Midway Atoll National Wildlife Refuge Seawall Repair Project – Conservation Measures Plan

September 27, 2018

Project Description

The U.S. Fish and Wildlife Service (FWS) and the Federal Aviation Administration (FAA) propose to replace sections of Sand Island's approximate 5,720-foot south seawall, to protect the Henderson Airfield runway and to control erosion of wildlife habitat. The FWS and the FAA have proposed a ten-year period for repairs, as funding is made available.
The overall purpose of the project is to repair sections, as needed, of the existing seawall. The project area is located along the south shore of Sand Island within Midway Atoll, which was designated as the Midway Atoll National Wildlife Refuge/Battle of Midway National Memorial (Midway), and is located within the Papahānaumokuākea Marine National Monument (Monument). Midway is located in the northwestern part of the Hawaiian archipelago at N 28° 12' and W 177° 21'. Midway Atoll NWR was designated as a National Wildlife Refuge in 1988 and became a part of the Monument in 2006, both of which are administered by the FWS.

Part of the seawall protects the Henderson Field runway which is a FAA-designated Extended-range Twin Operations (ETOPS) emergency landing site. This ETPOS site allows for the emergency use of the runway for all flights, charter, commercial or military, over the Pacific Ocean. The adjacent portion protects FWS National Wildlife Refuge land (Figure 1). At this time the FAA and the FWS are in the process of applying for a Standard Individual Permit with the U.S. Army Corps of Engineers, Honolulu District in order to address future repairs or modifications to the existing seawall in the time period 2019-2029. As funding becomes available, construction will take place along segments of the seawall that require immediate attention from threats such as erosion and design failure. The proposed action would utilize funds from both the FAA and FWS. 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. Repair and improvements to the seawall design will allow the continued use of the airfield as an ETOPS site, and uninterrupted transportation of people and goods to the atoll, as well as eliminate the detrimental impacts that would occur to both the marine and terrestrial environments if the seawall were to fail.

Seawall repairs would be conducted by replacing damaged sheet pile with armor rock revetment. Revetments would consist of large (2- to 3-ft diameter) armor rock placed over smaller underlayer rocks. The cumulative footprint of the "Maximum Construction Scenario" includes the footprint of all rock revetment that could be installed along the 5,720 linear ft. seawall. The total footprint would be approximately 100 ft. wide, with approximately 50 ft. of rock being placed within marine waters (6.6 acres) and a 50-ft. construction footprint on uplands adjacent to the seawall (6.6 acres) for a total area of 13.2 acres (Figure 1). Repairs would take place on an annual cycle following the Implementation Plan (Appendix B of the Environmental Assessment for the Seawall Long-Term Maintenance Project). 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. Because repairs would be made on an as-needed basis, some years may have little to no active construction while other years may have multiple or large repairs.

Figure 1. Potential footprint of project impacts, including silt curtain boundary (yellow line). Sand Island, Midway Atoll NWR. The FAA administered portion of the seawall is shown in orange and the FWS administered portion of the seawall is shown in green.

Project Site Description

Midway Atoll is an insular territory of the United States administered by FWS as a National Wildlife Refuge and Battle of Midway National Memorial, and is part of the Hawaiian Islands archipelago that lies to the northwest of the seven main Hawaiian Islands. The Refuge consists of three islands and a lagoon, enclosed by a circular coral reef (atoll) approximately five miles in diameter, and is surrounded on all sides by the Pacific Ocean (Figure 2). The largest island (and action area), Sand Island, has an area of about 1,100 acres, and has a permanent population that varies from 50 to 100 people.

Figure 2. Satellite imagery of Midway Atoll.

Henderson Airfield is an active runway and serves as a backup runway and emergency landing site for commercial airliners that experience trouble on transpacific flights. The runway is located along the southern coastline of Sand Island, extending from the island's southwestern tip and ending near the harbor (Figure 3). The shoreline is completely man-made, and was made from dredge spoils from around the island during U.S. Navy occupation after World War II. During construction the shoreline was hardened by a metal sheet pile design that is now failing in several places, leading to the erosion of land upland of the seawall. The erosion seriously affects the functioning capability of the runway, and has also become an entrapment hazard for wildlife. Multiple sections of the existing southern seawall have been identified as extremely corroded and in need of immediate repair (Figure 3).

The marine area immediately adjacent to the seawall is characterized as Reef Flat. Reef flat is defined as; Shallow, semi-exposed area between the shoreline intertidal zone and the reef crest of a fringing reef. This zone is somewhat protected from the high-energy waves commonly experienced on the shelf and reef crest. The reef flat at this site consists of mainly unconsolidated sediment.

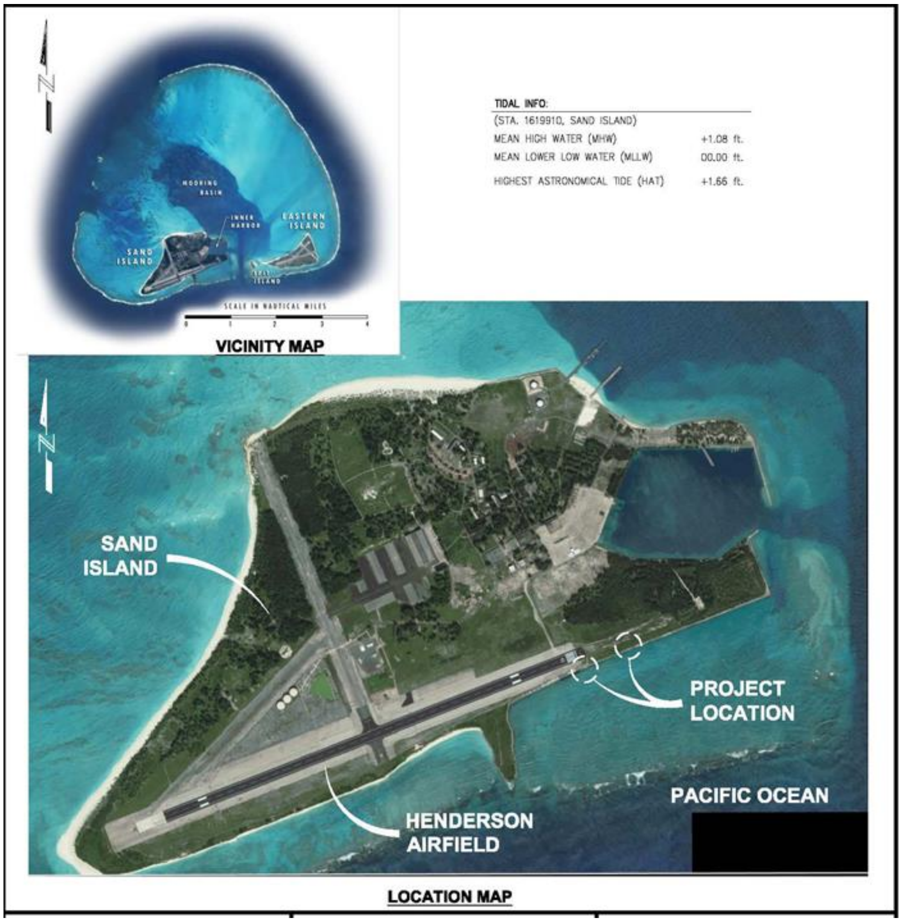

Figure 3. Sand Island, Midway Atoll National Wildlife Refuge, Henderson airfield and two of the priority seawall repair site locations A and B. Figure taken form EA.

Baseline Conditions

General

The current steel sheet pile seawall was installed by the US Navy in 1957-58 and was only expected to last 5-10 years. The seawall was placed in the water and filled behind with sand from the surrounding area to increase the size of Sand Island to accommodate the landing strip (Figure 4). The soils behind the seawall consist of unconsolidated fill that has eroded quickly after previous seawall breaches. The purpose of the action is to control this erosion and to protect Refuge resources, including Henderson Field taxiway, runway, and runway safety area (RSA).

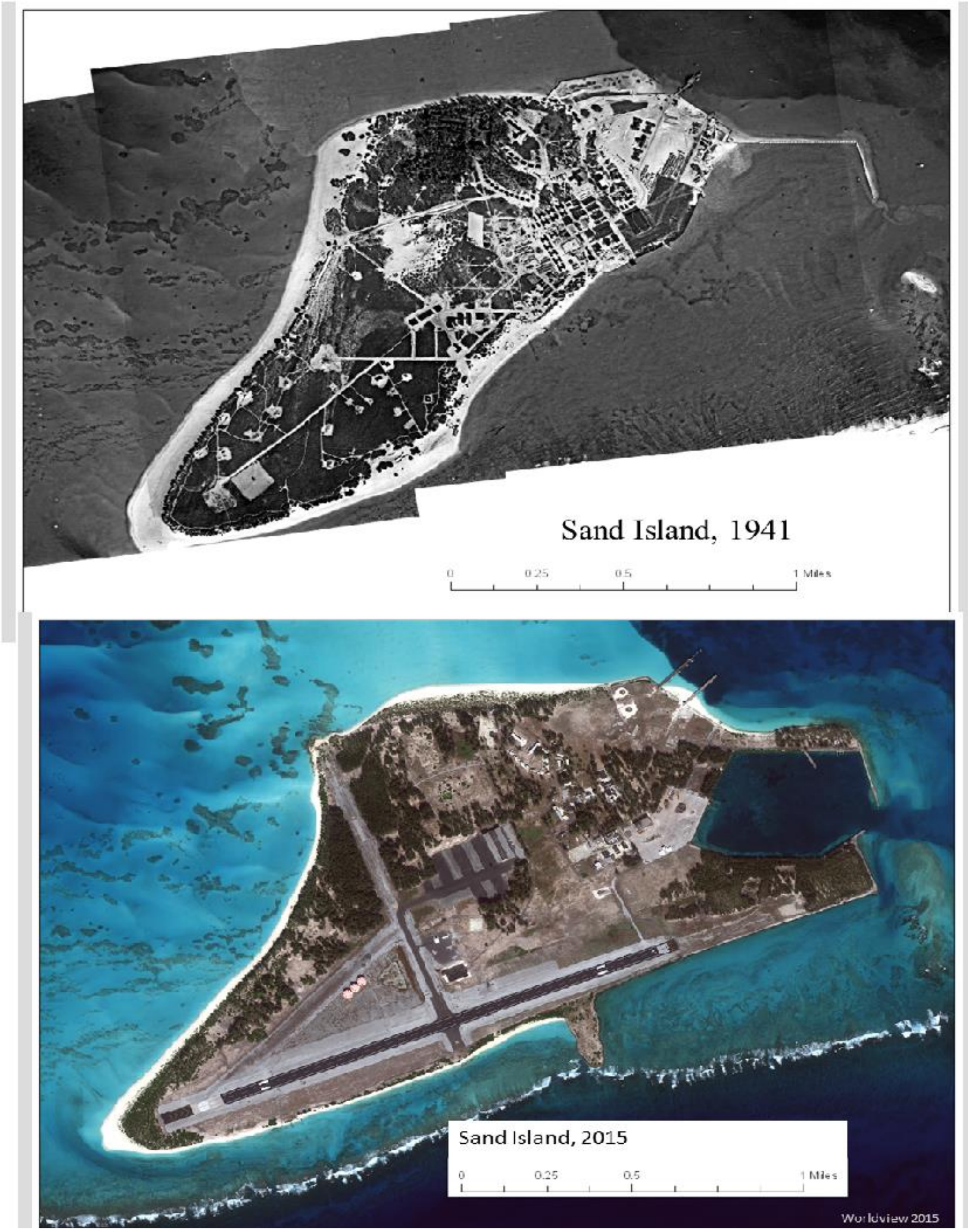

Figure 4. Sand Island in 1941 before the creation of the seawall and Henderson Field. Sand Island in 2015 showing the creation of Henderson Field runway and seawall that extends down to the boat harbor.

The metal sheet pile seawall has been severely corroded by the marine environment, causing large gaps in the wall (Figure 5). In its present state, the seawall provides an entrapment hazard for Hawaiian monk seals and green sea turtles. If seals and turtles are swimming or foraging near the seawall breach, there exists the possibility of waves washing them through the gaps in the seawall where they could become trapped. Although to date no marine animals have been observed trapped at Midway Atoll, they have been trapped behind the failing seawall at Tern Island, French Frigate Shoals Atoll (US Fish and Wildlife USFWS unpub. data). The failing and eroding area on the land side of the wall is an entrapment hazard for fledging albatross chicks, including the Laysan albatross, the near-threatened Black-footed albatross and the endangered Short-tailed albatross.

Figure 5. A portion of failed seawall. This area was repaired in 2014 using an armor rock revetment.

A previous repair effort was made in 2014, addressing a 75-ft gap in the seawall. One hundred feet of the sea wall were replaced with an armor rock revetment similar to the current proposed project. The 2016 Fish and Wildlife Coordination Act (FWCA) site survey revisited this section and found that the gradual slope appeared to be a better wave absorber than the previous vertical sheet pile wall. Albatross chicks and seabird burrows were present within 10 feet of the repairs. The priority areas for the future repair effort were noted to be in use for seabird breeding, nesting, feeding, and growth until fledging. A large hole covered with metal mesh was viewed at one of the two sites that could pose an entrapment threat. (USFWS PIFWO 2016). During a site visit in 2017 biologist found and freed three Laysan Albatross fledglings that were entrapped in the metal mesh covered area.

Over the years debris has been dumped over the seawall, possibly in an effort to shore it up. As a result debris (including unexploded ordinances, hot water heaters, automobiles, sinks, gas tanks, etc.) is present in the majority of the benthic habitat adjacent to the sheet pile seawall (USFWS PIFWO 2016).

A Hazardous Materials Inspection Report identified two “no dig” areas inland from the existing seawall (Jones and Jones 2008, shown in Figure 6). The proposed action includes no work within this area. However, if the seawall were to fail, all of the contaminants and hazardous materials within these areas would be exposed and potentially washed out into the marine environment.

Figure 6. “No dig” areas adjacent to the seawall repair project site. Taken from the EA.

Geomorphology

The majority of the proposed project area habitat zone is designated as Reef Flat. 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.

There is a high level of wave energy and surge in the project area that makes the area poor coral habitat. The high wave energy and surge stirs up the sand and creates a turbid environment, as well as shifting the substrate, so that corals cannot recruit and settle.

The substrate in the project area adjacent to the seawall is categorized as hard bottom and unconsolidated sediment (Figure 7). Unconsolidated sediment is defined as an area comprised of sand, mud, rubble, or cobble without isolated scattered coral/ rocks or large corals. The hard bottom in the “corner” of the seawall on the eastern portion of the map is an area where debris and rip rap has been dropped over the years in an attempt to combat the erosion problem due to the failing seawall. There is no longer natural bottom in that section as it has been replaced by artificial cover. The hard bottom on the western end of the project area is comprised of rip rap that was placed in the marine environment over time to prevent erosion of the coastline adjacent to the operational runway (Figure 7). In addition debris and sections of rip rap were observed throughout the majority of the benthic habitat adjacent to the sheet pile seawall.

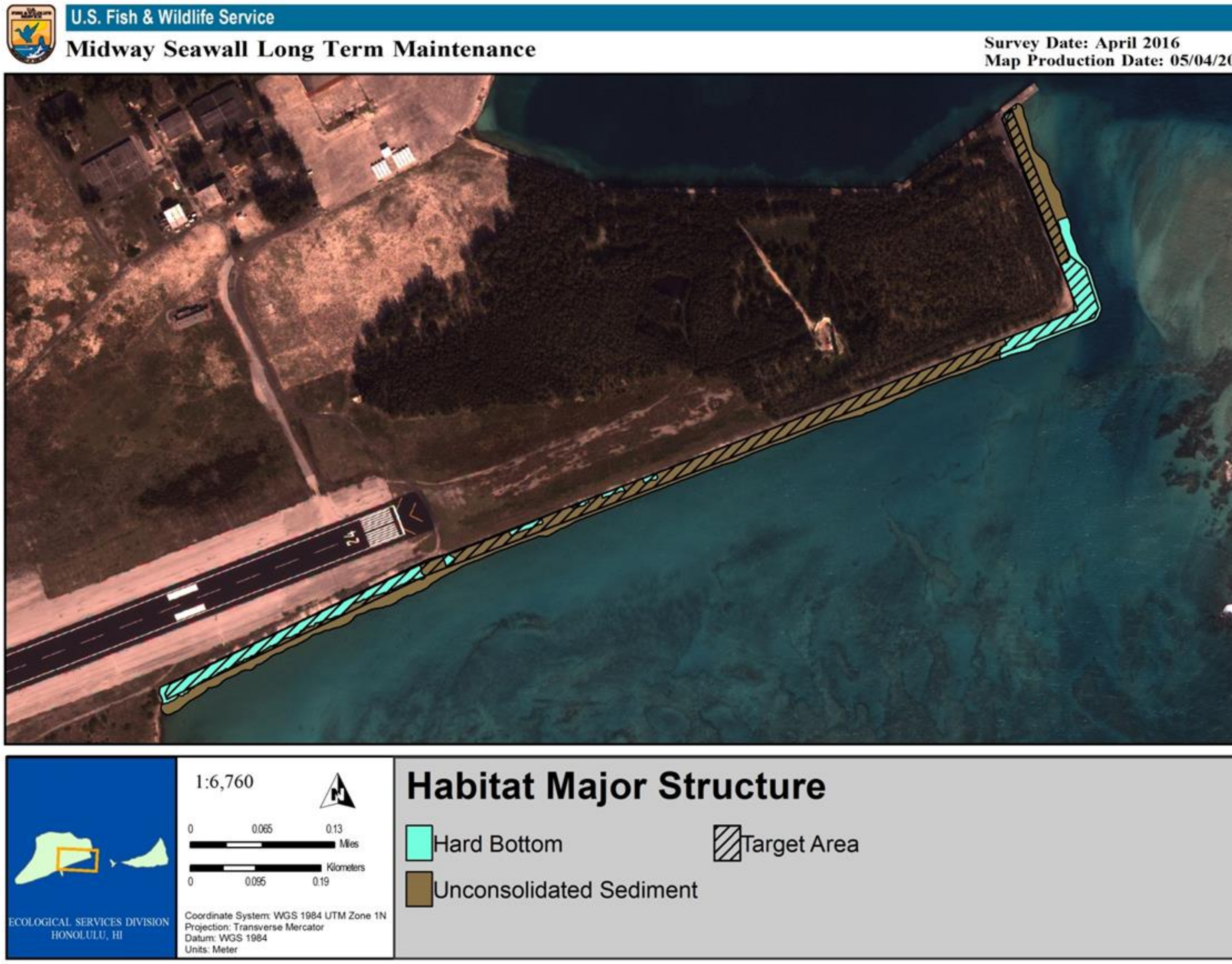

Figure 7. Major habitat structures within the project area.

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 (m2)), the survey area was larger than the proposed project foot print. The major habitat structures within the area surveyed consist of approximately 5 acres (20,289 m2) of unconsolidated sediment and 3 acres (12,151 m2) of hard bottom. As seen in Figure 7 the hard bottom is the artificial structure comprised of debris and rip rap. Within the unconsolidated sediment major structure habitat layer, approximately 4.24 acres (17,176 m2) was sand and rubble and 0.77 (3,112 m2) acres was only sand. The areas that were classified as "Artificial" are the areas of shoreline represented as hard bottom in Figure 7 above. There is no contiguous natural hard bottom in the project footprint.

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 (artificial)	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 Rock Unconsolidated Sediment	4.24	17,176	53
Unconsolidated Sediment	0.77	3,112	10
Total	8.02	32,440	

Biological Characterization

As part of the Environmental Assessment process, the Service's Ecological Services biologists documented coral colonies and species observed along the southern coastline of Sand Island in the 6.6 acre project footprint, plus an additional buffer that could potentially be impacted by construction activities (USFWS 2016).

There were 373 coral colonies observed on 26 random data transects in the entire survey area, all measuring less than 80cm (Table 2). Nine species from four families were recorded, with lobate, encrusting, and branching morphologies present. These species were found in mostly low densities (<one colony per m^2) and had a maximum diameter of approximately 50cm. The

transects were divided in benthic and vertical (sheet pile) directions so that both dimensions that would be lost would be captured. Twenty-six total quantitative transects were completed and coral data were collected on all 26 transects. Eighteen transects were on benthic substrate and eight were on sheet pile. The density of colonies observed was not uniform across the 26 random transects, with some areas having higher observations than others, and some areas having no observations of coral colonies present. Ten of the eighteen benthic transects did not contain any coral colonies, these ten transects were over sand and unconsolidated sediment. This shows the lack of coral present on sandy benthic environment adjacent to the sea wall within the project foot print. The harder substrate of the sheet pile walls and of areas where riprap was previously placed to control erosion are artificial habitat, but show more abundant coral colonization (USFWS PIFWO 2016). 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 (Table 2).

A total of 9 coral species were observed in the project area; 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 and the majority of the 8 sheet pile coral transect densities are higher than those of the 8 benthic transects where coral species were recorded present on debris and artificial substrate. 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. For the observed colonies, approximately 9.5% (36 colonies) showed signs of partial mortality 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. 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 a *P. meandrina* colony on the sheet pile, with a maximum diameter of 48cm and no visible mortality.

Table 2. Count of coral colonies per modified size class category (cm) for 26 transects, 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)
1	bottom/ artificial	*Pocillopora ligulata*	1	2					3		20
		Pocillopora meandrina		1	2				3	6	20
2	sheet pile	*Pocillopora damicornis*	8						8		22.5
		Pocillopora ligulata	9	5	1				15		22.5
		Pocillopora meandrina	4	7	8				19	42	22.5
3	bottom/ natural	No colonies observed							0	0	20
4	bottom/ artificial	*Pocillopora damicornis*	5						5		20
		Pocillopora meandrina		1	3				4	9	20
5	sheet pile	*Pocillopora damicornis*	10	1					11		22.5
		Pocillopora ligulata	1	4					5		22.5
		Pocillopora meandrina		2	8				10	26	22.5
6	bottom/ natural	No colonies observed							0	0	20
7	bottom/ natural	No colonies observed							0	0	20
8	sheet pile	*Pocillopora damicornis*	10						10		21.5
		Pocillopora ligulata	2	2	1				5		21.5
		Pocillopora meandrina		4	8	1			13		21.5
		Porites compressa		1					1		21.5
		Porites lobata		2	4				6		21.5
		Cyphastrea ocellina		2					2	37	21.5

Table 2. 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)
9	bottom/ natural	No colonies observed							0	0	20
10	bottom/ natural	No colonies observed							0	0	20
11	sheet pile	*Pocillopora damicornis*	25						25		12.5
		Pocillopora ligulata		1					1		12.5
		Pocillopora meandrina		3	4				7		12.5
		Porites compressa			2				2		12.5
		Porites lobata		1					1		12.5
		Cyphastrea ocellina		1					1	37	12.5
12	bottom/ natural	No colonies observed							0	0	20
13	bottom/ artificial	*Pocillopora damicornis*		1	1				2		20
		Pocillopora meandrina		1	2				3		20
		Cyphastrea ocellina	1	2					3	8	20
14	sheet pile	*Pocillopora damicornis*	12						12		21
		Pocillopora ligulata		2					2		21
		Pocillopora meandrina		5	6				11	25	21
15	bottom/ natural	No colonies observed							0	0	20
16	bottom/ artificial	*Pocillopora damicornis*	3						3		20
		Pocillopora meandrina		1					1	4	20
17	sheet pile	*Pocillopora damicornis*	17						17		21
		Pocillopora ligulata		3					3		21
		Pocillopora meandrina		2	8	2			12		21
		Porites lobata			1				1	33	21
18	bottom/ natural	No colonies observed							0	0	20
19	sheet pile	*Pocillopora damicornis*	12	3					15		15
		Pocillopora ligulata	2	3					5		15
		Pocillopora meandrina	2	9	10	1			22		15
		Cyphastrea ocellina	3						3	45	15
20	bottom/	*Pocillopora damicornis*	5						5		20

	artificial	*Pocillopora ligulata*	1			1		20
		Pocillopora meandrina	1	3		4	10	20
21	bottom/ natural	No colonies observed				0	0	20
22	bottom/ artificial	*Pocillopora damicornis*	5	2		7		20
		Pocillopora ligulata		2		2		20
		Pocillopora meandrina		5	7	12	21	20
23	sheet pile	*Pocillopora damicornis*		3	3	6		15
		Pocillopora meandrina		1	12	13	19	15
24	bottom/ natural	No colonies observed				0	0	20
25	bottom/ artificial	*Pocillopora damicornis*	2	2		4		20
		Pocillopora meandrina		6	3	9		20
		Cyphastrea ocellina	3	2		5	18	20
26	bottom/ artificial	*Pocillopora damicornis*	14	1		15		20
		Pocillopora ligulata		1		1		20
		Pocillopora meandrina	1	4	7	12		20
		Cyphastrea ocellina	3	2		5	33	20

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.

Objectives

For any project which may impact aquatic habitat, the preferred order of measures are avoid, minimize, and offset. Avoidance implies a change to the project design (i.e. alternative method) that prevents impacts from occurring. The design of the seawall while creating a larger foot print, will increase the area of suitable habitat for corals to recruit and settle. The revetment will cover sandy and unconsolidated substrate where corals cannot settle and is suboptimal for survival, and will replace it with hard substrate with relief and rugosity allowing for increased coral settlement and survival. Recruitment of coral is expected to increase species diversity within the project footprint, and result in beneficial impacts to aquatic organisms that depend on coral reef for one or more stages of their life cycle. The number and diversity of fish and mobile invertebrate species will also increase with the addition of the revetment. Mobile invertebrates thrive in the interstitial spaces of coral reefs where they can seek shelter from predators during the day. The boulders and rocks used for the seawall repair will provide hard substrate, cervices vertical and horizontal relief, increasing the available habitat for these creatures. The design and sloping face of the seawall revetment will eliminate entrapment hazards for seabirds, sea turtles and monk seals. With the rocks sloping into the sea, rather than a sheer face sheet pile, birds, turtles and seals, can enter and exit the water easily. The entrapment and death of fledgling Albatross will be eliminated, and the sloping face will allow tired birds to climb out of the water to rest on land, instead of drowning and dying of exhaustion, unable to climb the sheer face of the sheet pile seawall.

Minimization seeks to reduce the impacts from a project by carrying out some beneficial action (i.e. coral translocation). For this project coral translocation is being used to minimize impacts before the action takes place. The use of best management practices during constructions and repair will also offset and minimize potential impacts.

Project Design and Avoidance

If the repair of the seawall is not made in the very near future, there is a risk that ocean waters may continue to remove sand and material away from the island and the runway, eventually making Henderson Field unavailable for emergency landings. Doing nothing and allowing the seawall to deteriorate was considered but eliminated because widespread failure of the seawall would threaten Refuge and Monument resources and values, including the safe operation of Henderson Field and potential entrapment hazards for threatened and endangered species, including green sea turtles and Hawaiian monk seals, as well as many species of seabird. The erosion of the fill that is behind the seawall would cause the release of contaminants present within the fill, and the siltation of the surrounding area extending out to the forereef, detrimentally impacting far more habitat, including Essential Fish Habitat, than the repair itself.

The proposed seawall repair consists of using an armor rock revetment to replace the damaged sheet pile wall sections. The proposed repairs would be installed entirely from shore to minimize disturbance to the marine environment. Repairs would be made using conventional construction equipment such as an excavator and crane. Repairs would be accomplished during a brief, carefully selected window in order to reduce impact to marine and terrestrial resources and wildlife, and most likely occur annually during August and September. The removal of the sheet pile wall and placement of armor rock will temporarily impact habitat within the project area, but the armor rock revetment will form suitable coral substrate, as seen with previous artificial revetment construction. 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.

Armor rock revetments consist of large rocks over smaller underlayer rocks, placed to form a continuous sloping surface that dissipates and breaks wave energy. High quality armor rock is durable and would likely have the lowest long term maintenance cost. The sloping surface would prevent entrapment of wildlife that move between land and sea. An armor rock revetment covers a larger footprint than a vertical sheet pile wall. The revetment will cover the existing sandy bottom of the project footprint, habitat that is not suitable for coral recruitment, establishment and growth. The rock crevices provided by the revetment will add complexity to the shoreline and rugosity to the subtidal environment, and this is expected to result in beneficial impacts to marine species.

The recommended concept level design armor rock section for open ocean exposure at Midway is a revetment sloping at 2 horizontal: 1 vertical (Figure 8). The median armor rock size is 1500 pounds, and the cover layer is two stones (4 feet total) thick. The underlayer rock has a median rock size of 150 pounds and is an essential part of the system, interlocking with the armor rock cover. The underlayer rock is 2 feet thick total. A geotextile filter fabric separates the underlayer and granular fill material and prevents migration of the sediments through voids in the overlying rock. It typically has a long life requiring periodic maintenance to re-position rock as needed. Typical maintenance might be on the order of a 10-year cycle.

A similar repair was performed on Sand Island in 2014. Armor revetment has been proven to be an effective means of erosion protection. 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 (Corps Reference Number POH-2013-173). Personnel completed the rock revetment in the 100 ft. section of shoreline to stabilize the structure (Figure 8 and 9).

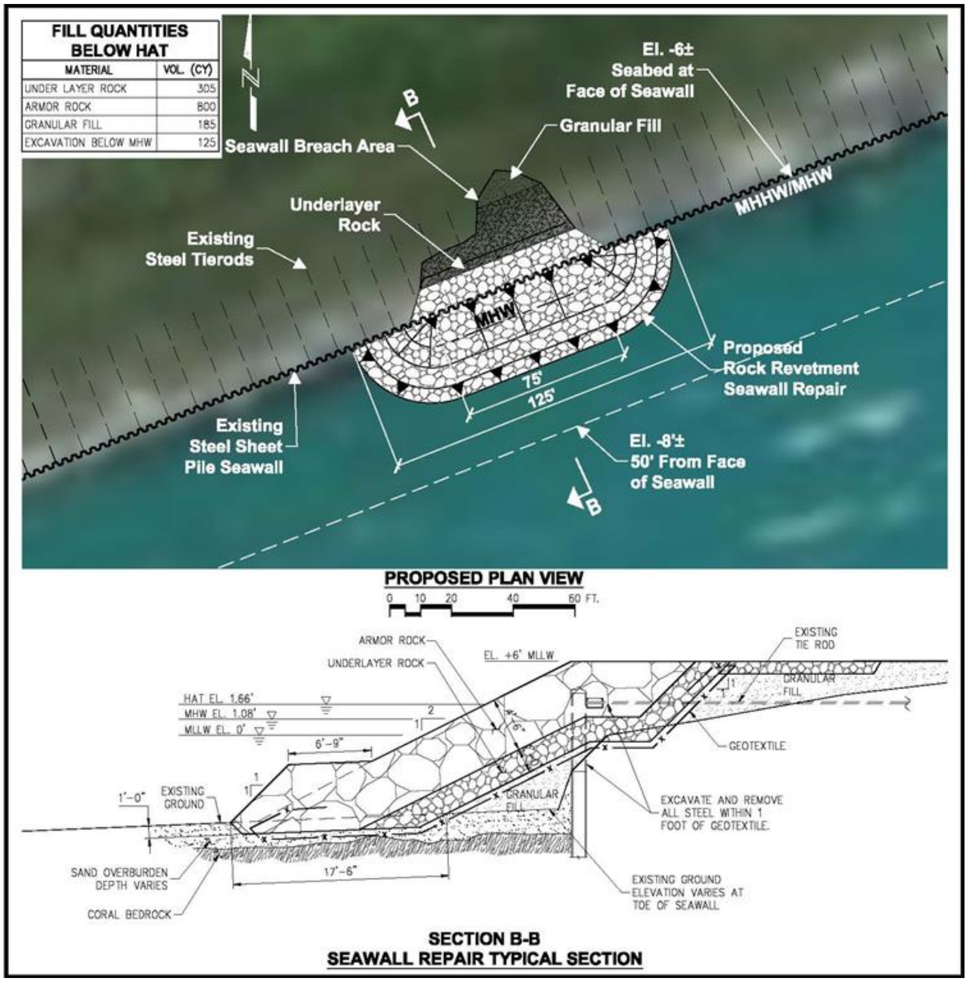

Figure 8. Example of a repair site, figure copied form the EA.

Figure 9. A) Repairing the failed site in 2014. B) After the repair 2014.

Tables 1- 2, and 5-7 of the Implementation plan list Environmental Measures for; Engineering Design (Table 1), Construction Materials (Table 2), Pre-Construction (Table 5), Construction (Table 6), and Post-Construction (Table 7).

Another alternative considered but eliminated from detailed study was to repair the seawall using the same method as before by using sheet pile. However, the sheet pile alternative was found to be less suitable in terms of cost and engineering and had no redeeming values in terms of environmental benefits. The sheet pile wall would obstruct bird and other wildlife movements between shore and water. Installation of the sheet pile wall would require a crane with a vibratory hammer and possibly an impact hammer as well. Use of such equipment would result in elevated noise levels which could result in adverse impacts to marine mammals and other wildlife.

Seawall Repair Implementation Best Management Practices

To avoid and minimize impacts to fish and wildlife resources, standard Best Management Practices (BMPs) as well as pre, during and post construction environmental measures will be implemented during the project. More in depth BMPs and environmental measures specific to each phase of the project can be found in the DRAFT Environmental Assessment Seawall Long-Term Maintenance Project and the Appendix B- Implementation Plan (page 41 of the EA).

To avoid and minimize project impacts to the maximum extent possible, the following BMPs to minimize the degradation of the coastal water quality and impacts to fish and wildlife resources and habitats will 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 will 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 will 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. Minimize the amount of in-water work (*e.g.*, buildout the rock revetment and underlying support layers from land);

d. Construction materials or sediments will not be stockpiled in the marine environment;

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

f. Prior to construction the area will be swam and all visible mobile macroinvertebrates removed from the project area, and footprint. Macroinvertebrates such as star fish, cowrie, sea snails, and mollusks will be collected by hand and placed in buckets. Macroinvertebrates will be relocated to selected translocation sites well outside of the current project foot print;

g. A qualified inspector will check the ship's hull for invasive species and shipments of equipment, cargo, and construction materials before departure to Midway Atoll, or the ships and barge hulls will be cleaned not more than 2 weeks prior to departure for Midway Atoll;

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 must 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 will occur away from the seawall construction site at a designated location (the fuel farm) 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 will be developed. Absorbent pads and containment booms will 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.

Coral Translocation

The intent of the coral translocation project is to minimize, to the extent possible, the loss of coral within the repair footprint by relocating coral colonies out of the work site, and giving them the best chance at survival. This is accomplished by transferring the coral colonies and their ecological function to an area close to the worksite, but outside of the area of direct impact.

The Pacific Islands Refuges and Monuments Office staff will implement a coral translocation project to remove corals in the project footprint and relocate them to a suitable recipient site. The coral transplantation efforts will occur prior to each section of seawall repair (repairs occurring in August –October). Selected coral colonies will be moved from each proposed repair section, as funds become available to repair those sections.

Whenever possible, suitable coral colonies will be removed from the vertical sheet pile, and any submerged debris. Suitable coral colonies include non-encrusting colonies 15 cm or larger, with greater than 80% live tissue. The majority of the corals present in the area are in the genus Pocillopora and have branching morphology. Debris may include rip-rap, large boulders/stones, and miscellaneous trash dumped over the seawall. Where possible corals will be transplanted onto suitable substrate seaward from the repair site and away from any potential future seawall repair work. This area will be well outside of the work area footprint.

Service staff must be conscious of the time required to perform translocations as well as the time needed for future monitoring of translocated colonies. With a project area of approximately 6.6 acres for the long-term repair project, there will be coral colonies of various sizes in various sections of the project area. Each translocation effort will vary based on the number and morphology of coral colonies present, as well as their location, benthic or vertical.

<u>Site Selection</u>

Patch reefs to the south of the sea wall have been identified as potential translocation sites. These areas have been categorized by the NOAA Atlas of Shallow-Water Benthic Habitats of the Northwestern Hawaiian Islands as both uncolonized hardbottom, and uncolonized linear reef (NOAA 2003). The sites are approximately 450 ft. to over 1000 ft. from the sea wall, and well outside of the project foot print (Figure 10). Since the sites are somewhat close to the seawall, while remaining a safe distance away from the project area, these sites share many of the same environmental conditions as the harvest site of the seawall. Pervious translocation sites are illustrated in figure 10. Site Y and Z were selected as the translocation sites for repair areas A and B (Figure 10). These sites are both long and narrow ridge patch reefs about 50 meters long and lie in 10 ft of water at low tide. The east facing side of the reefs are elevated off of the sand and have a higher elevation than the surrounding benthic structure that was scouted in the area. Site Y is roughly 1400 ft from site A, and 100 ft from site B. Two transects were surveyed at both site Y and Z, where every coral on the reef was counted. Site Y and Z had a total of 93 and 79 established corals respectively from three species *P. damicornis*, *P. meandrina* and *P. lobata*. As the repair project progresses, new translocation sites will be established on suitable patch reefs in the general area.

Figure 10. Coral translocation sites for seawall repair sites A and B.

Methods

The project footprint will be accessed by divers and snorkelers via a small boat and the area will be surveyed to get an estimate of the number of corals that need to be translocated prior to each repair event. Translocation areas will be scouted prior to removing corals from the seawall and the substrate prepared for coral translocation. Suitable translocation sites will be selected and marked with temporary markers, and the substrate at these sites will be cleaned with a wire brush to remove all macro and turf algae to enable good adhesion of coral and epoxy to the substrate.

Colony collection will be accomplished by personnel working in pairs using snorkel, and/or SCUBA. The corals will be removed from the seawall by hand, with hammer and chiseled to separate them from the substrate, and placed into a 5 gallon bucket. If a coral is attached to a movable rock or rubble, the rock will be relocated with the coral intact. This will serve to reduce the mortality associated with breaking the coral and subsequently reattaching it to another rock at the translocation site.

To minimize potential impacts due to handling the corals, they will be transplanted the same day as harvest. The coral will be attached to the recipient site using Splash Zone marine epoxy.

Once the corals have been removed from the work area they will be handed to a snorkeler or diver, placed in a bucket and either swum or driven by boat to the translocation site. There the snorkeler/diver will place corals in clusters of several colonies and the clusters will be approximately 1 m apart along a transect. A cow ear tag will be attached to the substrate adjacent to each transplanted coral and GPS coordinates will be recorded at the beginning and end of the transect, as well as at each transplant cluster site.

Post Translocation and Construction Monitoring

Monitoring of transplanted corals to determine the survival and success of the relocation effort will be conducted. Unforeseen events may contribute to higher coral mortality such as a strong El Nino event, prolonged elevated sea surface temperatures leading to corals bleaching, or a severe storm event. A control site will be identified and will be comparable to the translocation site in as many environmental factors as possible. Corals at the control site will be surveyed, and several will be marked with numbered cow ear tags as above, photographed, measured for size and any existing mortality recorded. This control/reference site will allow for the identification of coral mortality due to transplantation, or due to other unforeseen environmental factors or natural disasters such as severe storm events and elevated water temperature.

The first monitoring visit for each translocation event will be weather and personnel dependent but will try to be scheduled within one month of the relocation. The corals will be inspected to confirm that they are still attached to the substrate at the translocation site. If they are not, the attachment process will be repeated. Initial baseline measurements will be made for each coral (diameter or 2D planar) and general comments recorded concerning the corals appearance (i.e percent alive, algae growth, signs of predation, etc.). Photos will be taken of all of the transplanted corals with their corresponding tag numbers, using a scale bar for reference. Each tagged coral colony will be identified to species where possible, the diameter or 2D planar measurements will be taken, and any existing mortality recorded. Subsequent monitoring will be done every three months through the first year, and then every six months for the second year, at which point monitoring will cease for that transplant cohort (Table 3). During each follow-up survey cow ear tags will be cleaned of biofouling to ensure they can be easily read and transplants will be groomed of fouling organisms. If tags are missing they will be replaced and the change in number noted. All coral translocation sites and tag numbers will be cross referenced, so if a tag is lost the GPS coordinates can be used to determine the tag numbers that corresponds to a specific cluster of corals.

The Service will not measure fecundity of the transplanted corals as part of the monitoring plan. Fecundity is hard to measure and requires histology, and knowledge of when coral spawning occurs. This is both difficult to coordinate if spawning time is unknown and invasive because it requires breaking off pieces of the corals to collect tissue for histology, and then decalcifying the fragments. Little is known about coral spawning at Midway and breaking pieces off will introduce sites for bio-eroders, and coral diseases.

Repair site revetment monitoring will consist of surveys to count, size, and identify to species where possible, the corals that are growing on the revetment of the sites where rock revetment was placed. The submerged portion of the rock revetment repair sites will be surveyed for new coral recruitment and growth once every two years beginning 3 years after the repair is made and will cease eleven years post repair.

Table 3. Coral Translocation and Recruitment Monitoring Schedule

Monitoring event	Timing	Action
Baseline monitoring at translocation site	One week to one month after translocation	Photo document, take diameter or 2D planar measurements, existing mortality recorded
Follow up monitoring year 1at translocation site	Every three months after translocation for 1 year	Photo document and compare to baseline photos
Follow up monitoring year 2 at translocation site	Every 6 months during the second year after translocation	Photo document and compare to baseline photos
Revetment monitoring	Start three years post repair and will occur every two years	Count, size and identify coral to species on the revetment.

<u>Post Construction Reporting</u>

Once a section of the seawall is repaired a specific post-construction report for that repair site will be generated providing information on the species, size and the total number of corals transplanted. Information on the species, size and the total number of corals that were negatively impacted by the salvage operation and repair of the seawall because they could not be moved or transplanted, will be reported as well.

An annual report starting one year after the first corals are translocated and finishing two years after the last corals have been translocated will be sent to the US Army Corp of Engineers. Each annual report will include the Corps reference number POH-2013-173 and will be sent to: CEPOH-RO@usace.army.mil

This report will consist of monitoring data from translocation sites as well as surveys of new rock revetment at repair sites.

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