RESTORATION PLAN

FOR THE MV *PAUL RUSS* SHIP GROUNDING (2014)

SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

Final

October 2025

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This plan has been reviewed by the Trustees of the Paul Russ Restoration Fund and accepted by the following authorities. **Public input regarding the contents of this plan is encouraged and will be accepted until November 3, 2025**. Once received, relevant public comments and agency responses may be found in the Appendix.

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Hon. David M. Apatang Date

Governor, Commonwealth of the Northern Mariana Islands

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Sylvan O. Igisomar Date

Secretary, Department of Lands and Natural Resources

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Floyd R. Masga Date

Administrator, Bureau of Environmental and Coastal Quality

__________________________ ___________________

Asuncion S. Agulto Date

Treasurer, Department of Finance - Division of Treasury

__________________________ ___________________

Edward M. Manibusan Date

Attorney General, Office of the Attorney General

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ACRONYMS

We have limited the use of acronyms to the extent we could. The first time an acronym is used it is spelled out and in parentheses, otherwise please refer to this listing.

CNMI – Commonwealth of the Northern Mariana Islands

NRDA – Natural Resources Damage Assessment

UC – Unified Command

RP – Responsible Party

USCG – U.S. Coast Guard

NOAA -National Oceanic and Atmospheric Administration

PIRO – Pacific Islands Regional Office

CPA – Commonwealth Ports Authority

HSEM – Homeland Security and Emergency Management

DPS – Department of Public Safety

BECQ – Bureau of Environmental and Coastal Quality (a Division under the BECQ)

DCRM – Division of Coastal Resources Management (a Division under the BECQ)

DLNR – Department of Lands and Natural Resources

DFW – Division of Fish and Wildlife (a Division under the DLNR)

SCM – Smiling Cove Marina

AMP – American Memorial Park

CRI – CNMI Coral Reef Initiative

MMT – Marine Monitoring Team

GPS – Global Positioning System

OPA – Oil Pollution Act of 1990

SCUBA – Self Contained Underwater Breathing Apparatus

NEPA – National Environmental Protection Act

PEIS – (NOAA) Programmatic Environmental Impact Statement for habitat restoration activities implemented throughout the coastal United States

HEA – Habitat Equivalency Analysis

DEFINITIONS

Responsible Party – an individual with the authority and control to make decisions regarding the financial affairs and assets of a business or organization, or a person authorized to act on another's behalf

Trustee – an individual person or member of a board given control or powers of administration of property in trust with a legal obligation to administer it solely for the purposes specified

Natural Resource Damage Assessment – an assessment required by statutory laws whose purpose is to determine type and amount of mitigation/restoration needed to compensate the public for injuries or loss to their resources

Restoration Plan – a plan created for a purpose of satisfying regulations that is intended to guide coral reef and associated habitat actions, goals, and objectives towards achieving or restoring coral restoration

Impacts – any positive or negative change to the environment and its natural elements—land, water, air, plants, animals, and the atmosphere—resulting from human activity or a specific project. These changes can be direct or indirect, long-term or short-term, and include effects like pollution, loss of biodiversity, and alteration of physical geography, which can in turn affect human health and the quality of life.

Marine Disturbance – a distinct event or process, either natural or human-caused, that disrupts the structure, function, or physical environment of a marine ecosystem, potentially causing mortality or altering community dynamics. These disturbances can range from storms and oil spills to pollution and overfishing, affecting different scales and timeframes, and influencing the types and resilience of marine communities that develop in an area.

Coral Reef Restoration – the active process of rebuilding and repairing damaged coral reef ecosystems to promote their health, biological diversity, and resilience.

Primary Restoration – primary restoration, which is any action, including natural recovery, that returns injured natural resources and services to baseline

Compensatory Restoration – compensatory restoration, which is any action taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery

Ecosystem Function – functions performed by a natural resource for the benefit of another natural resource and/or the public

Ecosystem Services – Benefits that humans receive from natural systems.

PEIS – (NOAA) Programmatic Environmental Impact Statement for habitat restoration activities implemented throughout the coastal United States; a 2015 document used to guide environmental compliance for certain restoration activities funded by NOAA and other federal funding sources, adopted by federal USCRTF Agencies.

ACKNOWLEDGEMENTS

Since the ship's grounding in 2014, efforts to complete this plan were revitalized in 2023. This completed plan is the culmination of a multi-pronged, sustained, years-long effort. We would especially like to thank Shannon Ruseborne from NOAA's Office of Habitat Restoration, Steven McKagen from NOAA's Saipan Field Office under the Pacific Islands Regional Office, and Janice Castro, NOAA Coastal Zone Management Liaison for their abundant expertise, patience, and guidance during the creation of this plan and throughout this process.

We are grateful to our colleagues at the Coral Reef Initiative's Marine Monitoring Team, the Bureau of Environmental and Coastal Quality, and the Division of Fish and Wildlife's Smiling Cove Marina Office, and the Fisheries and Enforcement Sections for their assistance during and throughout this process and providing crucial historical information, photos, and documents. We are also grateful to those members of the CNMI Coral Reef Restoration Working Group for their work and input into this effort between 2014 to today, particularly David Benavente of Tasi Research and Consulting, John Gourley of Micronesia Environmental Services, Robbie Greene of Pacific Coastal Research and Planning, Lyza Johnston of Johnston Applied Marine Sciences, and others.

Further, the safekeeping and expenditure of these funds would not be possible without the assistance and participation of Asuncion (Connie) Agulto, Tracy Norita, and Ryan Camacho of the Department of Finance and Treasury, the Commonwealth Ports Authority, Homeland Security and Emergency Management, and the various government staff who assisted in some way.

Finally, we would also like to thank Hawai'i DAR staff for sharing their time and resources with the CNMI, Department of the Navy, and our leadership, DLNR Secretary Sylvan O. Igisomar and Honorable Governor David M. Apatang for his support throughout.

We would also like to acknowledge the important role of our island environments, the coral reef and the loss of it, the barrier lagoon that assures the safety of our island, and that these resources still exist because of those have stewarded these lands and oceans since 1500 B.C.

"Yanggen guaha para hita, pues guaha para i mana'tatte'"

"If we have, so will those who come after us"

In memory of Arnold I. Palacios, former CNMI Governor and DLNR Secretary, Richard B. Seman, former DLNR Secretary, and Eliceo D. Cabrera, former BECQ Administrator.

EXECUTIVE SUMMARY

When the M/V *Paul Russ* container ship grounded in the Saipan shipping channel in September 2014, it set off a series of events that distinguished it both from previous and future ship groundings.

The grounding triggered federal involvement due to the Oil Pollution Act of 1990. In the aftermath of the grounding and during the course of the follow-up biological assessments, the discovery of undetonated unexploded WWII-era underwater ordinance in the near vicinity of the grounding site also distinguished this grounding from any other.

The event also triggered the need for a Unified Command, something formed commonly during natural disaster events and large-scale disturbances. Although the UC at first was based at the Saipan Seaport in order to coordinate the Incident response, and the Commonwealth Ports Authority (CPA) were one of the original Trustees listed, once the process was further underway CPA excused themselves as a Trustee, leaving the BECQ, and DLNR to be the sole trustees, and the Paul Russ Restoration Fund (escrow account) in the care of the CNMI Treasury instead (*McKagen, S., pers comms*).

This plan describes and provides summarized information regarding the environmental consequences of the grounding of the M/V *Paul Russ* in 2014, and the subsequent response activities (collectively "the Incident"), including the affected environment, the determination and quantification of natural resource injuries, and proposed natural resource restoration alternatives to address those injuries. It further discusses the environmental implications of the proposed restoration alternatives, and addresses the environmental compliance of the proposed activities. Creation, approval, and acceptance of this plan by the Trustees and public fulfill the requirements of the Oil Pollution Act of 1990.

Much of the information compiled here came from primary and secondary sources provided by members of the UC, especially NOAA (represented by Steve McKagen), who played a large role from the outset. Specific accounts were also provided from people who were not in the decision-making rooms when decisions were made at the time. Many agencies and career staff hold multiple pieces of the puzzle that was the aftermath of the M/V *Paul Russ* ship grounding. We welcome corrections to any omissions and apologize for errors in the text.

INTRODUCTION

ADMINISTRATIVE BACKGROUND

This Restoration Plan describes the incident and provides summarized information regarding (1) the environmental consequences of the grounding of the M/V *Paul Russ* and the subsequent response activities (collectively "the Incident"), including the affected environment, (2) the determination and quantification of natural resource injuries, and (3) proposed natural resource restoration alternatives to address those injuries.

In September of 2014 the CNMI experienced a large marine disturbance in the form of a vessel grounding within Saipan's West Lagoon adjacent to the shipping channel, causing ecological damage and loss, and scrambling local and federal natural resource management and emergency agencies and authorities to coordinate the effort to characterize, document, and ultimately receive compensation for the loss of ecosystem services, coral reef habitat, and other impacts.

Photo 1. the container ship, MV Paul Russ, grounded on the reef in the Saipan Lagoon, tilted slightly, September 2014. Credit: CNMI CRI

Trustees

The Natural Resource Trustees for the M/V *Paul Russ* ship grounding incident included the Commonwealth Ports Authority (CPA), who recused and relieved themselves of this duty early in the process (McKagen, S., pers comms), the Department of Lands and Natural Resources (DLNR), and Bureau of Environmental and Coastal Quality (BECQ), (hereafter, "the Trustees") with technical guidance and assistance provided by the National Oceanic and Atmospheric Administration (NOAA) Pacific Islands Regional Office (PIRO), based in Saipan.

For the initial natural resource damage assessment (NRDA) and restoration activities, the Responsible Party (RP) was represented by Sea Byte Inc. The RP representative worked cooperatively with the local Trustees throughout the NRDA and as a result of completing their duties, were released from further responsibility by the CNMI government. Future restoration actions are the responsibility of the CNMI government.

Purpose

The Trustees propose to develop and implement this plan and project intended to benefit coral resources and associated habitats and the CNMI. The purpose of the proposed actions are to restore injured resources impacted by the Incident and to compensate the public for interim losses (ecological losses from the time of injury until "full recovery").

Need

This action is necessary because there were significant injuries to the public's natural resources caused by the Incident, it being a large marine disturbance, and the CNMI continuously has had to expend staff resources, time, and effort to characterize it. In the interim, these natural resources suffer from a diminished level of ecological services. In the absence of ecological restoration actions as proposed here, resources would remain injured longer, and the public would remain uncompensated.

Summary of the Natural Resource Damage Claim

In the case of the MV *Paul Russ*, due to the mobilizing, coordination, and work of CNMI government agency staff and federal partners, as well as the cooperation of the RP, a damage claim was able to be brought and settled for the loss of the natural resources the CNMI experienced. This settlement and creation of the Paul Russ Restoration Fund came about due to another ship grounding which occurred after Typhoon Soudelor in 2016, of the *Lady Carolina*, which also grounded within the Saipan West Lagoon. Due to the similarity in nature of the grounding events, a Habitat Equivalency Analysis was performed for the two, an amount was decided, and the RP was able to reach a settlement and be released from further liability.

For an in-depth discussion, including methodologies, please refer to Johnston et al. 2015 "M/V *Paul Russ* Grounding: Draft Natural Resource Damage Assessment Report", contained in Appendix 1-A, and the "Habitat Equivalency Analysis and Project Evaluation – Paul Russ and Lady Carolina" report found in Appendix 1-B.

Present

In 2023, the CNMI hired its first Coral Reef Restoration Coordinator, whose duties included, among others, the responsibility to create Restoration Plans on behalf of the CNMI government in order to address priority needs of the CNMI. Since that time, the Restoration Coordinator has held various meetings with leadership, those who were present during the initial grounding, subject matter experts, Department of Finance, Treasury, Fish and Wildlife, Coastal Resources Management, NOAA Pacific Islands Regional Office and Office of Habitat Restoration, legal counsel of the Attorney General, and those who remain with the CNMI today (even in other capacities) in order to understand how the past has informed the present. A majority of these meetings were held in 2023 and 2024.

# of Meetings regarding Paul Russ Restoration Plan: 7

Participants in the Meetings: 13 (local and federal)

Participating Agencies:

- **Local Government**: Department of Finance, Department of Lands and Natural Resources, Bureau of Environmental and Coastal Quality
- **Federal Government**: National Oceanic and Atmospheric Administration

The situation continues to evolve in the CNMI with regards to responding to "marine disturbances" it is our hope that this plan may compensate the CNMI for our loss and close this chapter.

Note: the CNMI established Public Law No. 20-79 or "The Coral Reef Protection Act" in 2018, after this incident's occurrence. Moving forward, this will be another guiding rule for future incidents of this nature.

CONTEXT

INCIDENT OVERVIEW

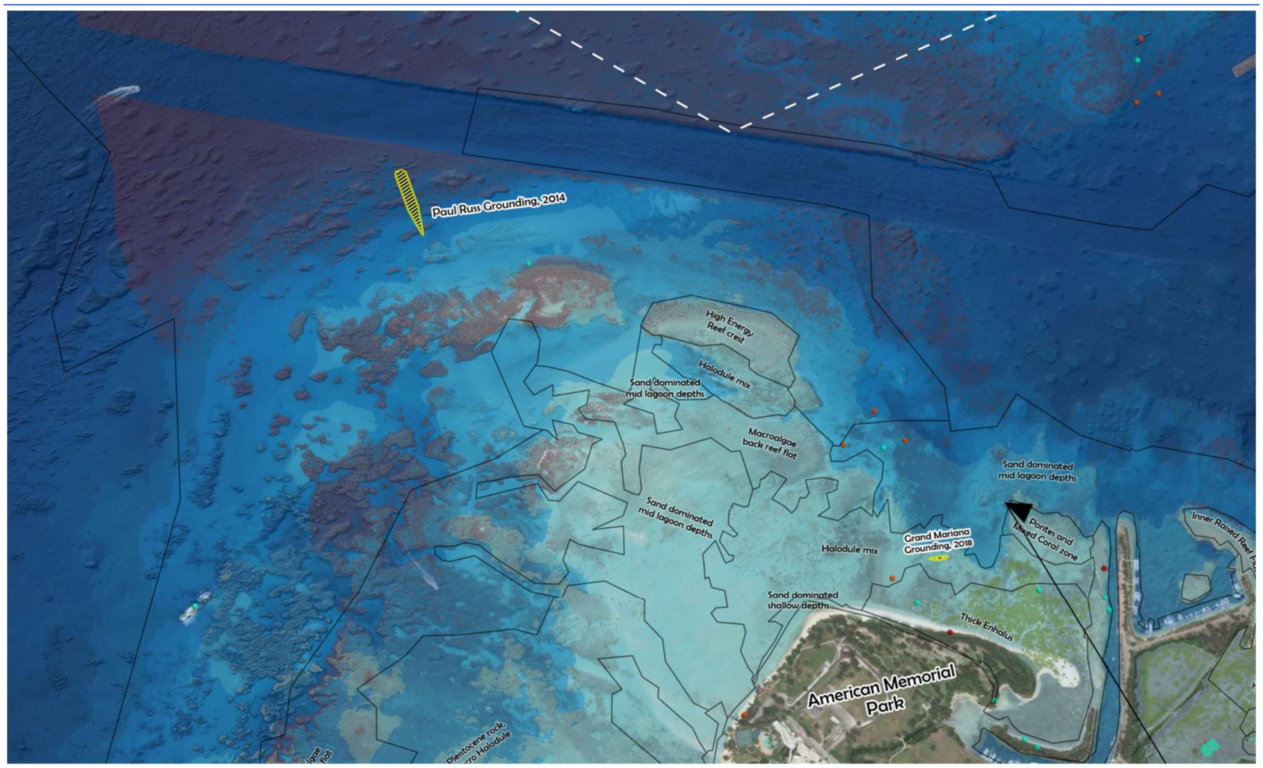

Figure 1. Part of a bathymetry map of the Saipan shipping channel dredged area, with the location of the 2014 Paul Russ grounding highlighted in yellow above, just South of the channel. Further South East is the location of the Grand Mariana 2018 grounding also highlighted in yellow. Created by Robbie Greene, PCRP & DLNR, 2024.

The West Lagoon of Saipan Island is the largest lagoon in the Commonwealth of the Northern Mariana Islands (CNMI). Formed by a barrier reef flanking patch reefs within, it contains a rich biodiversity of corals, fish, invertebrates, habitats, and wildlife sustaining a myriad of important ecosystem functions and services. Since being first settled by the Indigenous Chamorro and Carolinians, it has supported and continues to sustain the majority of the CNMI's cultural, recreational, and economic activities. For this location in the lagoon, between 1987-1992, the Saipan Shipping channel was dredged in order to accommodate vessels and remove barriers to navigation, and again in 2004-2005 (DCRM, pers comms).

On September 9, 2014, the 161 m (536 ft) M/V *Paul Russ* grounded on coral reef habitat just inshore of the channel leading into the Port of Saipan. The ship was laden with shipping containers and an estimated 380,000 gallons of intermediate fuel oil. Due to the large size, this disturbance initiated and necessitated a coordinated effort between local authorities, federal partners, the U.S. Coast Guard (USCG) and the U.S. Navy.

The Unified Command (UC) for the incident was made up of the USCG's Federal On-Scene Coordinator, Commonwealth Ports Authority (CPA), CNMI Homeland Security and Emergency Management (HSEM), CNMI Department of Public Safety (DPS), CNMI Division of Fish and Wildlife (DFW), CNMI Bureau of Environmental and Coastal Quality (BECQ), and a Responsible Party (RP) representative representing the owners of the M/V *Paul Russ*. Initially, the UC was based at the CPA Saipan Seaport.

On September 10, the CNMI Marine Monitoring Team (MMT) and a dive crew representing the RP's designated salvage company, T&T Salvage, independently conducted initial in-water assessments of the ship's hull and the surrounding environment using SCUBA. The state of the hull and the impacted reef habitat was documented with photos and videos.

Photo 2. ***The damaged hull of the M/V Paul Russ ship and damaged coral reef, September 2014. Credit: CNMI CRI.***

The geographic location and footprint of the ship were recorded using a handheld GPS unit from the surface. At that time, divers discovered potential unexploded ordnance on the seafloor near the grounded vessel, approximately mid-ship off the port side and at off the port side of the stern.

On September 11, the U.S. Navy Explosive Ordnance Division (USN EOD) arrived from Guam and conducted surface swims followed by an underwater assessment of the ordnance. The EOD determined that the ordnance were largely decayed and unlikely to come in contact with the hull of the ship during removal.

Photo 2. ***Unexploded ordnance from WWII discovered in the near vicinity of the grounding site, September 2014. Credit: CNMI CRI***

At approximately 11:00 pm on September 11, 2014, at high tide, three tug boats were able to dislodge the MV *Paul Russ* from the reef. During the removal efforts, the ship's propeller was engaged to help dislodge and steer the vessel, causing a "blow hole". This "blow hole" was formed from the concentrated force of propeller wash from the grounded vessel attempting to power off the bank, which formed a sediment and rubble debris field at the stern of the ship.

Although the hull shifted slightly over the course of the two and half days it was grounded, movement was deemed minimal and the ship was removed along the same path/heading that it entered, minimizing secondary damage to reef habitat from action of the ship. The hull remained intact throughout, preventing any fuel or hazardous substances from entering the environment.

Further information may be found in Johnston et al. 2015 "M/V *Paul Russ* Grounding: Draft Natural Resource Damage Assessment Report", contained in Appendix 1-A.

Post Incident Response Actions

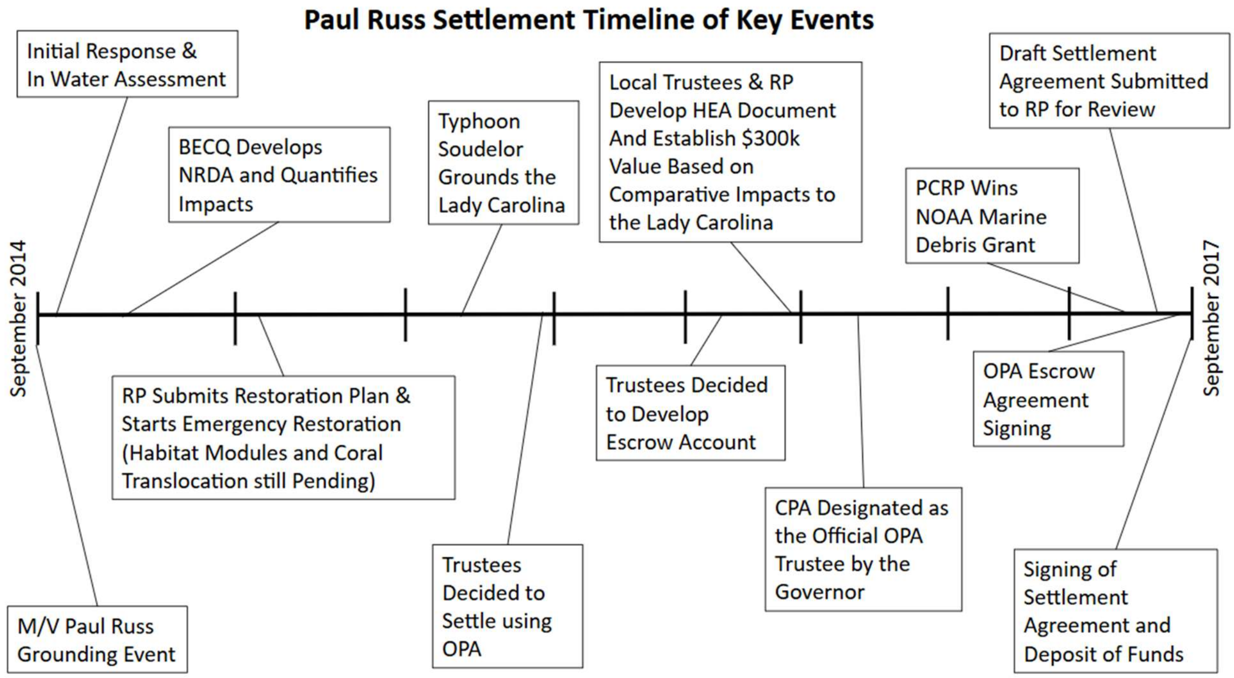

Figure 2. ***Paul Russ Ship Grounding and Restoration Fund Timeline. Provided by Steve McKagen, NOAA PIRO.***

Post-incident response actions are summarized in the above timeline provided by NOAA (contained in Appendix 1-C) as well as in the 2015 M/V *Paul Russ* Grounding: Draft Natural Resource Damage Assessment Report contained in Appendix 1-A. Following the Incident, an emergency restoration plan was prepared by the RP and submitted to NOAA detailing how the RP would conduct emergency restoration of the affected site. This plan was submitted by SeaByte Inc. to NOAA PIRO, and accepted. Primary restoration - i.e., actions taken to recover natural resources back to baseline or "before injury" status, was conducted (as emergency restoration) at the *Paul Russ* injury site in the form of emergency coral triage, vessel paint and rubble removal from the site, and coral reattachment between 2014-2015. At this point, the Trustees propose that the remainder of the primary restoration be achieved through natural recovery.

See "MV Paul Russ Proposed Plan for Coral Reef Restoration Draft, March 2015" by Sea Byte Inc. in the Appendix 1-B for a more thorough discussion of previous restoration actions.

Administrative Record

NOAA PIRO, DLNR, and BECQ have maintained records documenting the information considered and actions taken by the trustees during the assessment and restoration planning process. These records collectively comprise the Administrative Record (AR) supporting this Restoration Plan. Access to these records may be requested by the public at:

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CNMI NOAA Fisheries Liaison

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Beach Rd, Saipan

Kalani Reyes

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Coral Reef Restoration and Response Coordinator

Office of the Secretary

Department of Lands and Natural Resources

Capitol Hill Rd, Bldg 1315

Arrangements must be made in advance to review or obtain copies of these records by contacting the persons listed above. Access to and copying of these records is subject to all applicable laws and policies including, but not limited to, policies regarding copying fees and the reproduction or use of any copyrighted material.

Present Conditions

Today, years after the grounding, years after any emergency restoration actions were completed, the site remains unmonitored and in natural recovery, as confirmed by a follow-up visit to the site in 2024. Unfortunately, the area is one that would be subject to future disturbances due to the location being adjacent to the Saipan shipping channel. Indeed, in 2016, the *Lady Carolina* and in 2018, the *Grand Mariana* vessels grounded on the other side of the lagoon closer to Garapan. These concurrent ship grounding events cemented the need to continue to prioritize the ability of the local government to respond quickly and efficiently to various marine disturbances alongside federal and NGO partners, as well as the community.

In response, since 2014 the CNMI government has evolved in a number of respects, with the hiring of a Restoration Coordinator who is dedicated to coordinating restoration actions, and the hiring of technical staff who are trained in restoration methods, both who regularly attend trainings in order to gain experience in response and restoration, and represent the CNMI in various working groups of the USCRTF who share information and knowledge on their response activities in their jurisdictions. There is now a coral culture nursery located further to the North East of the location of the *Paul Russ* grounding site, and a quarterly Restoration Working Group meeting of restoration practitioners who share updates on their work. The CNMI has taken tangible steps to improve coordination and response to marine disturbances, with an update to the draft Restoration Action Plan from 2021 forthcoming.

Further, in 2024, then-Governor Arnold I. Palacios signed E.O. 2025-001 declaring Coral Reefs of the CNMI as Critical Natural Infrastructure due to their value in providing coastal protections, among many others. The DLNR, which has in 2025 absorbed the CRI program that was formerly based at BECQ during the initial grounding, has prioritized at the direction of leadership the promulgation of regulations of the P.L.20-79 the "Coral Reef Protection Act" of 2018, which would be another tangible step in the right direction for the CNMI in addressing future ship groundings, marine disturbances, and harms to coral reef and marine resources.

The Physical Environment

The purpose of this section is to provide a general description of the environment encompassing the geographic area where the incident occurred, where the Trustees conducted assessment activities related to the incident, and where the Trustees propose to conduct compensatory restoration.

Coral reefs are dynamic and highly variable environments, as well as among the most productive of marine ecosystems and critically important for the ecosystem services they provide. These services include providing habitat and food for thousands of species of fish, shellfish, and other marine life and maintaining important ecosystem functions and processes. In addition to their exceptionally important ecological role, coral reefs also provide numerous human use values. These include, but are not limited to: shoreline protection (through dissipation of wave energy); habitat for reef and pelagic fish species (providing human food/subsistence as well); being an environment for recreation and economic activities derived from diving, snorkeling, and other opportunities and associated economic benefits; in addition to their current and potential medicinal and technological uses (Barry et al. 2015).

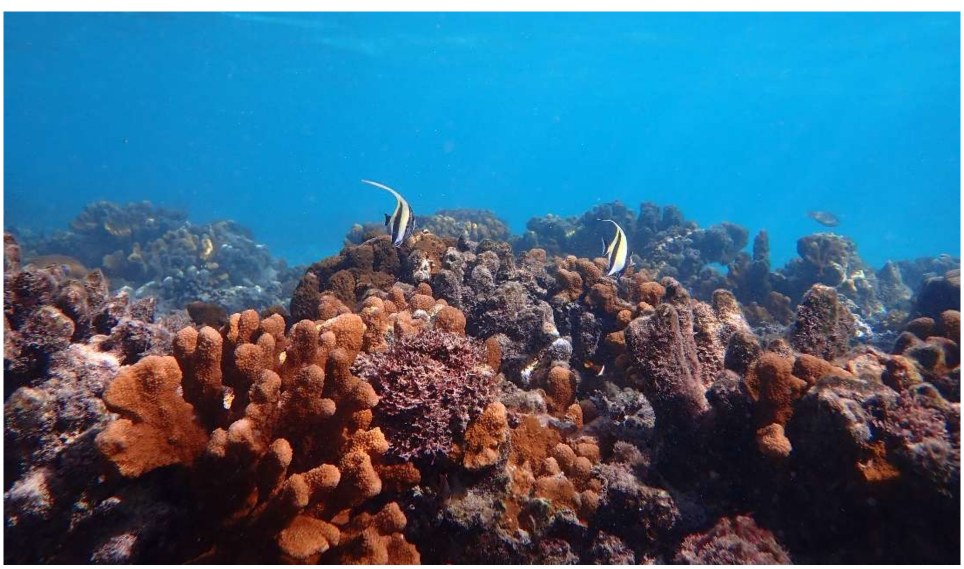

Photo 3. a healthy coral reef within the Saipan West Lagoon, November 2024. Credit: Olivia Banez.

Saipan island in the Commonwealth of the Northern Mariana Islands (CNMI), is located at approximately 15° 11' North latitude and 145° 43' East longitude. The CNMI are a group of fourteen islands, aligned north-south in a chain 708 kilometers (440 miles) long. Saipan, the largest island in the group is the capitol, with a majority of the government, business and in 2020, over 90% of the CNMI's resident population base (U.S. Census Bureau, 2020). Saipan is roughly 20.1 kilometers (12.5 miles) long and 8.9 kilometers (5.5 miles) wide, though the width differs throughout the length. Offshore to the West coast, there is a broad, shallow lagoon sheltered from the ocean by a barrier reef with numerous patch reefs, seagrass, mangrove, and other coral reef associated environments within. The lagoon is broadest and deepest immediately north of American Memorial Park at Puntan Muchot where the distance from the shore to the barrier reef is about 3 kilometers (2 miles) and the maximum water depth is about 12 to 15 meters (40 to 50 feet). A wide pass interrupts the barrier reef offshore and the commercial harbor and entrance to the Saipan shipping channel are located in this area, taking advantage of the reef pass. To the south and north, the lagoon transitions into a fringing reef from 0.5 to 1.3 kilometers (0.3 to 0.8 miles) wide with water depths typically less than 3 meters (10 feet).

A fringing coral reef and offshore barrier reef off the leeward (West) coast of Saipan create the Saipan Lagoon, which encompasses approximately 51.5 km2. The southern portion of Saipan Lagoon is referred to as Garapan Lagoon, while the northern portion is referred to as Tanapag Lagoon. Tanapag Lagoon is separated from the Philippine Sea by a long barrier reef about 3.2 km offshore at the entrance to Tanapag Harbor. The width of the lagoon created by the barrier reef ranges from less than 150 m to over 3.2 km, with the Mañagaha Island to the North West inner corner formed by the deposition of sand from the current and sediment dynamics. Water depths in Tanapag Lagoon range from 1 to 12 m, with maximum water depths in the Tanapag Channel (Sea Engineering, Inc., 2019).

Saipan's lagoon and fringing reef afford it some protection from coastal inundation as wave energy dissipates on the outer reefs and across wide stretches of the shallow lagoon; however, a number of channels and breaks in the reef allow wave energy to pass through in select locations (Green & Skeele, 2014).

Wind, Waves, Surge

While the tradewind waves predominantly approach from the East, typhoon and storm waves can and do approach from other directions. Even though typhoon and storm waves occur less frequently and for shorter durations, their force can cause backshore inundation, flooding, and rapid shoreline recession, such as within the Garapan Lagoon. These forces collectively have influence on nearshore and shoreline dynamics. Although the leeward (West) coast of Saipan is partially sheltered by a wide barrier reef, fringing reef, and shallow lagoon, the shoreline is still vulnerable to forces created by large waves during typhoons and high surf events. The windward (East) coast of Saipan is more exposed and vulnerable to inundation and storm surge as prevailing tradewinds and storms typically approach from an easterly direction. The windward (North East) coast also lacks a protective fringing reef in many areas.

A 2019 hydrodynamic study of Saipan lagoon found that although there may be many driving factors to circulation over a reef environment, waves are usually the dominant forces. Other factors such as wind, tides, and buoyancy forcing can influence flows throughout the lagoon, but are typically not the main driving factors. Waves outside of the grounding site generally run predominantly from the east-northeast and have a significant wave height (Hs) less than 2.4 m (8 ft) occurring 87 percent of the time (Sea Engineering, Inc., 2019).

Tides, Currents, Seasonal Variability

The tides in Saipan waters are semi-diurnal, with pronounced diurnal inequalities (two tidal cycles each day with the range of high and low water levels being unequal). The mean tide range is .45 m (1.5 ft), with a maximum diurnal range of .67 m (2.2 ft). According to "Sailing Directions of the Pacific Islands", "in the vicinity of Saipan the flood current generally sets westward and the ebb current eastward (NGA, 2017).

The tidal currents usually turn at the times of high and low water. The tidal currents in Saipan Channel set northwest at 2.5 knots (1.3 m/s) on the rising tide, and southeast at 1.25 knots (0.6 m/s) on the falling tide. During the Northeast Trades, the tidal currents set northwest almost continuously at a rate of 2.5 to 4 knots (1.3 to 2.0 m/s). The ebb current is hardly noticeable at this time. Though current flow directions reverse regularly with the periodicity of the semidiurnal tide, flows in the shipping channel have been reported to be as high as 3 to 4 knots (1.5 to 2.0 m/s) (Sea Engineering Inc., 2019).

Due to natural and human-induced weather variations, rainy/typhoon season and summer/dry season have been fluctuating somewhat, with more frequent and extreme typhoons and precipitation events, and periods of drought (Green & Skeele, 2014). Between January to April, tradewinds are stronger and steadier, and light and variable winds with intermittent trades occur during the summer and typhoon season between September to December.

The Cultural and Human Environment

As far back as 1500 B.C., those who call the CNMI and Saipan home have depended upon the coral reef and marine resources for survival; as a source of nourishment, culture, and recreation (Carson, M. 2020; Russell, S., 1998). Today this dependence continues, with the addition of economic activities such as tourism and fisheries. Fishing derbies, in particular, as well as families fishing for fiestas and gatherings are a key facet of life for many residents.

Photo 4. a talåya fisherman walks along the beach in Garapan, November 2024. Credit: Devon Lombard Hensley.

Although Saipan is the largest island protected by a barrier reef, its size and elevation advantage does not excuse it from climate impacts. This is especially true of the island's West side, where a coastal plain hosts the majority of its coastal populations, services and infrastructure (Green & Skeele, 2014). According to NOAA's recently released National Coral Reef Monitoring Program Socioeconomic Monitoring Summary Findings, CNMI residents depend on the continued access to the ocean's resources for subsistence, recreation, cultural practice, and much more. Key findings include:

- Activity Participation: Over 70% of CNMI residents participated in beach recreation and swimming/wading in both 2016 and 2024, and participation in most activities increased from 2016 to 2024.
- Seafood: Nearly all (98%) residents consumed seafood in at least some of their meals on average, and 84% of those residents ate seafood from local coral reefs.
- Importance of Coral Reefs: Over 80% of residents believed that CNMI's coral reefs were extremely important for coastal protection, food, and human health. Two-thirds of residents also believed that coral reefs were important for cultural events (such as fiestas and ceremonies) and for establishing or maintaining social relationships and family ties.
- Support for Management Strategies: At least 80% of residents supported active coral reef restoration, community participation in marine resource management, new requirements for improved wastewater treatment, and increased restrictions on coastal development.

Overall, the results of the study indicate that CNMI's residents are active marine resource users who have integral connections with coral reefs and rely on these ecosystems for a variety of social, economic, and cultural benefits (M.E. Allen, 2024).

The other side of having a beach and ocean-going public is also pertinent. According to the Saipan Shoreline Access and Shoreline Enhancement Assessment (SASEA) of 2018, drownings are a common cause of death in the waters of Saipan. Drownings are particularly common in areas that are subject to strong rip currents, which are the major cause of drowning in the CNMI. Rip currents are very common in Saipan Lagoon. The Department of Public Safety, Boating Safety Section is responsible for responding to any water related incidents. Such incidents include drowning, near drowning, missing divers/fishermen, overdue divers/fishermen, boat accidents, jet ski accidents, capsized vessels, distressed vessels, grounded vessels, and so on. There were no lifeguards, lifeguard towers, education signage, or rescue tubes observed at any of the beaches included in the 2018 SASEA (Sea Engineering Inc., 2018), however these reasons make it even more important that the proposed restoration actions be implemented due to the importance of maintaining boating access and emergency services for the island of Saipan.

The Biological Environment

Saipan's coral reef ecosystems consist of fringing reefs and a lagoon system with a barrier reef. The main shipping channel to the Port of Saipan passes through the central Saipan Lagoon, which consists of a system of patch reefs and breaks in the barrier reef. A 2019 report on the Value of Coral Reef and Seagrass Ecosystems of the CNMI reported that these environments generate an annual value of $104.5 million annually for coral reefs, and $10.3 million annually for seagrass habitat, combined for a total of $114.8 million in ecosystem services for the CNMI (Eastern Research Group, 2019). Ecosystem services are intrinsically tied to the biodiversity and ecosystem functions provided by the biological habitat. For these reasons, it is important to characterize the benthic habitat of the grounding site and contrast it with long term data in order to show if any recovery is occurring.

Briefly, in 2014, the hull of the M/V *Paul Russ* came in contact with four elongated patch reef formations in this area (~70-100 m long and 12-25 m wide), just inshore of the channel. The grounding affected the following natural resources:

- Coral colonies
- Three-dimensional reef structure
- Reef habitat
- Marine fish
- Marine Invertebrates
- Marine algal communities

The hull of the grounded ship was oriented perpendicular to the patch reefs at a heading of approximately 150°. The hydrodynamic forces from the ship's propeller caused a "blow hole" and a sediment and rubble debris field across low-relief hard bottom habitat. The depth of the impacted area ranged from 15-30ft.

Although pre-grounding ecological data does not exist for the grounding site, the BECQ Marine Monitoring Program has three long-term monitoring sites in the near vicinity: Managaha Patch Reef, Outside Garapan, and Akino Reef. Overall, although reefs in this area are adjacent to the main shipping port for Saipan and the population center of Garapan, monitoring data indicate that there has been moderate improvement to key reef health attributes over the last decade (see Johnston et al. 2015).

Benthic Conditions

The seafloor in the vicinity of the *Paul Russ* grounding is generally characterized as sand, rubble, and unconsolidated substrates. A total of 61 species of scleractinian (stony) coral, from 27 genera, were recorded during a thorough search of the impacted and reference patch reef and low-relief hard-bottom habitats associated with the grounding site, with 67 species of fish recorded (Johnston et al. 2015), a number of marine macroinvertebrates, and algae. Crustose coralline algae, which forms a habitat which attracts coral recruits, were also impacted by the site. Despite the efficient salvage operation, the direct impact of the ship pulverized approximately 1800 m^2 of patch reef habitat, including an estimated 15,000 coral colonies, including ~500 colonies greater than 25cm in size and ~41 colonies greater than 50cm in size (Johnston et al. 2015).

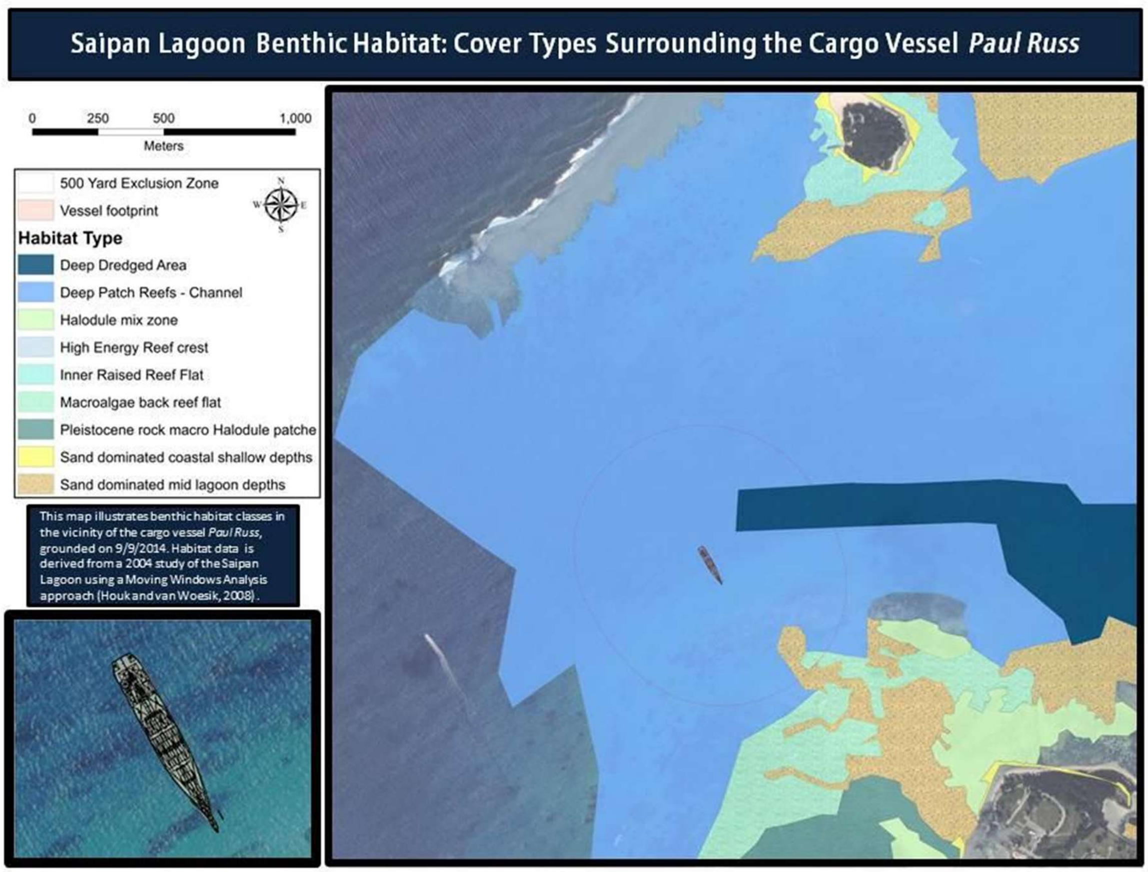

Figure 3. Saipan Lagoon Benthic Habitat Cover types surrounding the Paul Russ grounding site. Provided by Steve McKagen, NOAA PIRO.

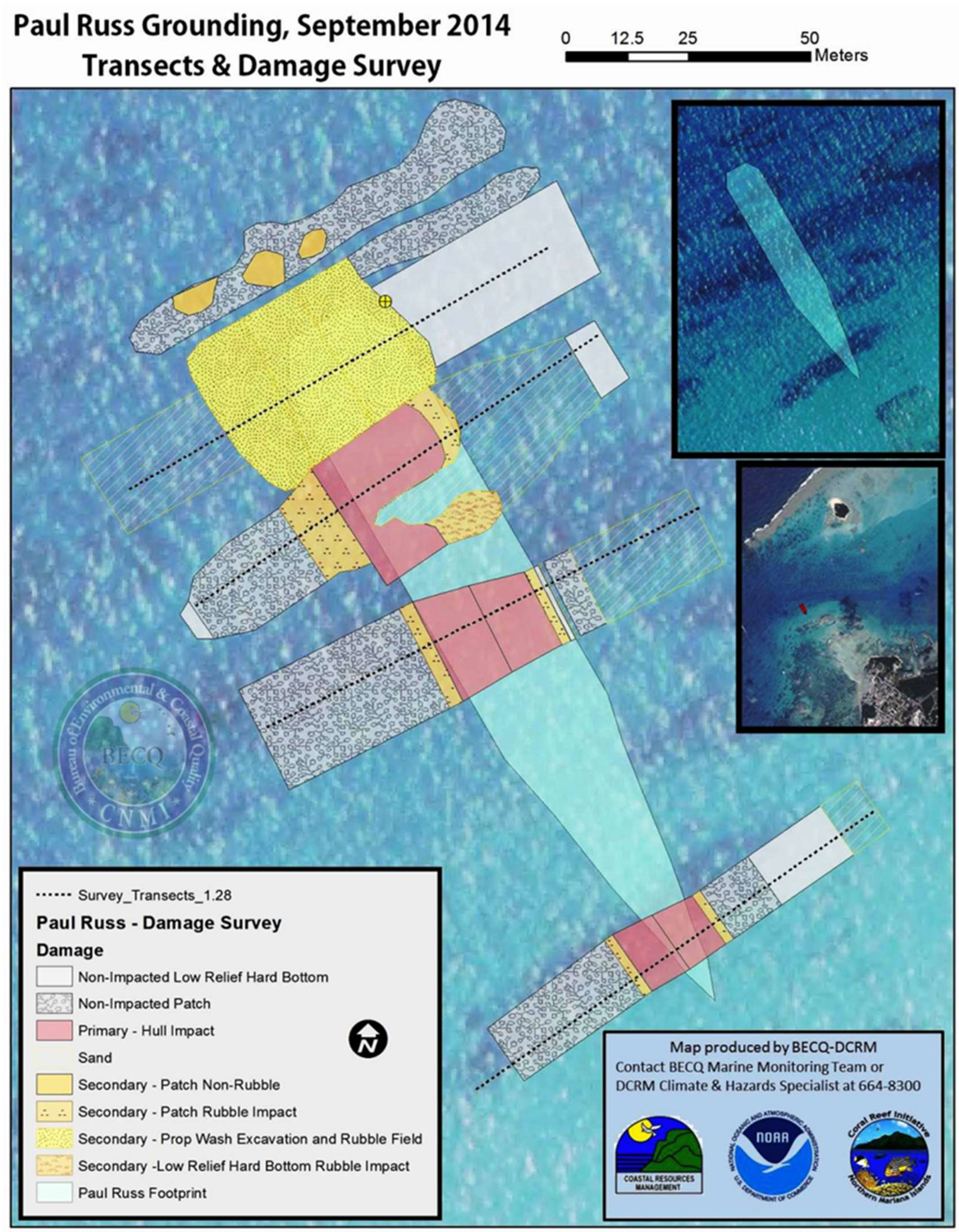

Figure 4. ***Paul Russ Grounding Transects and Damage Survey map, from Johnston et al. 2015. Provided by Steve McKagen, NOAA PIRO.***

Data on coral cover near the two long term marine monitoring sites monitored by the Coral Reef Initiative's Long Term Marine Monitoring Team in the area was observed to have experienced a marked decline since the 2014 grounding (MMT Data, 2025), however some coral cover recovery was also observed to be on the rise since after the 2017 coral bleaching event, as evidenced by Figure 5 below.

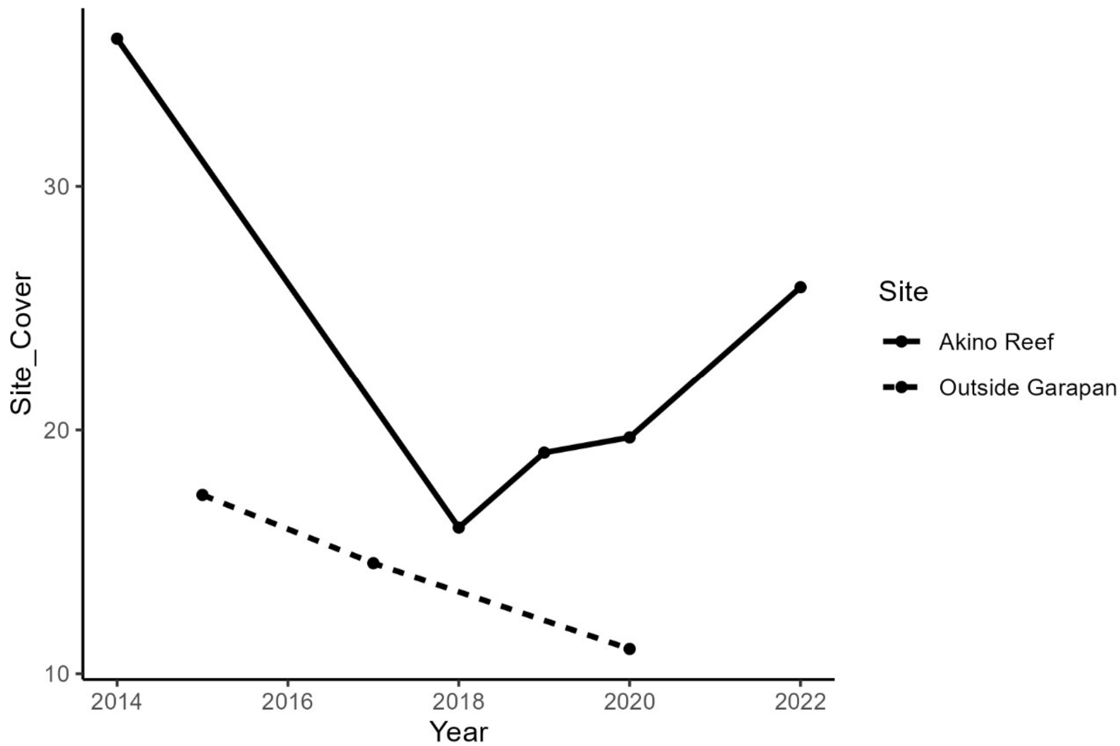

Figure 5. ***Benthic coral cover percentage from two nearest sites to the Paul Russ Grounding, Akino Reef and Outside Garapan Reef. The graph clearly shows a marked decline in coral cover percentage. Provided by Frank Villagomez and the CNMI MMT, 2025.***

Threatened, Endangered and Protected Species

The 2015-2025 State Wildlife Action Plan lists three species of coral as protected. They are:

- *Acropora globiceps*, a Federally protected species listed as Endangered
- *Acropora retusa*, a Federally protected species listed as Threatened
- *Seriatopora aculutea*, a Federally protected species listed as Threatened

Further, these vertebrate marine species also have Federal protected status:

- *Chelonia mydas*, or the green sea turtle, a Federally protected species listed as Endangered and by the CNMI as Threatened
- *Eretmochelys imbricata bissa*, the hawksbill sea turtle, a Federally protected species listed as Endangered and by the CNMI as Threatened

(Liske-Cark, J. 2015). These are the only marine species that may possibly be found within the vicinity of the *Paul Russ* grounding site, if at all, however none of these species were found to be within the vicinity (Johnston et al. 2015).

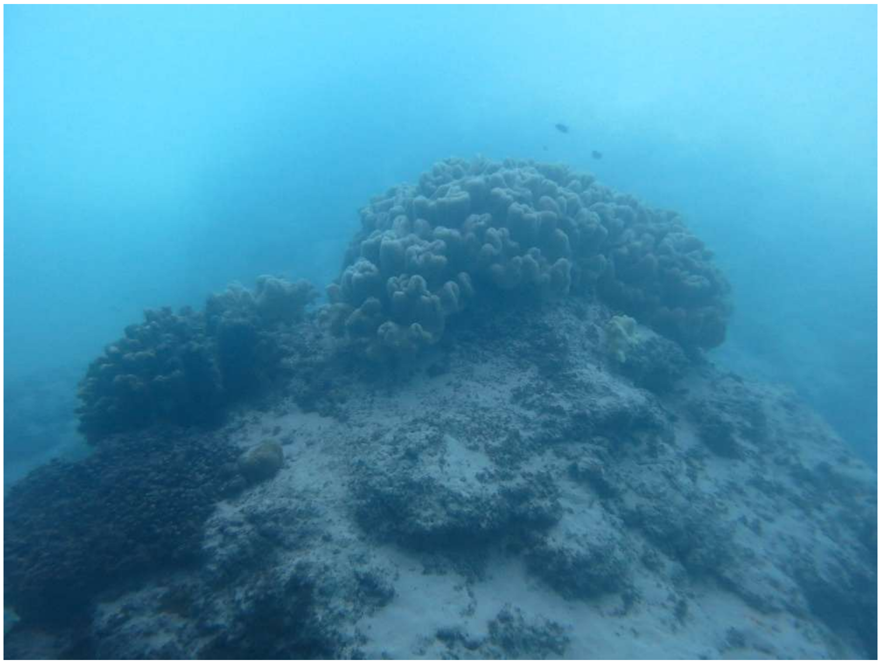

Photo 5. a photo of the reef in the nearby vicinity of the Paul Russ grounding site, September 2014. Credit: CNMI CRI

RESTORATION PLANNING

The objective of the restoration planning process is to identify objectives to restore, rehabilitate, replace or acquire natural resources and their services equivalent to natural resources injured or lost as a consequence of disturbances, such as the *Paul Russ* ship grounding. Due to the Oil Pollution Act (OPA) being triggered, OPA regulations were applicable to this incident. Under OPA, trustees can recover the cost of:

- primary restoration, which is any action, including natural recovery, that returns injured natural resources and services to baseline
- compensatory restoration, which is any action taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery
- reasonable assessment costs

OPA defines natural resources to include "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the exclusive economic zone), any State or local government or Indian tribe....” 33 U.S.C. § 2701(20); see also15 C.F.R. § 990.30.1

As described in the OPA Natural Resource Damages Assessment regulations (OPA regulations), a natural resource damage assessment (NRDA) consists of three phases –preassessment, restoration planning, and restoration implementation.

The preassessment is an information gathering phase, during which the trustees determine whether they have jurisdiction to pursue restoration under OPA, and if so, whether it is appropriate to do so. Specifically, before initiating an NRDA, the trustees must determine that:

- an incident has occurred;
- the incident is not from a public vessel;
- the incident is not from an onshore facility subject to the Trans-Alaska Pipeline Authority Act;
- the incident is not permitted under federal, state or local law; and
- public trust natural resources and/or services may have been injured as a result of the incident.

The restoration planning process may involve two components: primary restoration, and compensatory restoration, as mentioned previously. For the *Paul Russ* ship grounding site, remedial actions undertaken in 2014 and 2015 by Sea Byte Inc. were taken to protect the resources in the vicinity of the site from future harm, better allowing the natural resources to return to their baseline conditions as a result of this restoration. These actions included the triage of coral colonies of specific size classes in the area, hull paint removal from the reef, removal and consolidation of rubble to the extent practical, and temporary coral reattachment.

Natural Recovery/No Action Alternative

Due to these appropriate restoration and mitigation actions taken at the time, the Trustees deemed it unnecessary to plan for further primary restoration, preferring to allow for natural recovery of the site.

OPA regulations require that a “natural recovery” option be evaluated. Under the No Action/Natural Recovery alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services. In lieu of direct action, the Trustees would rely on natural processes of recruitment and growth for recovery of the injured natural resources including, but not limited to, corals, algae, fishes, sessile invertebrates and coralline algae. There are several advantages to natural recovery as primary restoration. The principal advantages would be simplicity of implementation and no cost. Because an injured area or species is expected to recover naturally, it may make sense to, in essence, “let nature take its course.”

The Trustees first note that, in this case, No Action/Natural Recovery would occur in an environment where emergency restoration, which is effectively the same as primary restoration, has already taken place. In other words, these alternatives could more accurately be described as considering whether the Trustees should take additional primary restoration action. As discussed below, **the Trustees have determined that natural recovery with yearly monitoring would be appropriate as ongoing primary restoration for coral reef resources at the injury site**.

However, adopting only the No Action/Natural Recovery approach would fail to meet the purpose and need discussed above. With even the most effective and fast-acting primary restoration, there will always be some period of interim loss between injury and full recovery. In this case, natural resource losses were, and continue to be, incurred by the public during this period of recovery from the grounding event. While full natural recovery is expected to occur eventually, the public would not be compensated for the interim losses under the no action alternative. Therefore, a no action alternative (natural recovery) would have to be coupled with other restoration actions to fully restore lost interim services.

Accordingly, this Final Restoration Plan addresses only compensatory restoration actions.

Compensatory Restoration Alternatives

When planning for restoration alternatives, the Trustees have kept these factors in mind:

- Cost to carry out alternative
- Extent to which alternative will return resource to baseline/compensate for interim losses
- Likelihood of success
- Extent to which the implementation of the alternative will avoid collateral injury to natural resources
- Benefit to more than one resource or service
- The effect of the alternative on public health and safety

In addition, the No Action Alternatives were considered as part of OPA regulations. These criteria were evaluated against the No Action Alternatives in order to better assess the viability, success, and impacts and outcomes of choosing one alternative over others.

The preferred compensatory restoration actions are to: allocate a majority of the fund to the Smiling Cove Marina sand spit emergency dredging project, allowing for the possibility of changing circumstances in the case of change orders and other unforeseen expenses and circumstances. For reference, the Scope of Work for the emergency dredging activities may be found in Appendix 1-E.

Other compensatory restoration actions may be found further below.

Evaluation Criteria for Preferred Alternatives

Consistent with NRDA regulations and NOAA guidance, the following criteria were used to evaluate restoration project alternatives and identify preferred actions for implementation under this plan:

1. Cost to carry out alternative

2. Extent to which alternative will return resource to baseline/compensate for interim losses
3. Likelihood of success
4. Extent to which the implementation of the alternative will avoid collateral injury to natural resources
5. Benefit to more than one resource or service
6. The effect of the alternative on public health and safety

The NRDA regulations give Trustees discretion to prioritize these criteria and to use additional criteria as appropriate. In light of this, the Trustees also propose a 7th criterion:

7. The capability of the CNMI to implement the alternative (in a timely manner)

In developing this Restoration Plan, the Trustees gave weight to 1, 5 and 6 and 7 most.

Preferred Compensatory Restoration Alternative 1

Photo 6. Approaching the Smiling Cove Marina sand spit from the South American Memorial Park and Micro Beach shoreline, November 2024. Credit: Anna Rothstein, DOI.

Photo 7. a panoramic view of the Smiling Cove Marina's current boating access pathway to the Garapan Lagoon, September 2025. Credit: Kalani Reyes.

Smiling Cove Marina's Sand Spit Emergency Dredging activities have been identified as a priority action for the CNMI. The following table addresses each criterion against a No Action Alternative.

Table 1. Evaluation Table for Preferred Restoration Alternative 1

Smiling Cove Emergency Dredging Activities		
1	Cost to carry out alternative	At minimum, $193,000 with the possibility of more expenses incurred should circumstances change. This alternative may further include monitoring with the possibility of adaptive management should the injured natural resources fail to meet expected recovery projections or additional resources become available.
2	Extent to which alternative will return resource to baseline/compensate for interim losses	The alternative is intended to address the smothering of sensitive seagrass, coral, and mangrove habitat within the vicinity of the SCM sand spit and marina. According to Johnston et al. 2016's HEA, compensatory mitigation for the habitat area that was unavailable during the recovery period was calculated to be **1,035.93m^2** of reef. Sea Engineering 2024 estimated the SCM sand spit to occupy 1,812 cubic meters of sand occupying a **2,716m^2** area, however this amount includes a stretch of berm which was left out of the calculations for the cost of emergency dredging in order to address the boating channel access as a priority. Because sand is not equivalent to reef in terms of ecosystem services and function, a habitat equivalency analysis cannot be performed for this alternative. However, the extent to which the alternative may compensate for interim losses is great, due to the impacts of the sand berm on seagrass habitat in the nearby vicinity. If left unchecked,

		the sand spit also will have an impact on the seagrass, mangrove habitat and corals within the harbor, as it will soon restrict the flow of water between the lagoon and the inner marina, having a negative effect on all three habitats in the vicinity. Against a No-Action alternative, the negative effect of taking no action would not compensate the public for their interim loss and would further reduce or compromise the public's access recreationally, economically, and safety-wise.
3	Likelihood of success	Due to the urgency and routine nature of this need, the likelihood of success for this alternative is high. The CNMI government previously dredged this area in 2005 and as directed by CNMI leadership, the political support to accomplish this project is high. Against a No-Action alternative, the likelihood of success of this action would be high. Taking no action would not adversely impact the success of this alternative.
4	Extent to which the implementation of the alternative will avoid collateral injury to natural resources	Estimates of dredging by potential stakeholders to clear the boating channel access way were 6,000 cubic yards/4,590 cubic meters of dredged material that will be removed. Although this dredging will have short term, temporary, negative impacts to natural resources in the vicinity in the short term (diminished water quality), in the long term this alternative will substantially benefit nearby resources. If no action were taken, the sand spit will eventually cut off water exchange between the outer and inner marina and lagoon, resulting in decreases in dissolved oxygen levels, resulting in mass mortality of corals, fish, invertebrates, and other organisms within the marina. It has also been growing at a pace quick enough to smother the seagrass habitat to the outskirts of the sand spit, causing further injury to the natural resources in the Saipan lagoon. Against a No-Action alternative, taking no action will have less collateral injury to natural resources in the short term, but in the long term have larger and more pronounced negative effects on the public and environment's wellbeing.
5	Benefit to more than one resource or service	Ecosystem services provided by implementation of the restoration alternative—the emergency dredging of the SCM, are numerous. 1. **Ecosystem integrity**—ensuring the connectivity of the ecosystem (Garapan Lagoon to the inner SCM)

		will benefit from the proposed dredging activities. Mangroves, seagrass, and corals will continue to be connected once the channel's depth is restored. Fish pathways will be restored, and fish, rays, and turtles will be able to move between habitats once more. 2. **Shoreline protection** will be reduced, due to the re-opening of the access channel allowing for further transportation of the sand, however as this is to ensure boating access, it is not counted as negative in this case. 3. **Recreational and commercial opportunities** will continue to occur and be enjoyed by the public as boating channel access will be restored by the implementation of the proposed dredging activities. 4. **Fisheries** will be positively impacted as the organisms within the vicinity of the SCM will not be disconnected from the lagoon. Fish will be able to continue coming and going from the lagoon to the marina for feeding, and fishers will benefit. Although organisms in the vicinity will be negatively impacted in the short term during the course of the dredging, over the long term these impacts are outweighed by the benefits. 5. **Research, monitoring, and restoration** activities will resume as the practitioners will be able to have access to the nurseries located in the lagoon during all tides and not just high tides as a result of the proposed dredging activities. 6. **Public safety** will be substantially increased as a result of the channel access being restored by the proposed dredging activities. Against a No-Action alternative, the public will not be able to avail of these additional benefits and restoration of ecosystem functions and services.
6	The effect of the alternative on public health and safety	Public safety will be substantially increased and safeguarded as a result of the channel access being restored by the proposed dredging activities. This is due to the sand spit posing a navigational hazard in the area to boaters and possible economic damage to vessels if boaters choose to continue using the impeded channel caused by the impact of taking no action, due to the SCM being one of the only approved mooring areas for recreational, commercial, government, and emergency vessels.

		Public health in the short term may be negatively impacted by the proposed dredging activities due to air and water quality impacts and loss of public access to the marina over the span of the proposed dredging activities for safety reasons, however these are substantially outweighed by the benefit to the public's health and safety over the longer term. Against a No-Action alternative, taking no action would result in reduced public safety and health in both the short term and long term.
7	The capability of the CNMI to implement the alternative (in a timely manner)	The Office of the Governor and Trustees have convened multiple working group meetings in the past two years (2024-2025) in order to address the proposed SCM emergency dredging activities and the encroaching sand spit that grows larger each day. Due to the importance of this and the substantial resources and staff time that have already been pledged by the Division of Parks and Recreation staff, Department of Public Lands, U.S. Navy SeaBees, National Park Service, Division of Fish and Wildlife Fisheries Section, and other heads of local and federal government agencies, the CNMI has demonstrated that it is capable and eager to implement this restoration alternative of emergency dredging, once a suitable funding source is located. Against a No-Action alternative, taking no action would not affect the CNMI's ability to implement this alternative.

The Trustees have determined that the situation at the Smiling Cove Marina and American Memorial Park sand spit has grown in urgency and are moving to prioritize the usage of the Paul Russ Restoration Fund to fund emergency dredging activities in order to address a number of issues associated with the growing sand spit. This action also follows a number of management recommendations included in other plans created as far back as 2018, such as the Saipan Shoreline Access and Shoreline Enhancement Assessment (SASEA) which recommended the CNMI dredge the AMP shoreline in order to maintain safe boating and navigational access, among other reasons (Sea Engineering Inc., 2018).

Site Specific Information for Restoration Alternative 1

A fringing coral reef and offshore barrier reef off the leeward (West) coast of Saipan create the Saipan Lagoon, which encompasses approximately 51.5 km2. The southern portion of Saipan Lagoon is sometimes referred to as Garapan Lagoon, while the northern portion is referred to as Tanapag Lagoon. Tanapag Lagoon is separated from the Philippine Sea by a long barrier reef about 3.2 km offshore at the entrance to Tanapag Harbor. The width of the lagoon created by the barrier reef ranges from less than 150 m to over 3.2 km. Water depths in Tanapag Lagoon range from 1 to 12 m, with maximum water depths in the Tanapag Channel.

Garapan Lagoon is bounded by a shallow fringing reef that extends 500 to 1,500 m offshore. The inner portion of Garapan Lagoon consists of a shallow reef flat with water depths ranging from 1 to 2 m.

The seafloor in the inner lagoon floor is relatively flat and is predominantly characterized as sand with macroalgae, scattered coral rubble, and seagrass (NCCOS, 2017). Common seagrass species include *Halodule universis* and *Enhalus acoroides*.

Photo 8. Enhalus seagrass located just outside of the Smiling Cove Marina, within the Garapan lagoon area. Credit: Anna Rothstein, DOI.

These environments are important because corals, mangroves, and seagrass provide fertile areas for commercial fish species to forage as well as a nursery habitat. They further function as carbon sinks. In this way, the mangroves and seagrass beds in the vicinity of the SCM play a vital role in the biological communities in Saipan's lagoon. In some parts of the lagoon, seagrass beds provide a valuable service as a buffer for beaches from increased wave energy and increasing resilience to potential coastal erosion (Guannel, et al. 2016), and for the island of Saipan, the mangroves located around the AMP are some of the only remaining stands in the CNMI.

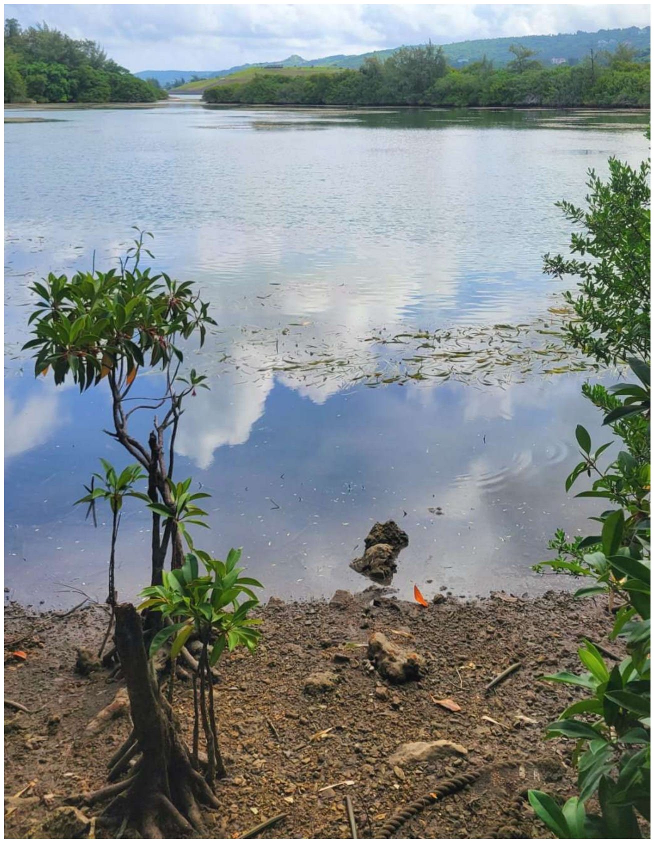

Photo 9. a photo of mangrove and seagrass habitat located on the opposite side of the Smiling Cove Marina, September 2025. Credit: Kalani Reyes

According to the Saipan Lagoon Beach Restoration Feasibility Study of 2024, the shoreline of this area is very sensitive to typhoons. Significant shoreline change has been observed following typhoons from 2017 to 2022. During these events, the southern profile eroded up to 10.6 m (35 ft), the central (point) profile accreted up to 18.3 m (60 ft), and the northern profile accreted up to 21.4 to 36.6. m (70 to 100 ft) (BECQ, 2022). This area has historically received attention due to the necessity of the Marina among other reasons. The report states: the sand spit currently abuts the navigation channel that provides vessel ingress/egress at Smiling Cove Marina. PCRP staff reported that the public has expressed concerns that continued accretion could infill into the channel and inhibit safe navigation. This is currently the situation the CNMI faces today. After reviewing a series of historical maps and aerial photographs, the table below was created (Sea Engineering, 2024).

Table 3-1. History and evolution of the sand spit at American Memorial Park

Year	Observations
1949	The sand spit was not present in 1949, at which time the shoreline was oriented at approximately 45° NE, and Smiling Cove Marina was protected by a continuous structure or land mass that was attached to the shoreline at American Memorial Park. There was no beach or sand spit present along the shoreline at this time.
1999	The initial stage of progradation is visible in maps and aerial photographs from 1999, at which time the structure or land mass at the west end of Smiling Cove Marina was no longer present. A beach had formed along the northern shore of American Memorial Park and the shoreline was oriented at approximately 20° NNE. A sand spit with an estimated area of 6,500 m^2 (1.6 acres) was present at the east end of the beach. At this time, the maritime forest at American Memorial Park began to expand onto the sand spit.
2005	The second stage of progradation is visible in an aerial photograph from 2005. The beach along the northern shore of American Memorial Park had prograded to the north and the shoreline was oriented at approximately 0° N. The estimated area of the sand spit increased to 21,500 m^2 (5.3 acres). At this time, the maritime forest was fully established over the entire area of the sand spit.
2023	The third stage of progradation is visible in an aerial photograph from 2023. The estimated area of the sand spit increased to 33,000 m^2 (8.5 acres).
2024	The fourth and final stage of progradation was confirmed during field investigations in April 2024. The estimated area of the sand spit increased to 35,716 m^2 (8.8 acres). The sand spit currently abuts the entrance channel to Smiling Cove Marina. Any additional progradation would be expected to infill into the channel.

Table 2. (Table 3-1) from the Saipan Lagoon Beach Restoration Feasibility Study by Sea Engineering, 2024. p.30

The report also used air jet probe measurements and AutoCAD to create a 3-dimensional (3D) digital surface model, enabling sand volume calculations. Sand volumes for the sand spit were calculated to contain a volume of 1,812 cubic meters of sand occupying 2,716 square meters (Sea Engineering Inc., 2024), with the volume estimates presented assumed to be conservative.

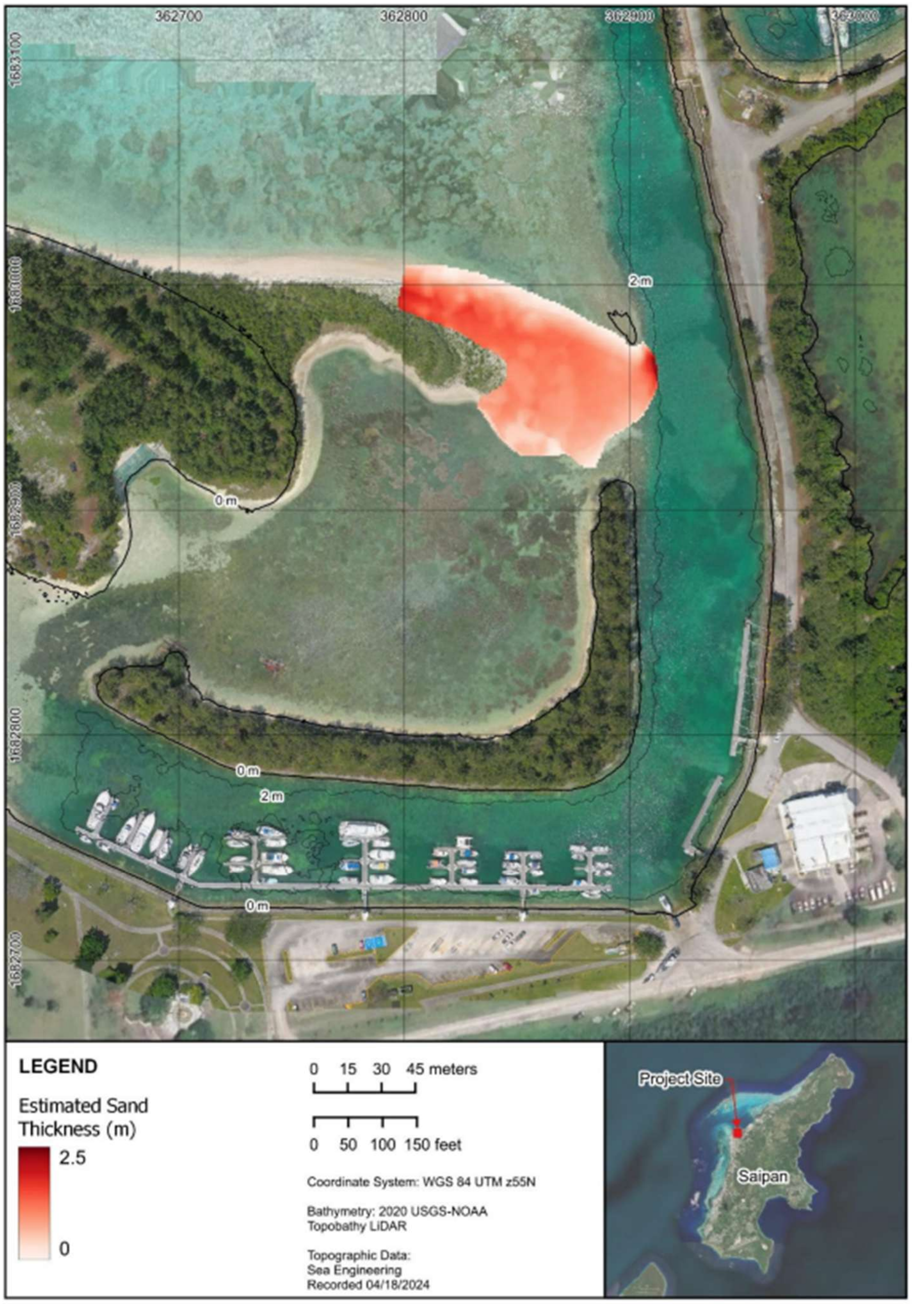

Figure 6. Estimated sand thickness at the American Memorial Park/Smiling Cove Marina sand spit with the area estimated highlighted in shades of red. Figure 4-5 from the Saipan Lagoon Beach Restoration Feasibility Study, 2024. p. 43

Further, according to the DCRM's 2022 Shoreline Monitoring and Beach Profile Report for Saipan and Mañagaha, the preferred restoration area is dynamic. The hydrodynamics are complex due to interactions between nearshore patch reefs, interactions of the hydrodynamics of the Smiling Cove Marina infrastructure, and the main shipping channel.

Photo 10. a photo of the Smiling Cove Marina's current boating access channel taken in the middle of an outgoing tide, with a white arrow indicating the channel's width, September 2025. Credit: Kalani Reyes

Site-specific, smaller scaled nearshore dynamic modelling may help bring better understanding of long-shore processes, but overall a troubling pattern has emerged: sand from the south generally shifts to the north, with some sand returning to the south and most headed for the north during regular and irregular weather and wave patterns. Particularly troubling is the observation of the growing shoreline of AMP North Points 1 through 3, which has been observed to have grown over 110 ft/33.5 m since 2017, a number which has undoubtedly been surpassed since the time of the report published in 2022 (BECQ, 2022).

Photo 11. A DFW Fisheries vessel enters the Smiling Cove Marina through what remains of the narrow boating channel access way during the construction activities of 2024, November 2024. Credit: Devon Lombard-Hensley.

Figure 7. Profile of the AMP South 1 and North sites with yellow arrows showing typhoon wave direction, from DCRM's Shoreline Monitoring Beach Profile Report for Saipan and Mañagaha, 2022. p.69-70. BECQ 2022.

The report concluded that the AMP North transects (within the National Park Service vicinity) received sand deposition from ongoing longshore transport process. Sand migration from the south of AMP to the northern area facing Smiling Cove was evident after the September 2021 storm. This sand build-up to the North of the AMP North 3 shoreline, also referred to as the Smiling Cove Sand Spit, has been found to smother sensitive *Enhalus* seagrass habitat holding the remaining sand and sediment in place, and has negatively affected the coral reef, mangrove, and sand ecosystems in the nearby area. A study in 2016 found that together, live corals, seagrasses, and mangroves supply more protection services than any individual habitat or any combination of two habitats (Guannel, et al. 2016). This further emphasizes the need to address this issue of the SCM sand spit otherwise the CNMI will further lose out on these ecosystems.

In conclusion, the Trustees propose to commit a majority of the Paul Russ Restoration Fund towards the Emergency Dredging of the Smiling Cove Marina sand spit, a volume of about 1,812 cubic meters of sand occupying a 2,716m^2 area, in order to adequately compensate the CNMI public for the interim loss of the resources at the time of the M.V. *Paul Russ* ship grounding in 2014, allowing room for possible changes in scope and circumstance of the dredging activities as they occur, as well as the inclusion of monitoring and adaptive management should the injured resource fail to meet expected recovery projections or as resources become available.

As one of the Trustees, the DLNR proposes to take the lead on this project with the support of the CNMI Office of the Governor and other agencies and federal partners. Environmental compliance is being coordinated with the assistance of Steve McKagen and the NOAA Pacific Islands Regional Office and USACE as of this writing. Permits and approvals are currently in the process of being acquired in order to expedite this proposed activity, and will be expanded on below in the Environmental Compliance section of this plan and in the Appendix.

Proposed Restoration Alternative Description

In order to compensate the CNMI for its loss and restore the CNMI and public's access to the Smiling Cove Marina boating access pathway, local and federal contractors and vendors will collaborate with the government and construction agents to execute various construction operations. The operations involve the construction of a temporary access path through the American Memorial Park beachside area and in a manner that avoids disturbing habitat but allows for access for the excavating equipment, the mechanical dredging of soft sand to return the channel to its previous depth using crawler excavators (one extended arm, one standard), the relocation and staging of dredged material following BMPs for their storage and disposal/use, and site cleanup once complete. This alternative may further include monitoring with the possibility of adaptive management should the injured natural resources fail to meet expected recovery projections or additional resources become available.

Mission and Proposed Activities:

The local CNMI government, in coordination with contractors, vendors, partners, and construction agents, will complete emergency dredging operations at Smiling Cove Marina. The mission includes:

1. Construction of a temporary access path (18' wide, 800' long).

2. Mechanical dredging of approximately 5,000–6,000 cubic yards of material to a depth not deeper than the access channel was when previously dredged.
3. Relocation of the dredged material to a temporary designated staging location (see below) following BMPs.
4. Cleanup of the site, including removal of all tools, equipment, and control measures.
5. Post-dredging monitoring of the site for recovery

Please see Appendix 1-E for full Scope of Work.

Impacts of Restoration Alternative to Natural and Other Resources

Table 23 - Summary of impacts to Channel Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short Term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Air	Direct	Short-term	Beyond Project Site	Minor	Adverse
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct & Indirect	Short-term & Long-term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Short Term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Short term & Long-term	Localized	Minor & Moderate	Beneficial

8. Summary of Impacts to Channel Restoration Activities, from p. 132 of NOAA RC-PEIS (see Barry, et al. 2015). Note: although these activities were intended for freshwater channel restoration, aspects still may be applicable here.

Emergency dredging activities, similar to "Channel Restoration Construction activities" as referred to in NOAA's PEIS, are the most similar in impacts to the proposed emergency dredging activities. We have modified some of the language in order to better address the adverse and cumulative impacts proposed as restoration alternatives here, as well as to modify it for a marine/saltwater habitat.

Impacts related to the dredging of SCM's boating access channel and nearby habitat can cause direct and indirect, short- and long-term, minor and moderate, localized, beneficial and adverse impacts. Geology, substrates, and marine natural resources would receive direct, short-term, minor adverse impacts due to a temporary increase in turbidity as a result of the restoration activity. Dredging can involve the use of heavy equipment, which could disturb soil and suspend substrates and sediments within the water column. This may also have an adverse effect of increasing erosion in the area of the shoreline, however, due to the need to restore the channel's depth, this will be temporary. While these adverse impacts are possible, they are unlikely to last at the restoration site due to mitigation measures which will be put into place to reduce turbidity during the activities, such as silt curtains. The boating access channel being restored will also have the benefit of flushing water throughout the marina and back into the lagoon, so impacts of turbidity are unlikely to last. Direct, long-term, moderate beneficial impacts (including increased water flow, water oxygenation and restored fish and vertebrate access pathways and habitat, habitat connectivity, and increased depth for vessels and organisms) would likely be the predominant result from this restoration activity. This alternative may further include monitoring with the possibility of adaptive management should the injured natural resources fail to meet expected recovery projections or additional resources become available.

Potential impacts to air quality could include direct, short-term, minor adverse impacts to air quality during construction or other on-the-ground activities. These impacts include exhaust emissions from construction equipment, on-road hauling, construction worker employee commuting vehicles, and fugitive dust emissions from paved roads and earthmoving activities. These impacts may extend beyond the project site but efforts will be taken to minimize them and to comply with Best Practices. Proposed emergency dredging activities would cause direct and indirect, short- and long-term, minor and moderate, beneficial and adverse impacts to living coastal and marine resources and EFH and threatened and endangered species. Habitat complexity and connectivity promotes higher benthic organism productivity throughout the system, increased feeding opportunities, lowered predation rates on juvenile fish, more suitable spawning substrate, and deeper rearing habitat—conditions that are beneficial to living coastal and marine resources and EFH, and threatened and endangered species. In-water restoration construction activities could cause temporary alteration of EFH and disruption or mortality of living coastal marine resources and threatened and endangered species. Due to this potential, in-water restoration projects may be limited to work windows when low flow conditions are present at the project site, and when the least number of ESA species are present in the project area. In-water emergency dredging activities could have direct, minor, short- and long-term adverse impacts on cultural and historic resources if unknown sites are disturbed during construction. These impacts will be avoided by avoiding known historic or cultural sites, and stopping project activities should previously unknown sites be uncovered. However, as this activity has been performed before in 2005 with only one historic underwater property located to the North of the Marina (outside of the scope of the proposed activities), and due to the activities being limited to the sand spit, this is unlikely.

The proposed emergency dredging activity will also have direct, short- and long-term, minor and moderate adverse and beneficial impacts to land use and recreation because increases in recreational opportunity will likely occur in the project area and beyond in the marina and Garapan Lagoon in the long term; however, short-term use may be curtailed during construction activities. Increased fishing pressure may occur in the short and long term. Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. The emergency dredging activities included in this analysis are designed to restore and maintain safe vessel and navigational access, restore ecological function and habitat connectivity, and are planned and designed with those principles in mind. Appendix 1-F contains Suggested Best Management Practices for Proposed Dredging Activities which will be provided to the contractors beforehand.

Non-Preferred Restoration Alternative

The Trustees have agreed that the non-preferred restoration alternative would be the equivalent of a No Action Alternative, as that alternative would leave the public uncompensated for the loss of their natural resources as well as jeopardize their safety, allow the exponential growth of a navigational hazard, and impede upon economic, cultural, recreational, scientific, and commercial activities of the CNMI.

Key Statutes, Regulations, Policies

Two major federal laws guiding the restoration of the injured resources and services from the *Paul Russ* incident are OPA and NEPA. OPA and its natural resource damage assessment regulations provide the basic framework for natural resource damage assessment and restoration. NEPA, as a procedural law, sets forth a specific process of impact analysis and public review. In addition, the Trustees must comply with other applicable laws, regulations and policies at the federal, state, and local levels. Hereafter, when referencing the “State”, it will be referring to the CNMI. Although we are a Commonwealth, for the purposes of these acts, the CNMI is treated as a State.

Key potentially relevant laws, regulations and policies are set forth below. This listing is not necessarily exclusive, as there may be other laws, regulations or policies with which the Trustees will need to comply.

Environmental Compliance

Oil Pollution Act of 1990 (OPA), 33 U.S.C. §§ 2701, et seq.; 15 C.F.R. Part 990

OPA establishes a liability regime for oil spills which injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. Federal and state agencies and Indian tribes act as Trustees on behalf of the public to assess the injuries, scale restoration to compensate for those injuries and implement restoration. Section 1006(e)(1) of OPA,33 U.S.C. § 2706 (e)(1), requires the President, acting through the Under Secretary of Commerce for Oceans and Atmosphere (NOAA), to promulgate regulations for the assessment of natural resource damages resulting from a discharge or substantial threat of a discharge of oil. Assessments are intended to provide the basis for restoring, replacing, rehabilitating, and acquiring the equivalent of injured natural resources and services.

The OPA regulations provide a framework for conducting sound natural resource damage assessments that achieve restoration. The process emphasizes both public involvement and participation by the responsible party(ies). The Trustees have followed the regulations in preparing this assessment.

National Environmental Policy Act (NEPA), as amended, 42 U.S.C. §§ 4321, et seq. 40 C.F.R. Parts 1500-1508

U.S. Congress enacted NEPA in 1969 to establish a national policy for the protection of the environment. NEPA applies to federal agency actions that affect the human environment. NEPA established the Council on Environmental Quality (CEQ) to advise the President and to carry out certain other responsibilities relating to implementation of NEPA by federal agencies. Pursuant to Presidential Executive Order 11514, federal agencies are obligated to comply with the NEPA regulations adopted by the CEQ. These regulations outline the responsibilities of federal agencies under NEPA and provide specific procedures for preparing environmental documentation to comply with NEPA. The Trustees have integrated this restoration plan with the NEPA process to comply, in part, with those requirements. This integrated process is recommended under §1500.2 “Integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively.”

The Trustees have integrated the federal and state environmental review requirements as they have proceeded with restoration planning and implementation.

Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. §§ 1801 et seq.

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires federal fishery management plans to describe the habitat essential to the fish being managed and describe threats to that habitat from both fishing and non-fishing activities. In addition, in order to protect this Essential Fish Habitat (EFH), federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. The Trustees determined that implementing the proposed restoration would not adversely affect any designated EFH, and NOAA has completed an EFH consultation with the PIRO Habitat Conservation Division.

Endangered Species Act (ESA), 16 U.S.C. §§ 1531, et seq., 50 C.F.R. Parts 17, 222, 224

The ESA directs all federal agencies to conserve federally listed endangered and threatened species and their habitats, and encourages such agencies to utilize their authorities to further these purposes. Under the Act, the NOAA Fisheries and the USFWS publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these two agencies to minimize the effects of federal actions on endangered and threatened species.

The Trustees have determined that implementing the proposed restoration would not be likely to adversely affect any listed species, and conducted an informal section 7 consultation, although the activities may temporarily affect the habitat of specific listed species (*Chelonia mydas*, or green sea turtle). A concurrence with this determination was received from the Pacific Islands Regional Office (PIRO) Protected Species Division.

Fish and Wildlife Coordination Act (FWCA), 16 U.S.C. §§ 661, et seq.

The FWCA requires that federal agencies consult with the USFWS, NMFS, and state wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license or review requirements and the Trustees have received concurrence from the Pacific Islands Regional Office (PIRO) Protected Species Division for the proposed activities.

Coastal Zone Management Act (CZMA), 16 U.S.C. §§ 1451, et seq., 15 C.F.R. Part 923 and CNMI BECQ Area of Particular Concern Permit

The goal of the CZMA is to preserve, protect, develop, and where possible, restore and enhance the nation's coastal resources. The federal government provides grants to the states with federally-approved coastal management programs. The CNMI has a federally approved program authorized by CNMI Law (PL 3-47). Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone shall be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the State the opportunity to concur that the project is consistent with the state's coastal policies. The regulations outline the consistency procedures.

The Trustees are in the process of receiving concurrence from the CNMI BECQ-DCRM that the project is consistent to the maximum extent practicable with the enforceable policies of the state coastal program and an APC Permit is in the process of review

Executive Order (EO) 13089 Coral Reef Protection

On June 11, 1998, President Clinton issued EO 13089, Coral Reef Protection, to address impacts to coral reefs. Section 2 of that EO states that federal agency actions that may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems.

Given that this Restoration Plan is designed to offset ecosystem functions and services of the injured coral and coral reef habitat from the *Paul Russ* Grounding, compliance with EO 13089 is inherent within the project.

Archeological Resources and Historical Preservation

Numerous acts afford protection to antiquities, abandoned shipwrecks, archeological resources, historic buildings and historic sites. These include the Abandoned Shipwreck Act of 1987 (43 USC 2102 et seq.), the Archeological Resources Protection Act of 1979 (16 USC 470, et seq.), the Historic Sites Act of 1935 (16 USC 461-467), the Historical and Archeological Data Preservation Act (16 USC 469-469c), and the National Historic Preservation Act of 1966 as amended (16 USC 470-470t, 110) as well as CNMI PL 3-39 or the “Commonwealth Historic Preservation Act of 1982”. This law created the CNMI Historic Preservation Office (HPO) and mandates HPO to preserve the islands' historic and cultural heritage, including archaeological sites and artifacts, and to prohibit their removal. The Act aims to safeguard CNMI's cultural legacy for future generations by promoting public understanding and preventing the destruction of historic properties. Any proposed action that may potentially affect any property with historic, architectural, archeological, or cultural value that is listed on or eligible for listing on the National Register of Historic Places (NRHP) must comply with the procedures for consultation and comment issued by the Advisory Council on Historic Preservation and CNMI HPO, through consultation with the state historic preservation officer.

An underwater archeological survey was conducted for the SCM in 1980, identifying a number of objects associated with WWII. The CNMI Historical Preservation Office identified one Object (referred to as Object #11, a Japanese anti-aircraft gun SP-4-7-0077) during the dredging of the SCM in 1987. While this object is not eligible for the National Register, it is listed on the CNMI Historic Sites Inventory and thus protected Commonwealth law. The Trustees have determined that the emergency dredging will not disturb this object as it is located on the other side of the man-made island created by previous construction activities, on the non-Marina side, nearer to AMP.

Rivers and Harbors Act of 1899 (Section 10)

Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through the Corps of Engineers, for the construction of any structure in or over any navigable water of the United States. Structures or work outside the limits defined for navigable waters of the United States require a Section 10 permit if the structure or work affects the course, location, or condition of the water body. The law applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or any other modification of a navigable water of the United States, and applies to all structures, from the smallest floating dock to the largest commercial undertaking. It further includes, without limitation, any wharf, dolphin, weir, boom breakwater, jetty, groin, bank protection (e.g. riprap, revetment, bulkhead), mooring structures such as pilings, aerial or subaqueous power transmission lines, intake or outfall pipes, permanently moored floating vessel, tunnel, artificial canal, boat ramp, aids to navigation, and any other permanent, or semi-permanent obstacle or obstruction. The Trustees are in the process of receiving concurrence from the USACE that the project is consistent with Section 10 policies.

Clean Water Act, Section 402: National Pollutant Discharge Elimination System

The Clean Water Act (33 U.S.C. § 1251, et seq.) is the principal law governing pollution control and water quality of the Nation's waterways and BECQ's CWA Section 401 Water Quality Section is the State's regulatory authority on the CWA. Section 404 of the law authorizes a permit program for the beneficial uses of dredged or fill material in navigable waters. The U.S. Army Corps of Engineers (USACE) administers the program. Coordination with the Army Corps of Engineers has been completed pursuant to Section 404 of this Act. Joint federal/state permits are in the process of being obtained for this project. All construction activity will be done in compliance with Section 404 of the law.

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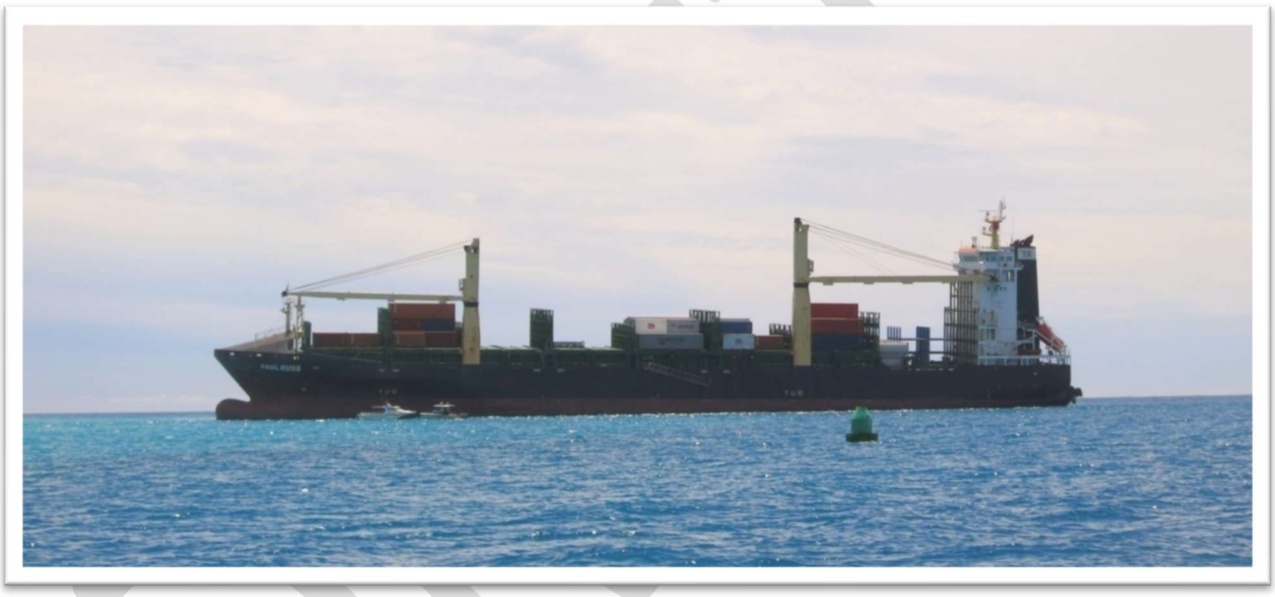
APPENDIX

1-A. 2015 M/V *Paul Russ* Grounding: Draft Natural Resource Damage Assessment Report
(see Johnston et al. 2015 in References for citation)

M/V Paul Russ Grounding: DRAFT Natural Resource Damage Assessment Report

Lyza Johnston, Ryan Okano, Steven Johnson, David Benavente, John Iguel, Robbie Greene, Sean McDuff, Todd Miller, Francisco Villagomez, Steven McKagan, Richard Shaul



Executive Summary

1 Table of Contents

2 Introduction

2.1 Overview of the Incident

On September 9, 2014, the 161 m (536 ft) *M/V Paul Russ* ran hard aground on coral reef habitat just inshore of the channel leading into the Port of Saipan (Figure 1). The ship was laden with shipping containers and an estimated 380,000 gallons of intermediate fuel oil (IFO380). The Unified Command (UC) for the incident was made up of the U.S. Coast Guard Federal On-Scene Coordinator, Commonwealth Ports Authority (CPA), CNMI Homeland Security and Emergency Management (HSEM), CNMI Department of Public Safety (DPS), CNMI Division of Fish and Wildlife (DFW), CNMI Bureau of Environmental and Coastal Quality (BECQ), and a Responsible Party (RP) representative. The UC was based at the CPA Saipan Seaport.

On September 10, the CNMI BECQ Marine Monitoring Team (MMT) and a dive crew representing the RP's designated salvage company, T&T Salvage, independently conducted initial in-water assessments of the ship hull and the surrounding environment using SCUBA. The state of the hull and the impacted reef habitat was documented with photos and videos. The geographic location and footprint of the ship were recorded using a handheld GPS unit from the surface. At that time, divers discovered potential unexploded ordinance on the seafloor near the grounded vessel, approximately mid-ship off the port side and at off the port side of the stern. On September 11, the U.S. Navy Explosive Ordnance Division (USN EOD) arrived from Guam and conducted surface swims followed by an underwater assessment of the ordnance. The EOD determined that the ordnance were largely decayed and unlikely to come in contact with the hull of the ship during removal.

At approximately 11:00 pm on September 11, 2014, at high tide, three tug boats were able to remove the *Paul Russ* from the reef. During the removal efforts, the ship's propeller was engaged to help dislodge and steer the vessel, causing a "blow hole" and a sediment and rubble debris field at the stern of the ship. Although the hull shifted slightly over the course of the two and half days it was aground, movement was minimal and the ship was removed along the same path/heading that it entered, minimizing secondary damage to reef habitat from action of the ship. The hull remained intact throughout, preventing any fuel or hazardous substances from entering the environment.

2.2 Natural Resource Trustees and Coordination with the Responsible Party

The Natural Resource Trustees for the *M/V Paul Russ* grounding include the CNMI BECQ, CNMI Division of Fish and Wildlife (DFW), and the National Oceanic and Atmospheric Administration (NOAA) local field office. For all damage assessment and restoration activities, the Responsible Party (RP) was represented by Sea Byte Inc. The RP representative worked cooperatively with the local Trustees throughout the NRDA.

[Paragraph(s) on legal authority?Applicable statutes and regulations?]

2.3 General Description of the Affected Ecosystem

Saipan's coral reef ecosystems consist of fringing reefs and a lagoon system with a barrier reef. The main shipping channel to the Port of Saipan passes through the central Saipan Lagoon, which consists of a system of patch reefs and breaks in the barrier reef. The hull of the *M/V Paul Russ* came in contact with four relatively small (~70-100 m long and 12-25 m wide), elongated patch reef formations in this area, just inshore of the channel. The hull of the grounded ship was oriented perpendicular to the patch reefs at a heading of approximately 150°. The hydrodynamic forces from the ship's propeller caused a "blow hole" and a sediment and rubble debris field across low-relief hard bottom habitat. The depth of the impacted area ranged from 15-30ft.

Although pre-grounding ecological data does not exist for the grounding site, the BECQ Marine Monitoring Program has three long-term monitoring sites in the near vicinity: *Managaha Patch Reef*, *Outside Garapan*, and *Akino Reef* (Figure xx). Overall, although reefs in this area are adjacent to the main shipping port for Saipan and the population center of Garapan, monitoring data indicate that there has been moderate improvement to key reef health attributes over the last decade. For instance, average coral cover at *Managaha Patch Reef* increased significantly from 2001 to 2012, from 8.82% to 23.10% (two tailed *t*-test; $t[2] = -4.35$, $p = 0.049$). Although *Outside Garapan* has seen an increase in percent cover of encrusting fleshy macroalgae (*Peysonellia* spp.) from 24% to 44% from 2005 to 2011, coral colony density has also increased significantly during this time frame, from 4.65 colonies/.25m^2 in 2006 to 9.5 colonies/.25m^2 in 2011 ($p = 0.003$). *Akino Reef* has remained stable, with minimal change in the ratio of reef accreting substrate (coral and crustose coralline algae) and non-accreting substrate (macroalgae, turf and encrusting fleshy macroalgae) over the past decade, 1.4:1 as of 2011 (MMT Data) and no change in coral colony density.

3 Emergency Restoration

Several actions were taken after the grounding incident, prior to any final restoration efforts, to reduce further damage to reef habitat and loss of coral. These actions included coral triage, hull paint removal, rubble removal, and temporary coral reattachment. Sea Byte Inc. was primarily responsible for completing these emergency restoration activities with oversight and pending approval from the local Trustees at each step. All necessary permits for emergency restoration efforts were obtained through DFW by Sea Byte, Inc.

3.1 Coral Triage

3.2 Hull Paint Removal

3.3 Rubble Removal

3.4 Temporary Coral Reattachment

4 Damage Assessment

4.1 Methods

4.1.1 Habitats Impacted and Area of Injury

The local Trustees conducted initial in-water assessments on September 16-17, 2014. During these assessments, divers searched the surrounding areas for any secondary damage that might have occurred as a result of the grounding and removal efforts. Several buoys were deployed to mark key points of impact. The locations of the buoys and other key reference points (e.g. WWII torpedo at the stern) were then marked at the surface using a handheld GPS unit. The broader impacted area was also outlined using GPS at the surface. The impacted and surrounding areas were documented with photos and videos.

The Trustees determined that two main habitat types were impacted by the *Paul Russ* grounding and removal; Patch Reef (PR) and Low Relief Hard-Bottom (LRH) habitats. Patch reefs are defined as raised (> 0.5 m) carbonate reef structures surrounded by sand and low-relief hard bottom habitat (Figure xx).

Low-relief hard bottom areas were defined as a mix of low-relief (< 0.5 m) pavement, sand, and rubble (Fig xx). Injury was categorized into primary injury from direct contact with the hull (Hull) and secondary injury sustained from rubble and sediment debris (Rub) and the hydrodynamic forces of the propeller (Prop) as the ship was being removed from the reef (Figure xx).

The dimensions of each of the hull scars and secondary impact areas were measured using transect tapes. The relative locations of the injured areas were determined using distances and headings from the geo-referenced points. Photoquadrats taken along four, 100 m transect lines laid out along known headings and distances from geo-reference points were used to further refine boundaries of impacted areas. Injury areas were then mapped and measured using ArcGIS software.

Figure xx. Representative images of non-impacted reference patch reef (top; PRRef) and low-relief hard bottom (bottom; LRHRef) habitats.

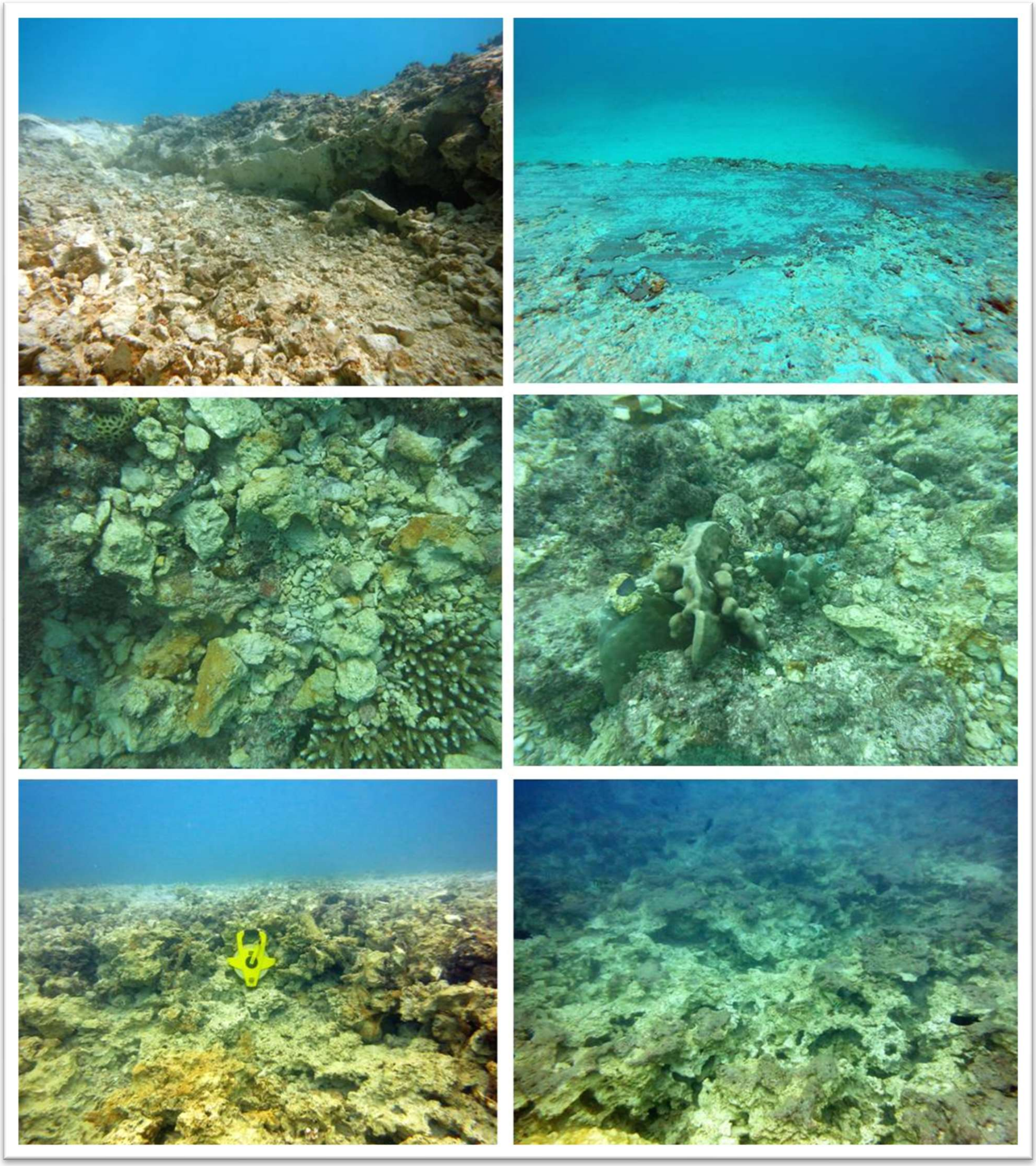


Figure xx. Examples of primary hull impact on patch reef habitat (PRHull; top), secondary rubble and debris impact on patch reef habitat (PRRub; middle), and secondary prop-wash impact on low-relief hard-bottom habitat (LRHProp; bottom). Hull paint is visible in the foreground of the top right photograph.

4.1.2 Biological Communities

The biological assessments were conducted along the four 100 m long transect lines laid out roughly centered on and perpendicular to the long axis of the hull scar. The transect lines were numbered 1-4, from southeast (inshore; bow impact) to northwest (offshore; stern/prop-wash impact). Lines 1-3 ran along the length of the impacted patch reef formations and into adjacent habitat areas and line 4 transected low-relief hard bottom and sand habitats impacted by the hydrodynamic forces of the propeller (Figure xx). The depth at the top of the patch reefs increased slightly from inshore to offshore; ranging from 4 m (line 1) to 6 m (line 3). Line 4 was at a depth of 8.7 m.

4.1.2.1 Benthic Cover

Photoquadrats were taken every meter along each transect. For photoquadrat analysis, the transect lines were blocked by distance, habitat type, and type of injury. Photoquadrats were nested within blocks. All blocks were 10 m in length except for one of the PRRub blocks (Block 3-1, Figure xx), which was 5 m in length due to the small size of the impacted area. Blocks were separated from each other by at least 2 m.

Using the program CPCe v.4.1, 16 points were digitally overlaid on each 0.25m^2 photo in a stratified random array. The type of biota or substrate under each point was identified to the lowest taxonomic level possible and grouped into one of the following main categories: Coral, Crustose Coralline Algae (CCA), Macroalgae (> 2 cm), Turf Algae (< 2 cm), Sediment (thin layer of sediment over hard substrate), Sand, Pavement, Damaged Reef Substrate (DRS), and Other. Damaged reef substrate included crushed, scraped, fractured, and excavated corals or reef framework.

4.1.2.2 Corals

Coral species richness at the site level was determined by swimming the length of the impacted and adjacent reference areas and recording all coral species observed. Cryptic species were searched for and identified within a total of 48 0.25m^2 quadrats, which were tossed haphazardly along the length of each transect.

Coral abundance and size class distribution were quantified using photoquadrats and video belt transects. Transects were blocked by distance, habitat type, and injury type, as above. All visible corals < 25 cm (maximum linear dimension) within each photoquadrat were identified to the genus, measure to the nearest 0.1 cm using the software ImageJ, and categorized by growth form (encrusting, small branching, large branching/columnar, free-living, or massive). Frame grabs of video transects were used to identify and measure all colonies over 25 cm within the 10 m x 2 m (or 5 m x 2 m for Block 3-1) video belt transects.

4.1.2.3 Algae

All algae species present within 0.25m^2 quadrats, which were tossed haphazardly along the length of each transect, were identified to the highest taxonomic level possible to provide a measure of community composition and species richness of algae. Patch reef reference (PRRef) transects were represented by 1C, 2C, and 3C (Figure xx). Patch reef hull impact (PRHull) transects were represented by 1B, 2B, and 3B. Low-relief hard-bottom reference (LRHRef) transects were represented by 1A and 4A and low-relief hard bottom propeller wash impact (LRHProp) was represented by transect 4B. Four quadrats were assessed for each transect except for 1A (LRHRef) which only had two quadrats assessed due to smaller relative area. Algal richness was not assessed in the PRRub impact areas due small size and uncertain boundaries of PRRub sites during algal surveys.

4.1.2.4 Fish

Within PRRef, PRHull, LRHRef (line 4 only), and LRHProp areas, fish surveys were conducted along 25 m belt transects. The survey diver swam at a constant height over the 25m transect and recorded all fish within 2.5 m on either side of the transect to the lowest taxonomic level while noting their abundance and fork length (cm).

4.1.2.5 Non-coral macro-invertebrates

Along the 25m fish transects, select non-coral macro-invertebrates within 2.5 m on either side of the belt (total 125 m^2) were identified to the lowest taxonomic level, counted, and measured (cm). If encountered, species from the Class Holothuroidea were measured from the mouth to the anus, species from the Class Asteroidea were measured from the mouth to the end of one arm, and species from the Classes Crinoidea, Ophiuroidea, Echinoidea, and Cephalopoda were counted individually. Bivalves were measured across the mantle. For Gastropods, the diameter of the base of the shell was measured. Length was estimated for species from the Class Scyphozoa from the base of the bell to the tip of its tentacle. Species from the Phylum Arthropoda were measured by carapace length when easily caught or estimated when immeasurable. All other macro invertebrate types were counted.

4.1.2.6 Statistical Analyses

We used a combination of multivariate and univariate analyses to evaluate the impact of the *Paul Russ* grounding on biological communities. Because sample sizes were necessarily small and the risk associated with making a type I error was low, we used an α of 0.10 to assess significance for all pair-wise comparisons between reference and impact sites. Because abiotic factors (e.g. depth, current regime, geomorphologic structure, etc.) varied little across the impacted area within habitat types, samples from different transect lines within HabitatxImpact groupings were treated as replicate samples and pooled.

4.1.2.6.1 Benthic cover

To validate our initial habitat and impact designations, we evaluated levels of dissimilarity in benthic cover composition using one-way Permutational Multivariate Analysis of Variance (PERMANOVA) with HabitatxImpact groupings as a factor. A significant test was followed by a canonical analysis of principal coordinates (CAP) to visualize groupings. Pair-wise one-way PERMANOVA tests were then conducted to test for differences in benthic cover composition between reference and impact areas within habitat types. The Aitchison (1986) centered log-ratio transformation for compositional data was applied to percent cover data prior to analysis using the software CoDaPack (ref). PERMANOVA tests were based on a Euclidean distance matrix and 10^5 permutations. Monte Carlo simulations were performed where actual permutations were low.

Crustose coralline algae (CCA) are important for reef health; they contribute to reef accretion/habitat formation and are a preferred settlement substrate for scleractinian corals. We thus used t-tests to test for significant differences in percent cover of CCA between reference and impact areas within habitat types. Proportion data were arcsine transformed to conform to statistical assumptions.

4.1.2.6.2 Corals

For both habitat types (PR and LRH), differences in coral size-class distribution between impact and reference samples were evaluated using one-way PERMANOVA with type (reference vs impact) as a factor. Coral abundances were expressed as densities (number per m^2) to account for differences in sample areas and the hierarchical size-class sampling scheme. Coral density values were Log(y+1) transformed and processed using Bray-Curtis similarity coefficients and a dummy variable of 1. Monte Carlo simulations were run for pair-wise comparisons where actual permutations were low due to small sample sizes.

We hypothesized that the nature of incident related sediment, rubble, and debris would disproportionately affect small colonies and encrusting colonies in the secondary rubble impact patch reef areas (PRRub). To test these hypotheses, we conducted a PERMANOVA as above to test for differences in coral size-class distribution of encrusting corals only, and a t-test to test for a difference in the density of small colonies (< 5 cm) between PRRef and PRRub sample areas. For the t-test, density data were log transformed prior to analysis in order to conform to statistical assumptions.

4.1.2.6.3 Algae

The first analysis of algal richness was between PRRef and PRHull. This demonstrates the impact to algal richness that occurred when the ship's hull went aground and settled on three patch reef segments. No difference (ANOVA, $p = 0.604$) was found between the PRRef transects, as a result they were pooled for an n of 12 (four quadrats per transect, three PRRef transects). Data from the PRHull transects were similarly treated (ANOVA, $p = 0.965$). Normality was established for this data set, therefore a T-test followed.

The second analysis of algal richness was between LRHRef and LRHProp. This demonstrates the impact to algal richness that occurred from the propeller wash that occurred when the ship was removing it's self from the reef. No difference (T-test, $p = 0.555$) was found between the LRHRef transects, thus they were pooled for an n of 6 (two quadrats for transect 1A and four quadrats for transect 4A). LRHProp is represented by only one transect and four quadrats ($n = 4$) hence no pooling occurred. Normality could not be established for this data set, therefore the Mann-Whitney Rank Sum test followed.

When carrying out the algal community analysis pooling of data followed the algal richness analysis, except in the case of PRRef. At the community level transect 1C was significantly different from transects 2C (PERMANOVA pair-wise test, $t = 1.877$, $p = 0.023$) and 3C (PERMANOVA pair-wise test, $t = 1.576$, $p = 0.030$), however no difference was detected between 2C and 3C (PERMNOVA pair-wise test, $t = 1.476$, $p = 0.092$) for that reason only 2C and 3C were pooled under label PRRef ($n = 6$). Transect 1C was still included in the analysis and labeled PRRef1C ($n = 3$). No significant difference was found between the PRHull transects (PERMANOVA main test, pseudo-f = 0.554, $p = 0.658$) therefore this data set was pooled. It is important to note that an outlier was removed from PRHull for an n of 11. No alga was detected within the quad of the outlier, giving it an extremely polarizing effect on the community analysis, if included. Data within LRHRef was pooled due to a lack of difference between transects 1A and 4A (PERMANOVA main test, pseudo-f = 0.937, $p = 0.481$), for an n of six. LRHProp is represented by only one transect and four quadrats ($n = 4$) hence no pooling occurred. Then PERMANOVA pair wise tests were performed between PRRef and PRHull, and PRRef1C and PRHull to assess the impact to algal communities that occurred when the ship's hull went aground and settled on three patch reef segments. A PERMANONA pair wise test was also used to between LRHRef and LRHProp to determine the impact to the algal community that occurred from the propeller wash that occurred when the ship was removing it's self from the reef. The Bray Curtis similarity resemblance measure was calculated prior to the PERMANOVA. Results from the community analysis were visually represented by a Canonical Analysis of Principal Coordinates (CAP) plot. Algal vectors at the 0.7

correlation level were included on the CAP plot to demonstrate which algal species were contributing to similarity within regions of the plot.

4.1.2.6.4 Fish

A *t*-test was used to test for an overall difference in fish abundances between impacted and reference patch reef areas (PRHull and PRRef, respectively). Data conformed to statistical assumptions and were therefore not transformed prior to analysis. PERMANOVA was used to assess differences in fish community composition (species abundances) between PRRef and PRHull sites. Statistical comparisons between LRHRef and LRHProp could not be carried out due to lack of replication.

4.1.2.6.5 Non-coral macroinvertebrates

4.1.2.7 Estimated Losses

When pair-wise comparisons between reference and impact sites were significant, the difference between the mean values per unit area was used as an estimate of loss due to the grounding incident.

4.1.3 Physical Reef Structure

4.1.3.1 Rugosity

Rugosity was estimated as the ratio of contoured distance to linear distance (Risk 1972). Contoured distance was measured by serially deploying a 9 m chain with 1 cm links across the substrate for 20 linear m across each PRRef and PRHull transect (n = 3 each) and then dividing the total contoured chain length by 20 m.

The prop-wash from the ship's propeller excavated an area of rubble and low-relief hard bottom at the stern of the ship, creating a "blow hole" and increasing the three dimensional structure. Because the area is a topographic low and prone to high sedimentation, we did not measure rugosity as the excavated area was likely to quickly fill back in.

4.2 Results

4.2.1 Area of Injury

Based on *in-situ* geo-referenced measurements and desktop spatial analysis using ArcGIS, we determined that a total area of 3,168 m^2 of benthic habitat was impacted by the *Paul Russ* grounding. A total of 1,785 m^2 of patch reef habitat was affected by either primary hull impact (1,358 m^2) or secondary rubble/debris impacts (427 m^2) while 1,383 m^2 of low-relief hard-bottom habitat was affected by secondary impacts from the hydrodynamic forces of the ship's propeller during removal (Table xx).

Table xx. Injury areas for primary and secondary impacts of the M/V *Paul Russ* grounding incident.

Habitat Type	Primary Impact (m^2)	Secondary Impact (m^2)	Total (m^2)
Patch Reef	1,358	427	1,785
Low-relief Hard-bottom	N/A	1383	1,383
Total	1,358	1,810	3,168

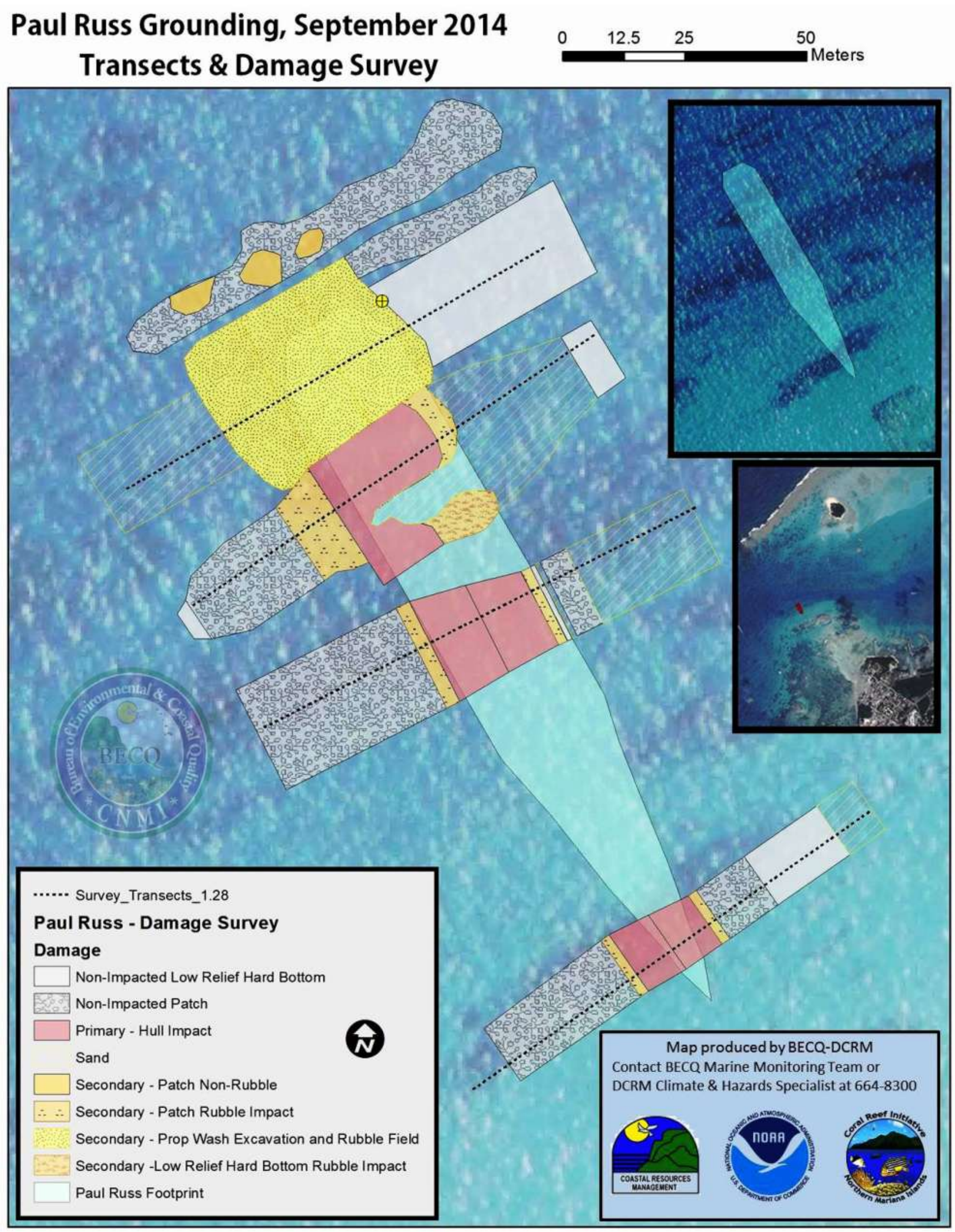


Figure 1 Location of the M/V Paul Russ ship grounding in the Saipan Lagoon (inset) and impact area map

4.2.2 Biological Communities

4.2.2.1 Benthic cover

Patch reef reference areas (PRRef) were dominated by turf algae, CCA, and macroalgae, and had coral cover of ~5% (Fig. xx). Low-relief hard-bottom reference areas (LRHRef) were dominated by turf algae and sediment, followed by CCA. Not surprisingly, primary hull impact areas (PRHull) and the low-relief hard bottom area impacted by the propeller (LRHProp) were dominated by damaged reef substrate. The patch reef areas impacted by rubble and sediment debris were dominated by damaged reef substrate and turf algae, followed by low cover of macroalgae, CCA, and coral (Fig. xx).

PERMANOVA analysis indicated that there was a significant effect of HabitatImpact designation on benthic cover composition (PERMANOVA: Pseudo-$F = 5.68$; $p < 0.001$; Table xx). Subsequent pair-wise tests revealed significant differences between PRRef and both primary and secondary patch reef impact areas (PRHull & PRRub) and between LRHRef and LRHProb areas (Table xx).

CAP analysis confirmed and provided visualization of these groupings and identified the benthic components associated with them (Fig. xx). The first three axes (CAP 1, CAP 2, & CAP 3) explained 81% of the variation in the data. The correlations of each of the major benthic categories with the first three canonical axes are reported in Table xx.

T-tests revealed that percent cover of CCA varied significantly between PRRef and PRHull ($t[12] = 7.17$; $p < 0.0001$), between PRRef and PRRub ($t[9] = 3.11$; $p = 0.006$), and between LRHRef and LRHProb areas ($t[3] = 2.82$; $p = 0.033$; Fig. xx).

Table xx. Results of PERMANOVA test for differences in benthic cover composition among HabitatxImpact groupings. Bold values are statistically significant.

Source	df	SS	MS	Pseudo-*F*	*P*(perm)	perms	*P*(MC)
HabitatxImpact	4	1555.7	388.94	5.6841	**< 0.0001**	92881	**<0.0001**
Residuals	16	1094.8	68.426				
Total	20	2650.6					

Table xx. Results of pair-wise PERMANOVA tests for differences in benthic cover composition between impact and reference areas. Bold values are statistically significant.

Groups	*t*	*P*(perm)	perms	*P*(MC)
LRHRef, LRHProp	2.3665	0.1001	10	**0.0336**
PRRef, PRHull	3.1401	**0.0005**	2000	**0.0003**
PRRef, PRRub	1.6098	**0.0905**	55	**0.0745**

Table xx. Correlations with canonical axes 1, 2, and 3 for each of the major benthic categories

	CORAL	OTHER	MA	TURF	CCA	PAV	SED	SAND	DS
CAP1	0.3528	-0.0441	0.8678	0.3096	0.3930	0.2959	0.3342	-0.1598	-0.9557
CAP2	-0.6645	-0.7033	-0.2556	0.1781	-0.2189	0.0739	0.6941	0.8664	-0.1471
CAP3	-0.1397	-0.3219	-0.0315	-0.1171	0.3316	0.8533	-0.4785	-0.3274	0.2353

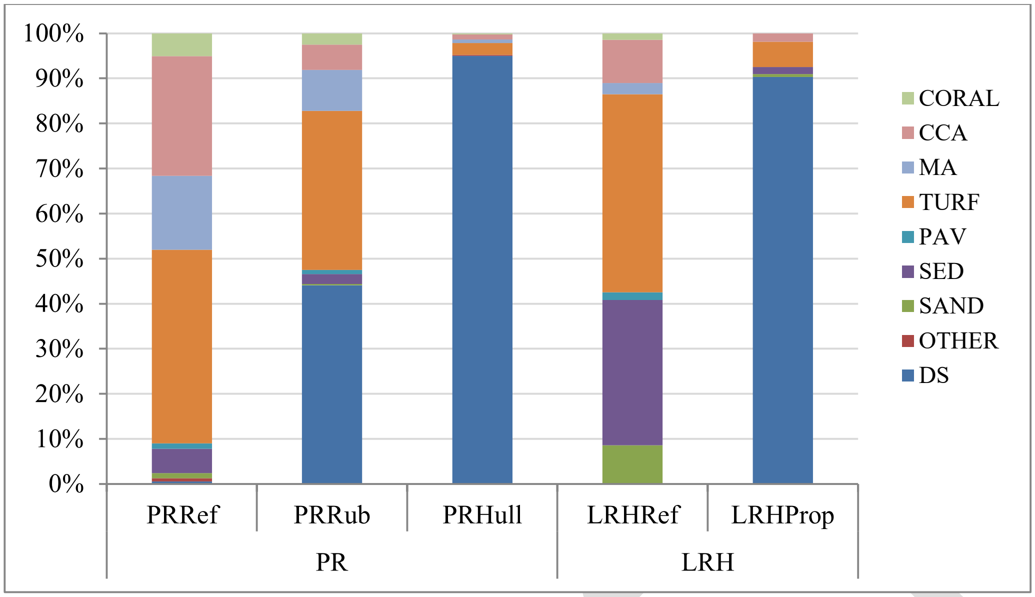


Figure xx. Benthic percent cover

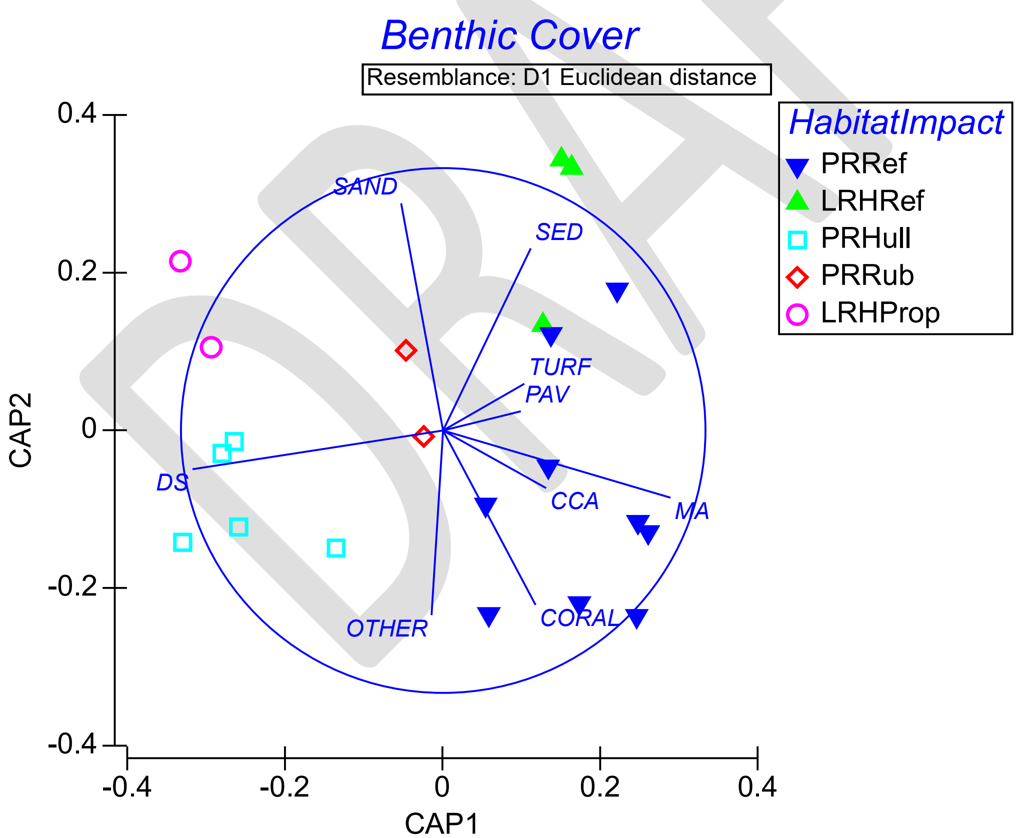


Figure xx. Canonical analysis of principal coordinates (CAP) graph showing benthic cover groupings and vectors based on correlations between the first two canonical axes and the benthic cover variables.

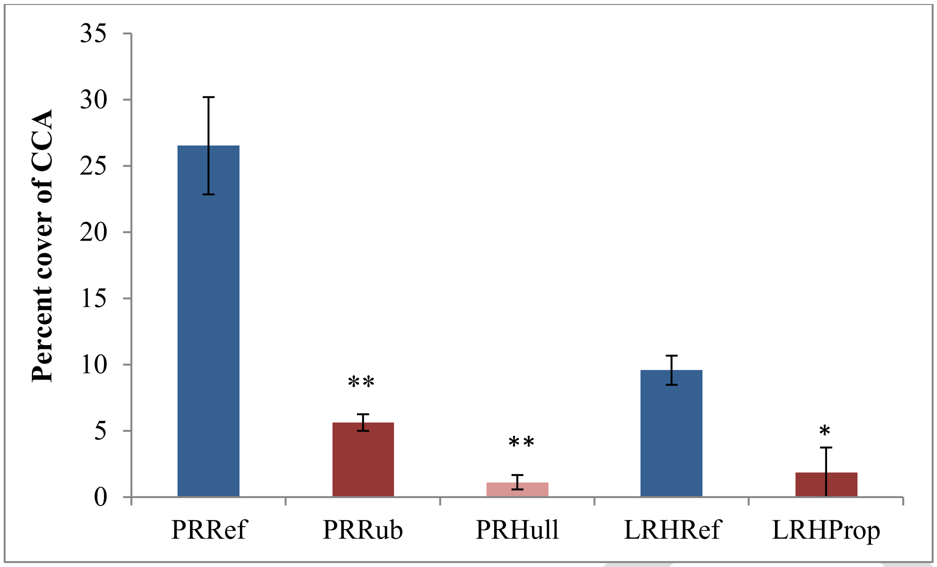


Figure xx. Percent cover of CCA for HabitatxImpact groups. Asterisks indicate a significant difference in pair-wise comparisons between impact and reference areas (**$p < 0.01$; *$p < 0.05$).

4.2.2.2 Corals

A total of 61 species of scleractinian coral, from 27 genera, were recorded during a thorough search of the impacted and reference patch reef and low-relief hard-bottom habitats associated with the grounding site (Table xx). Twenty one of these genera were represented in the quantitative coral surveys. Pair-wise PERMANOVA tests revealed that there was a significant difference in overall coral genus size class distribution between PRRef and PRHull sites but not between PRRef and PRRub or LRHRef and LRHProp (Table xx).

Because there was not a significant difference in overall coral size-class distribution between PRRef and PRRub samples, we conducted our planned comparisons looking at the effects of rubble impact on encrusting coral size-class distribution and on small coral colony density (all genera and functional groups pooled). Although the density of encrusting colonies was lower across size classes in the PRRub impact areas compared to the PRRef areas (Fig. xx), the differences were not significant (PERMANOVA: t = 0.324, p[perm] = 0.965, perms = 55, p[MC] = 0.916). However, there was a significant effect of rubble impact on the density of small coral colonies ($t = 2.0711$, d.f. = 9, $p = 0.0341$; Fig. xx).

Table xx. Coral species list for the patch reef and low-relief hard bottom habitats immediately adjacent to the main hull scar generated by the M/V *Paul Russ* grounding incident.

Species	Species (cont.)
Acanthastrea echinata	*Montipora hoffmeisteri*
Acropora aspera	*Montipora monasteriata*
Acropora gemmifera	*Montipora nodosa*
Acropora humilis	*Montipora tuberculosa*
Acropora surculosa	*Pavona cf. clavus*
Acropora tenuis	*Pavona divaricata*
Astreopora listeri	*Pavona duerdeni*

Astreopora myriophthalma	*Pavona varians*
Cyphastrea chalcidicum	*Pavona venosa*
Cyphastrea microphthalma	*Platygyra daedalea*
Cyphastrea serailia	*Platygyra pini*
Echinophyllia aspera	*Pocillopora ankeli*
Favia danae	*Pocillopora damicornis*
Favia favus	*Pocillopora elegans*
Favia matthaii	*Pocillopora eydouxi*
Favia speciosa	*Pocillopora meandrina*
Favites rotundata	*Pocillopora verrucosa*
Favites russelli	*Pocillopora woodjonesi*
Fungia paumotensis	*Porites australiensis*
Galaxea fascicularis	*Porites lobata*
Goniastrea edwardsi	*Porites lutea*
Goniastrea retiformis	*Porites rus*
Heliopora coerula	*Porites vaughani*
Hyndophora microconos	*Psammocora haimeana*
Ispora palifera	*Psammocora nierstrazi*
Leptastrea purpurea	*Psammocora stellata*
Leptastrea transversa	*Seriatoporacaliendrum*
Lobophyllia hemprichii	*Stylocoeniella armata*
Millepora platyphyllia	*Stylophora pistillata*
Montastrea colemani	*Turbinaria stellulata*
Montastrea valencienessi	

Table xx. Results of pair-wise PERMANOVA tests for differences in coral size-class distribution between impact and reference areas. Bold values are statistically significant.

Groups	*t*	*P*(perm)	Perms	*P*(MC)
PRRef, PRHull	8.1084	**0.0006**	1011	**<0.0001**
PRRef, PRRubble	1.4611	0.1096	55	0.1344
LRHRef, LRHProp	1.5048	0.2008	7	0.2057

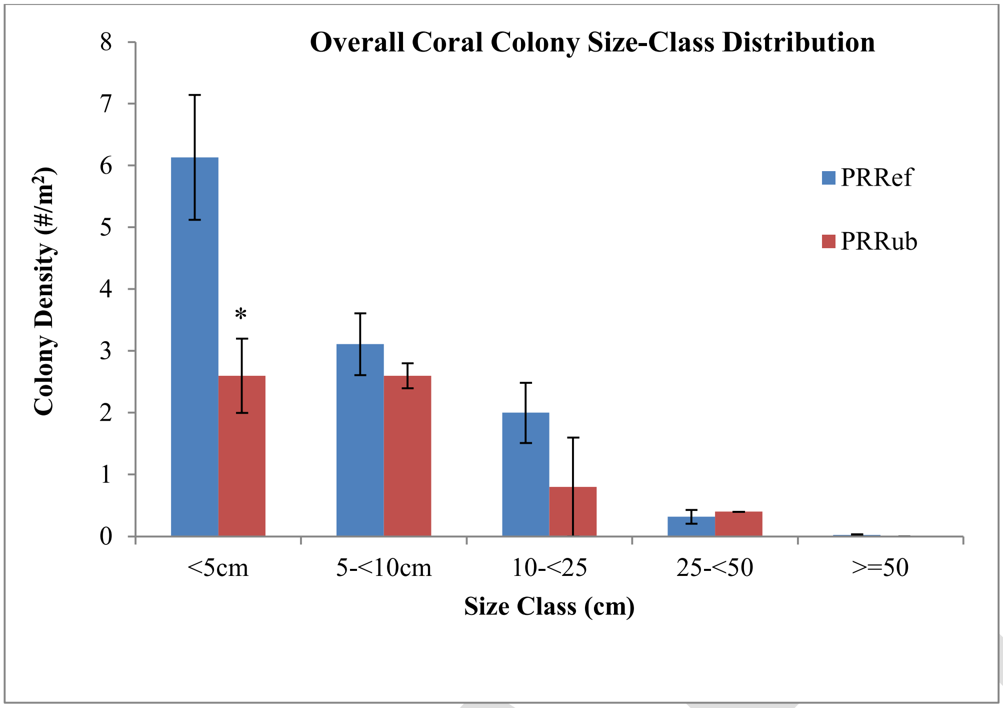


Fig xx. Overall coral colony size-class distribution (means ±SE) for non-impacted patch reef reference areas (PRRef) and patch reef areas impacted by grounding generated rubble and debris (PRRub). There was a significant difference in the density of small (<5cm) colonies between PRRef and PRRub (t-test; P= 0.09)

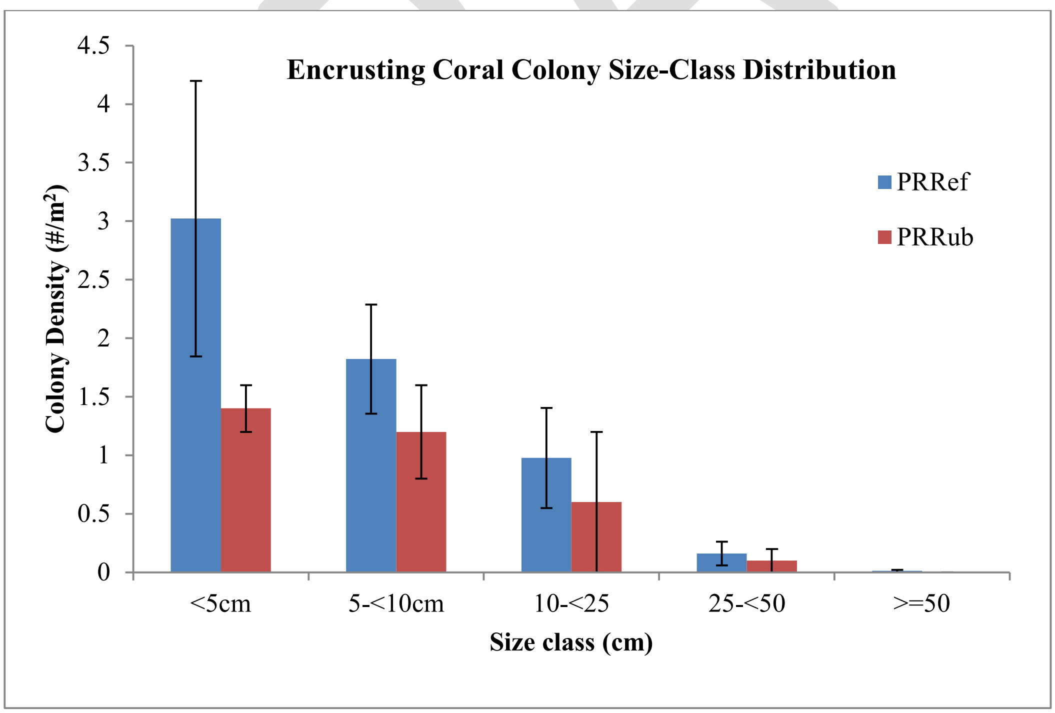
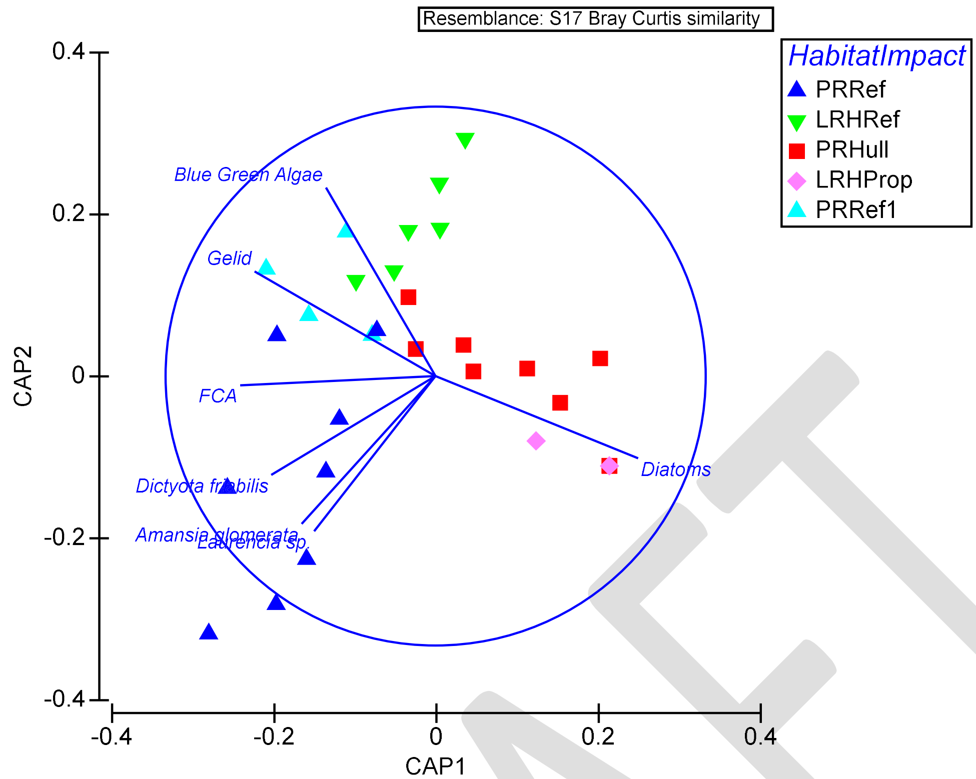


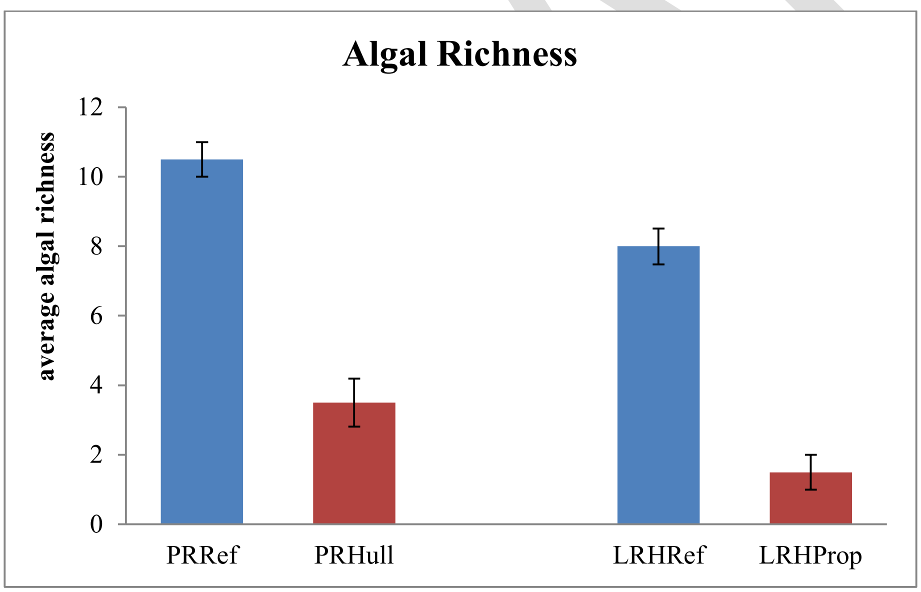
Fig xx. Encrusting coral colony size-class distribution (means ±SE) for non-impacted patch reef reference areas (PRRef) and patch reef areas impacted by grounding generated rubble and debris (PRRub). No significant difference in coral colony size-class distribution of encrusting corals (PERMANOVA; $p > 0.10$)

4.2.2.3 Algae

Based on the findings from statistical analysis, algal richness was reduced due to the ship grounding and recovery activities. Patch reef algal richness was significantly greater at PRRef relative to PRHull (T-test, $p < 0.001$). On average there were three times as many algae species detected within PRRef quadrats (average = 10.5, standard error = 0.501) when compared to PRHull quadrats (average = 3.5, standard error = 0.692). Similarly low relief hard bottom algal richness was significantly greater at LRHRef relative to LRHProp (Mann-Whitney Rank Sum test, $p = 0.010$). On average there was five times as much algae species detected within LRHRef quadrats (average = 8, standard error = 0.516) when compared to LRHProp quadrats (average = 1.5, standard error = 0.500).

Based on the findings from statistical analysis, algal communities were impacted, as a result of the ship grounding and recovery activities. Patch reef algal communities between PRRef and PRHull were significantly different (PERMANOVA, $t = 2.906$, $p = 0.001$), there were similar findings between PRRef1C and PRHull (PERMANOVA, $t = 1.505$, $p = 0.048$). Low relief hard bottom algal communities between LRHRef and LRHProp were also significantly different (PERMANOVA, $t = 4.560$, $p = 0.002$). Algal vectors from the CAP plot showed that Fleshy Crustose Algae (FCA), *Dictyota friabilis*, *Amansia glomerata*, and *Laurencia* sp. were major contributors to the PRRef algal community, species in the Gelidiales order and cyano-bacteria were major contributors to PRRef1C, while diatoms were major contributors the PRHull and LRHProp. No algae were identified as major contributors at the 0.7 correlation level for LRHRef.





4.2.2.4 Fish

In total, 67 species of fish were recorded along the survey transects. The overall abundance of fish varied significantly between PRRef and PRHull samples (t-test: t = 9.071, d.f. = 2, $p = 0.012$; Fig. xx). On average, the patch reef reference samples had nearly twice as many fish as the impacted samples. There was not a significant difference in fish community composition between HabitatxImpact groups (PERMANOVA: pseudo-F = 1.176, p[perm] = 0.251). Although no statistical tests could be performed, more fish were observed in the LRHProp impact area compared to LRHRef. Average numbers of fish by family are shown for each HabitatxImpact factor in Fig. xx and xx.

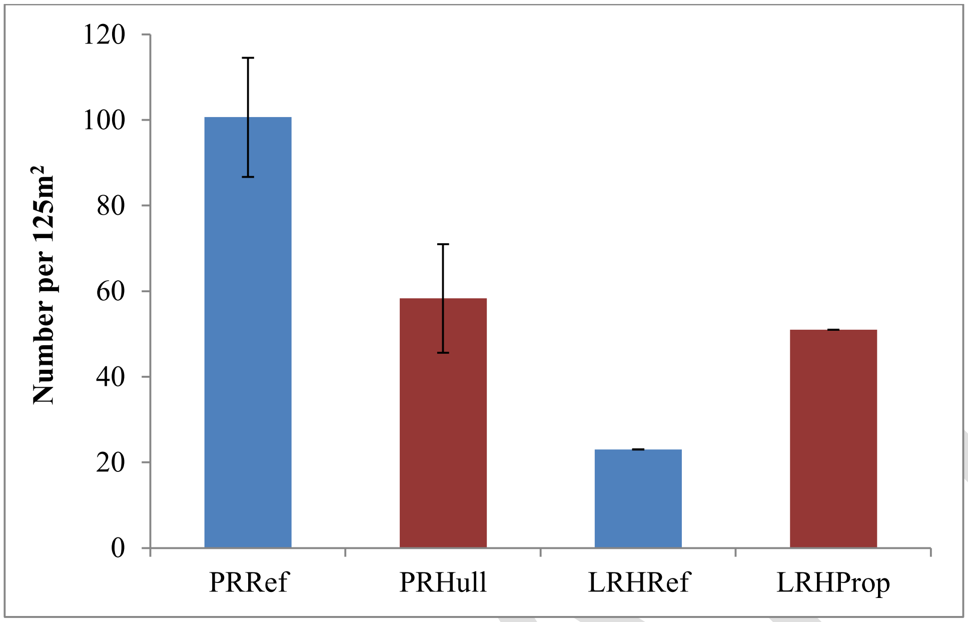


Figure xx. Abundances (mean ± SE) of fish for reference (PRRef & LRHRef) and impact sites (PRHull & LRHProp). There were significantly more fish in PRRef sites compared to PRHull sites.

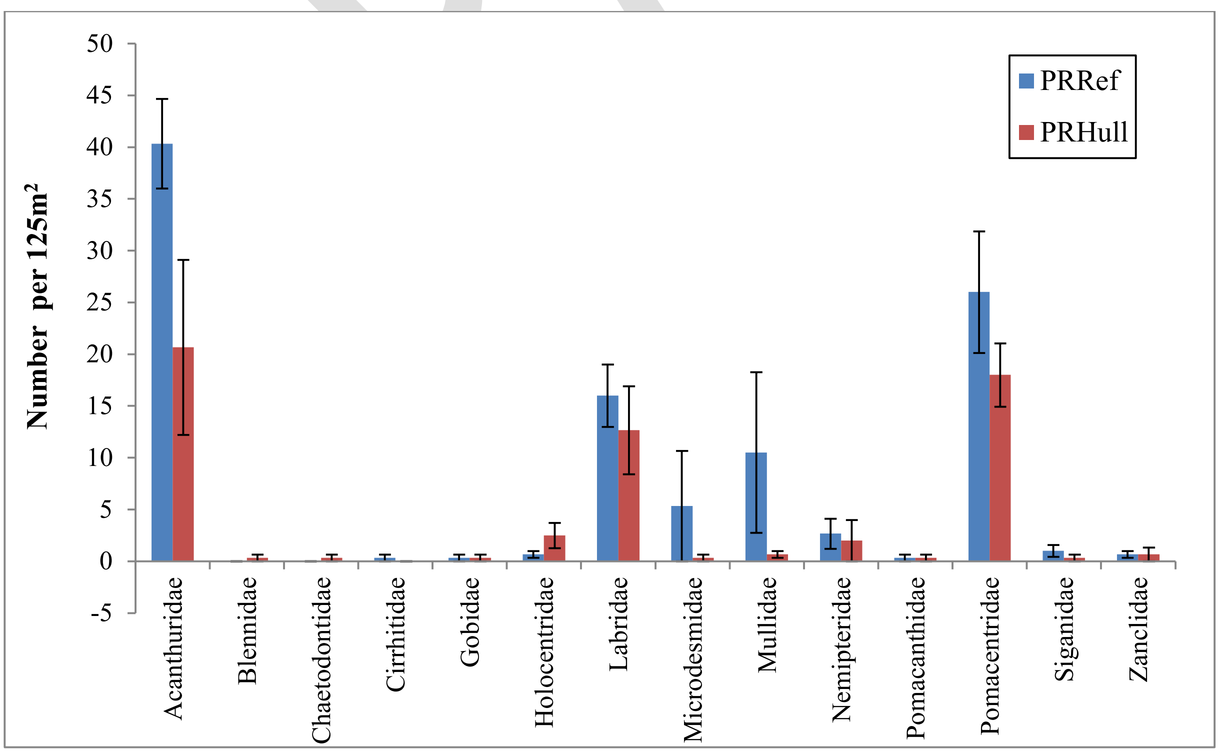


Figure xx. Abundances (mean ± SE) of fish by family for PRRef and PRHull sites.

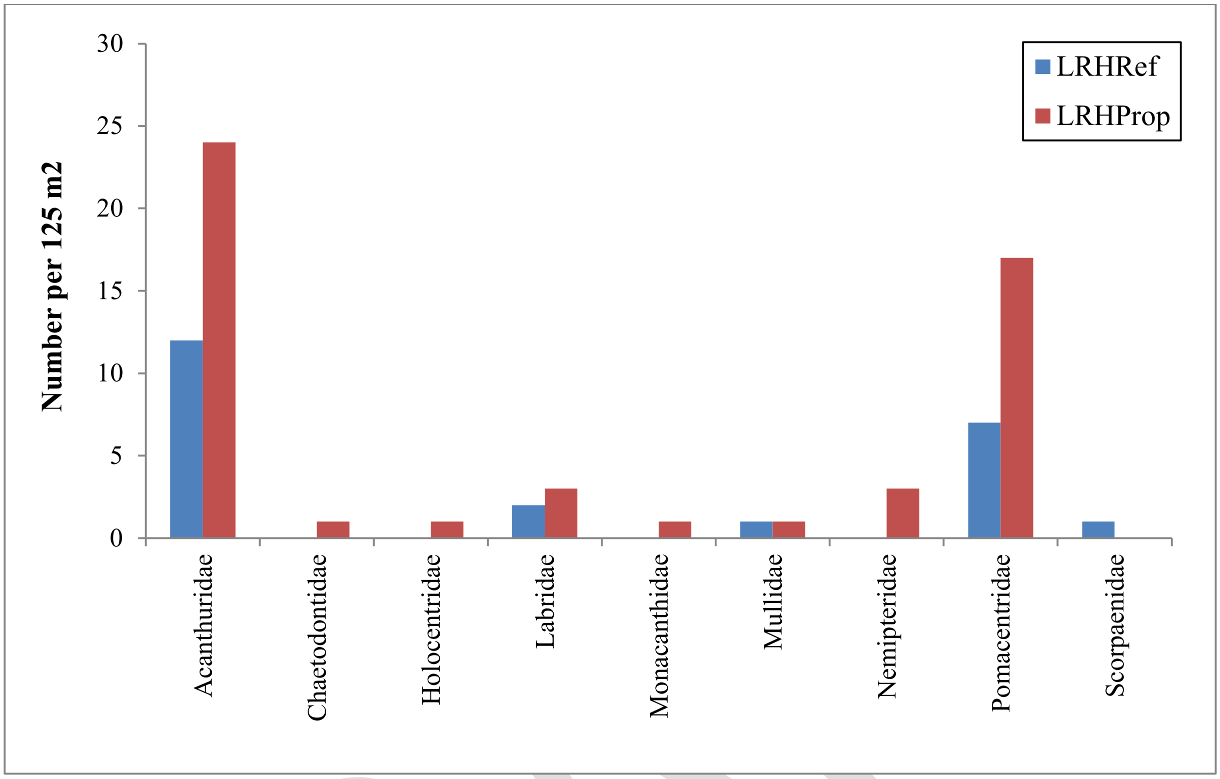


Figure xx. Abundances of fish by family for LRHRef and LRHProp sites.

4.2.2.5 Non-coral macro-invertebrates

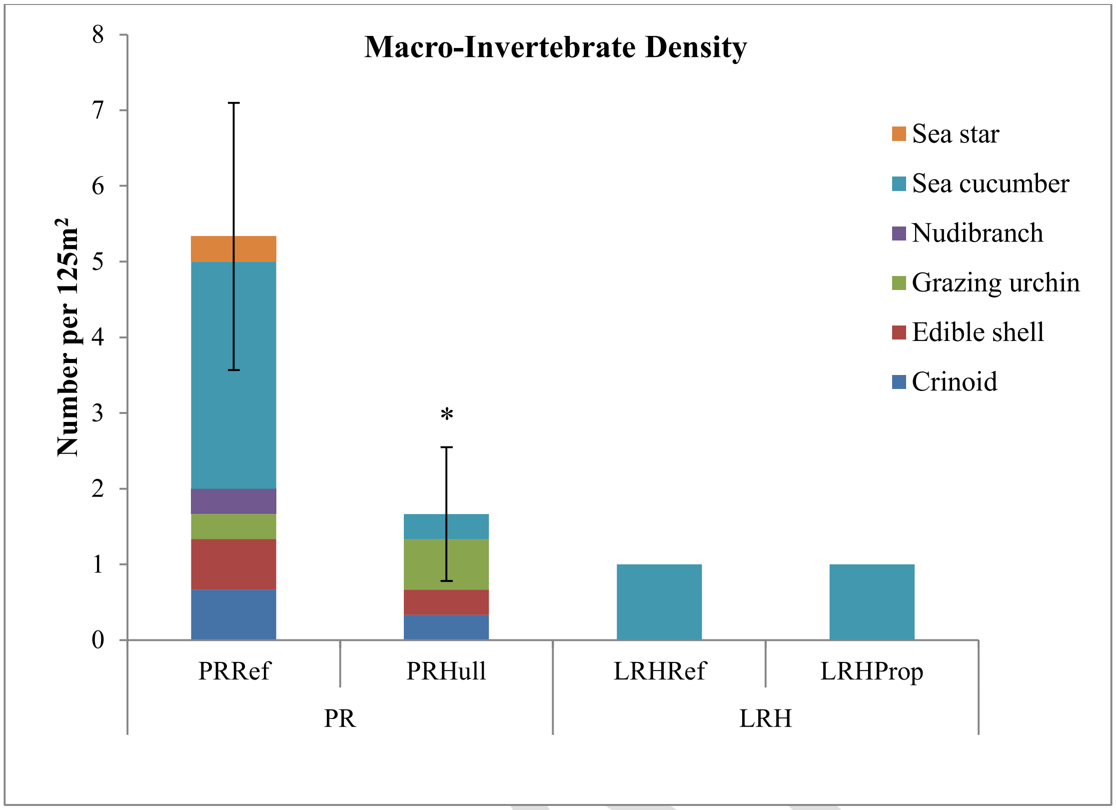


Figure xx. Number (PR habitat: means ± SE; n = 3 each) of macro-invertebrates for each HabitatxImpact group. Whiskers represent the standard error of the overall macro-invertebrate means. *significant t-test (α = 0.10; $p = 0.09$) for reference vs. impact within patch reef habitat.

4.2.2.6 Estimated losses

Based on our analyses, we estimate that a total of **16,619 coral colonies** and **533 $m^2$of CCA** were lost due to the grounding of the M/V Paul Russ (Tables).

Table xx. Estimated loss in percent cover of reef accreting crustose coralline algae (CCA) as a result of the M/V *Paul Russ* incident.

Habitat Type	Primary Impact (m^2)	Secondary Impact (m^2)	Total (m^2)
Patch Reef	345	81	426
Low Relief Hard-bottom	N/A	107	107
Total	345	188	533

Table xx. Estimated coral colony loss due to M/V *Paul Russ* primary hull impact (PRHull) on patch reef habitat.

		Size Category (cm)					
Genus	**Functional Group**	**<5cm**	**5 to<10cm**	**10 to <25**	**25 to <50**	**>=50**	**Total**
Acropora spp.	Small branching			122	27		149
Astreopora spp.	Massive	244	176	122	14		557

Cyphastrea spp.	Massive	611	367	54			1,032
Favia spp.	Massive	543	176				719
Favites spp.	Massive	54		122			176
Fungia spp.	Free-living			54			54
Galaxea spp.	Massive	421	176				597
Goniastrea spp.	Massive	489	122		27		638
Heliopora spp.	Large branching			122	14		136
Isopora spp.	Large branching	54	54	244	14		367
Leptastrea spp.	Encrusting	149	122				271
Millepora spp.	Large branching	122	244	54	68	14	502
Montastrea spp.	Massive	244					244
Montipora spp.	Encrusting	1,928	964	1,140	217	14	4,262
Pavona spp.	Encrusting	1,751	1,262	190			3,204
Platygyra spp.	Massive	244	54				299
Pocillopora spp.	Small branching	54		54	27		136
Porites spp.	Massive	122	244	176	41	14	597
Psammacora spp.	Encrusting	597	176	122			896
Stylocoeniella spp.	Encrusting	54					54
Stylophora spp.	Small branching	176	54				231
Total		**7,860**	**4,195**	**2,579**	**448**	**41**	**15,122**

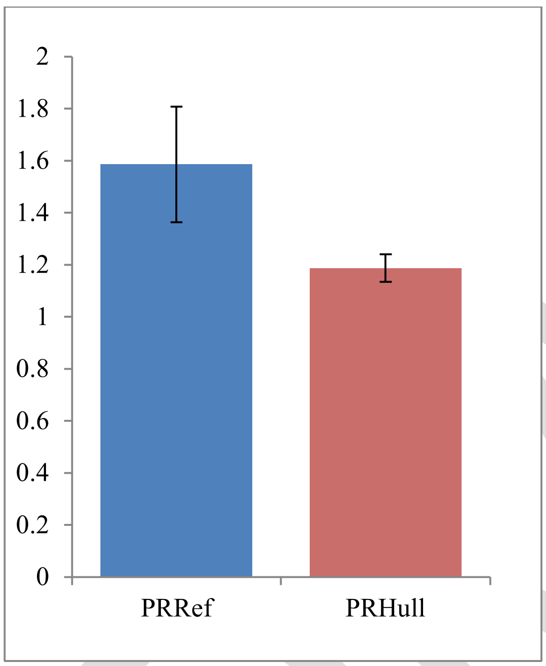
Table xx. Estimated losses of small size class (<5cm) coral colonies by genus due to M/V *Paul Russ* secondary ruble impact on patch reef habitat (PRRub).

Genus	# of colonies
Astreopora spp.	77
Cyphastrea spp.	226
Favia spp.	171
Favites spp.	17
Galaxea spp.	132
Goniastrea spp.	188
Heliopora spp.	-85
Isopora spp.	17
Leptastrea spp.	-55
Millepora spp.	38
Montastrea spp.	-94
Montipora spp.	520
Pavona spp.	209
Platygyra spp.	77
Pocillopora spp.	17
Porites spp.	38

Psammacora spp.	-68
Stylocoeniella spp.	17
Stylophora spp.	55
Total	**1,497**

4.2.3 Physical Reef Structure

4.2.3.1 Rugosity



5 Summary and Discussion

6 References

1-B. MV Paul Russ Proposed Plan for Coral Reef Restoration Draft, March 2015. Prepared by Sea Byte Inc.

M/V Paul Russ Grounding Site
Saipan,
Northern Marianas Islands, USA

Proposed Plan
for
Coral Reef Restoration

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M/V PAUL RUSS Grounding Site
Saipan, Commonwealth of Northern Marianas Islands, USA

PROPOSED PLAN for CORAL REEF RESTORATION

1.0 Background

The *M/V Paul Russ* grounded on the coral reef located within the lagoon approximately 1.5 miles from the dock at the Port of Saipan, Commonwealth of the Northern Marianas **ISLANDS** (CNMI) on 9 September 2014. The grounding location is on the south side of the shipping channel within the Port of Saipan. The Managaha Marine Protected Area lies directly north of the grounding location on the opposite side of the shipping channel. The vessel was removed from strand during the early morning of 12 September 2014.

To ascertain the nature and extent of possible injuries to the reef as a result of the grounding, Sea Byte Inc. was retained to conduct an injury assessment. This injury assessment was conducted jointly with Trustee personnel including representatives of the CNMI Bureau of Environmental and Coastal Quality (BECQ), Department of Fish and Wildlife (DFW) and National Oceanic and Atmospheric Administration (NOAA) The grounding resulted in various adverse impacts to the coral reef at the site, some of which may be reversible if proper restoration measures are implemented.

Three distinct injury types were identified within the affected area including: crushed reef, scraped reef, and blowhole and rubble areas **(Figure 1)**. Based on results of the injury assessment survey, approximately 3,000 m^2 of coral reef was immediately affected by the grounding. However, it is possible that the spatial extent of this injury area, as well as the natural resource damages associated with these injuries, can change depending upon what rehabilitation actions are subsequently pursued or neglected.

The natural resource injuries sustained at this site are characteristic of those observed when ships have run aground on coral reefs. However, there are no universally accepted standards on how to proceed with site restoration. To some extent, viewpoints of natural resource trustees on restoration priorities differ because coral reefs are obviously not all alike in terms of their perceived value.

But most, if not all coral reefs do share certain important features, particularly their sensitivity to rapidly changing environmental conditions. Numerous studies as well as anecdotal evidence have indicated that coral reef habitat worldwide has experienced degradation due to natural and anthropogenic factors. Without notable exception, this pace of habitat degradation appears to have accelerated over the past three decades.

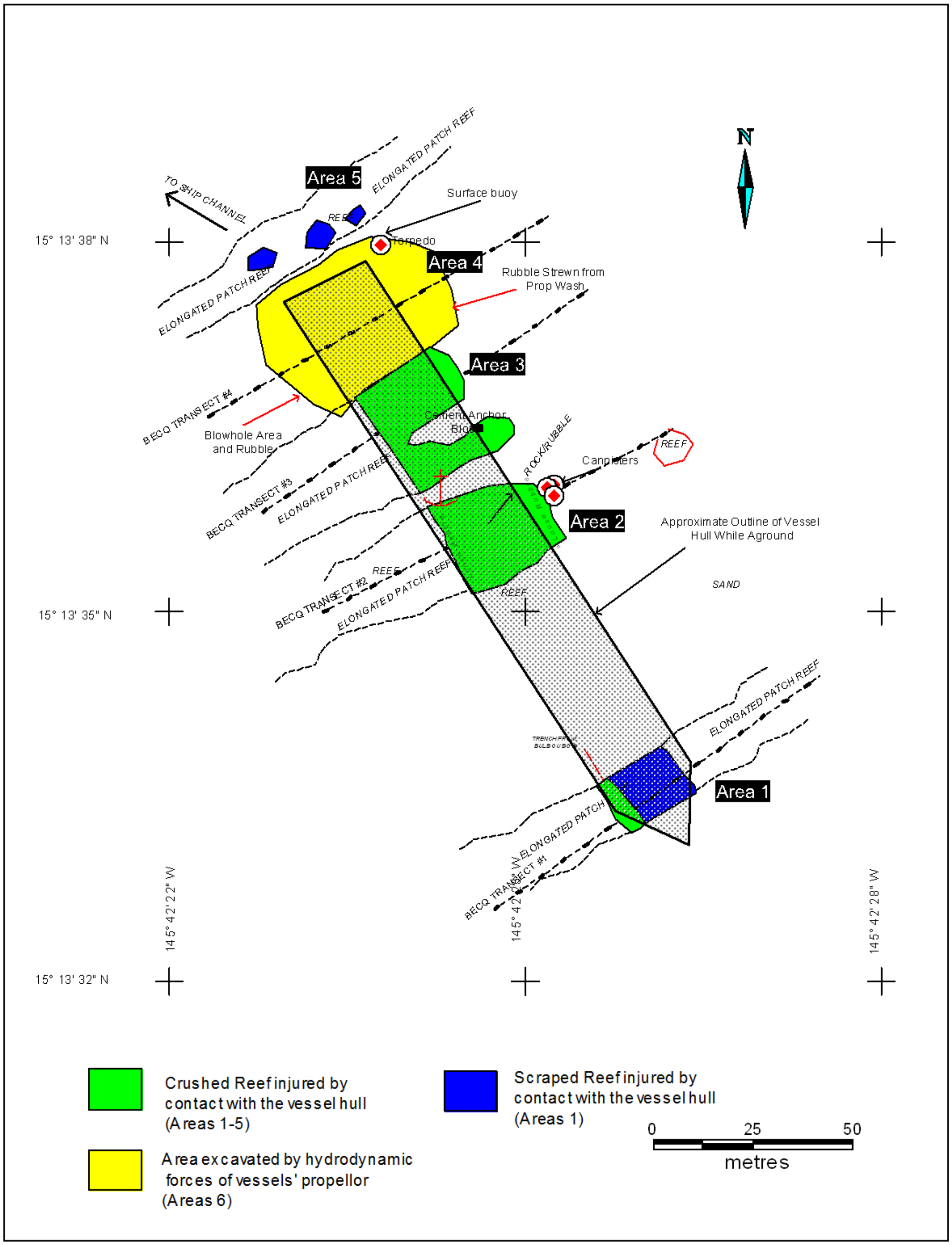


Figure 1. Injury types identified at the *M/V Paul Russ* grounding site.

The coral reefs off Saipan typify this trend, having experienced decline during the past 20 years. The decline is likely due to a variety of factors natural (i.e., typhoons), and anthropogenic factors (i.e., over-fishing and pollution). Efforts have been taken to reduce the adverse ecological impacts associated with anthropogenic factors such as runoff and overfishing. Other factors such as climate change are also likely affecting the health of coral reefs off Saipan.

Consequently, the attention devoted to the comparatively minor damages associated with events such as vessel groundings is understandable. More importantly, the active involvement of a Responsible Party allows government (natural resource) trustees the opportunity to cooperatively work towards meaningful habitat restoration at the injured site.

While trustees and Responsible Party representatives often disagree on what specific measures are appropriate following a vessel grounding, there is widespread belief among all interested parties that compensation without habitat restoration is of little overall benefit. Accordingly, particularly within the past several decades, scientific attention has increasingly focused on potential reef restoration activities (National Research Council 2002, Ebersole, 2001, Omori and Fujiwara, 2004, Hudson and Goodwin, 2001, Miller and Barimo, 2001, Shaul et al., 1999, Jaap et. al., 2006, Edwards and Gomez 2005) and has been highlighted at several international conferences (Fort Lauderdale, 1998; Bali, 2000; and Okinawa, 2004). Despite the dramatic expansion of information in this emerging field, there is still considerable disagreement amongst resource managers about which restoration approaches and techniques are most appropriate to employ under a given set of circumstances.

2.0 Overview of the Restoration Approach

Although there are diverse opinions about some restoration initiatives, there is broad consensus that several key criteria should at least be seriously considered as part of any proposed reef restoration effort. The primary goal of the restoration process should be to return the habitat to as close an approximation of its prior condition from an ecological services standpoint as reasonably possible. To accomplish this, four major concerns should be addressed:

1. Identify and locate injured coral and place them in areas where they can safely recover;

2. Remove bottom paint from the reef substrate that was deposited on the substrate as a result of contact between the hull of the vessel;

3. Stabilize loose debris and rubble created by the grounding so that secondary (additional) injuries can be avoided; and

4. Replace/repair physical components that will provide a structural framework for the reef to naturally recover.

Salvage (item #1 above) of biota (hard corals) at the M/V Paul Russ grounding site is readily achievable. During September to November 2014 dislodged and broken coral heads were triaged and cached to await re-attachment during the restoration effort. As part of an interim step to protect and preserve the health of the corals, temporary re-attachment was conducted to prevent movement and ultimate mortality of the corals. Restoration should include permanent re-attachment of the salvaged corals onto the rehabilitated substrate located within the crushed reef area. During restoration activities at the site, any additional coral colonies that are located should also be re-attached.

Bottom paint (anti-fouling paint) is applied to the surface of vessels to prevent the growth of fouling marine organisms on the hull of vessels. The paint is impregnated with heavy metals, typically chromium and zinc, to deter the settlement and growth of marine animals. During vessel groundings contact between the hull of the vessel and the reef substrate often results in the deposition of bottom paint on the reef surface. If left on a reef surface the paint will deter the biological recolonization process and ultimately deter the recovery of the reef substrate where it is present. Bottom paint was removed from the reef substrate immediately following the grounding.

Stabilization (item #3 above) of loose rubble and material at the site is also readily achievable. Rubble created by the impact of the hull contacting the coral reef is present throughout the grounding site. Some rubble was removed from otherwise uninjured reef habitat, immediately following the grounding, to avoid additional injury that is caused by moving rubble. The remaining rubble should be stabilized to prevent further movement and injury to surrounding areas of the coral reef.

Implementing rehabilitation measures (item #4 above) that enhance the ability of the reef habitat to return to pre-injury ecological services presents the most challenging technical aspects of the overall restoration process. The actions implemented should provide hard substrate for the recolonization of benthic biota such as hard corals, soft corals and sponges as well as provide structural habitat for fishes and mobile benthic invertebrates.

To provide these services, the physical characteristics of the substrate to be rehabilitated should be evaluated with respect to material composition, surface texture, surface chemistry and color. The design aspects of a substrate rehabilitation effort should include factors such as profile, shading, structural complexity, size/configuration and overall stability. Substrate rehabilitation should be designed to provide a habitat with similar characteristics as those that likely were found at the site prior to the grounding.

As indicated, four specific concerns are typically considered to be essential objectives associated with restoration at coral reefs where vessel groundings have occurred. These are salvage and re-attachment of affected biota (predominantly stony corals), bottom paint removal, rubble stabilization; and substrate replacement/rehabilitation. To date three of the four items have been implemented or completed completed. These include the salvage and triage of dislodged hard corals, the removal of bottom paint from the reef substrate and the removal of rubble from a portion of the otherwise uninjured reef. Each of these is discussed below. Regardless of the exact measures undertaken, it should be emphasized that operations implemented while conducting restoration must not cause any additional injury to the surrounding habitat.

3.0 Coral Salvage/ Re-attachment

3.1 Overview

A variety of biota including hard corals, were injured during the grounding of the *M/V Paul Russ,* Emphasis is placed on the restoration of hard corals since they form the bulwark of the physical infrastructure of which reef habitats consist. They also grow extremely slowly, so their value in terms of restoring the site to its pre-grounding status is relatively high.

It is proposed that all dislodged or broken hard corals that remain alive at the *M/V Pau Russ* grounding site be permanently re-attached within the crushed reef areas. These corals were originally cached in the best available area where it was hoped that they would not be affected by wave action, sedimentation or other potentially adverse impacts. Subsequent observations indicated that both wave action and sedimentation were affecting the health of the corals and they will be were then temporarily re-attached to the seafloor to enhance their survival (Sea Byte Inc. 2015). All of the corals temporarily re-attached to the seafloor will be used during the final re-attachment. Any additional living coral colonies or fragments will also be r-attached during this effort.

Corals that were re-attached to the seafloor will be carefully chipped from the substrate by divers using a hammer and chisel. Separation will be made between the cement used for re-attachment and the seafloor. Extreme care will be taken not to cause any additional injury to the coral colony.

Prior restoration efforts have utilized a variety of methods for re-attaching hard corals, meeting with various levels of success. These methods have included using cement, expansion anchors, steel rods, wire mesh, coated wires, plastic cable ties, nails and marine epoxy. Attachment by cement has proven to be superior to most other alternatives such as nails and cable ties primarily because the cement holds the corals more firmly, allowing greater opportunity for subsequent coral growth and reducing the risk of abrasion against other surfaces (Kaly, 1995).

At this site, Sea Byte Inc. proposes that dislodged corals be re-attached using cement medium. The earliest documented use of cement was by Vaughan (1916), who used it to attach hard corals to small pillars at Dry Tortugas, Florida, and Goulding Cay, Bahamas for growth rate experiments.

Cementing has been used far more extensively recently, notably at various Florida locations. For example, in March 1998, the container vessel *M/V Hind* ran aground off Florida's southeastern coast, causing various hard coral injuries. A total of 385 pieces of coral were re-attached to the reef substrate using hydraulic cement and epoxy. Smaller heads were re-attached using epoxy while larger heads were re-attached using a hydraulic cement mixture of Portland Type II Cement® mixed with sand and molding plaster (Sea Byte Inc. & SSR Inc., 1998).

The adhesive properties of cemented corals appear to be functionally similar (or superior to) to those naturally occurring bonds formed by living corals. As part of a monitoring program at the *M/V Hind* site, that began in 2000, 157 re-attached corals were randomly tagged for monitoring as well as 30 control corals from a nearby undisturbed area (Gilliam et al., 2001). Of the 157 tagged pieces, 156 were found one year later while all 30 of the control corals were found (Gilliam et al., 2001).These data suggest that the physical stability of the re-attached corals was not significantly different from that of undisturbed coral. The data also showed that 19% of the tagged re-attached corals had positive growth from 2000 to 2001, while 7% of the control corals showed positive growth during the same time period.

Sea Byte Inc. personnel have conducted numerous other coral re-attachment projects. During 1997, as part of the primary restoration effort associated with the grounding of the *M/V Contship Houston*, Sea Byte Inc. scientists participated in the re-attachment of more than 3,500 coral pieces within the Florida Keys National Marine Sanctuary (FKNMS) near Maryland Shoal. Monitoring of the attached corals indicated that, after two years, re-attached corals had a survival rate of 92% while control corals had a survival rate of 89% (ECM/Hudson Maritime Services, 2001). These success rates included the period when Hurricane Georges passed directly over the injury site with sustained winds greater than 80 miles per hour.

Similarly, approximately 350 corals were re-attached as a consequence of the grounding of the *M/V Lazaro Cardenas* in the Sea of Cortez near La Paz, Mexico. Corals were re-attached using hydraulic cement during fall 2002. About one year later, two major hurricanes passed directly over the restoration site. It was later found that re-attached corals remained completely intact and the survival rate was estimated to be 94% (unpublished data, 2004).

Another instance of re-attachment success using cement took place at the Miami (Florida) north sewer outfall in September 1997. At this site, 271 stony corals were transplanted from the exposed outfall pipe to a protective concrete armor mat used to cover the outfall (Thornton et al., 2000). Survivorship for the re-attached corals was 87% from 1997 to 1999 compared to 83% for control corals (Thornton et al., 2000).

Recently, over 2,000 corals were re-attached by Sea Byte Inc. personnel at three different vessel grounding sites off southeastern Florida (M/V *Eastwind, M/V Federal Pescadores* and *M/V Cosette*). Corals were re-attached with the same cement mixture proposed for use at the *M/V Paul Russ* restoration site. . Following the re-attachment effort, several hurricanes have passed directly over these locations. Upon revisiting the *M/V Federal Pescadores* site, it was found that virtually all of the re-attached corals remained attached to the substrate and the survival rate was estimated to be 98% (unpublished data, 2014).

3.2 Methodology

Due to the relatively low number of corals (approximately 150) that are likely available for re-attachment it is recommended that re-attachment occur as close as possible to where the corals were discovered. Should any additional corals be identified within the rubble located at the injury site, the corals will also be re-attached to suitable stable substrate located within the crushed reef area.

The initial phase in coral re-attachment will be detaching the corals temporarily attached to the seafloor. All corals that were re-attached to the seafloor will be carefully chipped from the substrate by divers using a hammer and chisel. Separation will be made between the cement used for re-attachment and the seafloor. Extreme care will be taken not to cause any additional injury to the coral colony.

It is proposed that the corals be re-attached to the substrate using Portland Cement® mixed with sand and molding plaster as a drying catalyst. This is the same mixture that has previously been successfully utilized by Sea Byte Inc. at other restoration locations.

The medium will be mixed on a work vessel and formed into balls. The size of the balls will be directly proportionate to the size of the coral awaiting re-attachment. The prepared balls will be placed in a 5 gallon bucket aboard the work vessel and then lowered to the divers via a "down line." Buckets will be lowered with lids to prevent turbidity and sloughing of cement materials onto the reef. Every effort will be made to minimize the turbidity and sedimentation that may occur during the re-attachment operation.

The consistency of the cement balls will vary depending on the distance of the attachment site from the down line. Attachment sites that are relatively close to the down line will receive balls with a high ratio of plaster to facilitate faster drying and less dissolution of the medium. Sites that are further away from the down line will receive balls with a lower ratio of plaster to keep the cement pliable during transportation to the re-attachment site(s).

Once a cement ball is retrieved from the bucket by a diver, it will be carried to the point of re-attachment. The ball will then be manually attached to the substrate. After the ball is secured to the substrate, the coral to be re-attached will be placed onto the concrete ball and manually pressed into place. In addition, any superficial lesions caused by the grounding/salvage events will be covered with cement to minimize further stress (for example, from algae or bioeroders) to the injured coral.

The re-attached coral will be held in place until the medium sets, usually in 2-3 minutes. While setting occurs, the diver will work the cement around the base of the coral to form a smooth, uninterrupted attachment border. The cement fully cures in approximately 8-12 hours. If currents present a problem in movement of the re-attached coral prior to cement curing, concrete blocks, soft dive weights, and/or sand bags will be used to stabilize the re-attached coral and reduce current induced cement sloughing while the cement hardens.

All dislodged Corals will be re-attached to stable reef substrate. **Photographs 1 and 2** show representative examples of coral re-attachment from prior restoration efforts.

Photograph 1. Diver using cement around to re-attach a large coral head at a grounding site off southeast Florida.

Photograph 2. Re-attached *Montastrea annularis* coral at a grounding site off southeast Florida.

4.0 Bottom Paint Removal

Bottom paint was deposited onto the reef surface during contact between the hull of the vessel and the underlying coral reef. Intense pressure and friction between the two surfaces results in the relatively soft bottom paint being "smeared" onto the surface of the reef in relatively thin flat layers. If left on the reef surface, the bottom paint will slow re-colonization of marine organisms and deter the recovery of the reef to pre-incident conditions.

Immediately following the grounding, as part of the emergency response activities undertaken by the Responsible Party, bottom paint was removed from the reef substrate. This action was completed approximately 15 November 2014. All paint material observable by divers was removed from the reef using paint scraping tools and deposited into sealed plastic bags and 5 gallon buckets on the seafloor. The collected bottom paints materials were then removed from the reef and are awaiting disposal as directed by the Trustees.

Efforts were made to remove every identifiable pieces of bottom paint on the reef. It is recognized that some small pieces of bottom paint may still be present within the rubble and sand that occurs at the restoration site. If additional bottom paint is observed by divers, working on other aspects of the restoration effort, they will be collected and properly disposed of.

5.0 Rubble Stabilization

Small pieces of rubble debris (< 0.5 m), produced by fracturing structural components of the coral reef, cannot be practically re-attached. Yet its presence also cannot be ignored since, if left unattended, it will cause further injury. In some instances, the spatial extent of such post-grounding, rubble-related injury can exceed that caused by the grounding itself; for example, as seen at a site restored by Sea Byte Inc. (HMMS, 2002) in the Sea of Cortez (Baja California, Mexico) that was subject to strong currents and prone to storm events.

Other examples of collateral injury from such "loose" rubble abound; for example, at the grounding site of the *M/V Wellwood* on Molasses Reef in the Florida Keys National Marine Sanctuary. Gittings et al. (1988) showed that extensive damage occurred to coral colonies adjacent to the initial injury area and furthermore, that coral recruitment was severely reduced as a result of the rubble being left in place. Rogers (1990) also showed that unstable substrate conditions do not allow recruited larvae to become fully established.

At the grounding sites of the *M/V Alec Owen Maitland* (25 October 1989) and *M/V Elpis* (11 November 1989), just south of Carysfort Reef off Key Largo Florida Keys National Marine Sanctuary, rubble debris was also (unintentionally) left in place pending agreement on the scope of the restoration effort. As a result of this inaction, Kenney and Simmons (1995) reported that the injury areas created by the ships' hulls increased sharply until restoration efforts commenced.

Typically, vessel groundings and subsequent efforts to free the vessel from its strand create significant amounts of rubble, which is accumulated in areas where it may cause deterioration of surrounding reef health and coral viability. *The M/V Paul Russ* grounding site is typical of vessel grounding sites in this respect.

As a result it is recommended that rubble material be removed from the shallow portion of the grounding area immediately adjacent to the elongated patch reef on which the vessel grounded. A portion of the rubble that accumulated on the area adjacent to Area 3 has already been removed from the otherwise uninjured reef surface and p collected in a pile on the nearby sand bottom. It is proposed that all rubble be collected and deposited into the deeper areas of the blowhole area created by the hydrodynamic forces of the vessels propeller. This includes moving the rubble already collected to the deeper area. Rubble, smaller than (0.5 m diameter), will be placed into these low areas and stabilized with a concrete "cap". The concrete will be mixed and installed by divers using the same methodology described for coral re-attachment. This procedure will have a twofold result:

1. It will stabilize the material to prevent its re-suspension and ability to migrate no matter what hydrodynamic forces are experienced, and
2. It will help to fill the excavated area and restore it to its original pre-incident condition.

All large rubble pieces (>0.5 m diameter) will be separated from the smaller collected rubble and used as part of the substrate rehabilitation portion of the restoration. These rubble pieces will be stabilized by attaching them to the seafloor in an effort to provide structural relief and complexity (rugosity), The rubble will be stabilized within the rehabilitated area using hydraulic cement (similar to previously described for coral re-attachment). This will serve to stabilize the rubble and prevent its ability to move despite any prevailing conditions. This stabilization procedure has been successfully used by Sea Byte Inc. in prior restoration projects (Sea Byte Inc. and SSR, 1998, Sea Byte Inc., 2008).

6.0 Substrate Replacement/Rehabilitation

6.1 Overview

In evaluating the benefits and costs associated with various habitat replacement options, two specific goals were identified as key elements of the coral reef's rehabilitation.

The first of these is to enhance natural recruitment; i.e., to improve upon the ability of the (restored) habitat to serve as suitable substrate for the addition of new coral as a consequence of reproductive effort. Although the reproductive process itself cannot be directly influenced, recruitment success can potentially be enhanced by providing more suitable attachment surfaces for the coral progeny.

The injury area contains large flat patches of sea bottom. These areas are generally devoid of structural relief, in contrast to the coral reef that existed there before the vessel grounding.

Although there are few comprehensive, long-term scientific studies that examine the relative success of hard coral recruitment onto various substrates, there is considerable anecdotal evidence to suggest that such recruitment and subsequent growth is more likely to occur on stable hard substrates such as exposed rock rather than sandy, soft or mobile surfaces. Therefore, one important objective in the site's proposed rehabilitation is to increase the total available stable hard surface area.

The second goal is to establish the physical presence of replacement habitat. This would be accomplished by creating artificial habitat that mimics some of the structural features provided by a coral reef.

As a consequence of extensive practical experience, Sea Byte Inc. has found that it is preferable to allow the existing habitat conditions to dictate what types of reef restoration are most appropriate rather than force the adoptions of a specific technique or methodology simply because of vested interests or the success it may have had at another location. In this case, it is essential that the proposed habitat replacement be suitable for the relatively high energy environment (large swells and strong currents) found at the grounding site and that the effort should attempt to replace the topography and structural complexity of the existing reef prior to the incident.

Among the most valuable ecological services of a coral reef is to provide suitable habitat for both sessile and mobile biota. Since hard coral growth is very slow, it would take decades for the habitat features in the injury area to begin to resemble those that were formerly provided by the pre-existing structures. There are thus obvious advantages to jumpstart this natural restoration.

Based on the area immediately surrounding the grounding site it is obvious that the most significant change to the habitat was the removal of topographic relief and complexity. In order to be successful, the method of replacement of the lost topographic features should have several characteristics. Ideally these would include: providing similar topographic and structural complexity characteristics (and thus ecological characteristics), similar aesthetic appearances, and be able to withstand the wave and sea forces that occur within the site.

6.2 Methodology

A variety of habitat replacement structures have been used in both reef restoration and reef creation projects. In this instance, the relative high energy nature of the environment (large swells and strong currents) plays a key role in determining the possible options available for restoration. Any structure placed at the site must be strong enough to stand up to these forces as well as be stable enough to prevent movement.

It is therefore proposed that habitat modules and limestone boulders, both of which are securely anchored to the seafloor, be placed within the area to replace the topographic features lost as a result of the grounding. In addition to the immediate creation of habitat complexity and vertical relief, modules will also provide suitable substrate for the recruitment of reef biota. The modules and boulders have considerable ability to withstand strong wave action, can be anchored to the seafloor to ensure stability during storms, and offer similar aesthetic appearance to existing topographic structures lost during the grounding.

The earliest reported occasion when habitat modules were installed was in 1991 at a coral reef location (Sunny Isles) near Miami, Florida. The most recently available monitoring data from the site showed that the modules were successful in providing suitable habitat for a broad variety of sessile invertebrates and fish. The abundance and density of both hard and soft coral species was clearly far greater than found in the bottom areas surrounding each module that were left untouched.

Limestone boulders have been commonly used to create reef habitat in many different locations and applications. These include the simple creation of new "artificial reefs" as well as to mitigate for loss of existing reef habitat from injury caused by incidents such as dredging, development and vessel groundings.

At several restoration projects associated with vessel groundings in the Florida Keys limestone boulders were placed on the site to recreate lost topography. At the *M/V Contship Houston* grounding site, also in in the Florida Keys limestone boulders were placed on crushed reef to recreate suitable substrate for coral recruitment and to create topographical relief and complexity that was lost as a result of the grounding impacts (ECM Hudson Maritime Services 1998).

To mitigate the loss of low relief reef habitat as a result of a subsea natural gas pipeline installation, limestone boulders (and habitat modules) were used to create additional habitat

(Gulfstream Natural Gas 2000). Sea Byte Inc. personnel were involved in the design and installation of this mitigation project off Florida in the Gulf of Mexico. Similarly, in a study of methods to increase productivity and recovery at a bomb-fishing blast site in Indonesia, limestone boulders were clearly superior to other methods of habitat replacement investigated during the study (Fox et al 2005)

It is proposed that habitat modules interspersed with limestone boulders be deployed at the *M/V Paul Russ* grounding site as part of the restoration effort. The combination of both modules and boulders provides a diversity of structure and surfaces as well as providing increased structural complexity. Given the occasional large swells and strong currents that occur at the grounding site all materials placed on the seafloor must be securely attached to provide stability for future reef recolonization. Securely anchoring the modules to the seafloor and then attaching the boulders to the secured modules ascertains stability in rough seas which is critical to the recolonization and recovery of the coral reef. .

Figure 1 shows a schematic diagram of the proposed modules to be placed at the site. Modules will be built on land and transported to the site and precisely placed into position by divers using lift bags. Modules are built from a combination of cement and limestone to encourage re-colonization by hard coral and other reef biota. Modules are reinforced with fiberglass rebar to ensure durability and eliminate corrosion that occurs when steel rebar is placed in the marine environment. **Photographs 3 through 6** show examples of habitat modules that have been placed at other vessel grounding sites. Modules can be built to different heights to add variability to the appearance and increased (or decreased) structural complexity. **Photographs 7 and 8** show examples of limestone boulders that have been placed at other coral reef restoration sites.

Modules will be anchored to the seafloor using stainless steel bolts that are drilled and epoxied into the seafloor to create a stable permanent substrate. Following attachment to the seafloor, large pieces of naturally occurring rubble will be attached to the base of each module at the seafloor to increase the structural complexity, stability and aesthetic appearance of each module.

It is proposed that approximately 40 habitat modules be placed atop crushed reef area located at the grounding site. Modules will be placed in a random but relatively evenly spaced pattern throughout the crushed reef areas. Final module placement will be approved by Trustee personnel prior to permanent anchoring into the seafloor. A map showing the approximate proposed location and orientation of each module is presented in **Figure 2**.

Upon completion of module placement and anchoring, limestone boulders (quarried in Saipan) will be placed interspersed between the modules. Boulders ranging in size from 2-4 ft. in diameter will be used to create additional topography between the modules. Boulders will be secured to the seafloor and to the anchored modules using cement. Cement will be mixed and used for attachment using the identical technique described previously for coral attachment.

Following placement of the modules and boulders, dislodged corals will be transplanted to the structures using techniques described previously in this restoration plan. This effort will attempt to jump start the re-colonization of hard corals within the area.

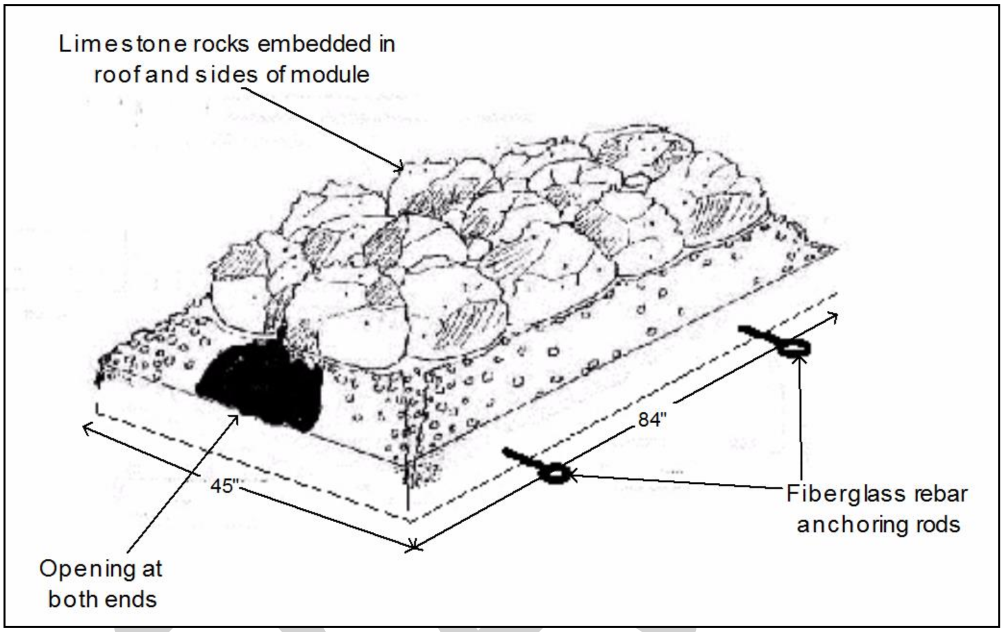


Figure 1. Diagram of habitat module with approximate dimensions proposed for use at the *M/V Paul Russ* restoration site.

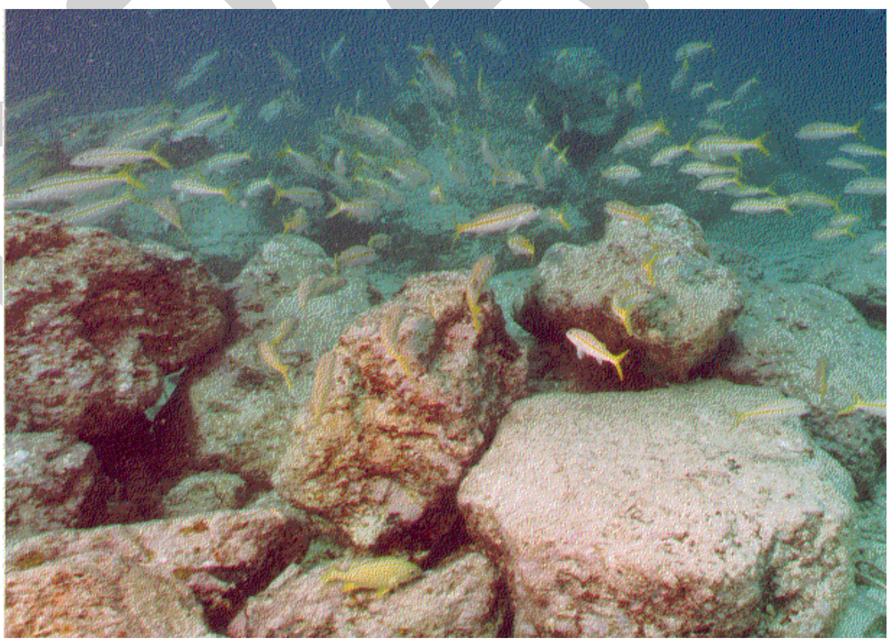
Photograph 3. Habitat modules immediately following construction awaiting deployment.

Photograph 4. View of habitat modules immediately after deployment at a vessel grounding site.

Photograph 5. Habitat module with corals re-attached to surface at a vessel grounding site.

Photograph 6. Close-up view of habitat module showing the opening that extends through the center of the module. Recently re-attached corals are also visible on the module.

Photograph 7. Limestone boulders placed at a grounding site within the Florida Keys National Marine Sanctuary.



Photograph 8. Limestone boulders placed at a vessel grounding site in Florida

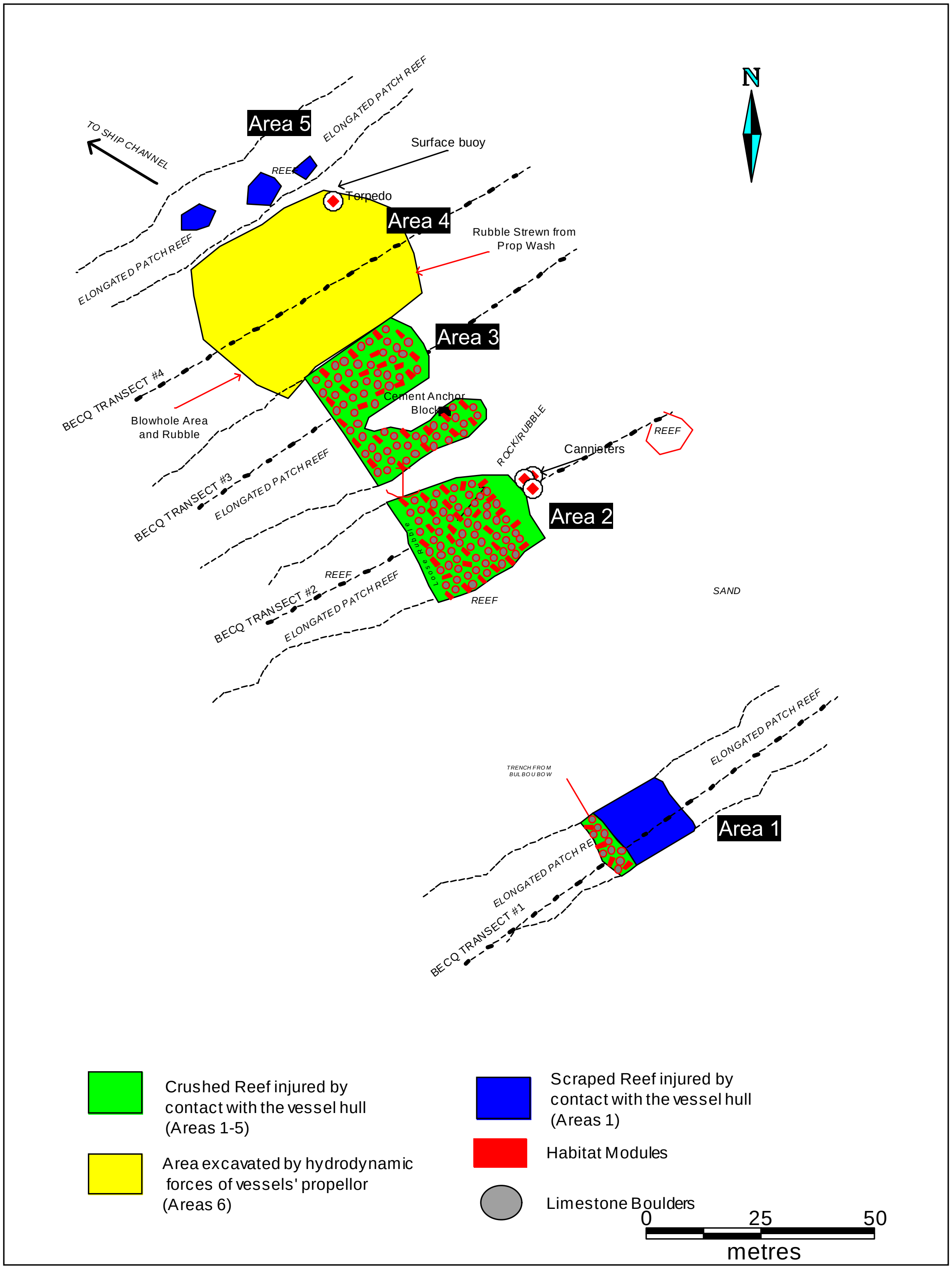


Figure 2. Location of proposed placement of habitat module and boulders at the *M/V Paul Russ* restoration site.

7.0 Steps to Avoid Additional Impacts to the Environment

As described in the temporary coral re-attachment plan (Sea Byte Inc. 2015), the foremost goal of any environmental restoration effort is to not do any additional injury to the environment while conducting the restoration. Identical goals will be set and achieved during this restoration effort. A variety of steps will be taken to ensure that no additional injury occurs including (but not limited to):

1. Anchors can cause considerable damage to coral reefs. Anchoring will be done by attachment t structures (likely old channel buoy anchors) that occur within the sand areas of the reef environment. No anchors will be placed on living coral within the area.
2. During restoration divers will take extreme caution not to touch or harm any surrounding coral reef area in the vicinity. This includes typical common sense dive practices such as not walking on the reef, not kicking the reef and avoiding contact with any reef organisms other than the corals that will be re-attached.
3. During re-attachment efforts divers will not handle dislodged corals except in areas of dead skeletal tissue. Every effort will be made not to contact live tissue of the hard coral.
4. During cementing divers will be extremely careful not to allow contact between live coral polyps and the cement.
5. A small amount of turbidity will be created by the cement while it is being used for the re-attachment of corals and boulders. Turbidity will be minimized by using a proper mixture of cement which hardens quickly, by transporting cement to the divers below in closed buckets which avoid/minimize turbidity and by carefully monitoring and fanning any small deposition of fine particles that can occur during a an underwater cementing operation away from the re-attached corals and the living reef. Attachment of corals and structures will occur on bare substrate void of living corals hence reducing the chance of contact with the cement and turbidity.
6. No materials including topside mixing containers or equipment used to prepare the cement will be cleaned and dumped overboard at any time.
7. All divers conducting the restoration have considerable experience working on coral reefs and avoiding additional injury to the reef. .
8. All work will be overseen and approved by Trustee personnel throughout the project.

8.0 Summary of Proposed Restoration

Multiple steps are proposed for restoration to begin the process of returning the ecological services provided by the coral reef prior to the incident. Some of these steps have already been implemented or partially implemented and the remainder should be implemented as quickly as possible. Proposed restoration measures include:

1. Salvage and re-attachment of injured/dislodged hard corals within the injury area,
2. Removal of bottom paint from the reef substrate,
3. Collection and stabilization of loose rubble created by the grounding, and
4. Placement of habitat modules, limestone boulders and large rubble (created by the incident)to replace the structural relief and complexity (rugosity) lost as a result of the incident.

All restoration activities will be accomplished without causing any additional injury to the coral reef in the vicinity of the grounding site.

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1-C. Habitat Equivalency Analysis and Project Evaluation – Paul Russ and Lady Carolina Report. *(see Johnston et al. 2016 in References for citation)*

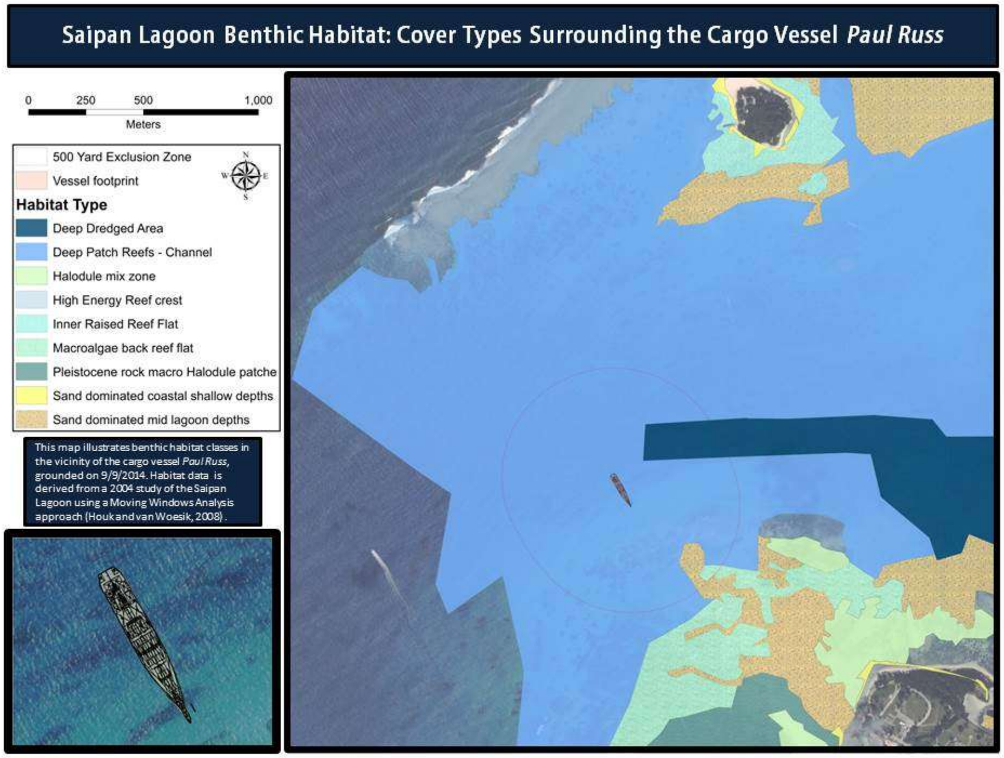
Habitat Equivalency Analysis and Project Evaluation – Paul Russ and Lady Carolina

11/14/16

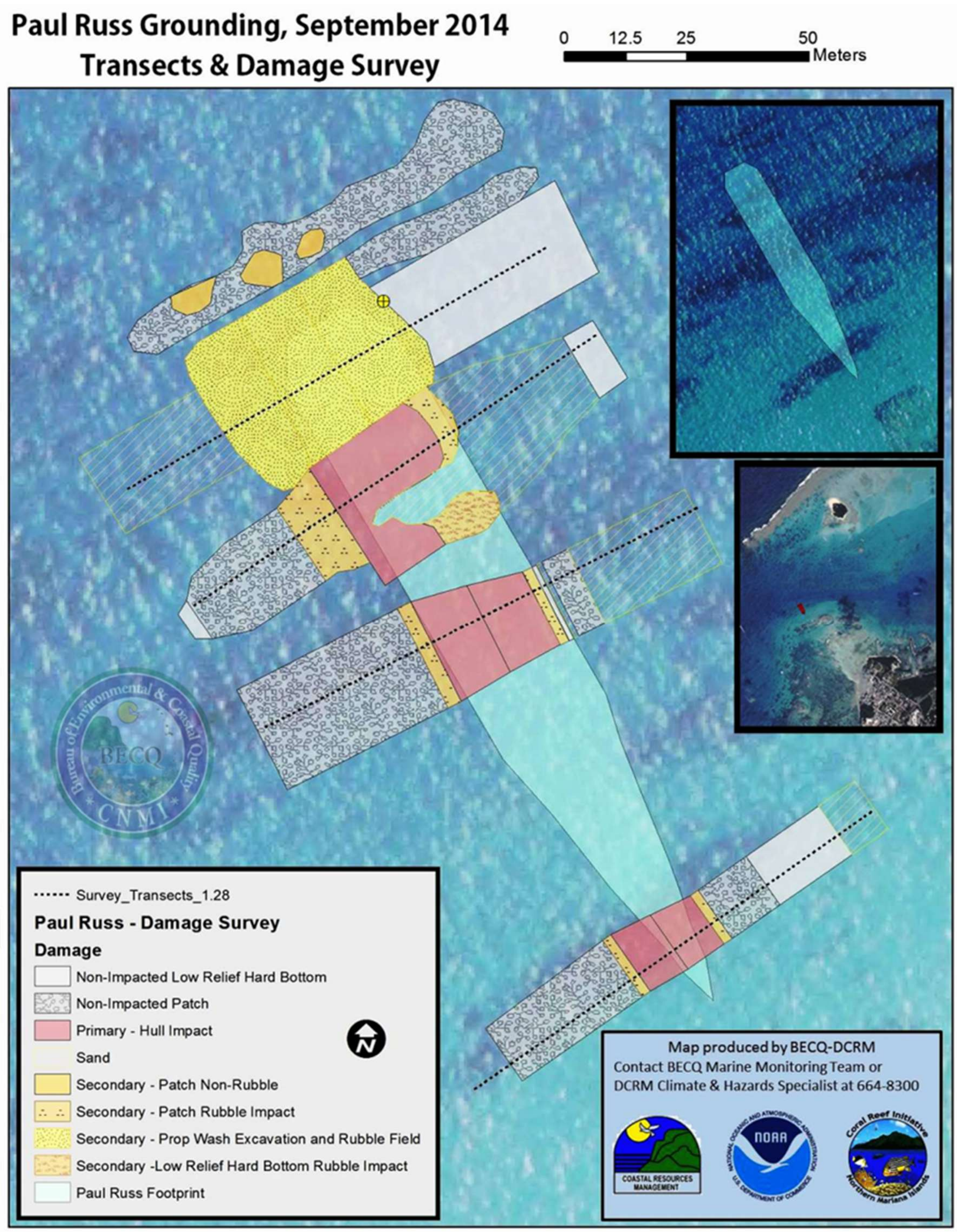
Lyza Johnston (CNMI BECQ)
Robbie Greene (CNMI BECQ)
Richard Schaul (SeaByte)
Steve McKagan (NOAA Fisheries)

Paul Russ –Compensatory Mitigation Required (as Service Acre Years)

On September 9th, 2014, the 536ft M/V *Paul Russ* ran aground just off the southern channel of Saipan harbor. On September 11th, the vessel was removed with the support of three tug boats at high tide, backing essentially directly off the impact scar without leaking any of the estimated 380,000 gallons of intermediate fuel oil on board.



Despite the efficient salvage operation, the direct impact of the ship pulverized approximately 1800 $m^2$of patch reef habitat, including an estimated 15,000 coral colonies, including ~500 colonies greater than 25cm in size and ~41 colonies greater than 50cm in size (JohnstonBECQ, Draft Damage Assessment 2015).


Paul Russ Grounding, September 2014
Transects & Damage Survey
0 12.5 25 50
Meters
BECQ
Bureau of Environmental & Coastal Quality
CNMI
Survey_Transects_1.28
Paul Russ - Damage Survey
Damage
Non-Impacted Low Relief Hard Bottom
Non-Impacted Patch
Primary - Hull Impact
Sand
Secondary - Patch Non-Rubble
Secondary - Patch Rubble Impact
Secondary - Prop Wash Excavation and Rubble Field
Secondary -Low Relief Hard Bottom Rubble Impact
Paul Russ Footprint
N
Map produced by BECQ-DCRM
Contact BECQ Marine Monitoring Team or
DCRM Climate & Hazards Specialist at 664-8300
COASTAL RESOURCES MANAGEMENT
NOAA
Coral Reef Initiative
Northern Mariana Islands

		Size Category (cm)					
Genus	**Functional Group**	**<5cm**	**5 to<10cm**	**10 to <25**	**25 to <50**	**>=50**	**Total**
*Acropora*spp.	Small branching			122	27		149
*Astreopora*spp.	Massive	244	176	122	14		557
*Cyphastrea*spp.	Massive	611	367	54			1,032
*Favia*spp.	Massive	543	176				719
*Favites*spp.	Massive	54		122			176
*Fungia*spp.	Free-living			54			54
*Galaxea*spp.	Massive	421	176				597
*Goniastrea*spp.	Massive	489	122		27		638
*Heliopora*spp.	Large branching			122	14		136
*Isopora*spp.	Large branching	54	54	244	14		367
*Leptastrea*spp.	Encrusting	149	122				271
*Millepora*spp.	Large branching	122	244	54	68	14	502
*Montastrea*spp.	Massive	244					244
*Montipora*spp.	Encrusting	1,928	964	1,140	217	14	4,262
*Pavona*spp.	Encrusting	1,751	1,262	190			3,204
*Platygyra*spp.	Massive	244	54				299
*Pocillopora*spp.	Small branching	54		54	27		136
*Porites*spp.	Massive	122	244	176	41	14	597
*Psammacora*spp.	Encrusting	597	176	122			896
*Stylocoeniella*spp.	Encrusting	54					54
*Stylophora*spp.	Small branching	176	54				231
Total		**7,860**	**4,195**	**2,579**	**448**	**41**	**15,122**

In an effort to offset some of the mitigation required for the Paul Russ grounding, the restoration team was able to collect ~800 corals of opportunity from pilings previously located just west of the Puerto Rico dump on Saipan (Picture from spring 2016).

The corals were placed on nearby hard bottom and sand habitat to await transplantation, where, unfortunately, they have experienced over 50% mortality to date, presumably due to bleaching and algal overgrowth. We now expect to only transfer ~25% of the largest corals and nearly ~25% of the corals sized between 25cm and 50cm. Credit for this translocation was taken into account by limiting the analysis of potential injury associated with leaving the Lady Carolina in place to a 20 year window.

The updated Habitat Equivalency Analysis models, as developed using modelled outputs from NOAA's Visual HEA tool (http://cnso.nova.edu/visual_hea/), are available upon request both from SeaByte and the CNMI trustees. Modeled outcomes were generated with joint participation from CNMI BECQ, NOAA and SeaByte and concluded that as recovery takes place, the Paul Russ will still owe compensatory mitigation for the habitat area that was unavailable during the recovery period, calculated to be **1035.93m^2 of reef**.

The Lady Carolina - Estimated Benefit of Salvage (in Service Acre Years)

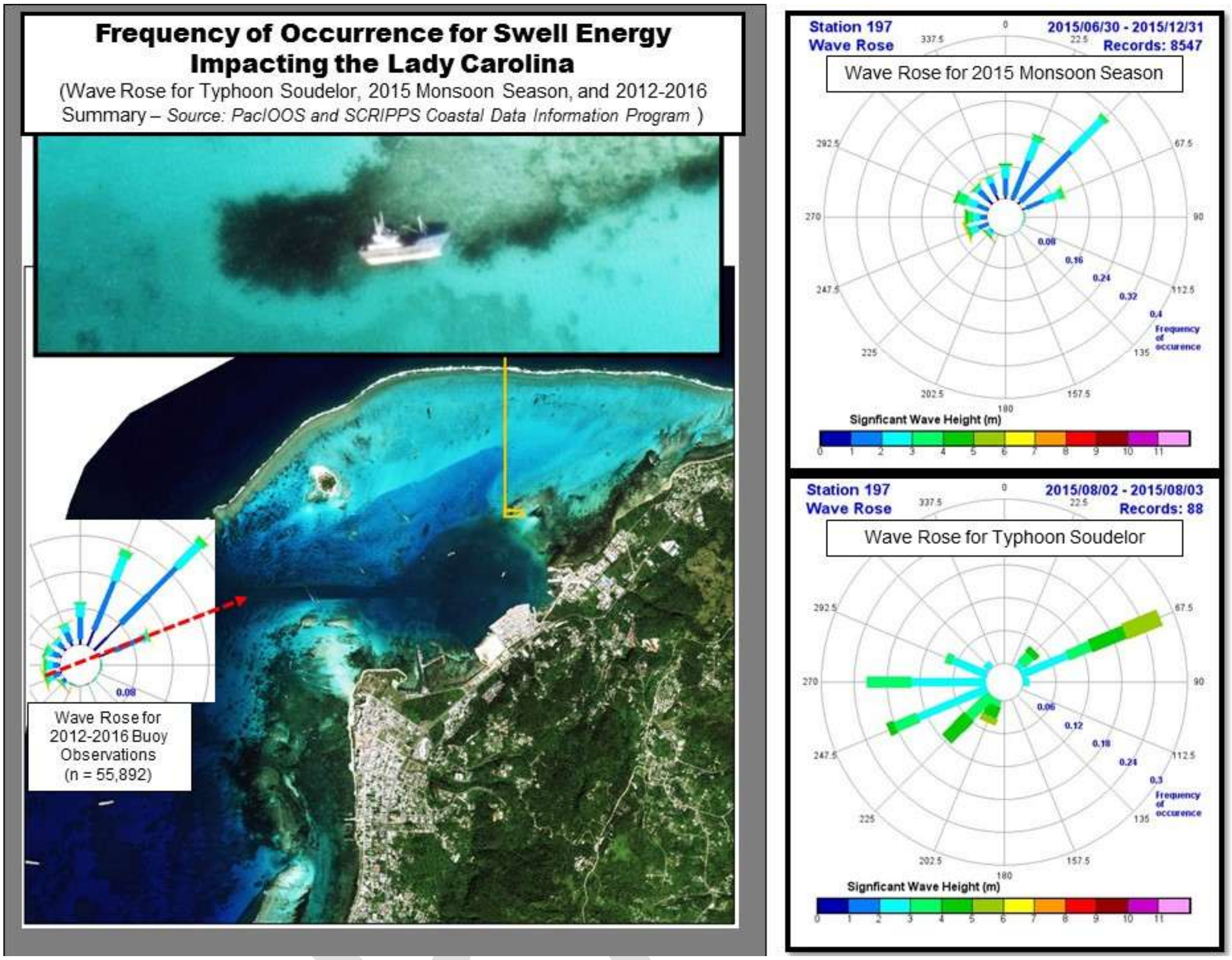
On August 2, 2015, Typhoon Soudelor passed directly over Saipan, grounding the 83ft fishing vessel *Lady Carolina* on an inshore patch reef, just west of the Commonwealth Port Authority. The sister ship, F/V *Miss Saipan*, also broke free of its mooring during Typhoon Soudelor, but it ran hard aground on the Delta Dock at the port doing minimal damage to the reef and posing a minimal threat to coral reef habitat. Due to the minimal benefit to the HEA of trying to salvage the *Miss Saipan*, it is not included in the current assessment to establish an offset for compensatory mitigation required from the Paul Russ.

Conversely, the Lady Carolina pin-balled out of the port and onto a very shallow section of lagoonal patch reef, impacting an estimated 560 m^2 of habitat (Johnston BECQ, Lady Carolina Brief 2015). Further, dominant coral species observed near the Lady Carolina were very similar to those observed at the scar of the Paul Russ, which is located less than 3 miles south. As such the habitat types are similar enough to **justify a 1 to 1** offset for any damages avoided.

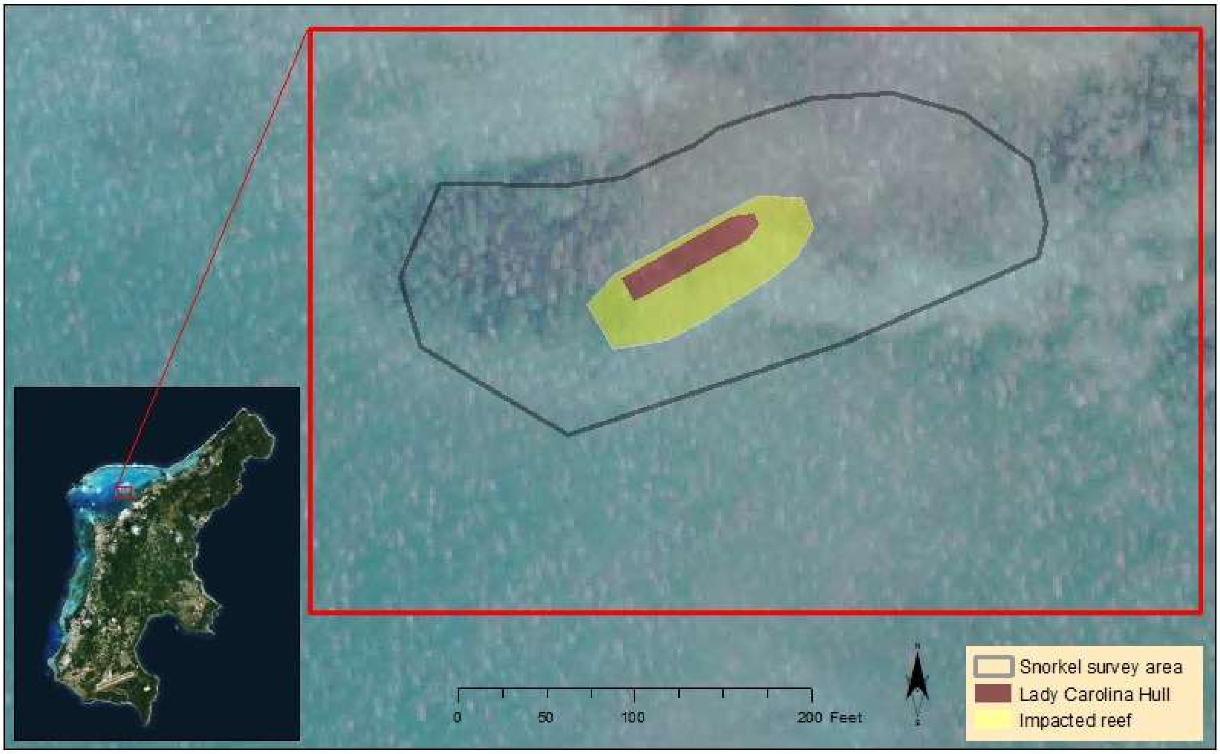
Coral Species
Faviamatthai
Galaxeafascicularis
Goniastrearetiformis
Helioporacoerulea
Isoporapalifera
Leptastreapurpurea

Montipora c.f. hoffmeisteri
Pocilloporaanekli
Pocilloporadamicornis
Porites cylindrica
Porites lobata
Porites lutea
Porites sp.
Psammocoradigitata

Tropical storm Goni passed by Saipan shortly after Typhoon Soudelor and generated enough force to turn the Lady Carolina onto its side from an upright position. As such, the Lady Carolina is not considered stable in its current placement and it is very likely that if left in place, future wind and wave action will cause the vessel to move, and eventually begin generating a debris field. The vessel's physical location and immediate surroundings within the Saipan Lagoon leave it particularly vulnerable.Currently the Lady Carolina is exposed to all wind directions, with an unobstructed fetch within a 180° window from 200° (SSW) to 380° (NNE). In addition, the patch reef is located at the northeast extent of Saipan's ship channel and port turning basin, resulting in minimal dissipation of wave energy as swells out of the southwest (200° - 250°) travel through deeper water before reaching the grounding site. This swell window generally corresponds with the highest frequency of occurrence for waves greater than five meters around Saipan (SCRIPPS Coastal Data Information Program –*graphic below*). Such conditions are rare, but generally occur at least once on an annual basis, coinciding with the passage of a tropical cyclone through the Archipelago or the onset of southwesterly monsoon flow.



2015 was an unprecedented year for storms in the Pacific and the strongest El Nino episode since the record-breaking 1997 event. Though tropical storms and typhoons have the potential to impact Saipan on any given year, the probability of experiencing typhoon force winds (65 kts or greater) increases during El Nino years, from roughly 10% to 33% (Lander 2004). During a positive ENSO phase, the center of cyclone generation in the Western Pacific shifts eastward, allowing additional time for storm intensification prior to passage through the Marianas. ENSO cycles occur every 2 to 7 years, so if we take a conservative approach and assume the ship will move only in the most severe ENSO events, an average of every 7 years, then if left alone we would expect the ship to move 3 times in the 20 year recovery period being used for the Paul Russ. In each of these major ENSO cycles it isn't unrealistic to expect the ship to roll around and damage an amount of reef area rough equal to the damage done during Typhoon Soudelor, corresponding with the size of the yellow polygon in the figure below per major ENSO cycle. Thus, we would expect the Lady Carolina, over a 20 year period, to destroy 560 m^2 X 3 Events = **1680 m^2** of reef.



Mitigation Required vs Offset Value (in Service Acre Years)

From the above we can see that the Lady Carolina poses a threat to reef area over the next 20 years that exceeds the debt the Paul Russ will owe once restoration and coral transplantation efforts are completed. **1032.93m^{2}Owed /1680 m^{2}Offset Value** within the Habitat Equivalency Analysis suggests that we can realistically expect the responsible party from the Paul Russ to pay for **61%** of the proposed cost to salvage the Lady Carolina in order to satisfy their compensatory mitigation requirement.

The details within the proposal to salvage the Lady Carolina are not fully public at this time, but the trustees were cleared to share the proposed budget so that costs could be used to articulate mitigation costs for the Paul Russ.

Based on the current proposal provided in response to phase one of the RFP put out by the Commonwealth Port Authority and CNMI Government, the cost to salvage the Lady Carolina will run $640,574. The pure cost of removal from the reef, without the costs associated with cutting up and scrapping the vessel, can be calculated by looking at the difference in the costs proposed for the Lady Carolina and the Miss Saipan, which is currently grounded across CPA Delta Dock. Based on this comparative approach, the cost of removal only for the Lady Carolina is **$484,000**.

With this new approach we have updated our findings and the HEA credit with the new information from the staged corals and isolated the salvage costs for the vessel to focus on the removal action. The result of this new information would put the compensatory mitigation requirement of the Paul Russ at 61% of the removal costs of the Lady Carolina.

61% of $484,000 =**<u>$297,582</u>** due as compensatory mitigation.

The CNMI trustees have developed language and rules for the development of an Escrow account to be housed within the Commonwealth Port Authority but managed through unanimous decisions across all local resource trustees for use to fund projects leading to the full removal of the Lady Carolina. The details of the account can be made available upon request and should be available whenever funding for this project, or other grounding related resources, become available.

1-D. Biological Assessment of the Sand Spit at Smiling Cove Marina, Saipan, CNMI. September 2025.

Rapid Biological Assessment of the Sand Spit at Smiling Cove Marina, Saipan, CNMI

Prepared by: Rodney Camacho, Halle Martineau, Michael Tenorio, and Nathan Van Ee
Affiliation: CNMI Division of Fish and Wildlife, Fisheries Research and Development Section (DFW FRDS)
Date: September 10, 2025
Prepared for: Vicente A. Camacho
CNMI DFW Boating Access Program Manager

Executive Summary

Sand accumulation within the main navigation channel at Smiling Cove Marina (SCM) has restricted safe vessel passage. To evaluate potential biological impacts of proposed emergency dredging, the CNMI Division of Fish and Wildlife conducted a rapid biological assessment on June 6, 2025. The survey documented benthic habitats, seagrasses, macroinvertebrates, and fish communities within the proposed dredge footprint and adjacent areas, with special attention to ESA-listed species, CNMI-protected species, and Essential Fish Habitat (EFH).

Key findings:

- Habitat within the dredge footprint was primarily unconsolidated sand with patches of macroalgae.
- Seagrass beds (*Halodule uninervis*, *Enhalus acoroides*) were present north of the dredge site.
- Twelve common reef-associated fish species were identified; no threatened or endangered fish were observed.
- ESA-listed green sea turtles (*Chelonia mydas*) and CNMI-protected species, including the spotted eagle ray (*Aetobatus narinari*) and tawny nurse shark (*Nebrius ferrugineus*), were observed adjacent to the dredge area.

The dredging footprint does not overlap with coral colonies or seagrass meadows. With mitigation measures including silt curtains, biological monitoring, and timing restrictions, ecological impacts are expected to be minimal and temporary.

Background and Purpose

Smiling Cove Marina has experienced ongoing sand accretion that constricts navigation channels, creating safety hazards for vessels. The Department of Public Lands has proposed emergency maintenance dredging to restore safe navigability. Prior to dredging, federal partners require an assessment of potential impacts to habitats, fisheries resources, and protected species.

Objectives of this rapid biological assessment were to:

1. Characterize benthic habitats, seagrasses, macroinvertebrates, and fish assemblages within and adjacent to the dredge footprint.
2. Identify the presence of ESA-listed species, CNMI-protected species, and EFH.
3. Provide management recommendations and mitigation measures to minimize ecological impacts.

Methods

On June 6, 2025, FRDS staff conducted snorkel-based underwater visual surveys. A timed swim rapid resource assessment procedure was carried out to assess fish, invertebrates, and benthic habitat in and adjacent to the project footprint. The rapid assessment lasted approximately 45 minutes and began from the southern side of the sand spit and proceeded towards the northern end. Resources were photographed and identified to the lowest taxonomic level, and photographic documentation was taken at representative stations within the proposed dredging area. Seagrass bed boundaries were estimated from a review of current satellite and drone imagery immediately following the survey.

Results

Benthic Habitat and Seagrass

- Substrate: Predominantly unconsolidated sand.
- Macroalgae: *Halimeda* and *Dictyota* are abundant; *Caulerpa* and *Padina* are present in low cover.
- Cyanobacteria: Thin mats covering algal substrates.
- Seagrass: *Halodule uninervis* and *Enhalus acoroides* were observed in shallow northern margins of the sand spit (Figure 3). No seagrass observed within the dredge footprint.

Macroinvertebrates

- Minimal presence. Only *Holothuria edulis* (sea cucumber) was observed.

Fish Communities

Twelve fish species were recorded within the dredge footprint (Table 1). All are common, small-bodied reef-associated species.

Table 1: List of fish species observed within the proposed dredge footprint

Scientific Name	Local or Common Name
Lethrinus harak	Mafute'
Myrichthys colubrinus	Banded/ringed snake eel
Gobiidae spp.	Sand goby
Lutjanus fulvus	Buha
Lethrinidae spp.	Mafute'
Halichoeres trimaculatus	A'aga
Trachinotus blochii	Pompano
Chaetodon ephippium	Butterfly fish
Carangoides orthogrammus	I'e' (juv.)
Canthigaster solandri	Toby
Pomacentrus pavo	Damselfish
Stethojulis bandanensis	Red Shoulder Wrasse

Additional observations from shoreline and vessel included larger species such as bluefin trevally (*Caranx melampygus*), mullet (*Mullidae*), surgeonfishes (*Acanthuridae*), spotted eagle ray, tawny nurse shark, and green sea turtle (Table 2).

Table 2: List of species observed from the SCM shoreline or vessel within the SCM.

Scientific Name	Local or Common Name
Caranx melampygus	Bluefin trevally, Tarakitu (juv.)
Mullidae sp.	Mullet, Peggi (juv.)
Dascyllus aruanus	Whitetail dascyllus
Acanthurus triostegus	Convict tang, Kichu
Acanthurus sp.	Surgeonfish, Hugupau

Mulloidichthys flavolineatus	Yellowstripe goatfish (Tiao)
Aetobatus narinari	Spotted eagle ray (Protected, CNMI Law)
Nebrius ferrugineus	Tawny nurse shark (Protected, CNMI Law)
Chelonia mydas	Green sea turtle (ESA listed)

Protected Species

- **Green sea turtle (*Chelonia mydas*)** – ESA listed
- **Spotted eagle ray (*Aetobatus narinari*)** – Protected under CNMI law.
- **Tawny nurse shark (*Nebrius ferrugineus*)** – Protected under CNMI law.

No ESA-listed corals or scalloped hammerhead sharks were observed.

Discussion and Impact Assessment

The dredge footprint consists of low-complexity sandy substrate, with no corals or seagrasses present. Adjacent habitats include seagrass beds that may serve as important foraging grounds for ESA-listed green sea turtles and locally protected spotted eagle rays. Fish assemblages were typical of Saipan's mixed sand/macroalgae habitats and not of high conservation concern (Van Ee and Robie, 2023). Potential impacts include:

- **Sedimentation and turbidity** – Risk to adjacent seagrass beds and corals further offshore.
- **Behavioral disturbance** – Potential temporary displacement of turtles and rays during dredging.

With mitigation, these impacts are expected to be temporary and minor.

Proposed Activity

Emergency dredging of accumulated sand in the SCM channel will be conducted using two crawler excavators (one extended-arm, one standard). A 12-ft silt curtain will contain dredged material in deeper areas; a 3-ft curtain will be deployed in shallow areas. Dredged material will be staged temporarily upland (Figure 4). If on-site staging is not approved, material will be hauled to an approved upland site within NPS grounds.

Mitigation Measures

1. **Sediment Control**
    - Install and inspect silt curtains before dredging.
    - Suspend operations if plumes extend beyond containment.
    - Conduct daily turbidity monitoring inside and outside the silt curtain.

2. **Coral Spawning**
    - Avoid dredging within ±5 days of full moons from May–August. In the CNMI, soft corals tend to spawn earlier in the year. While hard coral spawning in the CNMI can happen later, with some events documented in the summer months. Various Acropora (staghorn) coral species have been observed spawning in May and again in late July.

3. **Seagrass Protection**
    - No dredging in mapped seagrass beds.
    - Maintain buffer zone between dredge footprint and nearest seagrass.

4. **Sea Turtle Mitigation**
    - Trained observers present during all in-water work.
    - Morning pre-dredge surveys to ensure absence of turtles within 50 ft.
    - Cease operations if turtles approach within 50 ft.
    - Maintain vessel speeds at idle near dredge site.

5. **Shark Mitigation**
    - Observers to monitor for scalloped hammerhead sharks.
    - Cease operations if sharks are observed within 50 ft.

6. **Post-Dredging Monitoring**
    - Conduct a rapid benthic survey to assess recovery and detect unanticipated impacts.
    - Submit a report of monitoring results to permitting agencies.

Conclusion

The SCM sand spit dredging project will restore safe navigation while avoiding significant impacts to coral, seagrass, or ESA-listed species. With strict adherence to mitigation measures and BMPs, ecological impacts are expected to be minimal, localized, and temporary.

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Appendices

Figure 1: *Map of the assesment area. The presence of various marine species were recorded within the red polygon*

Figure 2: *Thin mat of cyanobacteria covering the algae present in the area.*

Figure 3*: The presence of the seagrasses H. uninervis and E acoroides are scattered and sparse in the shallow northern section of the assessment area.*

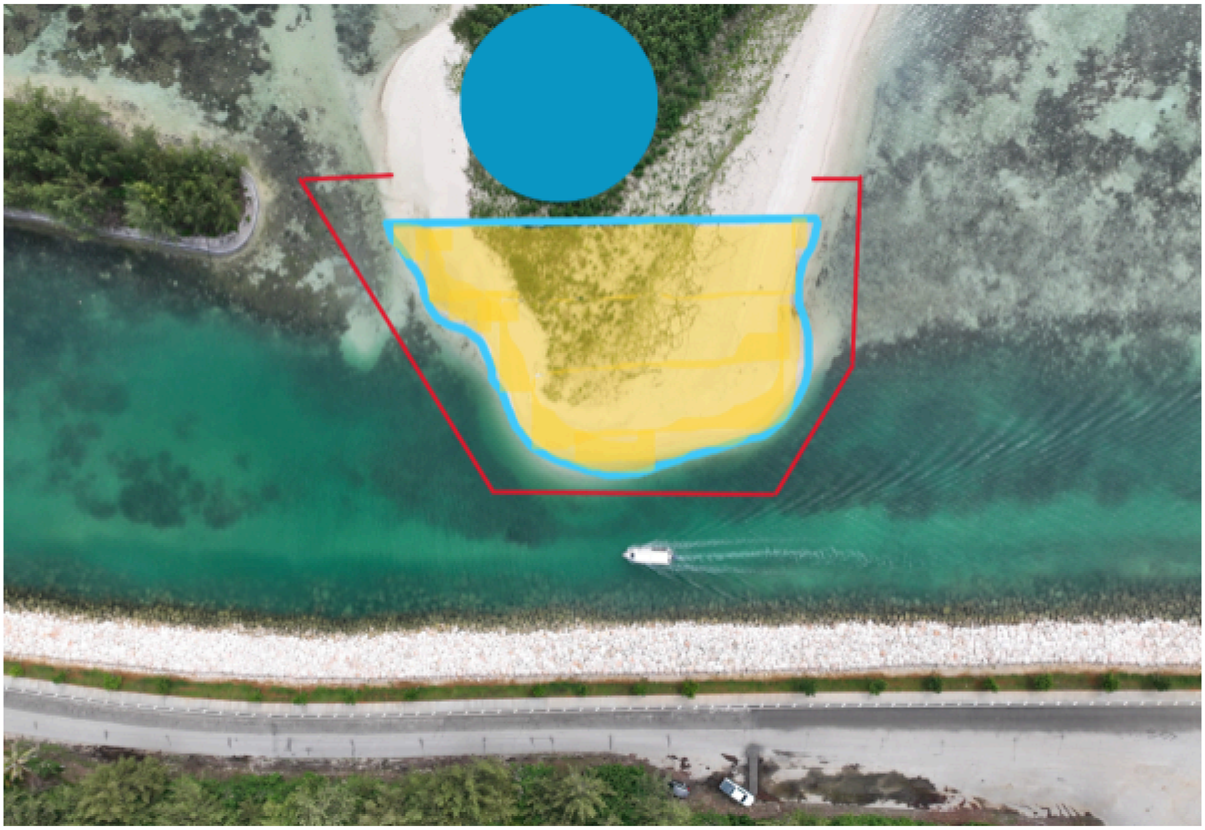


Figure 4. Project site image with dredge footprint, dredge material staging area and silt curtain placement.

1-E. Scope of Work for Smiling Cove Marina Emergency Dredging Activities

SOW for Smiling Cove Access Channel

Spot Dredging Operations, Saipan Lagoon, Island of Saipan, CNMI

SITUATION:

The Smiling Cove Marina located in Saipan Island, CNMI, is one of two commonly used boating access ramps for the island, and contains one of the only mooring and berthing docks with slips that can be used by government, private, temporary, emergency, and recreational vessels to lease and/or moor at safely. It is a hub for commercial, recreational, scientific, research, economic, subsistence fishing, tourism and diving activities and is managed by the Department of Lands and Natural Resources Division of Fish and Wildlife's Smiling Cove Marina Manager. Maintaining adequate and safe boating channel access is necessary to ensure the safety of the public and economic livelihood of the island's residents, government staff, emergency personnel, and visitors alike. Further, the Marina is a site for local cultural activities such as fishing derbies, and forms a habitat for many species of fish, turtles, algae, mangroves, seagrass, invertebrates, and corals which provide important ecosystem functions and services for this ecosystem.

For these reasons, the encroachment of the sand spit to the West of the boating access channel impeding vessel access to the marina, smothering corals and seagrass habitat, and threatening the mangrove ecosystem around the marina is an urgent priority that needs to be addressed, as the sand spit continues to grow in size. The local CNMI Government has prioritized the need for initial dredging operations to take place at the Smiling Cove Marina. Securing funding, appropriate permits, tools, and equipment to perform these dredging operations at Smiling Cove Marina are of the utmost importance. Local and federal contractors and vendors will collaborate with the government and construction agents to execute various construction operations. The operations involve the construction of a temporary access path through the beachside area and in a manner that avoids disturbing habitat but allows for access for the excavating equipment, the mechanical dredging of soft sand to return the channel to its previous depth using crawler excavators (one extended arm, one standard), the relocation and staging of dredged material following BMPs for their storage and disposal/use, and site cleanup once complete.

Mission and Proposed Activities:

The local CNMI government, in coordination with contractors, vendors, partners, and construction agents, will complete emergency dredging operations at Smiling Cove Marina. The mission includes:

1. Construction of a temporary access path (18' wide, 800' long).
2. Mechanical dredging of approximately 5,000–6,000 cubic yards of material to a depth not deeper than the access channel was when previously dredged.
3. Relocation of the dredged material to a temporary designated staging location (see below) following BMPs.
4. Cleanup of the site, including removal of all tools, equipment, and control measures.

5. Post-construction monitoring for recovery

MINIMUM BUDGET ESTIMATE

Item Description				TOTAL COST
Excavator	$180/7 hrs	x 30 days	x 2 (mos)	$75,600
Backhoe	$75/7 hrs	x 30 days	x 2 (mos)	$31,500
Dump truck (10 cy)	$65/7 hrs	x 3 trucks	x 30 days x 2 (mos)	$81,900
HE Mobilization	$1,000			$1,000
Silt curtain (200 ft x 12 ft) rent	$2,000	X 2 units	X 2 mos	$4,000
Silt curtain (120 m x 2 m) buy	$6,000			$6,000
Misc. Supplies	$5,000			$5,000
			TOTAL est cost	**$193,000**

*Estimate provided by the SCM Manager Ben Camacho as of 9/2025

**Note: this estimate does not include other items such as staff/personnel costs, it represents the minimum amount of funding needed for the project to proceed.*

EXECUTION:

1. **Phase 0 – Administration:**
   - Ensure all participating stakeholders understand the timeline and concept of operations.
   - Submit required paperwork and permits needed for construction to commence work.
2. **Phase 1 – Environmental Controls:**
   - Identify and implement all necessary environmental control measures, including the following:
     - Conducting a biological assessment prior to the commencement of activities to ensure that a baseline is captured and impacts can be accurately assessed.
     - Acquiring and employing a spill containment kit for heavy equipment and refueling areas (2 kits).
     - Installation of a silt fence for erosion control along the edges of the temporary access path.
     - Installation of a turbidity/silt curtain around the dredging site to contain dredged material and sediment, and limit wildlife impacts.
     - Crew members will maintain vigilance and monitor for any hazardous materials or spills and remove/cleanup any spills promptly during activities using spill kits and dispose of the material(s) in a safe and proper manner.
     - Additional control measures for other environmental hazards, to limit natural resource impacts, and implementation of additional mitigation measures as required by local and federal agencies.

3. **Phase 2 – Safety Controls:**
    - Ensure compliance with OSHA regulations for all crew members, including but not limited to the following:
        - Area guides for heavy equipment.
        - PPE for crew members operating chainsaws.
        - Warning signs and barricades for general site and public safety.
        - Eye wash station for emergency use.
    - Trained in-water and above water observers will be present during all in-water work to address safety and endangered species concerns.
    - Public signage will be present and visible around work areas to ensure public safety.
4. **Phase 3 – Site Clearing for Temporary Path:**
    - Mark and stake out the temporary access path (18' wide, 800' long).
    - Use various pieces of heavy equipment and chainsaws to clear and move trees and vegetation from the designated area(s) of work in a manner that least disturbs the environment.
    - Installation of silt fencing around path to minimize erosion impacts.
5. **Phase 4 – Compaction/Stabilization of Path:**
    - Use heavy equipment and chains to move downed trees and spread across the temporary path to stabilize the surface.
    - Wood chips can be used in low, soft sand areas to raise the elevation and create a stable path for all equipment and crew movement.
6. **Phase 5 – Material Removal:**
    - Deploy trained in-water and above water observers to monitor for endangered and protected species before the commencement of daily work. All ESA-listed species will be logged as appropriate.
    - Installation and daily inspection of turbidity curtains around the removal area to limit negative impacts.
    - A long reach excavator and dump trucks will be used to stage and hold all dredged material from the marina to the designated dump site(s). This cycle of operations will continue until the project is complete.

- Dredging will not exceed previous access channel depths and will utilize in-water observers and measurements to confirm adequate depth has been reached prior to the commencement of daily work.
- Dredged material will be deposited at the dump sites located at Lot No. 117 D 09 (Across Gov. Eloy S. Inos Peace Park), approximately 1.33 km (roughly 4,360ft) away from the dredging site; and Lot No. TR. 24-3 (American Memorial Park Sand Accretion Site), approximately 650 meters (roughly 2,134 ft) away from the dredging site.

7. **Phase 6 – Cleanup and follow-up monitoring:**
    - Removal and cleanup of all debris from all areas where operations took place, including removing temporary control measures, trash, tools, and equipment.
    - Ensure the access path and surrounding site are left in a safe, clean condition.
    - Conduct post-dredging monitoring as appropriate to assess natural resource recovery and detect/limit unanticipated impacts to corals, seagrasses, mangroves, and associated beachside and benthic habitats.
    - Conduct follow-up habitat monitoring and restoration if needed and appropriate in adjacent affected areas as funding allows to ensure that ecosystem function is preserved and services are continued.

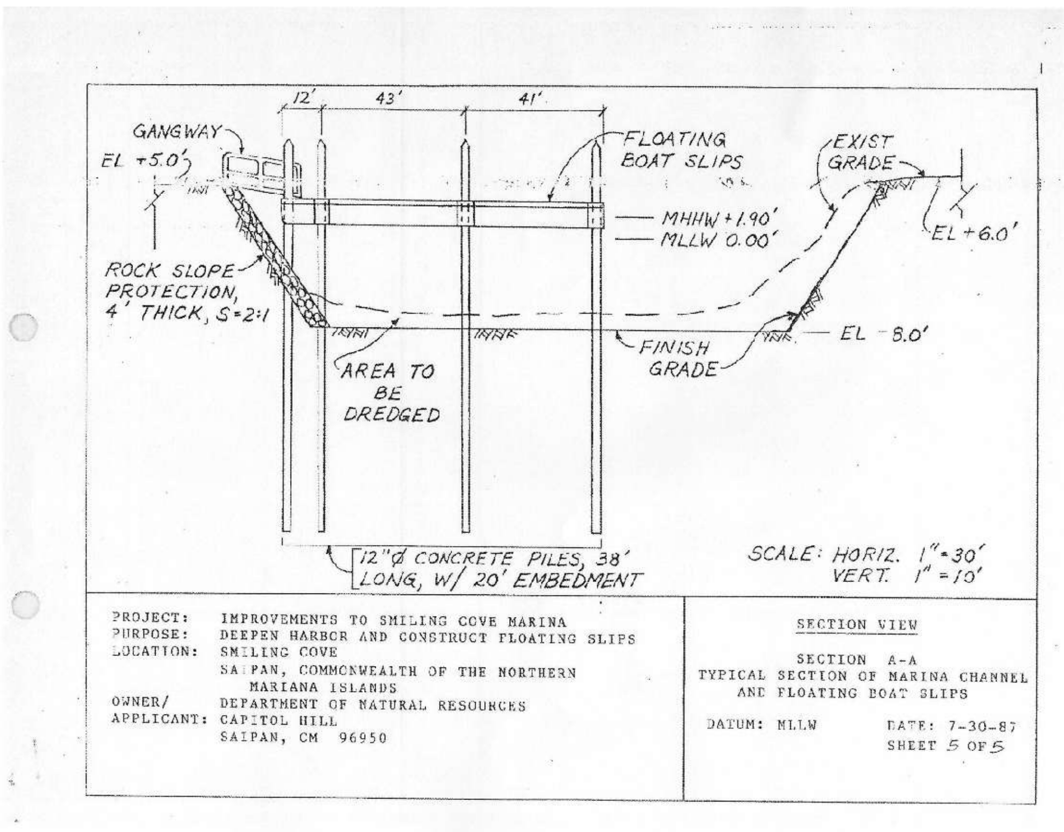
ADMINISTRATION AND LOGISTICS:

1. **Funding:** Ensure that necessary funding is secured for the completion of the dredging operations and associated tasks prior to the commencement of work.
2. **Public Notice:** Notify partners, agencies, stakeholders, and leadership in advance of the activities. Assign POCs to each participating agency and distribute these contact(s) to all participants of the project. Ensure that adequate signage and notice is given to the community and stakeholders.
3. **Weather:** Monitor weather forecasts and tides and adjust work schedules as necessary to avoid delays caused by adverse weather conditions and to ensure safety of all personnel.
4. **Equipment Condition:** Regularly inspect the condition of all equipment and ensure it is properly maintained and in good condition to operate. Coordinate with contractors to avoid any conflicts with other obligations.
5. **Timeline:** May be adapted to account for changes in weather and circumstances. Ensure expectations are managed appropriately, especially since the holiday season and other important days celebrated in the community are fast approaching. Work will slow down.
6. **Permit and Documentation:** Ensure all paperwork and permits are submitted on time to avoid project delays. Ensure all regulatory requirements are met throughout the project. Receive required authorizations to proceed and environmental compliance concurrence prior to the

commencement of work. Document any issues and notify leadership of changes in scope/timeline.

7. **Safety and Environmental Compliance:** Ensure that the contractor(s) and crew adhere to all safety and environmental regulations and assure BMPs are followed before, during, and after the operation and activities. Ensure the correct and appropriate disposal of waste and adherence to best practices for environmental protection and compliance.

Attachment of 1987 SCM Dredging Project illustrating the depth of the previous dredging activities



1-F. Suggested Best Management Practices for Proposed Dredging Activities

Best Management Practices (BMPs) are typically required to minimize adverse impacts to coastal water quality and the marine ecosystem as part of the permitting process. A detailed Best Management Practices Plan (BMPP) is typically prepared during the final design and permitting phase. The BMPP should include but not be limited to the following:

- Vehicle, Equipment, and Materials Management
- Waste Management
- Monitoring Procedures and Protocols
- Turbidity Containment
- Erosion and Sediment Control
- Oil and Spill Containment
- Noise Control
- Dust Control
- Air Pollution Control
- Operational Controls
- Structure, Authority, and Responsibilities
- Training
- Health and Safety
- Inspection and Monitoring
- Emergency Procedures, Spill Response Plan, and Contacts
- Contingency Plan
- Suspension of Work
- Record Keeping and Documentation

Examples of typical project specifications that a Contractor would be required to adhere to for environmental protection measures include but are not limited to the following:

- The Contractor shall perform the work in a manner that minimizes environmental pollution and damage as a result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of the construction period.
- Any construction related debris that may pose an entanglement hazard to marine protected species must be removed from the project site if not actively being used and/or at the conclusion of the construction work.
- The Contractor shall submit a Best Management Practices and Environmental Protection Plan for approval prior to initiation of construction. The plan shall include, but not be limited to:
    1. Protection of Land Resources
    2. Protection of Water Resources
    3. Disposal of Solid Waste
    4. Disposal of Sanitary Waste
    5. Disposal of Hazardous Waste

6. Dust Control
7. Noise Control

The construction contractor shall be required to employ standard BMPs for construction in coastal waters, such as daily inspection of equipment for conditions that could cause spills or leaks; cleaning of equipment prior to operation near the water; proper location of storage, refueling, and servicing sites; and implementation of adequate spill response procedures, stormy weather preparation plans, and the use of silt curtains and other containment devices.

- No contamination (trash or debris disposal, alien species introductions, etc.) of marine (reef flats, lagoons, open oceans, etc.) environments adjacent to the project site shall result from project related activities.
- The Contractor shall confine all construction activities to areas defined by the drawings and specifications. No construction materials shall be stockpiled in the marine environment outside of the immediate area of construction.
- The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface or marine waters. Construction-related turbidity at the project site shall be controlled so as to meet water quality standards. All water areas affected by construction activities shall be monitored by the Contractor. If monitoring indicates that the turbidity standards are being exceeded due to construction activities, the Contractor shall suspend the operations causing excessive turbidity levels until the condition is corrected.
- Effective silt containment devices shall be deployed where practicable to isolate the construction activity, and to avoid degradation of marine water quality and impacts to the marine ecosystem.
- In-water construction shall be curtailed during sea conditions that are sufficiently adverse to render the silt containment devices ineffective.
- Waste materials and waste waters directly derived from construction activities shall not be allowed to leak, leach or otherwise enter marine waters.
- Fueling of project related vehicles and equipment should take place away from the water.
- A contingency plan to control the accidental spills of petroleum products at the construction site should be developed. Absorbent pads and spill kit(s) will be stored on site to facilitate the cleanup of petroleum spills.
- The project shall be completed in accordance with all applicable Commonwealth health, environmental, and safety regulations.
- All construction material including sand shall be free of contaminants of any kind including: excessive silt, sludge, anoxic or decaying organic matter, turbidity, temperature or abnormal water chemistry, clay, dirt, organic material, oil, floating debris, grease or foam or any other pollutant that would produce an undesirable condition to the beach or water quality.

- Any spills or other contaminations shall be immediately reported to the CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality.
- Best management practices shall be utilized to minimize adverse effects to air quality and noise levels, including the use of emission control devices and noise attenuating devices.
- A dust control program shall be implemented, and windblown sand and dust shall be prevented from blowing offsite by watering when necessary.
- Public safety best practices shall be implemented, possibly including posted signs, areas cordoned off, and on-site safety personnel.
- Public access along the shoreline during construction shall be maintained so far as practicable and within the limitations necessary to ensure safety.

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