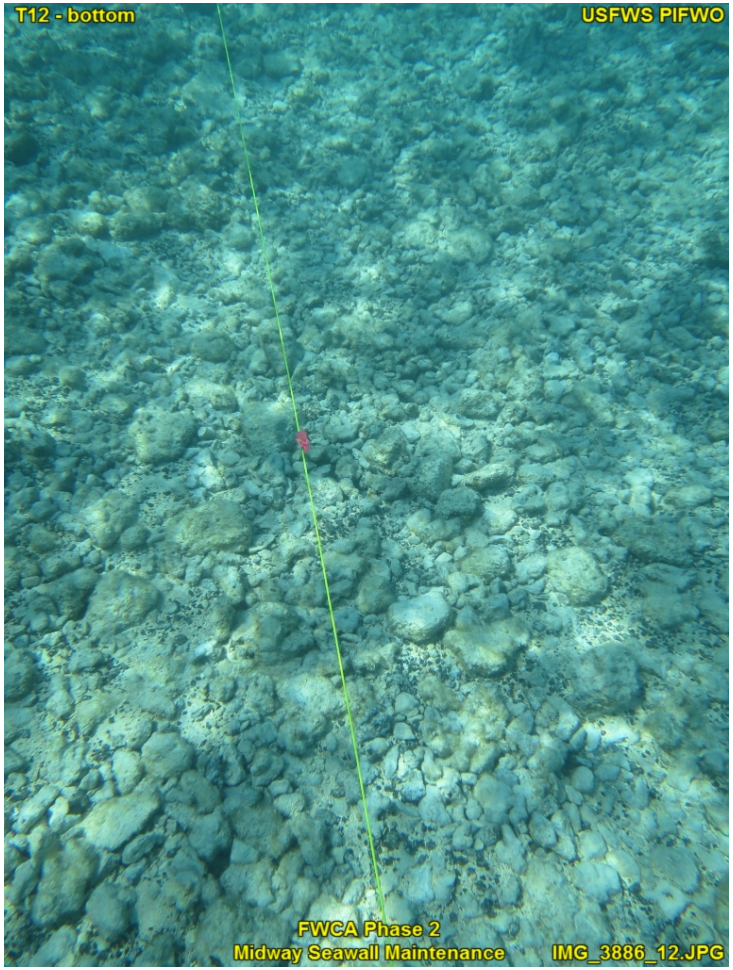

T10 - bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3875_10.JPG

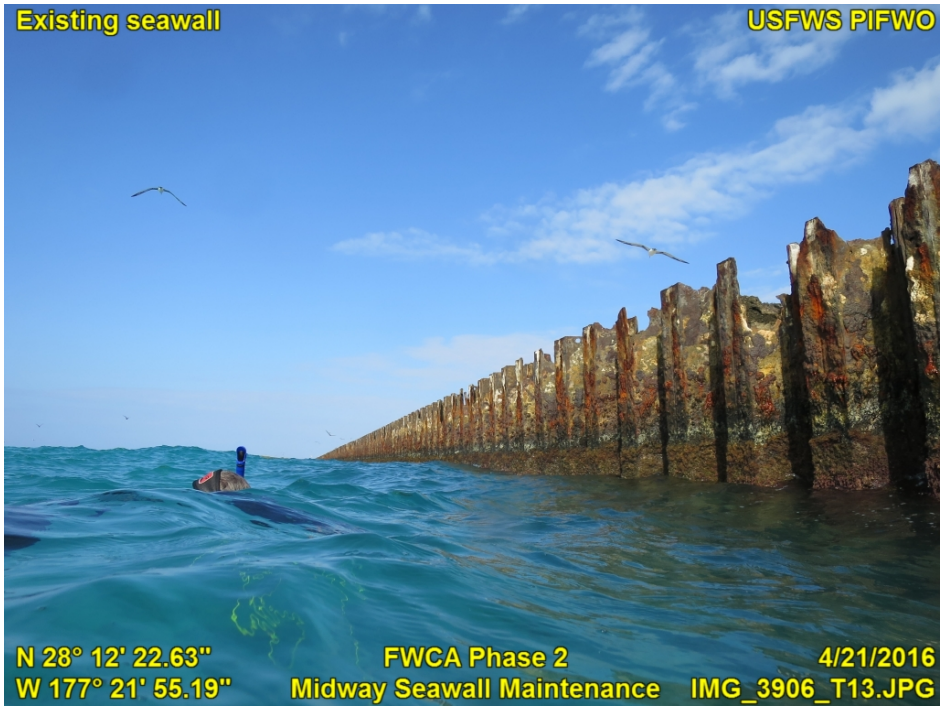

T11 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3876_11.JPG

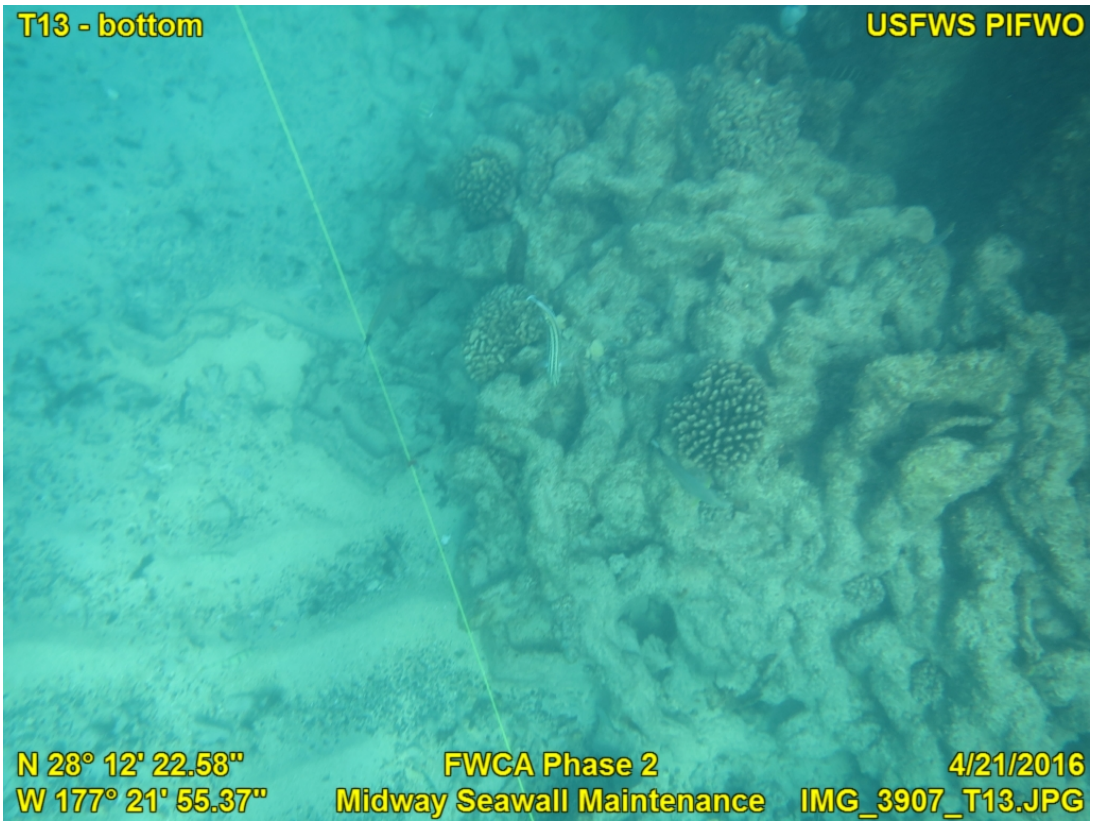

T11 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3877_11.JPG

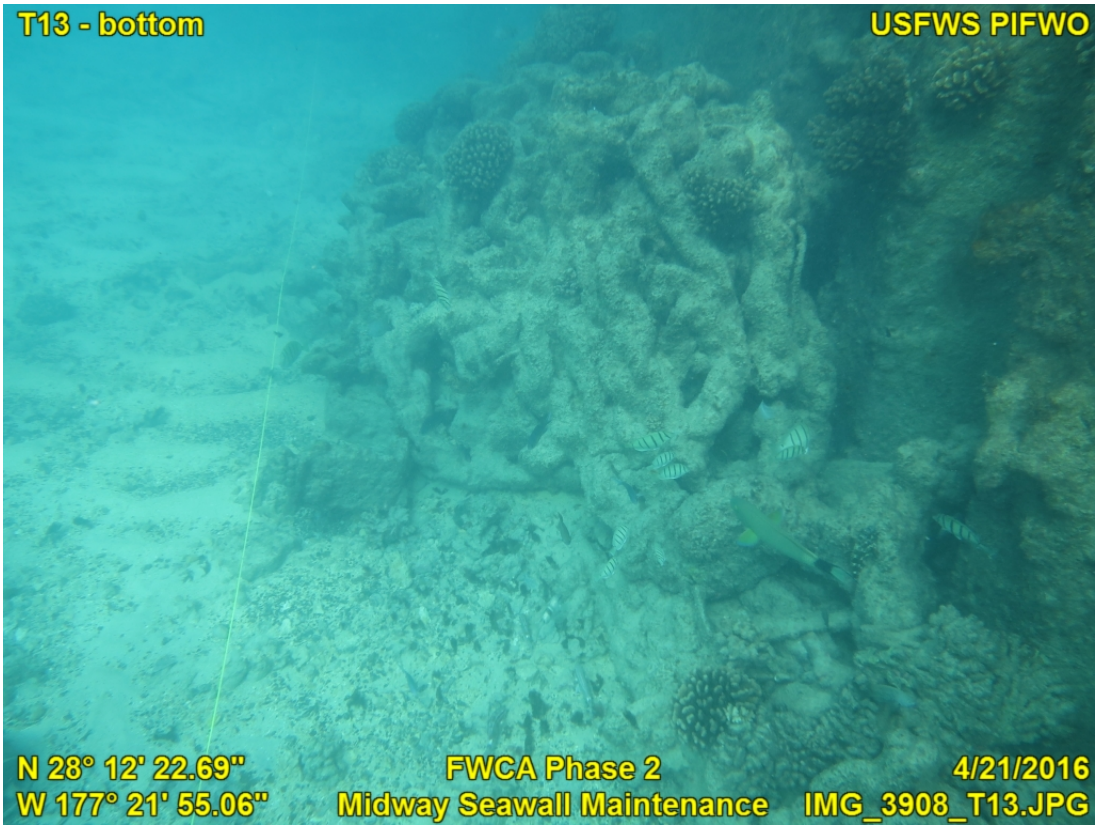

T11 - sheet pile
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3881_11.JPG

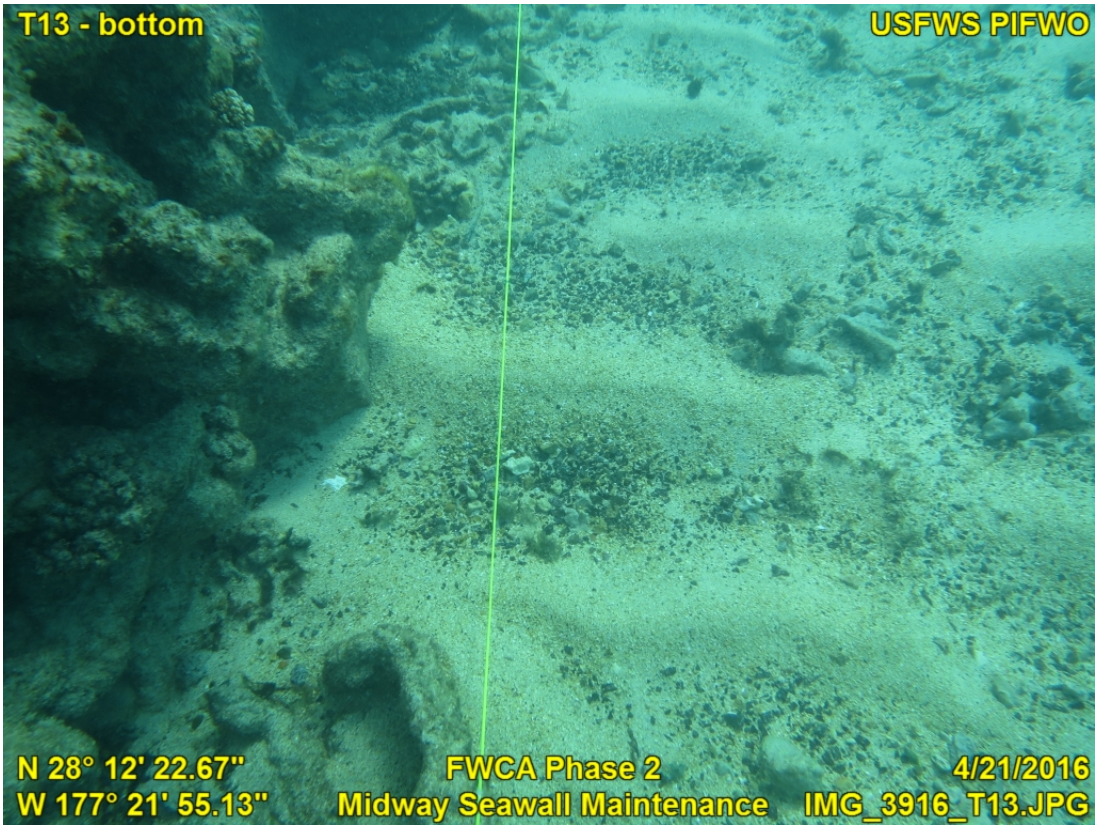
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3883.JPG

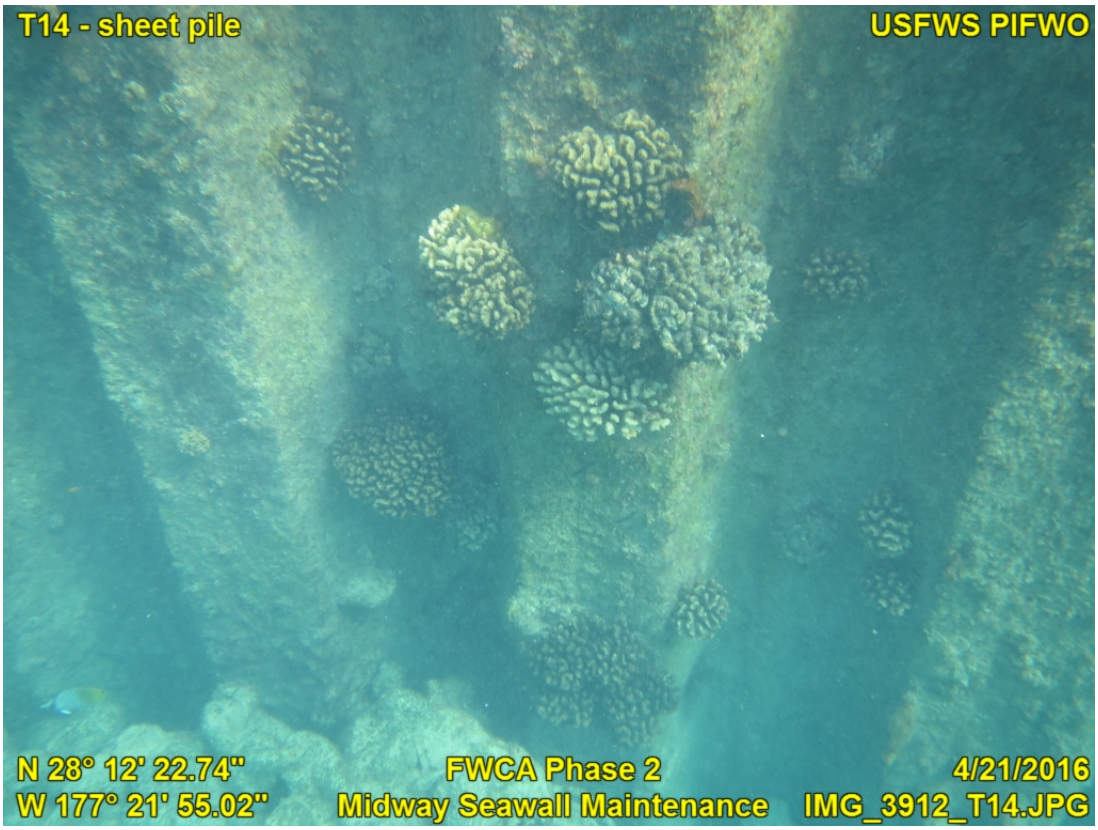

T12 - bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_3886_12.JPG

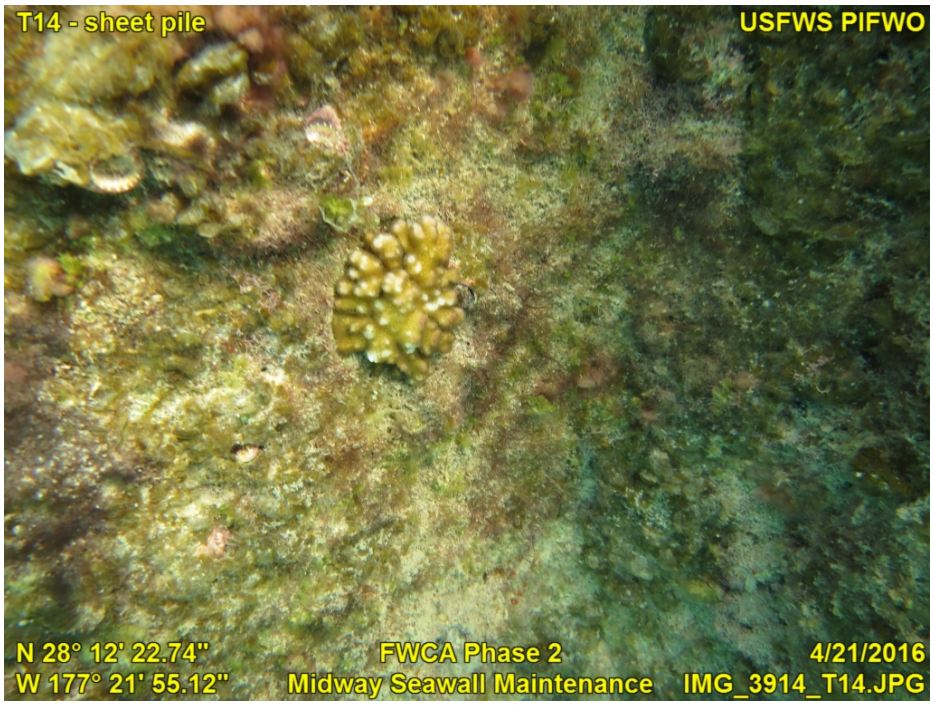

Existing seawall
USFWS PIFWO
N 28° 12' 22.63"
W 177° 21' 55.19"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3906_T13.JPG

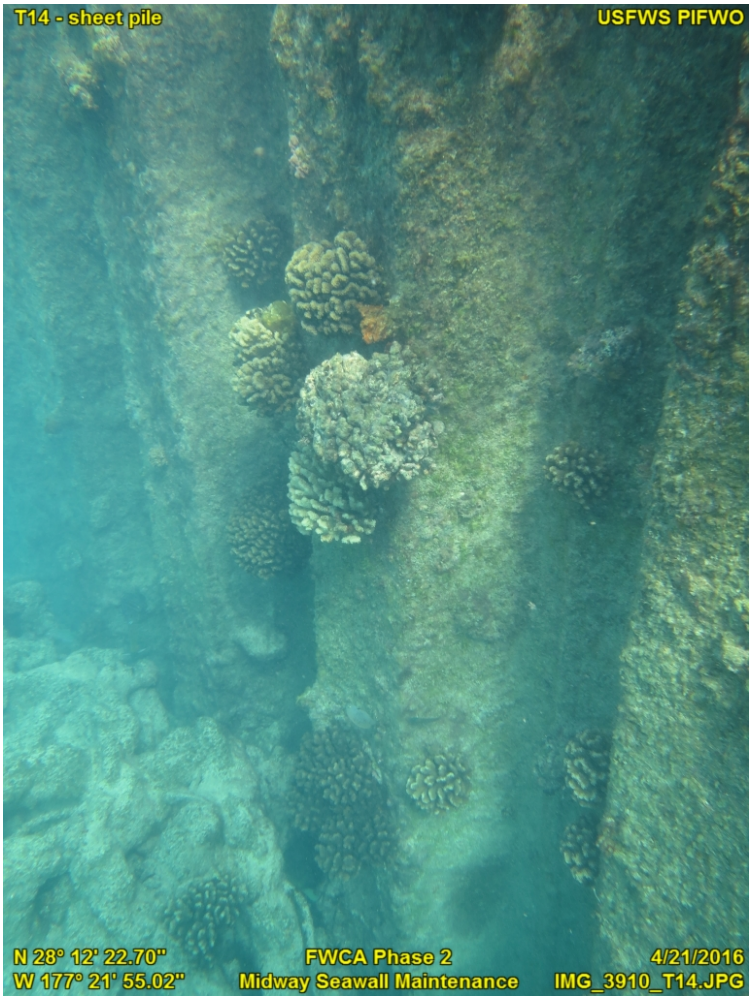

T13 - bottom
USFWS PIFWO
N 28° 12' 22.58"
W 177° 21' 55.37"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3907_T13.JPG

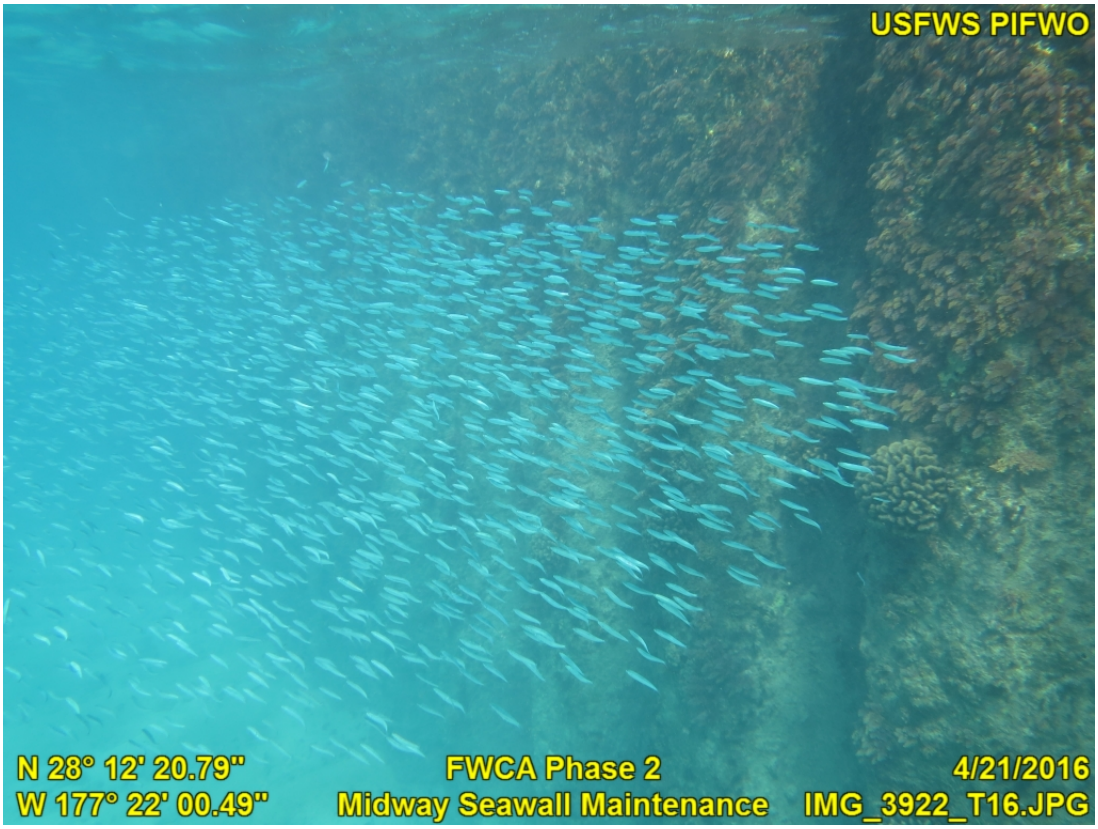

T13 - bottom
USFWS PIFWO
N 28° 12' 22.69"
W 177° 21' 55.06"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3908_T13.JPG

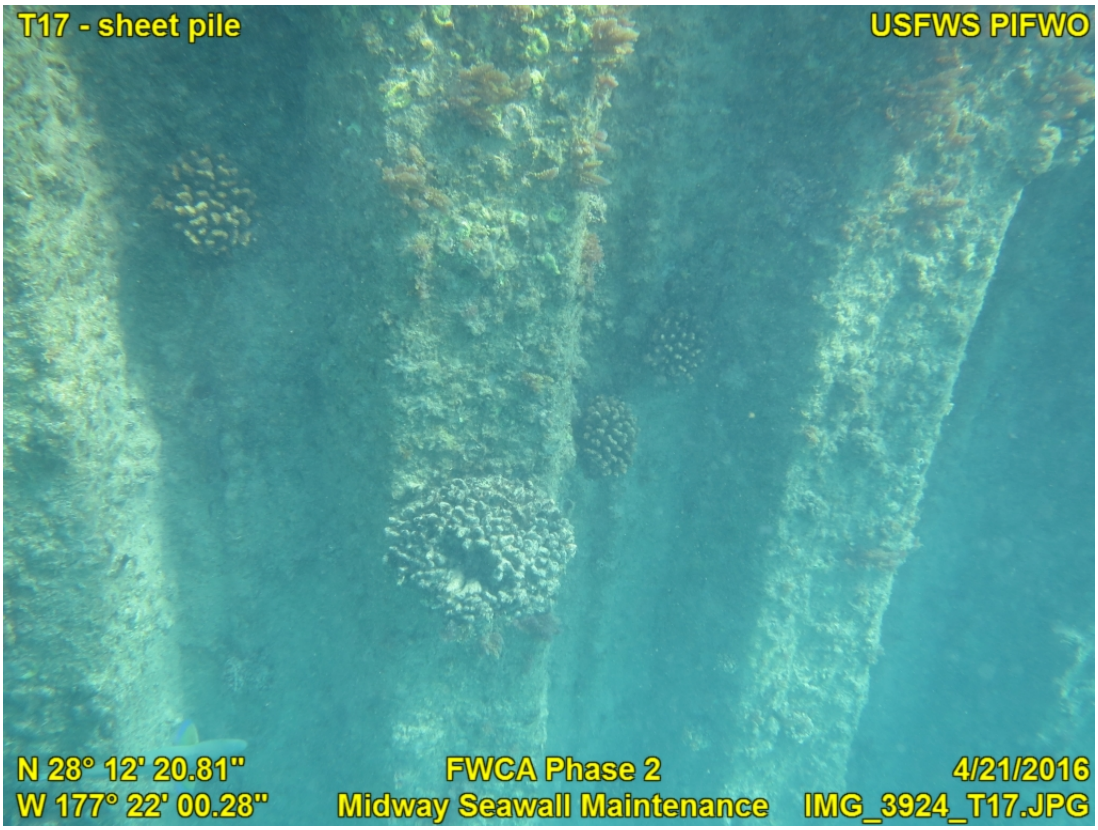

T13 - bottom
USFWS PIFWO
N 28° 12' 22.67"
W 177° 21' 55.13"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3916_T13.JPG


T14 - sheet pile
USFWS PIFWO
N 28° 12' 22.74"
W 177° 21' 55.02"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3912_T14.JPG


T14 - sheet pile
USFWS PIFWO
N 28° 12' 22.74"
W 177° 21' 55.12"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3914_T14.JPG


T14 - sheet pile
USFWS PIFWO
N 28° 12' 22.70"
W 177° 21' 55.02"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3910_T14.JPG


USFWS PIFWO
N 28° 12' 20.79"
W 177° 22' 00.49"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
IMG_3922_T16.JPG


T17 - sheet pile
USFWS PIFWO
N 28° 12' 20.81"
W 177° 22' 00.28"
FWCA Phase 2
Midway Seawall Maintenance
4/21/2016
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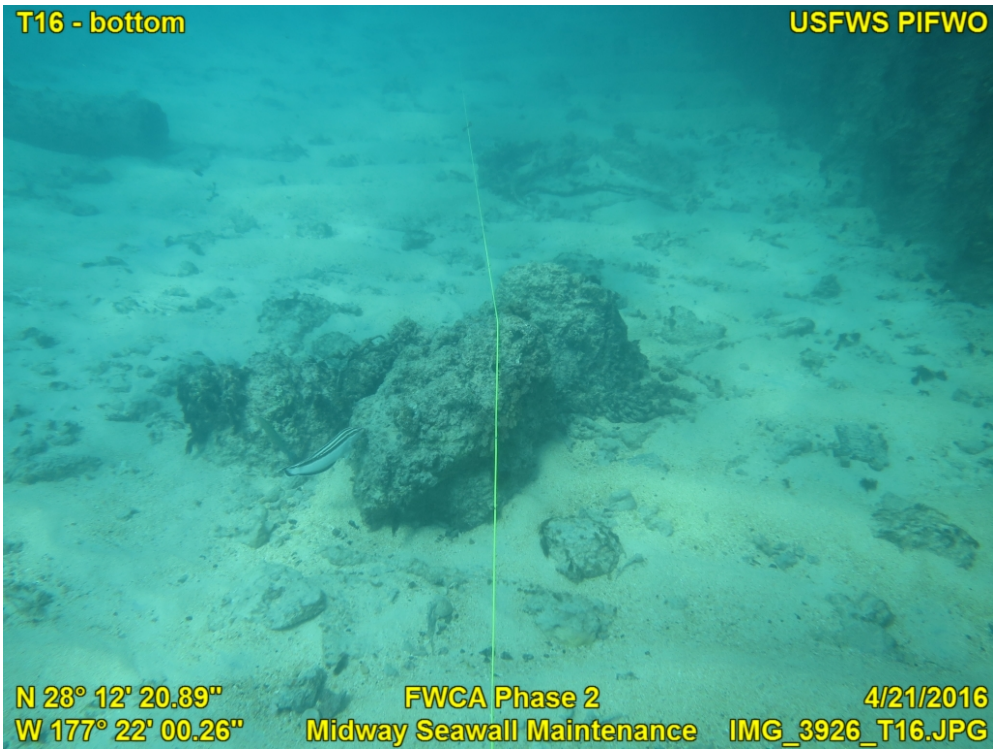
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FWCA Phase 2
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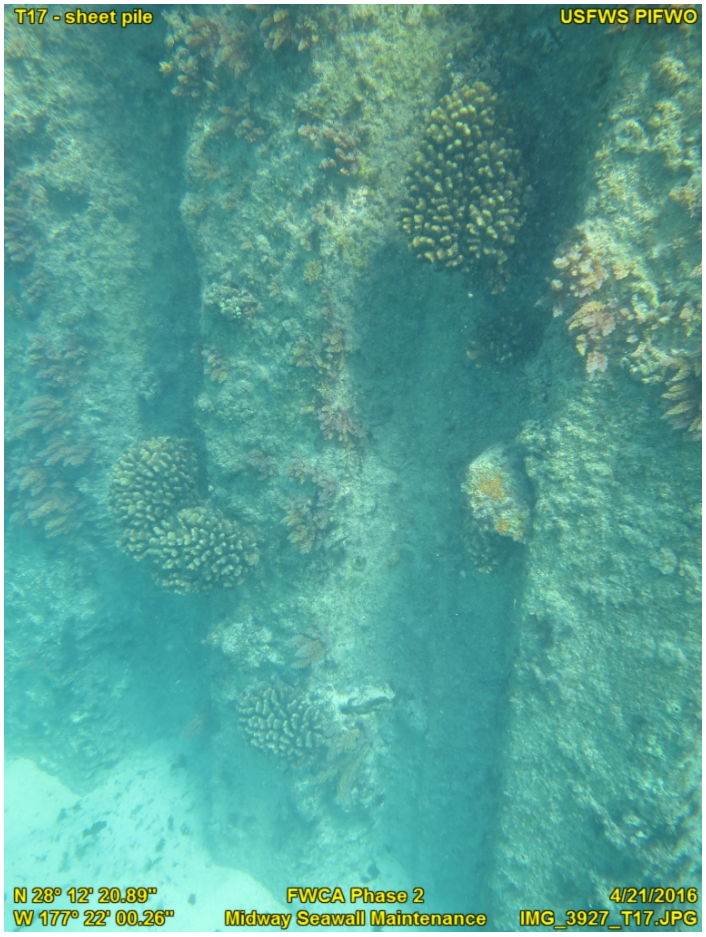
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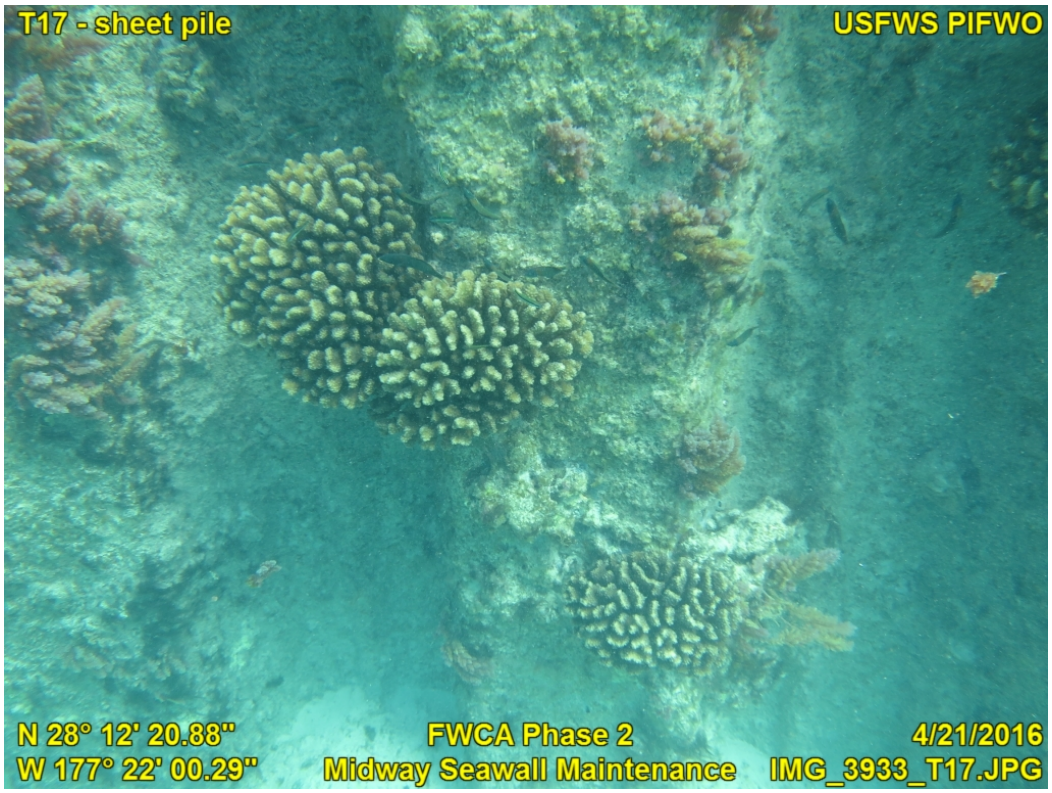
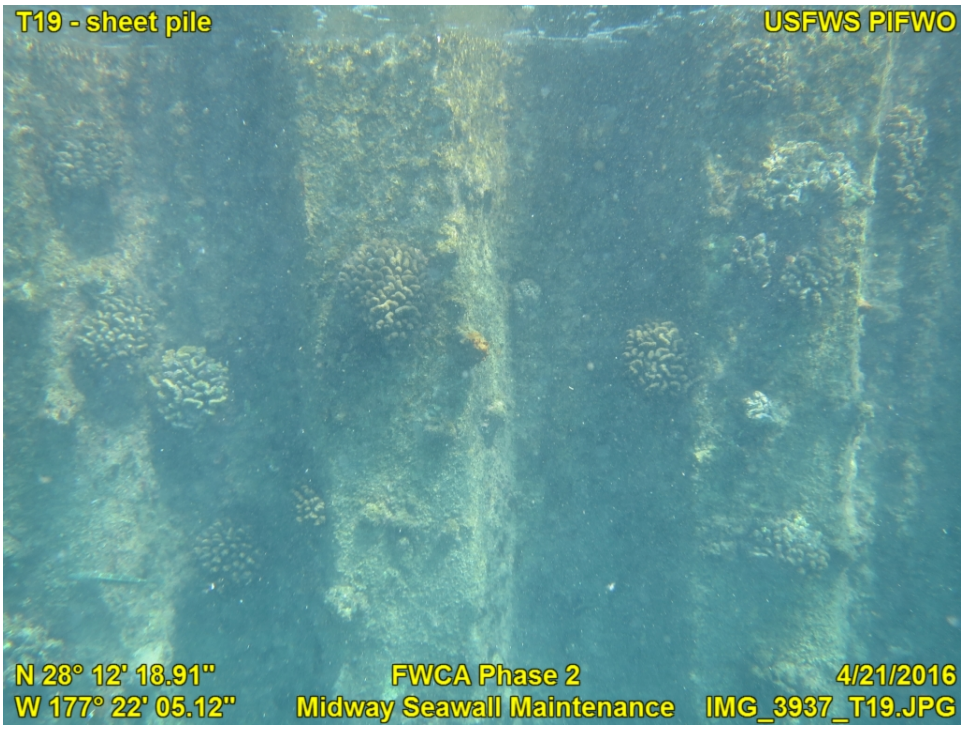


Transect 19 (below)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FWCA Phase 2
Midway Seawall Maintenance
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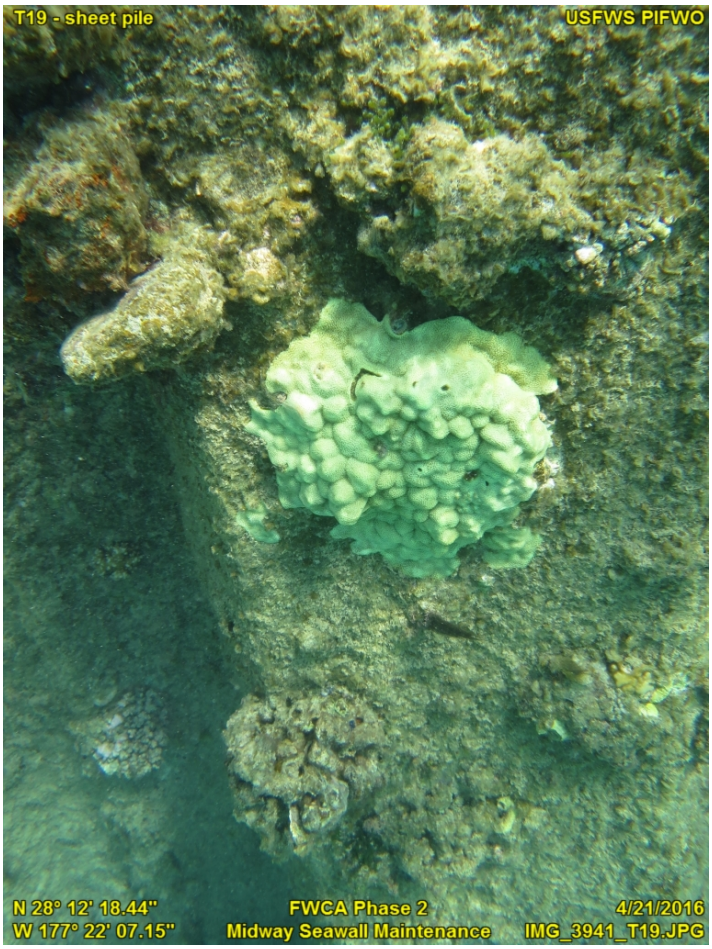
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FWCA Phase 2
Midway Seawall Maintenance
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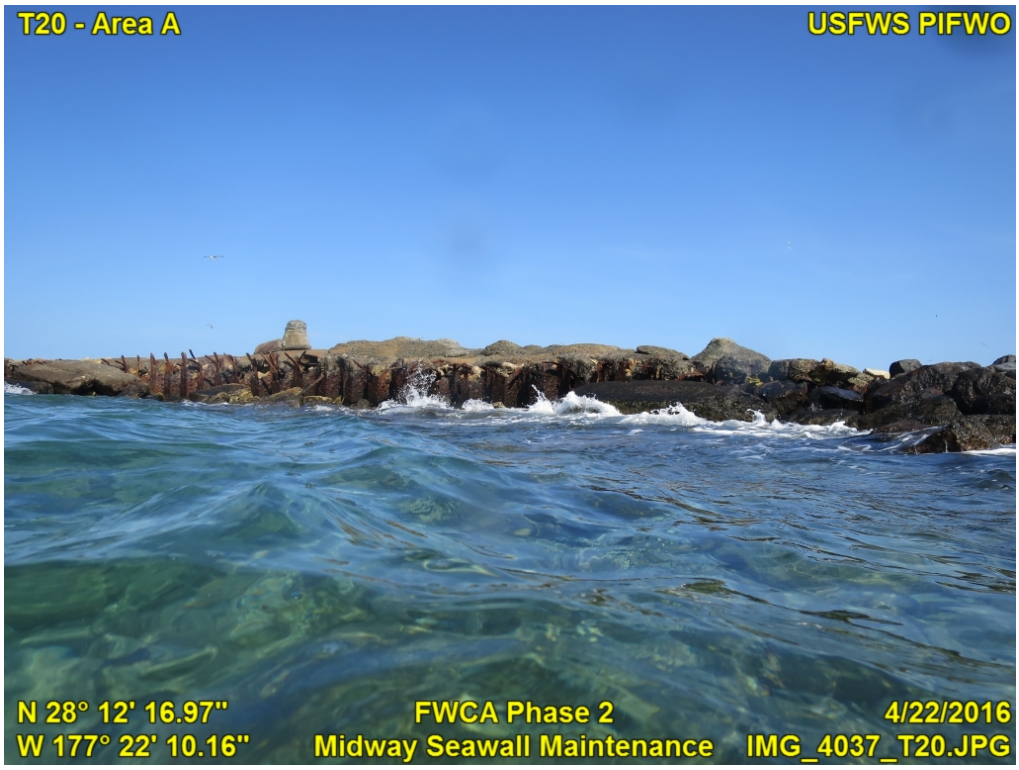
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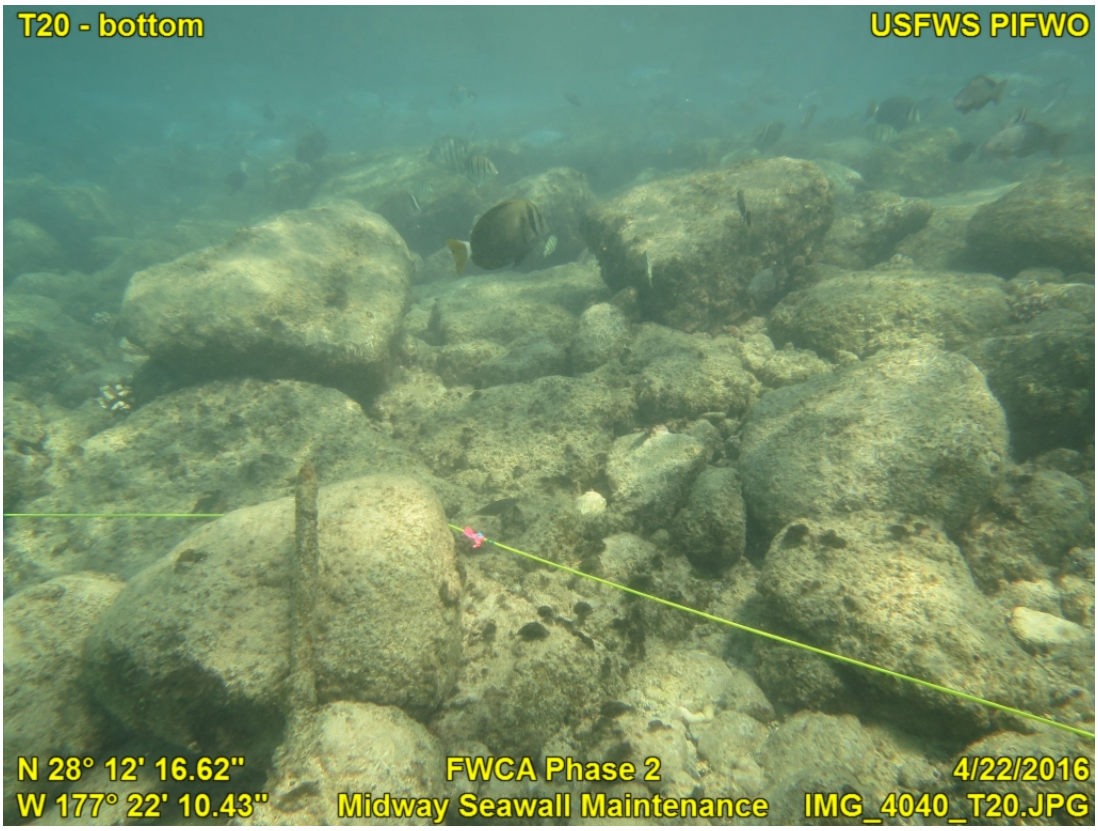
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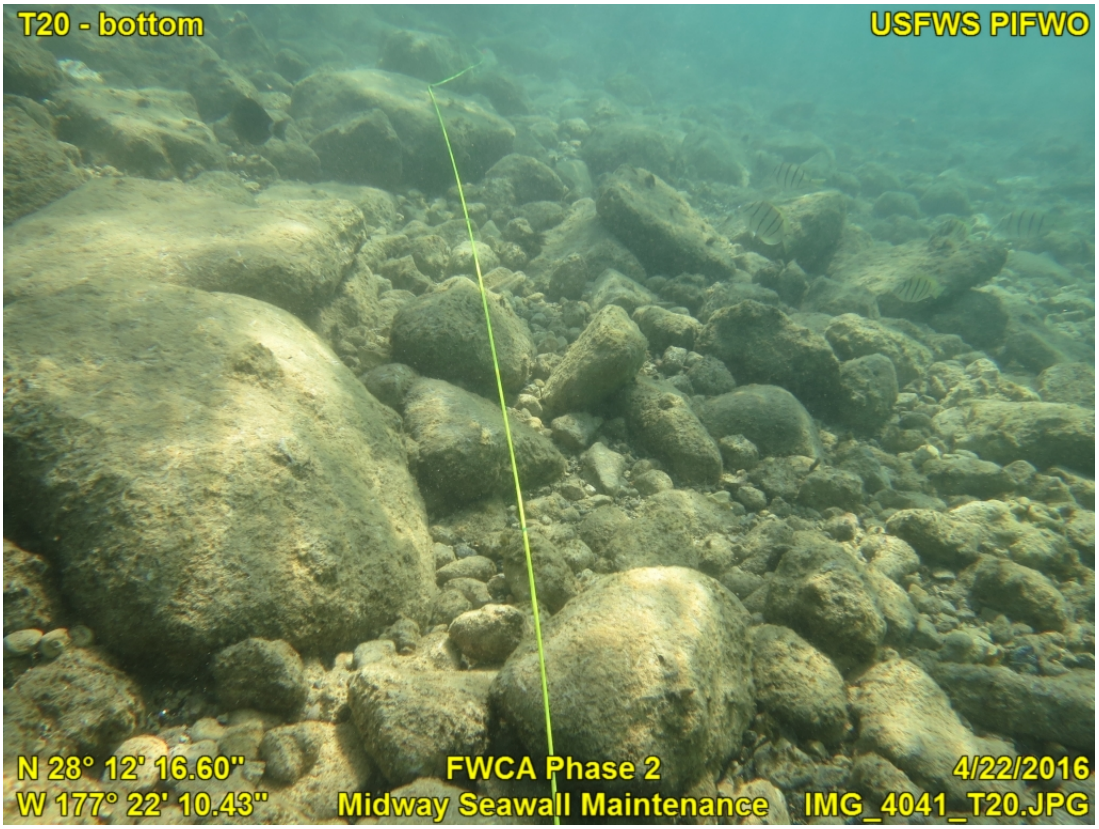
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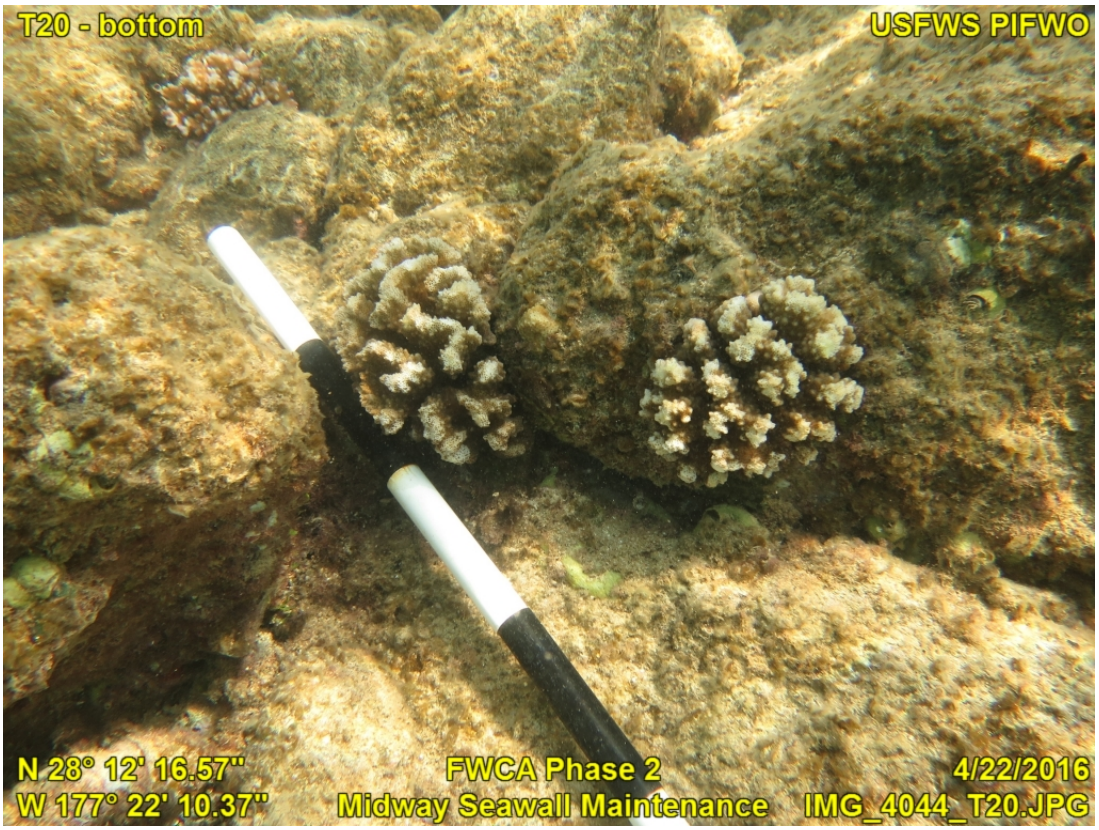
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FWCA Phase 2
Midway Seawall Maintenance
4/22/2016
IMG_4044_T20.JPG

T20 - Area A
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FWCA Phase 2
Midway Seawall Maintenance
4/22/2016
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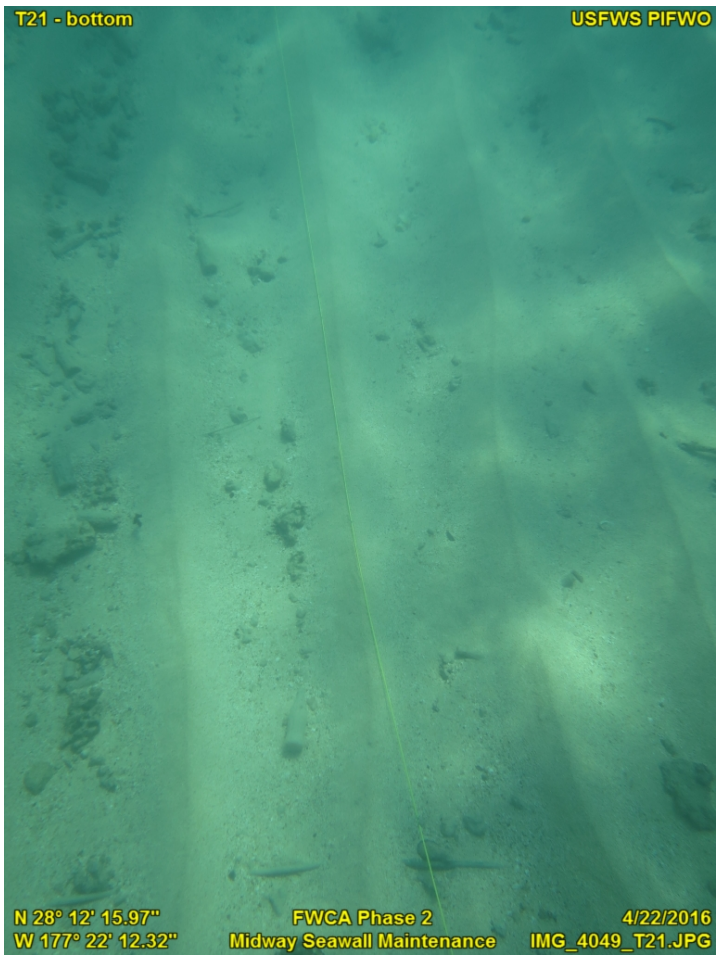
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FWCA Phase 2
Midway Seawall Maintenance
4/22/2016
IMG_4049_T21.JPG

T22 - bottom
USFWS PIFWO
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W 177° 22' 13.66"
FWCA Phase 2
Midway Seawall Maintenance
4/22/2016
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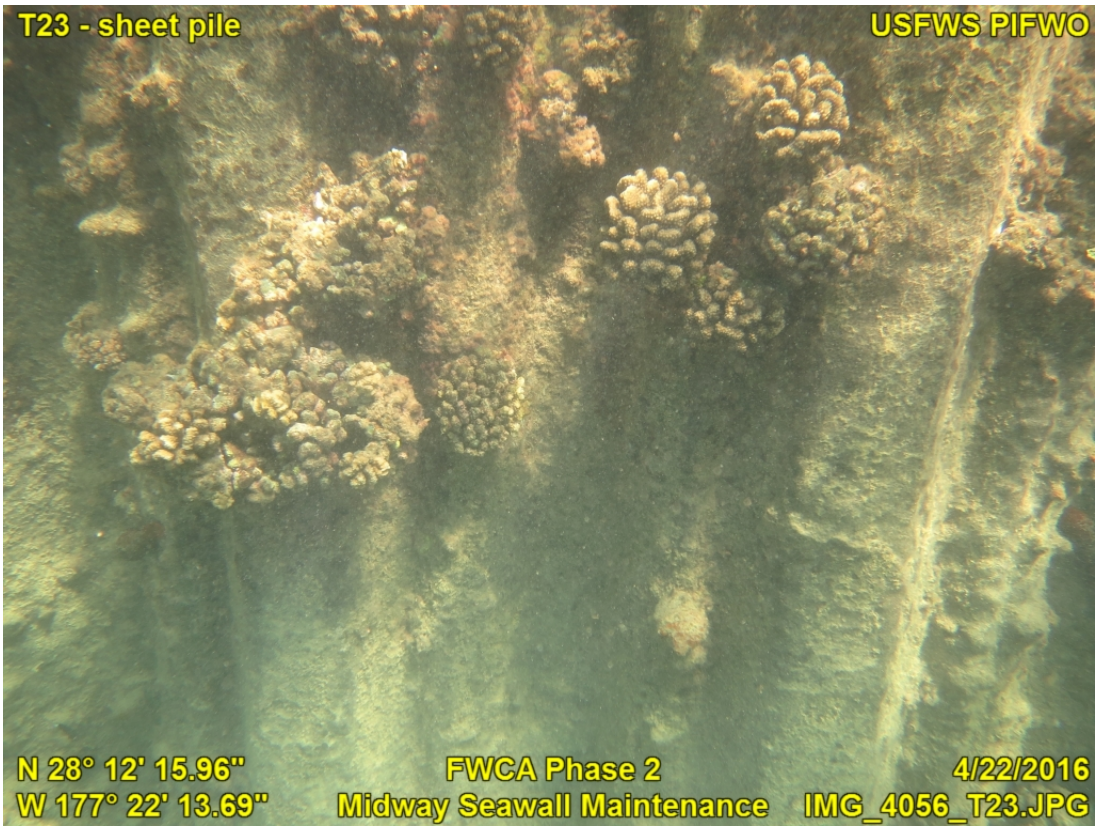
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FWCA Phase 2
Midway Seawall Maintenance
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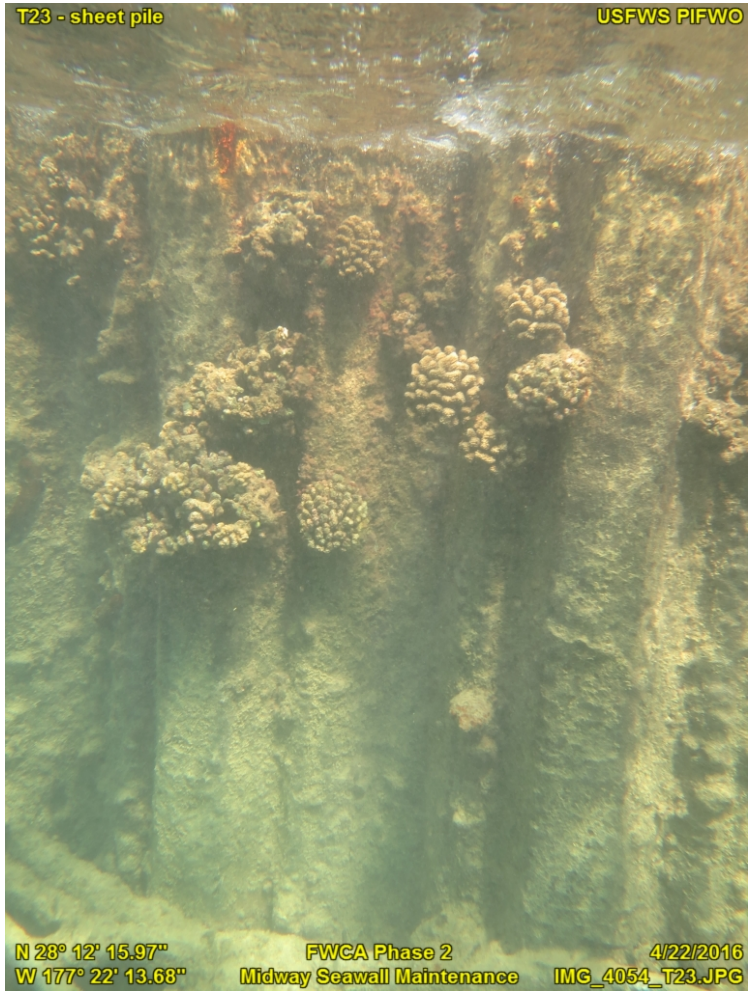
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FWCA Phase 2
Midway Seawall Maintenance
4/22/2016
IMG_4054_T23.JPG

T23 - sheet pile
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FWCA Phase 2
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4/22/2016
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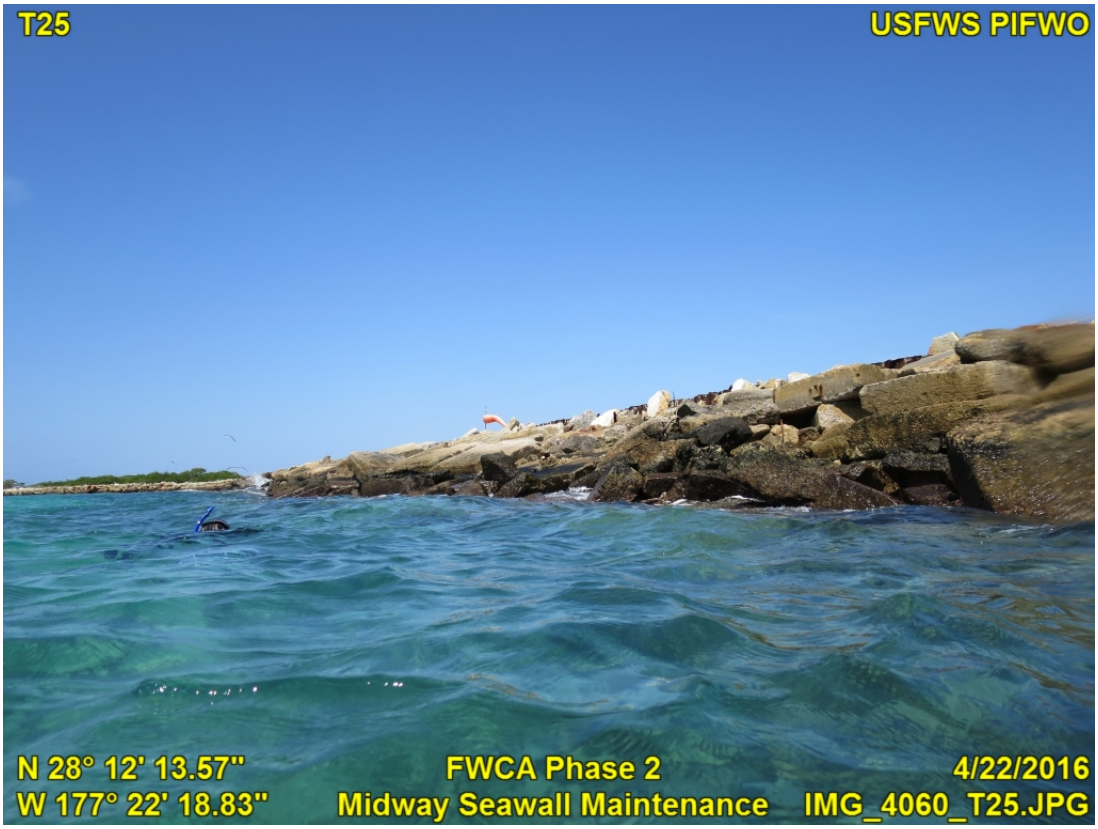
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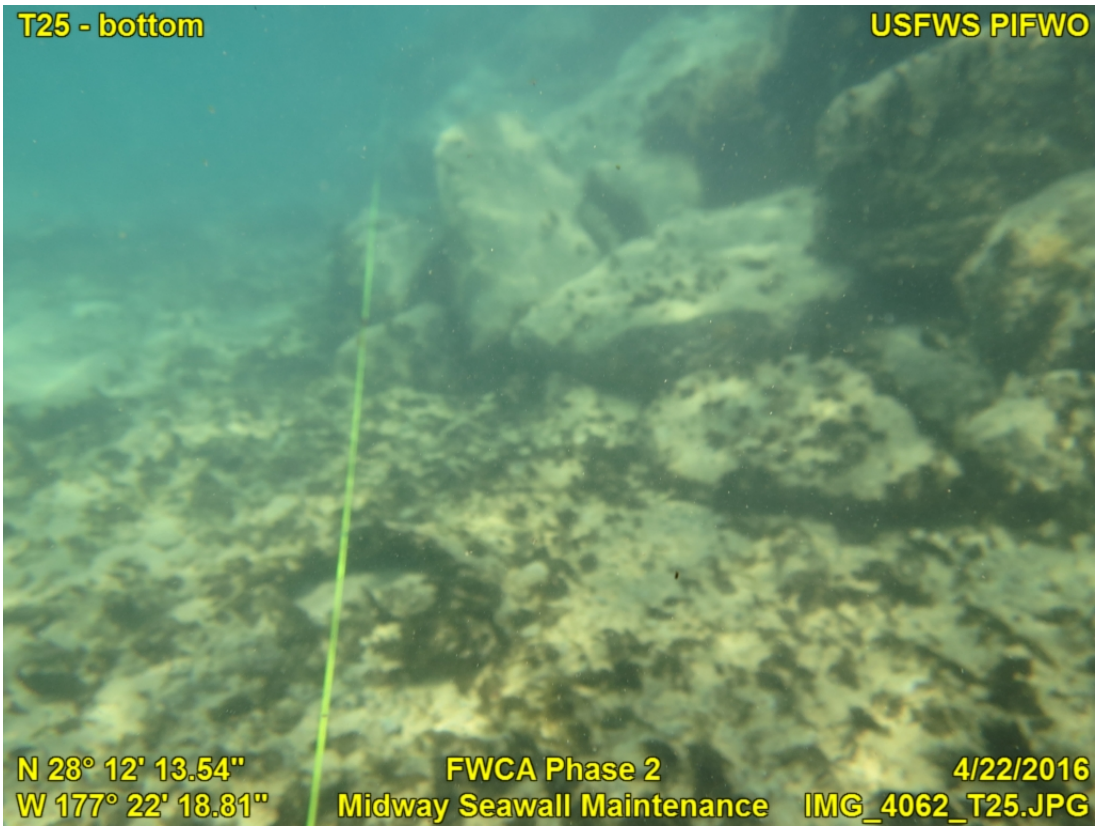
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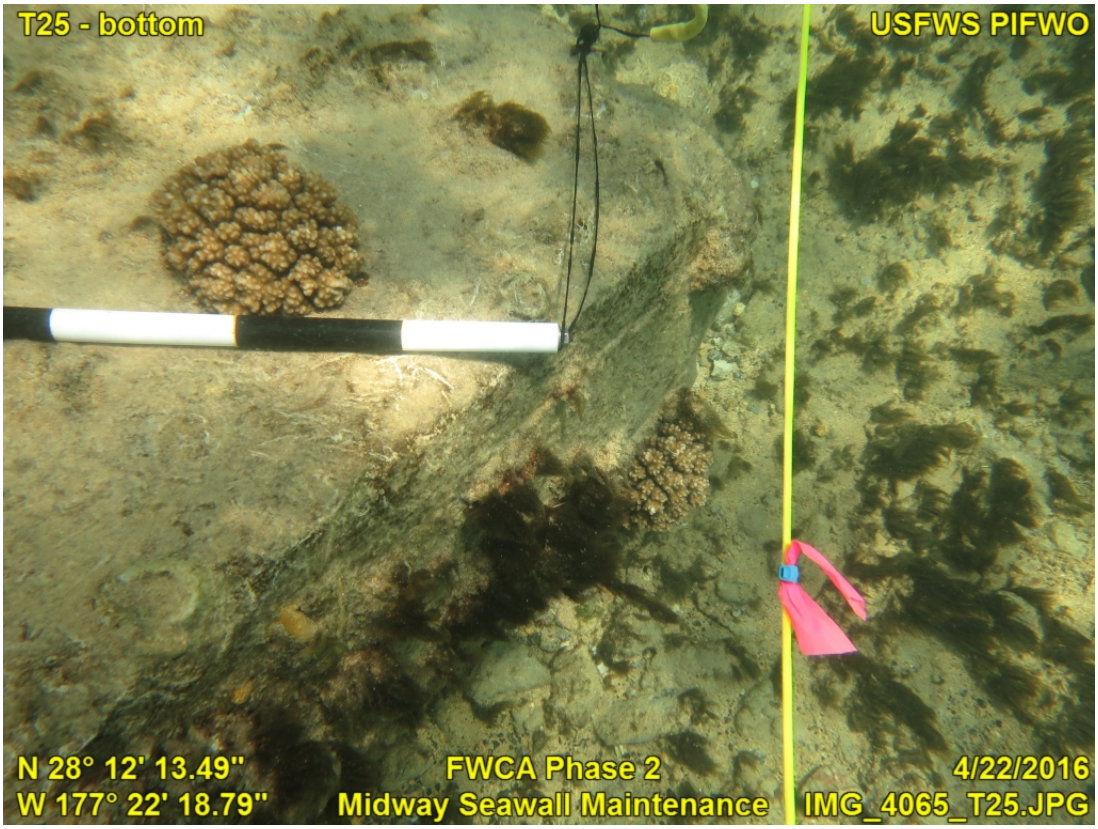
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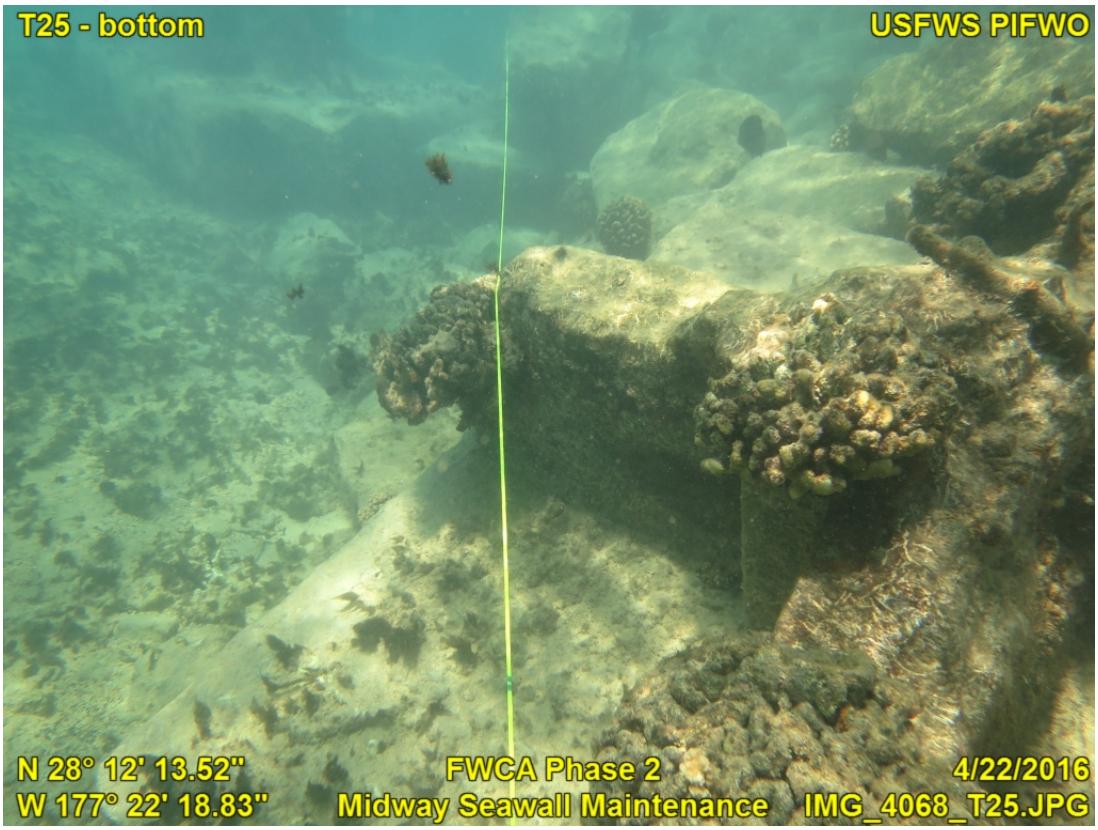
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USFWS PIFWO
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W 177° 22' 18.83"
FWCA Phase 2
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4/22/2016
IMG_4068_T25.JPG

T26
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
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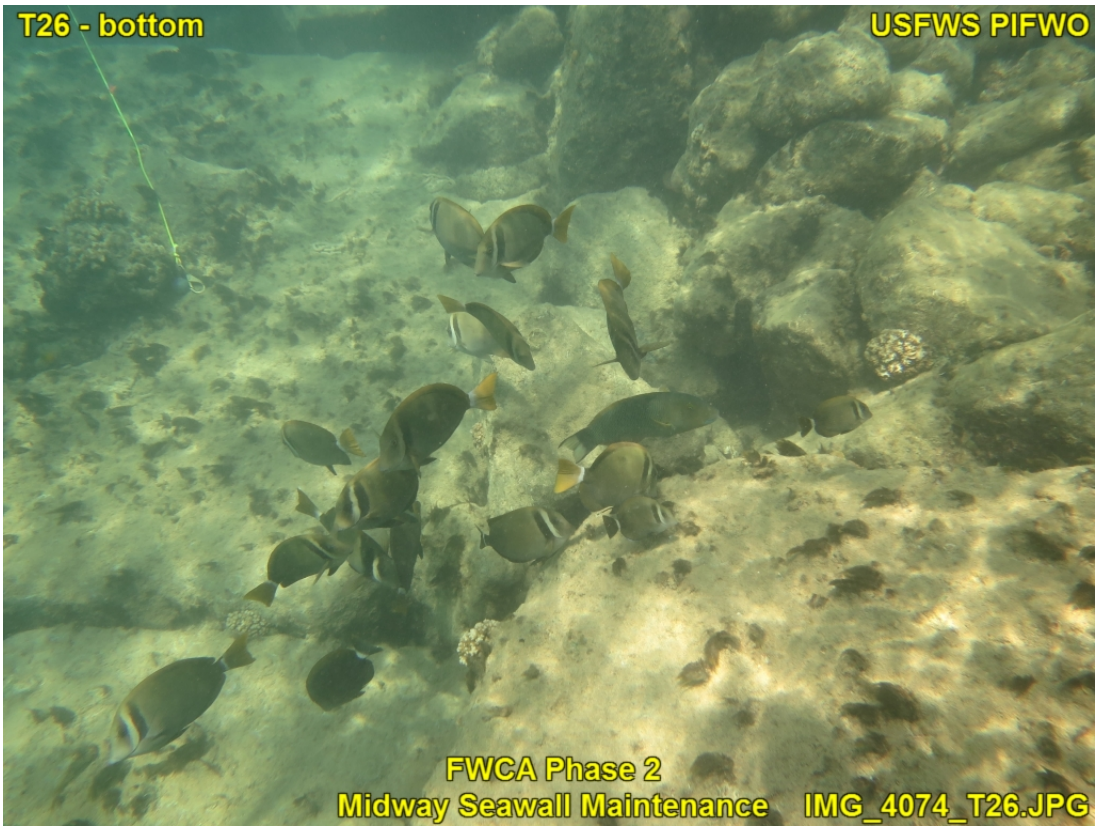
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FWCA Phase 2
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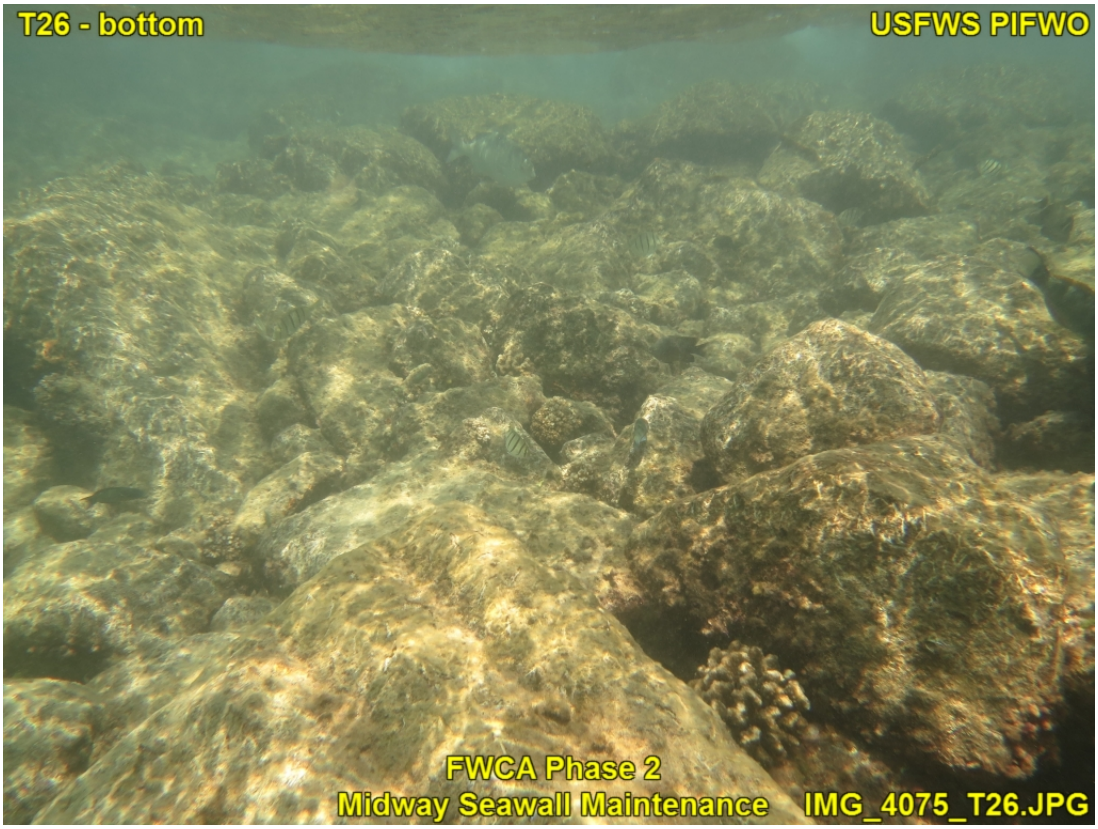
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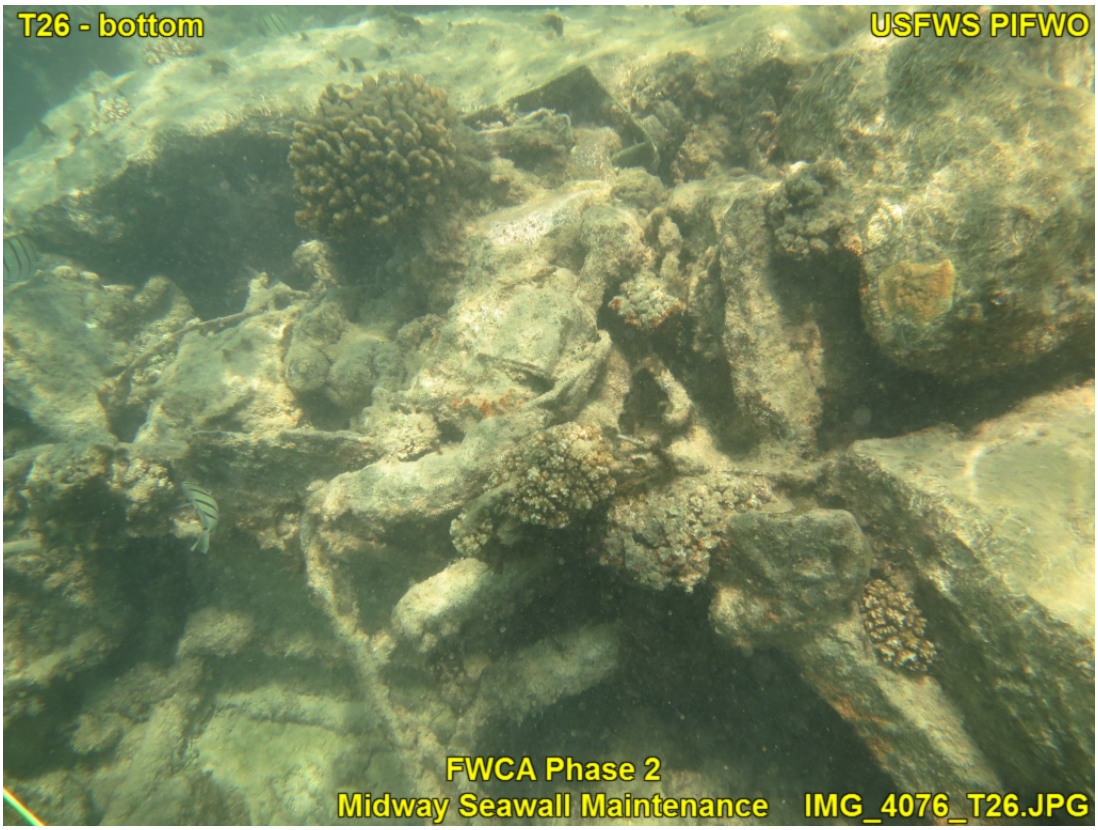
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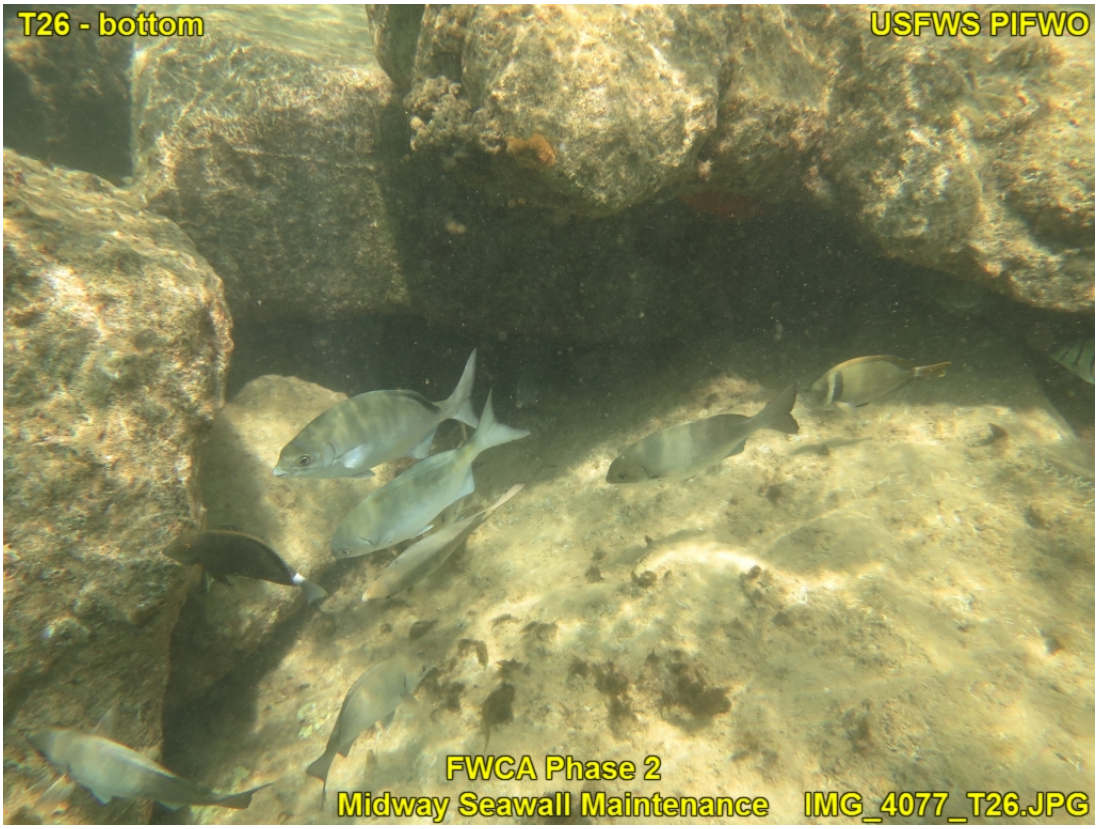
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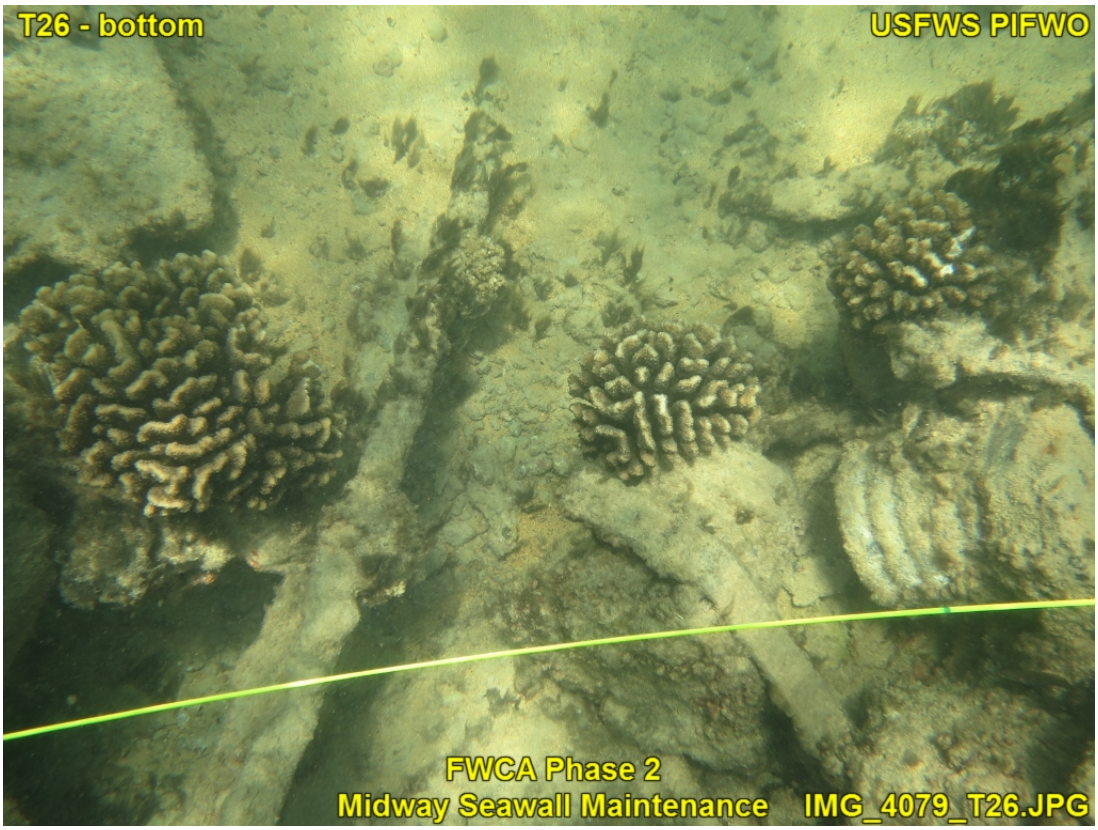

T26 - bottom
USFWS PIFWO
FWCA Phase 2
Midway Seawall Maintenance
IMG_4079_T26.JPG

APPENDIX C

Site visit to Priority Repair Areas A, B, and C
Tuesday, April 19, 2016

Prepared by Nadiera Sukhraj, Ph.D.
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, HI
May 5, 2016

U.S. Fish Wildlife Service, Pacific Islands Fish and Wildlife Biologists (USFWS PIFWO) Nadiera Sukhraj and Gordon Smith spent the afternoon of April 19, 2016, visiting three proposed priority repair areas provided by PND Engineering. The three priority areas were identified as A, B, and C, and are shown on the map provided by PND Engineering. In addition, the biologists also visited the 100 ft. repair area that was constructed in June 2014 under the previous U.S. Army Corps of Engineers Honolulu District construction permit. At the time of the site visit, a final engineering design for the repairs had not been decided on and the Draft Environmental Assessment was not yet complete. The February 2016 Draft EA Project Description included construction in the marine environment (potentially 6.6 acres) as well as a 50 ft. (15.2 m) construction footprint on uplands adjacent to the seawall (potentially another 6.6 acres). Permanent fill will occur on both sides of the existing seawall, affecting natural resources in both the terrestrial and marine environments.

2014 Previous Repair Area

The 100 ft. section of failed seawall was repaired in 2014 using a rock revetment design. The breach was located within the Henderson Airfield runway safety area and was critical in preventing additional erosion that would affect the continued function of the runway, and is located directly adjacent and east of the Priority Repair Area A. The area was inspected from the land-side and the submerged-side, and it was noted that the rock revetment is still in place as constructed. The gradual slope from the surface to the seafloor appears to be a better wave absorber than a vertical steel sheet pile. The new construction has now also survived two winter swell cycles. It appears that not all of the backfill was completed on the upland side of the previous existing sheet pile seawall and that additional material may need to be placed here when Area A is addressed. Albatross chicks and petrel or shearwater burrows were present within 10 m of the old seawall boundary (no photos).

This area was permitted as a 75 ft. section for repair but during construction the contractors expanded that length to 100 ft. increasing the footprint of the project.

Priority Repair Area A [N 28° 12' 17.35", W 177° 22' 10.64"]

The 70 ft. section of failed seawall proposed for repair is located directly adjacent and west of the 2014 rock revetment repair. The breach is located within the Henderson Airfield runway safety area with heavy erosion. The remnants of the sheet pile seawall are barely visible as there has been a previous attempt to fill the area with rip rap on both the marine and terrestrial portions in order to protect the runway. On the land side, seabirds such as the Laysan albatross (*Phoebastria immutabilis*), the black-footed albatross (*Phoebastria nigripes*), and the Bonin petrel (*Pterodroma hypoleuca*) use the habitat directly adjacent to the sea wall. The upland area is used heavily for breeding, nesting, feeding, and growth until fledging. In the photos, Gordon

Smith is standing at a distance of 10 m from the seaward remaining sheet pile structure where petrel burrows and albatross chicks were present. An upland fill of 50 ft. will cover an additional 5 m of length, almost to the edge of the asphalt at Henderson Field. Making the two repair sections one seamless piece would increase the amount of erosion protection for this end of the runway. Loss of habitat for seabirds will need to be addressed.

Area B [N 28° 12' 19.27", W 177° 22' 04.94"]

The 60 ft. section of failed seawall proposed for repair is located east of Area A and still within the Henderson Airfield runway safety area. The breach in the sheet pile allows seawater through and the upland area is rapidly eroding. There appears to have been a previous attempt to fill the upland area with asphalt. Only a portion of the asphalt still remains as it was undercut but wave action and the underlying sediment is now gone. Only an asphalt "ledge" remains along the sheet pile. The large hole in the sheet pile poses a risk for entrapment by marine organisms, including the green sea turtle (*Chelonia mydas*) and the Hawaiian monk seal (*Neomonachus schauinslandi*). A green sea turtle was observed swimming in front of the breach. There is currently a large piece of metal mesh blocking the hole on the land side. This should be removed as it poses an entanglement risk and does not appear to be holding any sediment in place.

On the land side, seabirds such as the Laysan albatross (*Phoebastria immutabilis*), the black-footed albatross (*Phoebastria nigripes*), and the Bonin petrel (*Pterodroma hypoleuca*) use the habitat directly adjacent to the sea wall. The upland area is used heavily for breeding, nesting, feeding, and growth until fledging. In the photos, Gordon Smith is standing at a distance of 10 m from the seaward remaining sheet pile structure where a large network of burrows and chicks are present. An upland fill of 50 ft. will cover an additional 5 m of length. Loss of habitat for seabirds will need to be addressed.

It appears that this area will require more than a linear 60 ft. repair in order to maintain the integrity of the new construction. The seawall is regularly overtopped by high tides and erosion will continue to occur on both sides of the new 60 ft. section.

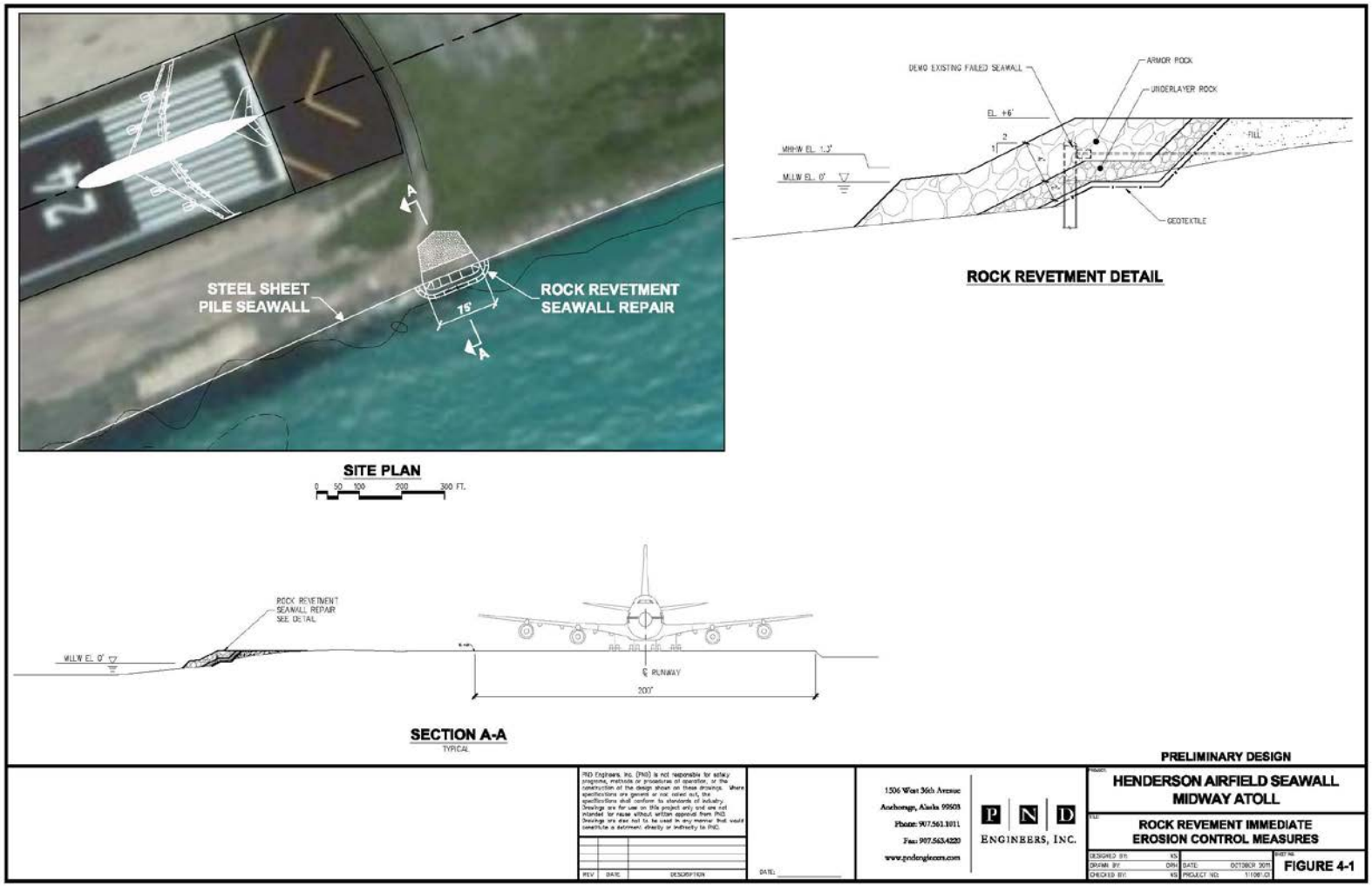
Area C [N 28° 12' 27.39", W 177° 21' 41.73"]

The 60 ft. section of failed seawall proposed for repair is located on the eastern side of the southern seawall, before the turn north towards the harbor. There is a large breach in the seawall that allows seawater through and the upland area is rapidly eroding. Overtopping of the seawall occurs almost all day and all types of debris have been dumped as backfill to try and slow down the erosion. On the land side, there is a large stand of ironwood trees. Some of the trees will have to be removed in order to accommodate construction machinery and upland fill.

On the land side, seabirds such as the Laysan albatross (*Phoebastria immutabilis*), the black-footed albatross (*Phoebastria nigripes*), and the Bonin petrel (*Pterodroma hypoleuca*) use the habitat directly adjacent to the sea wall. White terns (*Gygis alba*) are also using the ironwoods for nesting. The upland area is used heavily for breeding, nesting, feeding, and growth until fledging. In the photos, Gordon Smith is standing at a distance of 10 m from the seaward remaining sheet pile structure where a large network of burrows and chicks are present. An upland fill of 50 ft. will cover an additional 5 m of length. Loss of habitat for seabirds will need to be addressed.

A length longer than the proposed 60 ft. repair may be necessary in order to maintain the integrity of the new construction. The seawall is regularly overtopped by high tides and erosion will continue to occur on both sides of the new 60 ft. section. As with Area B, the previous attempt to backfill with poured concrete failed. Only a portion of the concrete still remains as a "ledge", as it was undercut by wave action and the underlying sediment is now gone.

Map of breach areas received from Doug Kenley, PND Engineers. Received April 8, 2016.



PND Engineering schematic of construction and rock revetment design for 2014 repair area. (November 2011)

Previous Repair Area

Previous Repair Area (continued)

Priority Repair Area A

Priority Repair Area A (continued)

Gordon Smith is 10 m from the most seaward remaining visible sheet piles.

Priority Repair Area A (continued)

Priority Repair Area A (continued)

Area is currently used by young birds and contain burrows.

Priority Repair Area B

Priority Repair Area B (continued)

Gordon Smith is 10m from the most seaward remaining visible sheet piles.

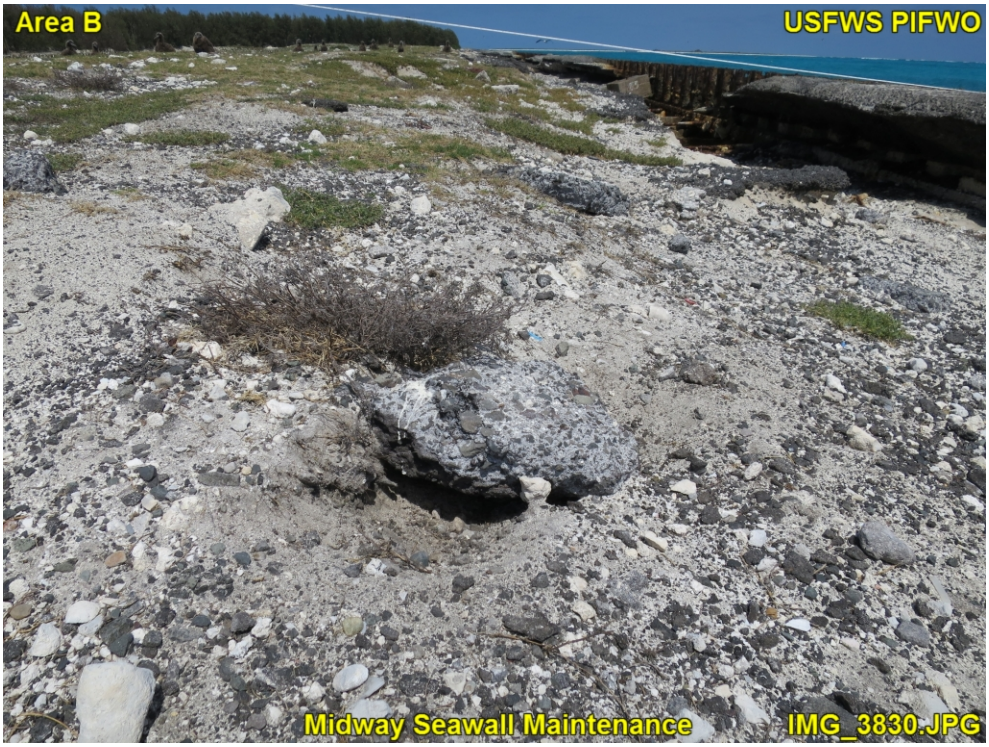
Priority Repair Area B (continued)

Priority Repair Area B (continued)

Priority Repair Area B (continued)

Petrel burrows in project footprint

Priority Repair Area B (continued)



Petrel burrows in project footprint

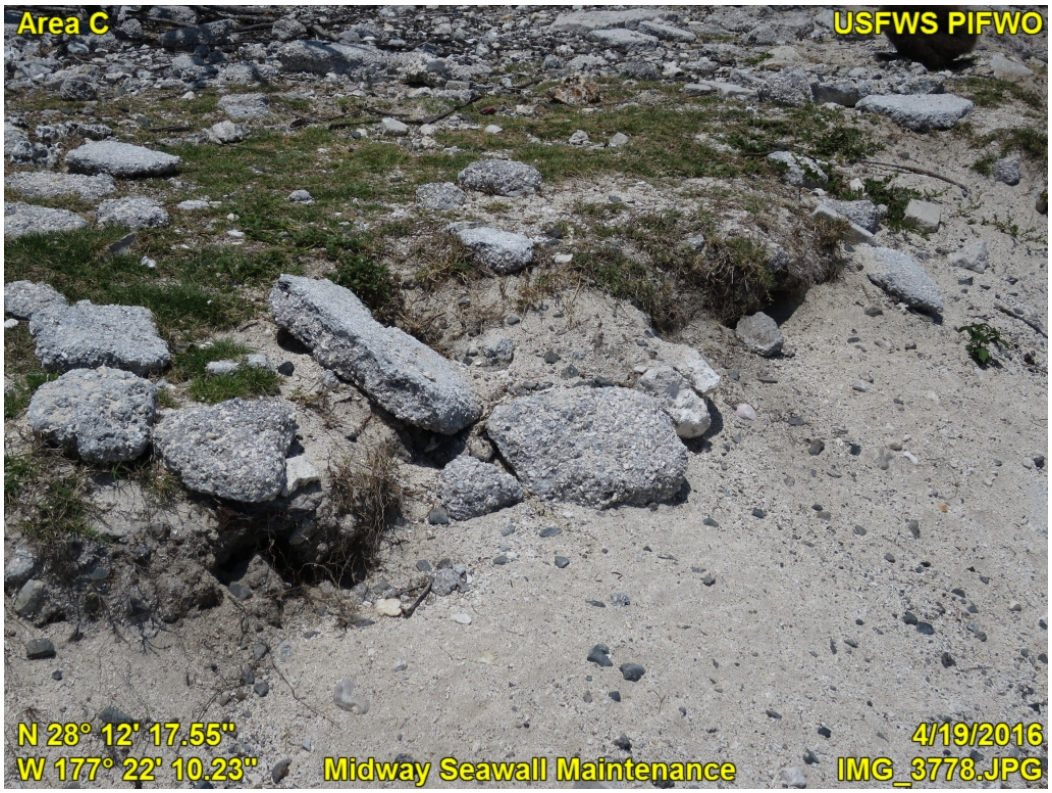
Green sea turtle swimming in front of Area B.

Priority Repair Area C

Priority Repair Area C (continued)

Gordon Smith is 10 m from the most seaward remaining visible sheet piles.

Priority Repair Area C



Petrel burrows in project footprint

APPENDIX D.

Sample Coral Transplantation and Re-Attachment Plan

Sample of Coral Reattachment Guidelines

Prior to any coral reattachment activities, all divers must undergo a coral briefing from a qualified marine biologist. This is to allow the divers to become familiar with basic coral biology and local species. It is encouraged to have a copy of the book "Corals of Hawaii" on-site as a reference for coral species.

1) Collect and store as many reattachable coral fragments as can be located. These fragments can be stored in a central location or nearby the re-attachment location.

2) Corals that should be reattached should be in good condition. Good coral condition is indicated by a large portion of the coral tissue intact. Corals greater than 10 centimeters should be considered for reattachment. Some species may not be suitable for reattachment and further clarification can be provided by the local and federal resource agencies. Smaller corals may be reattached if in good condition, but smaller fragments in less than good condition generally have a very low survival rate.

3) Prior to reattachment, a suitable specific site needs to be identified. This site must be hard substrate and free of sand, sediment, or loose material. Generally, flat or slightly elevated areas are considered ideal. Loose material should be removed and disposed of in an area considered appropriate. It is recommended to consult with the local and federal resource agencies for questions or guidance on material removal and disposal.

4) Once the specific site has been identified, the surface must be properly prepared to maximize the effectiveness of cement or other adhesive material (various marine epoxies). After the loose material has been removed, the hard substrate should be free of algae or other biological growth. The biological growth can be cleared with scrappers and/or wire brushes. Other organisms that cannot be removed with scrappers or brushes may need to be removed with a hammer and chisel, but this should be avoided if possible. The bare limestone should be exposed in the complete area that the coral will be re-attached. The underside of the broken coral, the section that will be in contact with the cement, must also be cleaned similarly to the substrate.

5) On the topside vessel, the cement is prepared and mixed. The recommended cement mixture to be used is Portland cement mixed with molding plaster[1]. This mixture can be mixed in a bucket by a garden hoe or mixing paddle. Add only enough water to convert cement to a firm putty-like consistency (seawater can be used). Final kneading by hand is recommended to break up unmixed lumps of cement (it is recommended to wear rubber gloves when handling cement as it is very caustic to the skin). The bucket is then handed or lowered to the divers. Timing of the site preparation and cement mixing must be coordinated between

topside support and divers[2]. Care should be taken that additional damage does not occur during the process of transporting the cement to the attachment location.

[1]Note: Other adhesives can be used such as Z-spar© or other two part epoxies suitable for marine applications. Some epoxies can be mixed underwater while others should be mixed above water. Typically, these techniques are not recommended for large applications and are most suitable for only a few small coral colonies.

[2]Note: The ratio of cement to plaster can vary based on specific conditions. Molding plaster will decrease the time the mixture sets and decrease the working time. In rougher water conditions, a shorter setting time is desirable while maximizing the working time the divers require. Ratios can vary from a 1:1 ratio to no molding plaster included. It is encouraged to start with a small amount of molding plaster and increase the amount based on specific conditions.

6) Once the cement is mixed and brought to the reattachment site, the cement should be deposited onto the cleaned surface. The cement should be carefully flattened out into a thick (2-3 inch thick) "pancake." The “pancake” may need to be thick for tall branching corals. As a rule of thumb, the diameter of the flattened cement "pancake" should be at least 1/2 that of the coral to be attached.

7) After the cement is in place, the coral should be placed onto the cement “pancake.” Press coral firmly and use a twisting motion to help embed coral into cement layer. Be sure your gloves or hands are free of cement when handling corals as cement on coral tissue will damage the tissue. Do not try and reposition the coral after it has been pressed in place. This will introduce water between bonding surfaces and prevent effective attachment. The coral should remain immobile for approximately 2 hours, so weather conditions should be monitored carefully for large swells and surge. Movement of the coral before initial hardening of the cement may break the attachment bond and reduce the attachment effectiveness.

8) Corals should be re-attached in a manner that they do not touch anything else (i.e., substrate other than the attachment point or other corals). Different coral species should be at least 0.5 meters from each other.

9) Newly attached corals should be assigned a unique identifier that corresponds to the colony information (species, size, percent mortality, etc.) The unique identifier should be displayed in more than one location on the transplant and/or platform. In the event that one marker breaks free or is grown over, the second marker will be visible for future identification.

10) Each newly attached coral should be photographed in situ. Photographs should show at least two sides of the colony and the attachment point. All photos should be taken with a scale marker in the photo and from the same distance if possible.

11) A GPS waypoint can also be taken to locate each colony in the future.

APPENDIX E

Site visit to Reef Hotel, 2014 coral translocation site
Thursday, April 21, 2016

Prepared by Nadiera Sukhraj, Ph.D.
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, HI
May 10, 2016

In May 2014, Midway Atoll National Wildlife Refuge (Midway NWR) staff removed coral colonies from within a proposed seawall repair area on the south shore of Sand Island as part of their mitigation requirements for the loss of habitat that would occur with the new seawall design and construction. The 100 ft. linear length area had been permitted for construction activities by the U.S. Army Corps of Engineers, Honolulu District in 2014 for the permittees [the U.S. Fish and Wildlife Service Midway NWR and the Federal Aviation Administration (FAA)]. The coral colonies were held in a holding tank on land and attached to pieces of concrete with marine epoxy. After an acclimation period of one week in the holding tank, the coral colonies were transported via small watercraft to a location on the northeastern side of the atoll called "Reef Hotel".

In the June 2014 Coral Translocation Report (Midway NWR), the coral transplant monitoring conditions were listed:

- Midway NWR staff will schedule visits to the coral relocation site at Reef Hotel at 1-2 month intervals for the first year to verify that the colonies survived the transplanting and to assess the health of the transplanted corals.
- Midway NWR will monitor at 6 month intervals after the first year.
- Primarily, the monitoring will be accomplished via photo documentation.
- Midway NWR will record the water temperature and take general notes concerning the condition of the transplants and the relocation site (e.g. algae growth, signs of predation, movement from storms, etc.)
- If there is high mortality of the transplanted coral (>50%), then alternative mitigation measures will be discussed with the resource agencies, including recolonization of the seawall repair site by translocating corals onto the new substrate.

On April 21, 2016, U.S. Fish and Wildlife Service, Pacific Island Fish and Wildlife Office (USFWS PIFWO) biologists Nadiera Sukhraj and Gordon Smith made a site visit to Reef Hotel (Map 1), escorted by Midway NWR staff Meg DuhrSchultz and Ann Humphrey. Due to Midway NWR staff turnover, the group did not have a geo-referenced location for the coral transplants. The Reef Hotel location was calm upon arrival. After anchoring in the sand, the group set out using snorkel gear to search for the concrete blocks. It was unknown if the coral colonies were still alive due to the widespread coral bleaching event that occurred in the summer of 2015. A recent monitoring report was also not available to track conditions of the colonies over time, as required by the previous permit.

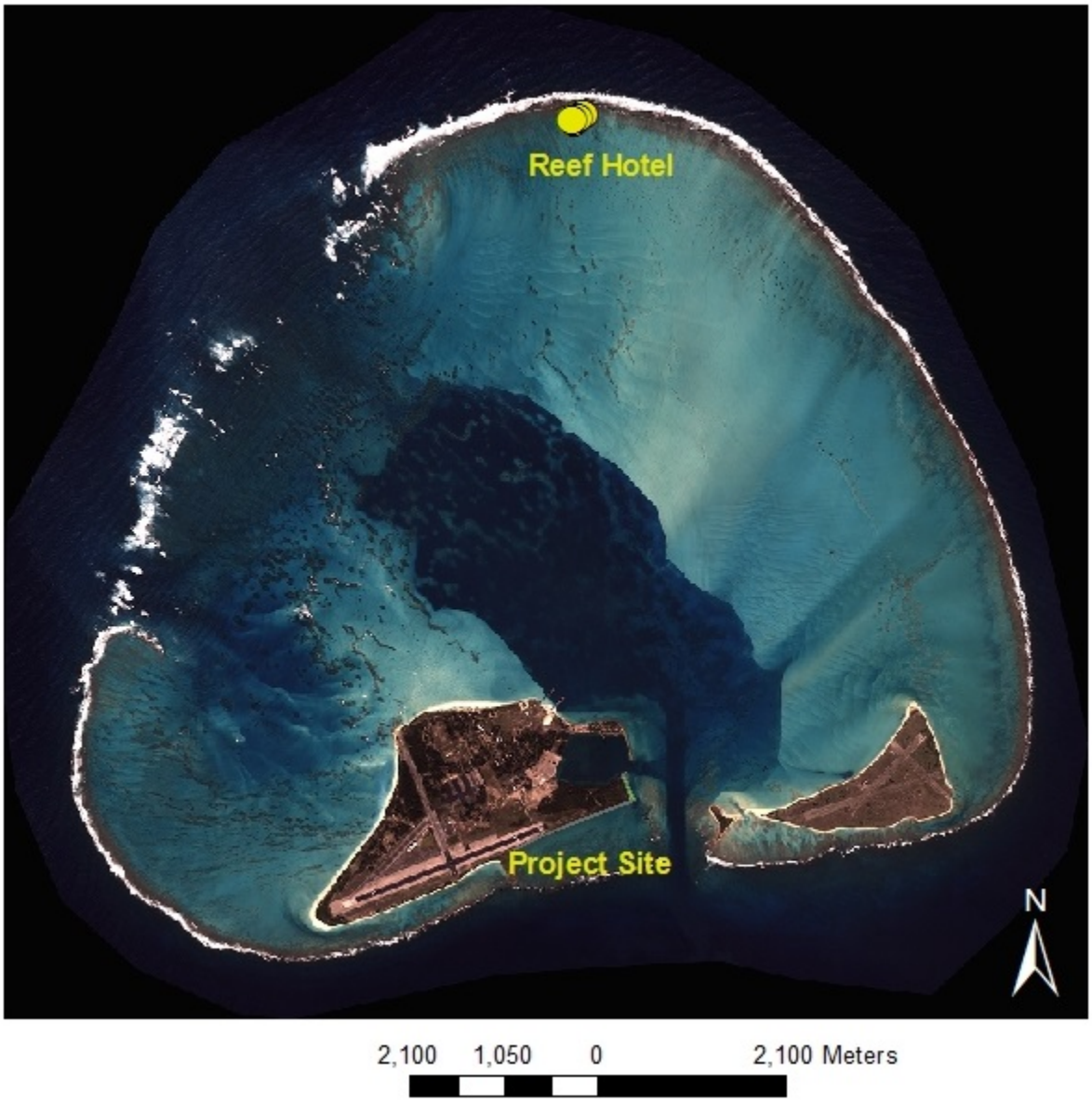
Ms. Humphrey had been present on the day of the 2014 translocation event, and after an hour of swimming, was able to locate the first cluster of concrete blocks. A GPS Waypoint was marked at the location for future reference [N 28° 16' 36.9438", W 177° 22' 1.776"] (Map 2). The blocks

were located on an open, sandy bottom, with no reef structure present. The water depth was approximately 3 to 4 m.

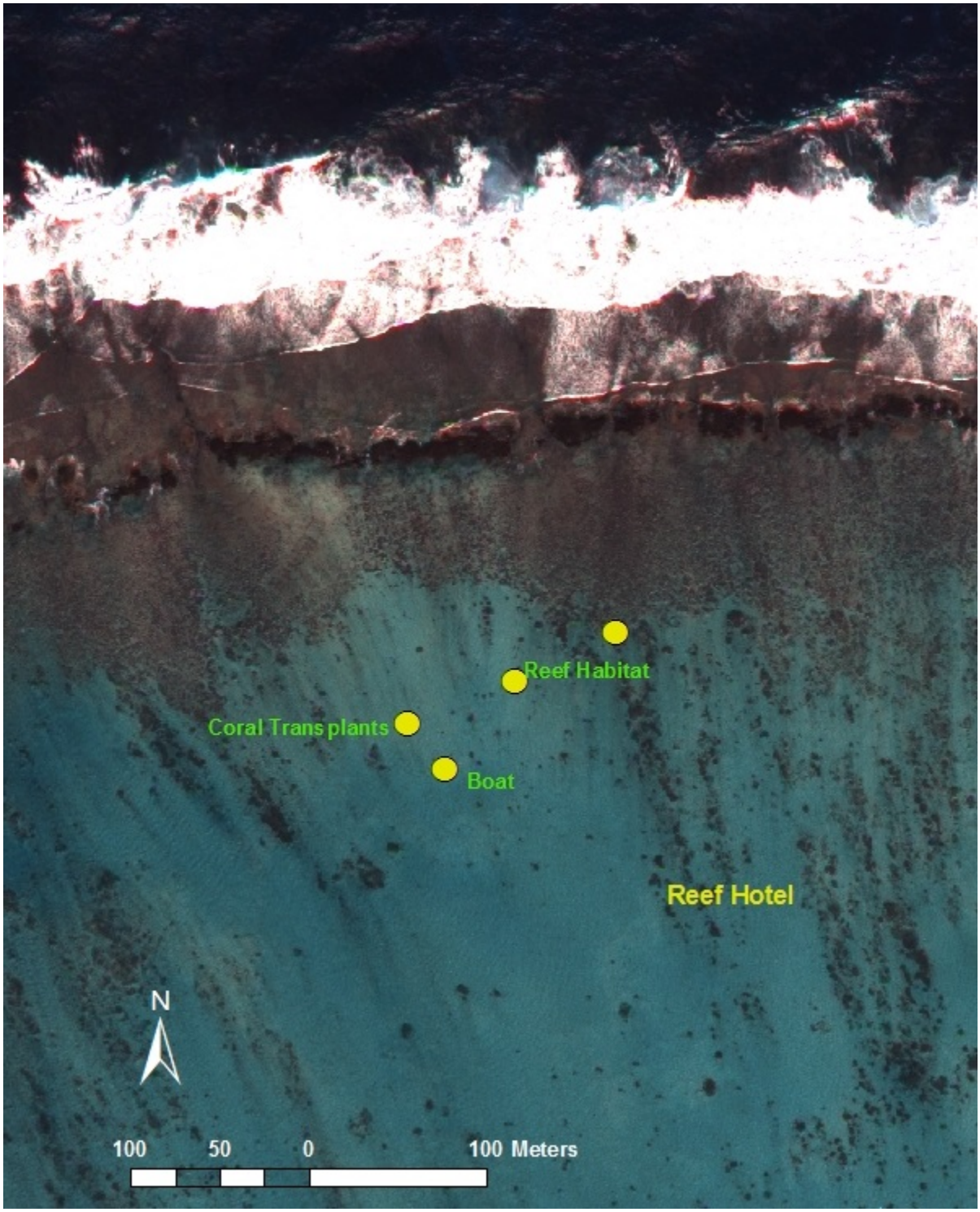
The concrete blocks were hard to distinguish from the surface as shown in the following photos. Upon further inspection, only one block still had a visible identifier, a number “23”. Of the original ~35 blocks that were placed in the sand area, 27 were located. Some of the blocks were bare, some were flipped on their side, and some had been flipped upside down. The blocks had not been elevated off the sandy bottom, so sedimentation may have been a factor in mortality or limited growth of the remaining colonies. The blocks were also not large enough or heavy enough to withstand the wave energy and currents in this section of the atoll, which resulted in the small concrete blocks shifting in the sand and eventually changing orientation. Some of the missing blocks may be buried. There is no way to currently identify which blocks are present or which blocks are missing, therefore collecting information on colony survival, species, or colony size change is not possible. There was no live coral at the translocation site, except for the remaining colonies on the concrete blocks. Small coral colonies from the genus Pocillopora were present, some with visible partial mortality. Those colonies still present and with mortality, were colonized by turf algae. There are herbivorous fish swimming through the area and they may be feeding on the macroalgae.

Before finding the cluster of concrete blocks, the biologists were swimming through adjacent areas with much more structure and live coral cover. Two representative photos are included at the end of this appendix. Macroalgae cover was also very low in this area.

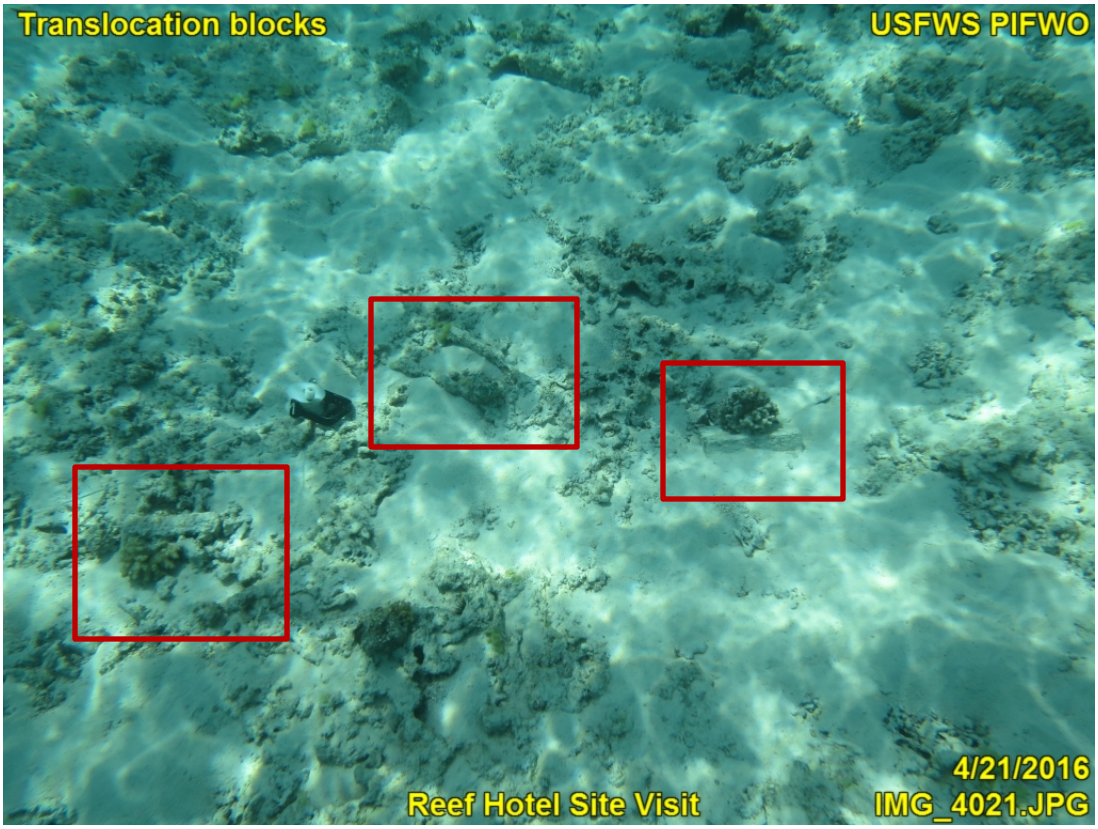
No quantitative data was collected. Photos were taken by USFWS PIFWO biologists as documentation of the current status of the site.

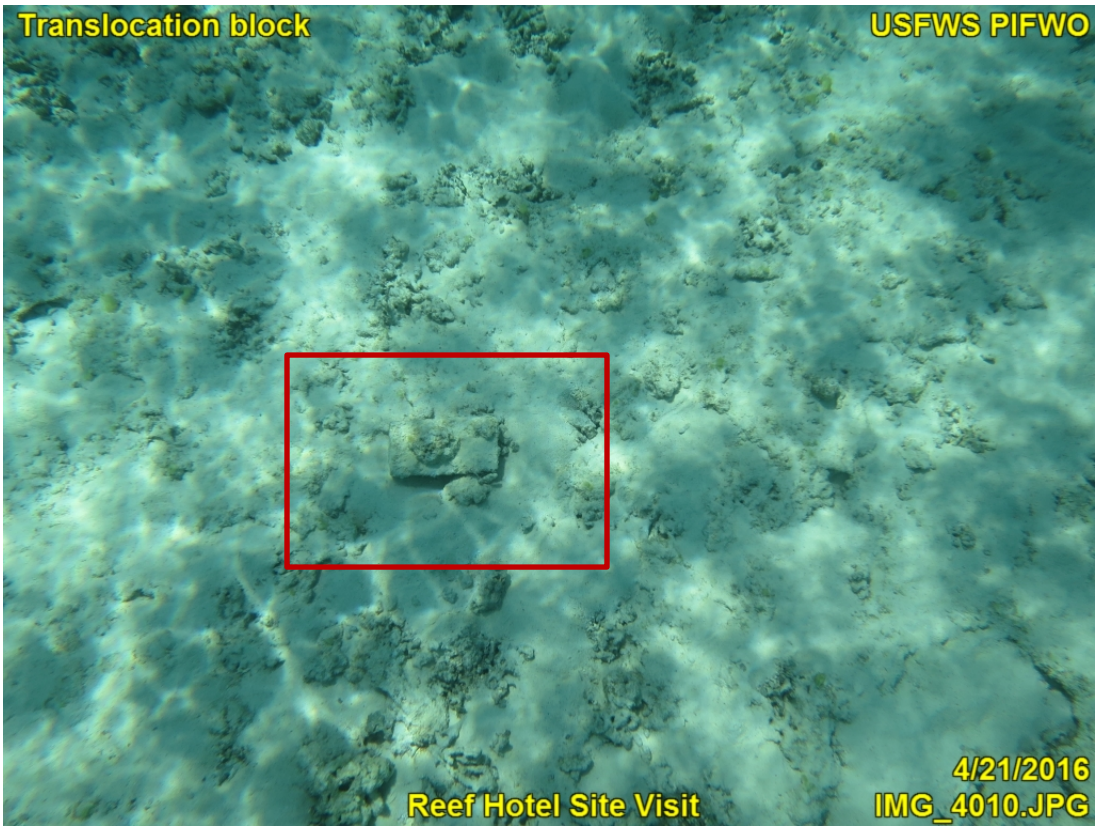


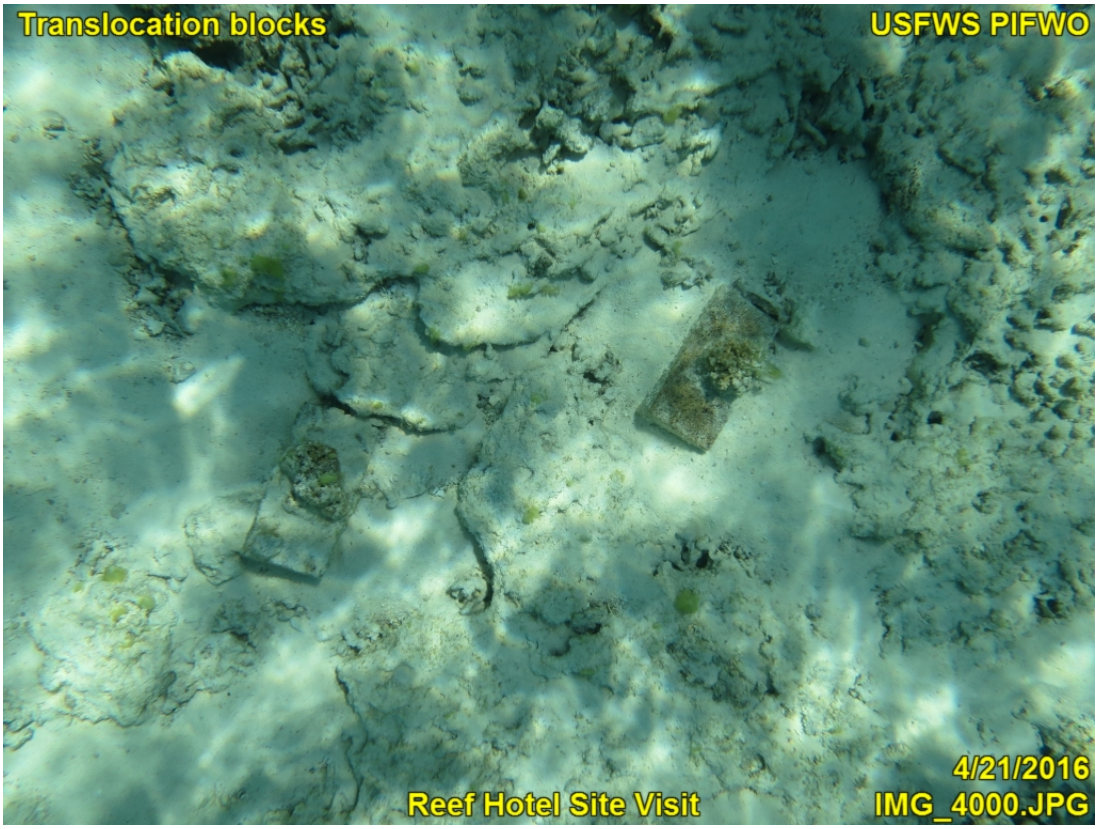
Map 1. Location of Reef Hotel at Midway Atoll. 2014 coral translocation site for previous Henderson Airfield/Midway NWR seawall construction project. Yellow circles indicate waypoints taken on April 21, 2016, site visit.

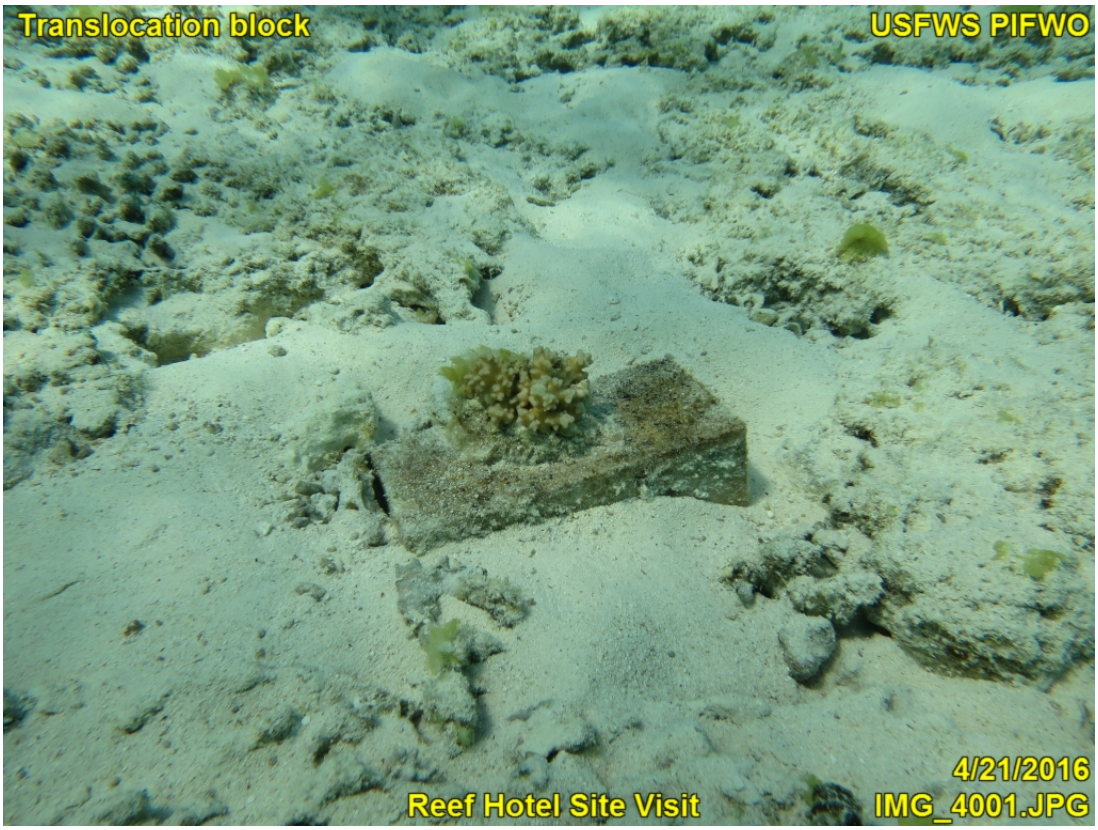


Map 2. Waypoints collected during USFWS PIFWO site visit. Reef Hotel, Midway Atoll. April 21, 2016. Photos included in report from "Coral Transplants" and "Reef Habitat" waypoints.

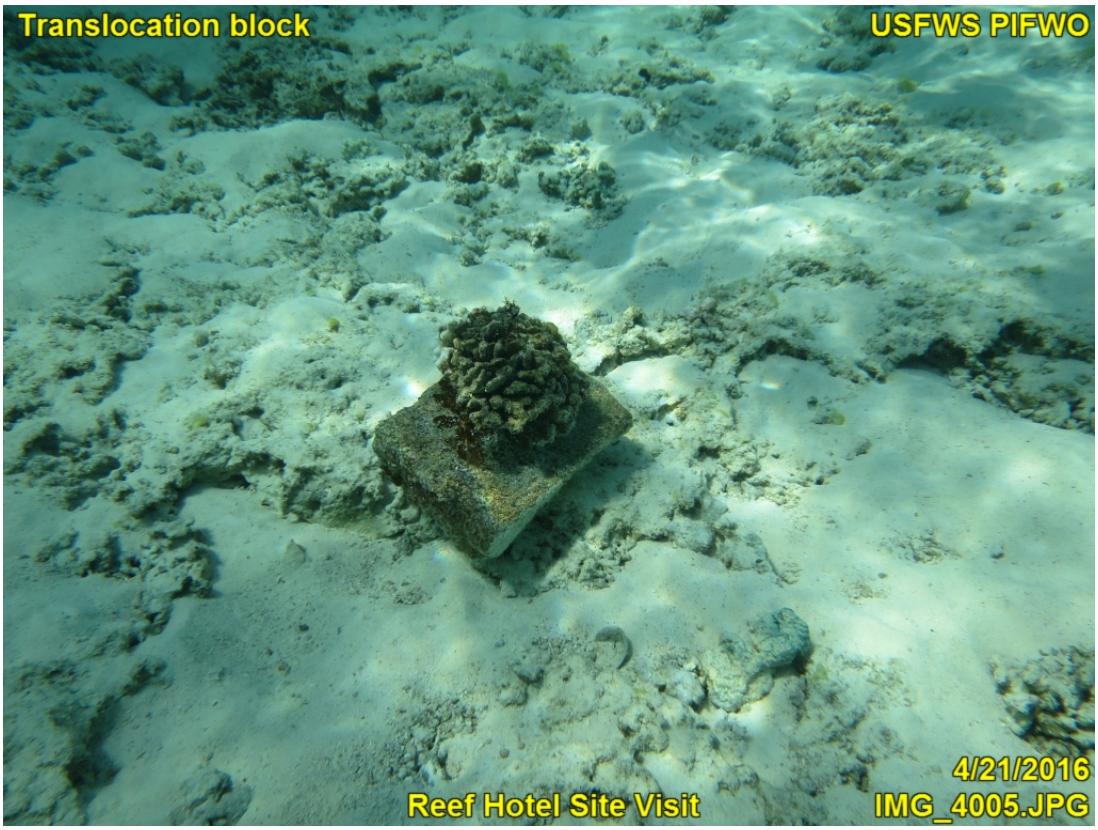

Translocation blocks
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4021.JPG


Translocation block
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4010.JPG


Translocation blocks
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4000.JPG


Translocation block
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4001.JPG

Translocation block
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4006.JPG


Translocation block
USFWS PIFWO
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Reef Hotel Site Visit
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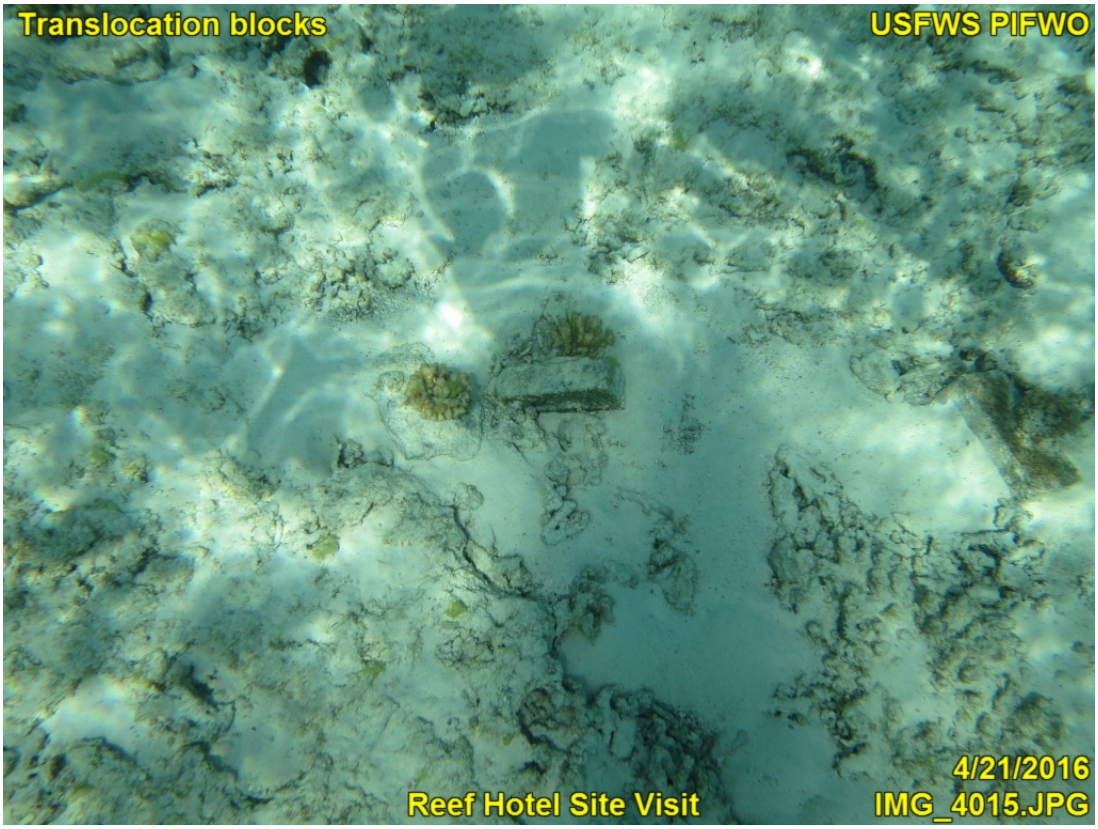
Translocation blocks
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
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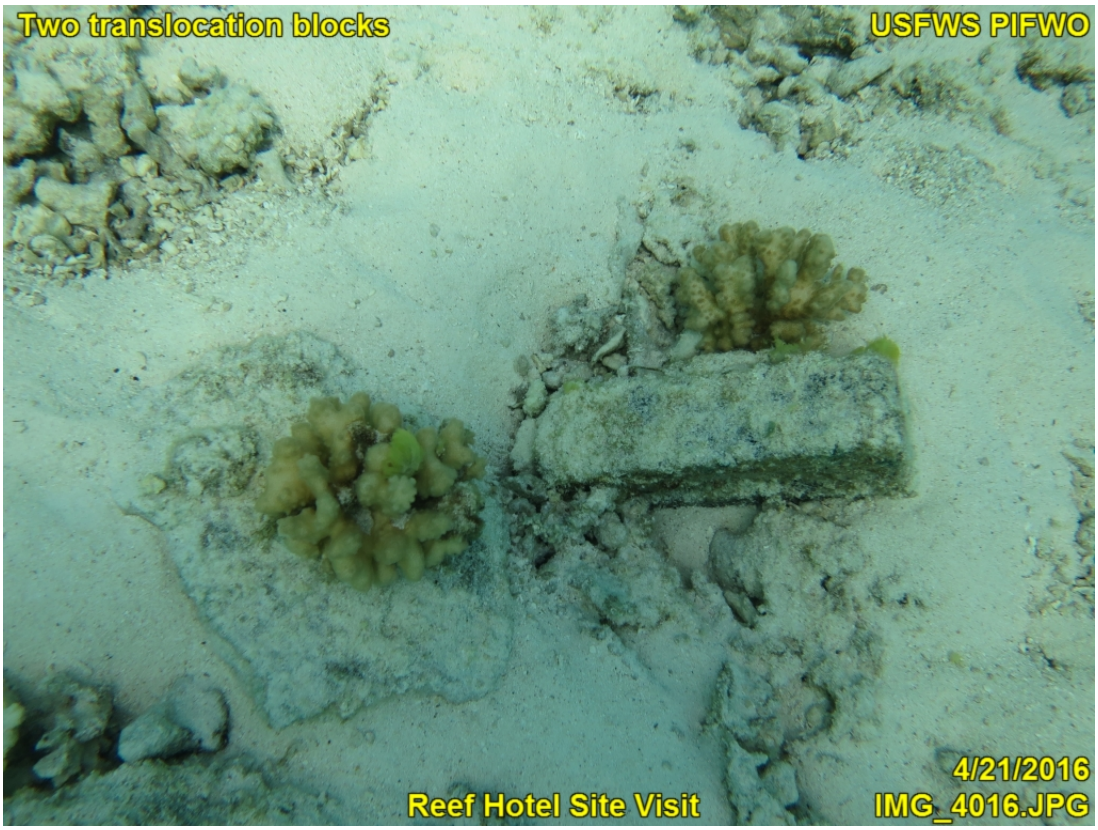
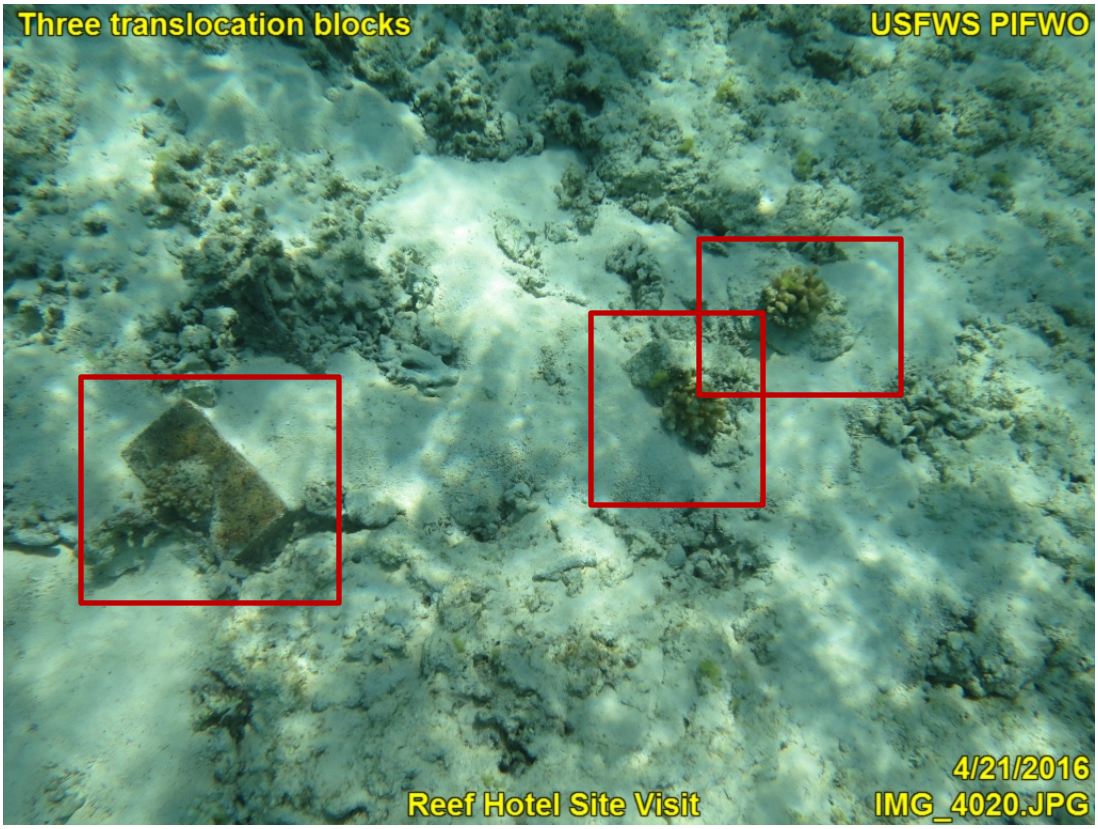
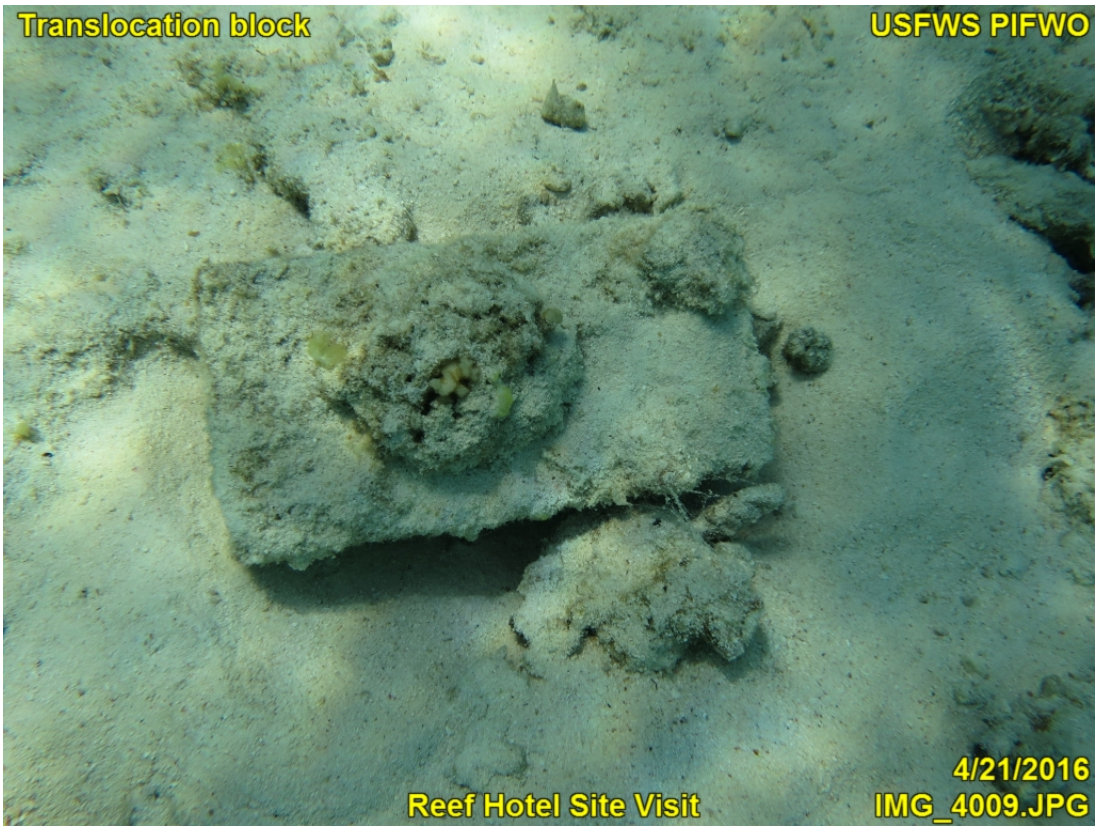
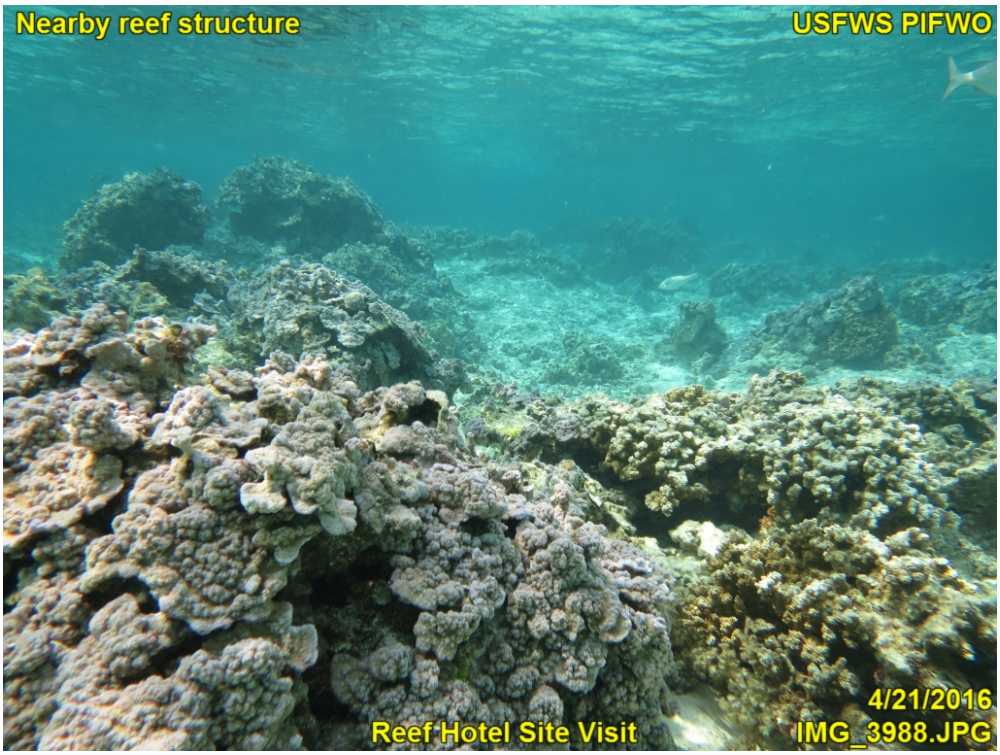

Two translocation blocks
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4016.JPG

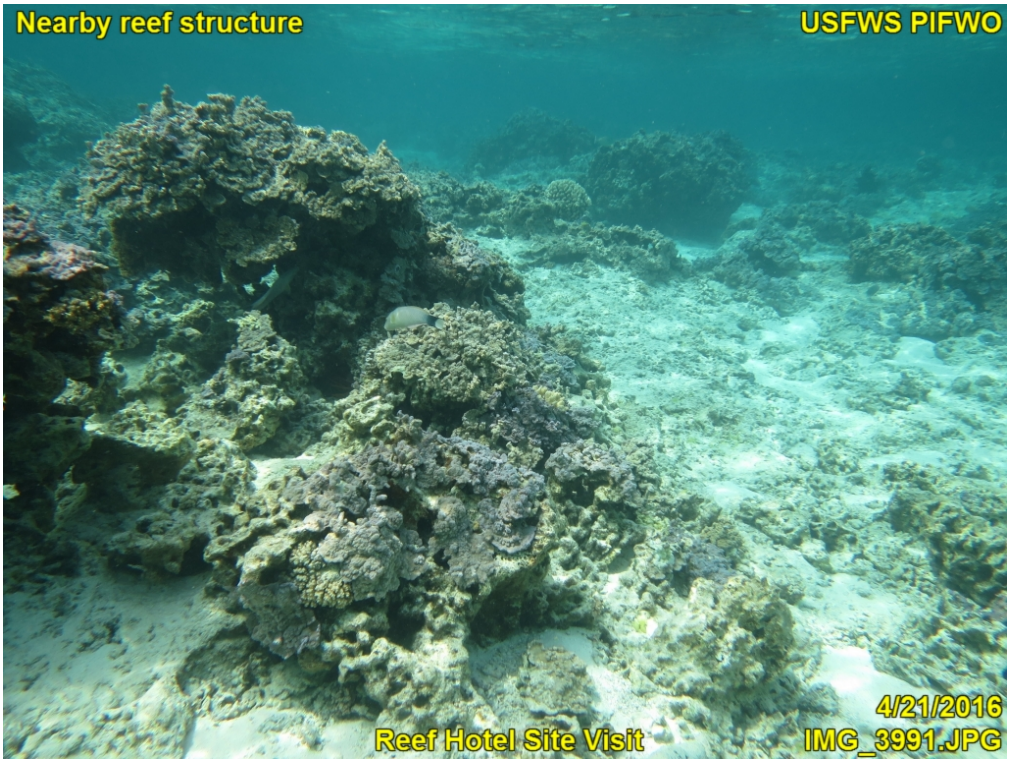

Three translocation blocks
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4020.JPG


Translocation block
USFWS PIFWO
4/21/2016
Reef Hotel Site Visit
IMG_4009.JPG



Reef Habitat from Map 2. Location above: [N 28° 16' 38.6148", W 177° 21' 57.492"]

Reef Habitat from Map 2. Location below: [N 28° 16' 37.7142", W 177° 21' 59.594"]



APPENDIX F.

Comments received on the Draft Seawall Long Term Maintenance Project, FWCA PAR

McCarthy, Nadiera <nadiera_mccarthy@fws.gov>

NMFS FWCA Reports Review and Comments

1 message

Richard Hall - NOAA Federal <richard.hall@noaa.gov> Tue, Sep 27, 2016 at 2:54 PM
To: "McCarthy, Nadiera" <nadiera_mccarthy@fws.gov>
Cc: Gerry Davis - NOAA Federal <gerry.davis@noaa.gov>, Samantha Brooke <samantha.brooke@noaa.gov>

Naderia,

The U.S. Fish and Wildlife Service's, Pacific Islands Fish and Wildlife Office (PIFWO) prepared a draft report on plans developed by the National Wildlife Refuge System (Refuges), the Federal Aviation Administration (FAA), and PND Engineers Inc. for modification to the southern seawall on Sand Island, at Midway Atoll. The Draft Fish and Wildlife Coordination Act Planning Aid Report for the Seawall Long-term Maintenance Project Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial was prepared under the authority of the Fish and Wildlife Coordination Act of 1934 (16 U.S.C 661 *et seq.*; 48 Stat. 401), as amended, which requires all federal agencies to consult with NOAA Fisheries, U.S. Fish and Wildlife Service, and state wildlife agencies when proposing an action that might result in modification of a natural stream or body of water. NOAA Fisheries comments provided under the Fish and Wildlife Coordination Act are intended to reduce environmental impacts to migratory, estuarine, and marine fisheries and their habitats.

Refuges and the FAA are proposing to repair, as needed, the seawall that runs some 5,750 feet along the length of Henderson Field along the southeast portion of Sand Island at Midway Atoll by installing rock wall revetments. Midway Atoll lies in the North-Central Pacific Ocean approximately 1,200 miles northwest of Honolulu, Hawaii at Latitude 28°12'N and Longitude 177° 22'W. Henderson Field serves as an Extended-range Twin Operations emergency landing site for trans-Pacific flights.

Proposed modifications include fill 50 feet (15.2 m) upland of the designated section of shoreline that has failed and washed into the ocean, as well as the construction of a rock revetment approximately 40 feet (12.2m) seaward from the existing sheet pile seawall in order to protect the runway from long-term erosion. The proposed action has the potential to leave a footprint of 287,500 sq. ft. (6.6 acres) on both the marine side and on the upland side.

The National Marine Fisheries Pacific Islands Regional Office has reviewed the Draft Fish and Wildlife Coordination Act Planning Aid Report, and offers the following comments which are provided to guide the project proponent in developing a project plan that will have less impact on marine resources under our authority.

Page 32 – 33: Recommended Coral Transplantation - The FWCA report PIFWO recommends that the FWS Refuges relocate coral colonies and macroinvertebrates that would be lost through the construction effort, and to establish a monitoring protocols for corals relocated.

NMFS Suggestion - Based on the lack of success from the relocation effort done in accordance with the repairs made in 2014, NOAA Fisheries suggests that the corals to be relocated be placed on hard substrate at the relocation site selected that is devoid of corals, and secured with one of the following two methods:

The coral colony could be epoxied directly to a suitable hard substrate devoid of corals, rather than epoxied to PVC plates or concrete blocks and placed on the sandy bottom; or
The coral colony could be epoxied to a PVC plate and secured to a suitable hard substrate devoid of corals using screws and a pneumatic drill.

NOAA Fisheries/PIFWO staff can help with the development of such plan if necessary.

Also, after the completion of any repairs, FWS Refuges should submit a report to NOAA Fisheries and PIFWO that details the number, size and species of corals and macroinvertebrates that were moved. If the Refuges lacks the capacity to perform these follow-up surveys, the Refuges and FAA should provide funds to bring in NOAA Fisheries and/or PIFWO staff to do the surveys and prepare the reports.

Page 33: Recommended Compensatory Mitigation – The draft FWCA report mentions that the U.S. Army Corps requires a compensatory mitigation plan be submitted as part of the supporting documentation for a permit application process. PIFWO recommended that, should compensatory mitigation be deemed necessary from the resulting impacts to ecological function, a mitigation project be developed in coordination with all involved agencies (FAA, USWFS Refuges, USFWS PIFWO, NOAA NMFS, and EPA).

NMFS Comments – The proposed action of replacing the seawall along the entire length of the Henderson Airfield runway is expected to result in a footprint of 287,500 sq. ft. (6.6 acres) on both the marine side and on the upland side. NMFS agrees that a compensatory mitigation plan should be developed prior to any repairs being undertaken, and will participate in those discussions when they are held.

Page 33 – 35: Recommendations for Endangered and Protected Species – The draft FWCA report mentions that federally endangered Hawksbill sea turtles, the threatened green sea turtle, and the Hawaiian monk seal may occur within the vicinity of the proposed project site, and that construction activities may increase the risk of entrapment, exposure to noise, and debris, along with other potential impacts.

NMFS Comments – NMFS offers the Best Management Practices below that have been established for In-Water Projects which are designed to reduce likely impacts to protected species that may be found in a project area.

a. The project manager shall designate an appropriate number of competent observers to survey the areas adjacent to the proposed action for ESA-listed marine species.

b. 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. Periodic additional surveys throughout the work day are strongly recommended.

c. All work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; divers performing surveys or underwater work would likely be permissible, whereas operation of heavy equipment is likely not.

d. Special attention will be given to verify that no ESA-listed marine animals are in the area where equipment or material is expected to contact the substrate before that equipment/material may enter the water.

e. All objects will be lowered to the bottom (or installed) in a controlled manner. This can include the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.

f. In-water tethers, as well as mooring lines for vessels and marker buoys shall be kept to the minimum lengths necessary, and shall remain deployed only as long as needed to properly accomplish the required task.

g. If boats or other floating vessels are used, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.

h. If boats or other floating vessels are used, vessel speed should be reduced to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.

g. If despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.

h. Marine mammals and sea turtles shall not be encircled or trapped between multiple vessels or between vessels and the shore.

Page 35: Recommended Best Management Practices – The PIFWO provides several BMPs designed to avoid or minimize project impacts.

NMFS Comments – Along with the BMPs listed above for in-water activities, NMFS suggest that another BMP to include would be to perform as much of the construction activities during low tide periods in order to minimize run-off and sedimentation.

The comments provided here, in no way, constitute either an Essential Fish Habitat or Section 7 Endangered Species Act consultation, but are an attempt to provide guidance to the USFWS Refuges and FAA with project planning for the repairs to the seawall along Henderson Airfield. Both of those consultations will be required for any individual repair actions, or through the process that may be developed under a programmatic consultation. That process will include other recommendations intended to minimize or avoid impacts to marine resources and habitats impacted by the seawall construction projects and related activities.

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Richard Hall
Fishery Policy Analyst
Pacific Islands Regional Office
NOAA Inouye Regional Center
1845 Wasp Blvd., Building 176
Honolulu, HI 96818
808-725-5018