

Saipan Lagoon Use Management Plan Update—2017 FINAL



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Prepared for:

CNMI Bureau of Environmental and Coastal Quality,
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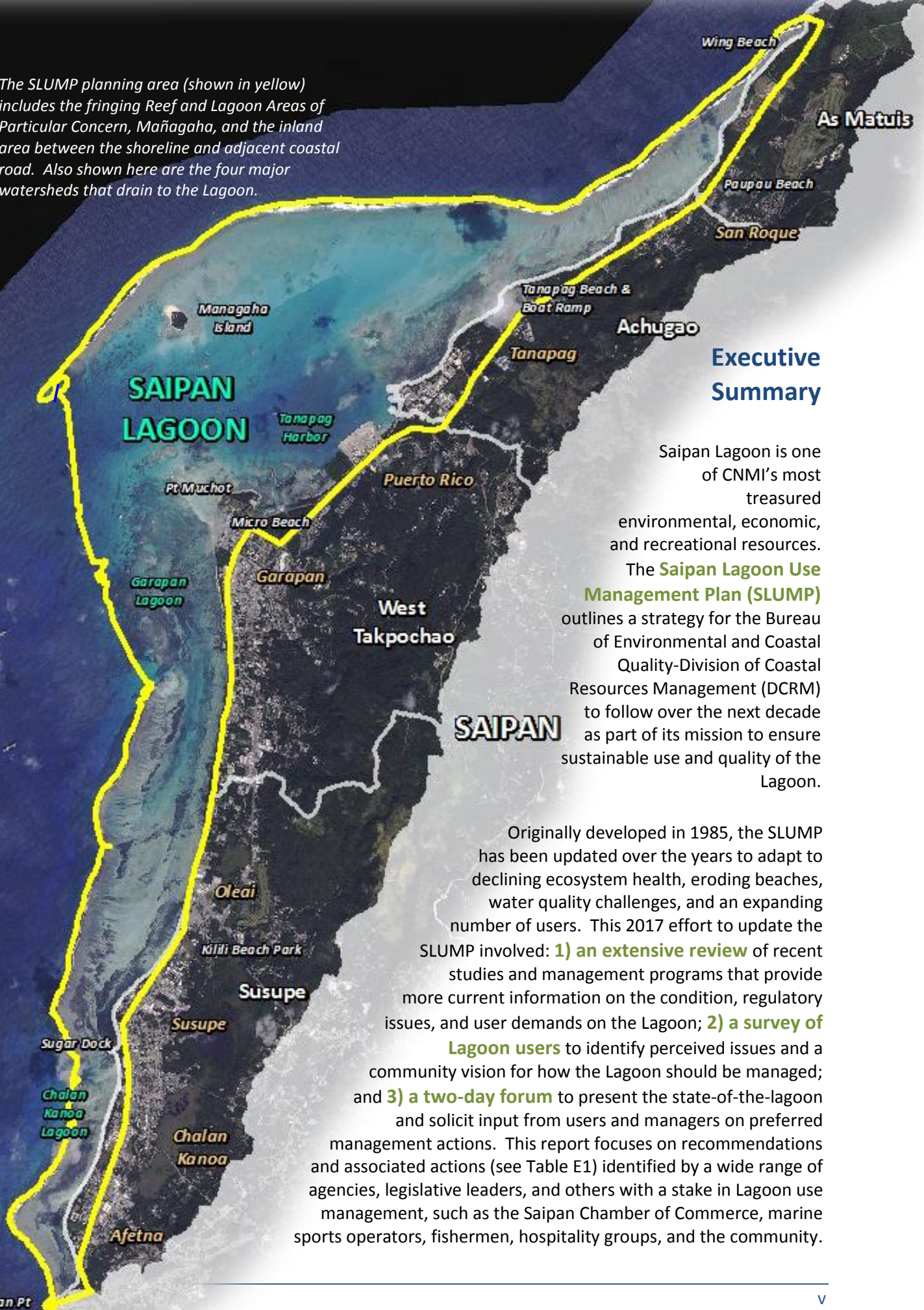
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List of Acronyms

AMME	American Memorial Park
APC	Area of Particular Concern
BECQ	Bureau of Environmental and Coastal Quality
CAP	Conservation Action Plan
CIP	Capital Improvement Project
CNMI	Commonwealth of the Northern Mariana Islands
CPA	Commonwealth Ports Authority
CRM	Coastal Resources Management
CUC	Commonwealth Utilities Corporation
DCRM	Division of Coastal Resources Management
DEQ	Division of Environmental Quality
DFW	Division of Fish and Wildlife
DLNR	Department of Lands and Natural Resources
DPL	Department of Public Lands
DPS-BS	Department of Public Safety-Boating Safety
DPW	Department of Public Works
GIS	Geographic Information Systems
HANMI	Hotel Association of the Northern Mariana Islands
MINA	Micronesia Islands Nature Alliance
MMCA	Mañagaha Marine Conservation Area
MPA	Marine Protected Area
MS4	Municipal Separate Storm Sewer System
MSO	Marine Sports Operator
MSOA	Marine Sports Operator Association
MVA	Marianas Visitors Authority
NMIAC	Northern Mariana Islands Administrative Code
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
SASEA	Shoreline Access and Shoreline Enhancement Assessment
SFA	Saipan Fishermen's Association
SLUMP	Saipan Lagoon Use Management Plan
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
WERI	Water and Environmental Research Institute of the Western Pacific
WWTP	Wastewater Treatment Plant

The SLUMP planning area (shown in yellow) includes the fringing Reef and Lagoon Areas of Particular Concern, Mañagaha, and the inland area between the shoreline and adjacent coastal road. Also shown here are the four major watersheds that drain to the Lagoon.



Executive Summary

Saipan Lagoon is one of CNMI's most treasured environmental, economic, and recreational resources.

The **Saipan Lagoon Use Management Plan (SLUMP)** outlines a strategy for the Bureau of Environmental and Coastal Quality-Division of Coastal Resources Management (DCRM) to follow over the next decade as part of its mission to ensure sustainable use and quality of the Lagoon.

Originally developed in 1985, the SLUMP has been updated over the years to adapt to declining ecosystem health, eroding beaches, water quality challenges, and an expanding number of users. This 2017 effort to update the SLUMP involved: **1) an extensive review** of recent studies and management programs that provide more current information on the condition, regulatory issues, and user demands on the Lagoon; **2) a survey of Lagoon users** to identify perceived issues and a community vision for how the Lagoon should be managed; and **3) a two-day forum** to present the state-of-the-lagoon and solicit input from users and managers on preferred management actions. This report focuses on recommendations and associated actions (see Table E1) identified by a wide range of agencies, legislative leaders, and others with a stake in Lagoon use management, such as the Saipan Chamber of Commerce, marine sports operators, fishermen, hospitality groups, and the community.

Public meetings and surveys were used to solicit input from users on issues and management suggestions related to commercial activities, user safety, and environmental quality of the Lagoon.



The following recommendations provide DCRM with a roadmap for updating policies and permitting requirements, as well as identify opportunities for collaboration with other managers:

1. Establish designated Lagoon use areas for motorized marine sports operations.
2. Update DCRM marine sports permits.
3. Minimize watershed impacts on corals in the northern Lagoon.
4. Develop and implement a unified Lagoon users' education plan.
5. Collaborate with CUC on critical wastewater infrastructure improvements.
6. Improve public access for Lagoon users.
7. Encourage sustainable use of Mañagaha resources.
8. Create a fishing safety equipment program.
9. Continue to support BECQ's marine monitoring program.
10. Evaluate and implement appropriate shoreline stabilization and erosion control projects.
11. Implement stormwater management improvements.
12. Establish a sustainable, dedicated funding mechanism for Lagoon use management.

Table E1. 2017 SLUMP Update Summary of Recommendations and Actions

Recommendations	Partners	Actions
#1 Designate Lagoon use areas	DPS-BS, DFW, US Coast Guard, USACE, HANMI, NOAA, MSOA	<ul style="list-style-type: none"> 1.1 Collaborate to finalize and adopt designated use areas. 1.2 Develop a companion map that shows historical/cultural locations and areas for habitat protection. 1.3 Map designated swimming areas to help with monitoring and enforcement of seagrass removal regulations. 1.4 Evaluate the number, type, and location of existing and additional Lagoon moorings and markers. 1.5 Educate MSOs, residents, and visitors on designated use areas, transits, and launches.
#2 Update marine sports permit	DPS-BS, NOAA, MSOA, DLNR-DFW, Other Lagoon Groups	<ul style="list-style-type: none"> 2.1 Enforce the current cap on the number of commercial operator permits. Formally establish a quota. 2.2 Update DCRM rules and regulations. 2.3 Update permit conditions to be consistent with Sections 101 and 102 of the 1987 Boating Safety Regulations.
#3 Minimize watershed impacts on northern Lagoon	DPL, Office of Zoning, CRM Agency Board, DLNR-DFW, BECQ-DEQ, DLNR-Parks & Recreation, DPW, Mayor's Office	<ul style="list-style-type: none"> 3.1 Collaborate with DPL to incorporate land conservation in the northern Lagoon. 3.2 Establish a northern Lagoon watershed district with stringent environmentally-sensitive development criteria. 3.3 Strengthen language in Chapter 15-10-100,300 regarding major and minor APC permit requirements. 3.4 Develop a CAP or comprehensive watershed management plan for the Northern Lagoon Watershed. 3.5 ID opportunities for improvement at permit renewal, road repair, and utility upgrades.
#4 Develop and implement Lagoon user education plan	DLNR, DFW, DPL, Litter Control Board, MVA, MINA, Chamber of Commerce, MSOA, Northern Marianas Diving Operators Association, SFA	<ul style="list-style-type: none"> 4.1 Develop an overarching Lagoon education plan with target audiences, messaging, and delivery mechanism. 4.2 Expand MVA pilot educational program targeting snorkeling and diving tour operators. 4.3 Create Saipan Lagoon Sustainable Use educational brochures and maps for permittees, tourists, and residents. 4.4 Develop a trash disposal educational video that could be shown on airplanes or at the airport. 4.5 Collaborate with MVA, DFW, MINA, and DPL on trash management in the Lagoon. 4.6 Consider implementing in-water/beach signage to provide information.
#5 Improve wastewater infrastructure	CUC, BECQ-DEQ, US EPA	<ul style="list-style-type: none"> 5.1 Coordinate on wastewater infrastructure demands, planned improvements, and water quality monitoring. 5.2 Support CUC in enforcement, securing grant funds, and fast-tracking permitting for priority upgrades. 5.3 Develop a better understanding of the bacteria concentrations in effluent discharge from the Sadog Tasi WWTP.
#6 Improve public access infrastructure	HANMI, DPL, DPS-BS, MSOA, DFW, DLNR-Parks & Recreation, USACE	<ul style="list-style-type: none"> 6.1 Work with partners on priority improvements at Outer Cove Marina, Sugar Dock, and beach barbeque areas. 6.2 Determine if there is a benefit to moving concessionaires off the beaches and into hotels. 6.3 Ensure developers/hotels maintain a clearly marked, publicly-accessible passage to the shoreline

Recommendations	Partners	Actions
#7 Encourage sustainable use of Mañagaha resources	DFW, DPS-BS, DPL, MVA, MINA, BECQ-DEQ	<ul style="list-style-type: none"> 7.1 Determine how to enforce motorized vessel restrictions and integrate use area designations and transit routes. 7.2 Discuss water quality and habitat protection concerns related to overcrowding with DFW and MVA. 7.3 Discuss incorporating eco-friendly green business practices into permit requirements with partners. 7.4 Review NPDES permit conditions, monitoring reports, and treatment technology to assess necessary upgrades 7.5 Provide signage about trash management on Mañagaha
#8 Create fishermen safety equipment program	DLNR-DFW, DPS-BS, SFA	<ul style="list-style-type: none"> 8.1 Establish free equipment program for fishermen that distributes adequate safety equipment and clothing. 8.2 Provide a venue for a safety training program for fishermen, as part of a Lagoon education plan (Rec. #4). 8.3 Distribute educational brochure to fishing community. 8.4 Discuss a possible regulatory approach that would require fishermen to wear/carry proper safety equipment.
#9 Support BECQ monitoring program	BECQ-DEQ, NOAA, CUC, DPW, University of Guam-WERI	<ul style="list-style-type: none"> 9.1 Improve monitoring capabilities. 9.2 Use monitoring data from permit requirements as additional data points for Lagoon-wide studies. 9.3 Consult with the University of Guam-WERI about prioritizing data collection and analysis of ecological systems.
#10 Evaluate and implement appropriate shoreline stabilization and erosion control projects	CIP Program, BECQ-DEQ, DFW, DPL, Legislature, DPW, USACE	<ul style="list-style-type: none"> 10.1 Require that public infrastructure improvement projects constructed a certain distance from an eroding shoreline implement viable shoreline stabilization and/or beach re-nourishment projects. 10.2 Secure grant funding for shoreline enhancement and stabilization projects not covered by CIP funds. 10.3 As part of APC permit review, ensure that private applicants have considered shoreline stabilization concerns and needs. 10.4 Consider allowing shoreline projects as part of permit mitigation alternatives. 10.5 Incorporate education and outreach components into shoreline protection and climate adaptation projects. 10.6 Collaborate with DFW in re-vegetation efforts at Mañagaha. 10.7 Condition as part of permitting that beach re-nourishment projects use clean, uncontaminated sand.
#11 Improve stormwater management	DPW, CUC, US EPA, BECQ-DEQ (Water Quality Section)	<ul style="list-style-type: none"> 11.1 Meet with DPW and US EPA to review new MS4 program requirements, before the permit is issued. 11.2 Update the CNMI stormwater management manual post-construction standards. 11.3 Prepare GIS maps and track status of stormwater outfalls and piped contributing drainage areas within Lagoon watersheds. 11.4 Update permitting conditions for redevelopment projects, repaving, and road improvements to encourage retrofitting of existing unmanaged impervious cover.
#12 Establish a dedicated funding mechanism for Lagoon protection	Legislature, MINA, HANMI, Chamber of Commerce	<ul style="list-style-type: none"> 12.1 Appeal to the Legislature to establish a dedicated, sustainable funding source for Lagoon protection. 12.2 Leverage the Micronesia Challenge funds to protect Lagoon. 12.3 Collaborate with MINA on grant funding opportunities. 12.3 Explore alternative revenue to the Marine Resource Investment Act, such as user fees or voluntary funds. 12.4 Collect fees for luxury private boat and yacht docking or anchoring within the Lagoon. 12.5 Research opportunities for public-private partnerships related to water quality improvements.

Introduction

This report serves as an update to the **Saipan Lagoon Use Management Plan (SLUMP)** and provides recommendations for the CNMI Bureau of Environmental and Coastal Quality's (BECQ) Division of Coastal Resources Management (DCRM) to promote sustainable use of the Lagoon while ensuring that residents and visitors continue to enjoy the Lagoon safely without compromising environmental quality or economic development. Lagoon uses are diverse and include a variety of traditional shoreline and in-water recreational, commercial, and fishing activities, as well as a number of emerging uses. The primary focus of the 2017 SLUMP update is to ensure balance between resource use and conservation, and to address the management status of marine sports operations.

To respond to complaints regarding user conflicts and safety concerns, DCRM instituted a **moratorium on issuing new commercial marine sports operator permits** in 2000. This moratorium was extended in 2014, but included an exemption for SCUBA operators. The cap is intended to promote commercial operations while protecting the high-value coral and seagrass ecosystems that support tourism in CNMI. Since the implementation of the moratorium, numerous inquiries have been submitted to DCRM requesting additional or expanded permits for existing uses and emerging technologies (e.g., aquawalkers, sea breachers). In order to further DCRM's goal of ensuring wise, sustainable resource use, the 2017 SLUMP considers various user needs, and, where possible, recommends best management practices to support economic and ecological vitality in Saipan Lagoon.

The primary focus of the 2017 SLUMP update is to ensure balance between resource use and conservation, and to address the management status of marine sports operations.

Development of the 2017 SLUMP recommendations was supported by a review of previous SLUMPs and recent studies characterizing Lagoon conditions and use demands. In addition, research was conducted on how other jurisdictions manage marine operators within sensitive areas. Significant input on perceived issues and preferred solutions was solicited from the SLUMP Technical Advisory Group, agency and legislative representatives, and other organizations and users (e.g., Chamber of Commerce, marine sports operators, hospitality groups, and the community at large) through surveys and participation in a two-day user forum. These recommendations provide DCRM with a roadmap for updating policies and permitting requirements, as well as identify opportunities for collaboration with other managers of the Lagoon.

State of the Lagoon Report

To update the SLUMP, recent scientific studies, technical reports, and mapping information were reviewed to better support Lagoon management decisions. This information was consolidated and summarized in the "2017 State of the Lagoon Report" (see **Appendix A**), which documents what is currently known about the quality of Lagoon resources, provides information on coastal dynamics, characterizes potential climate change and watershed threats, and summarizes the diversity of Lagoon uses, conflicts, and past management priorities.

Jetski Management Research

Given the interest of commercial investors in expanding jetski (and other) commercial operations, a literature review was conducted to identify jetski management techniques applied across 12 other comparable jurisdictions, impacts of personal water craft on marine ecosystems and other users, and methods for establishing a carrying capacity (see **Appendix B**). This assessment confirms that restricting jetski operations is a common strategy for minimizing impacts on natural

resources, improving boater safety, and reducing conflicts with other uses in both freshwater and marine areas across the U.S. and internationally. **Much of the justification for use restrictions centers on safety and minimizing impacts to other users (e.g., noise, erratic operation).** There are a number of techniques used to manage personal watercraft, ranging from exclusionary bans, designation of operating areas, and limitations on the number of permits available. There appears to be no consensus on a general method for establishing a carrying capacity (i.e., how many vessels can operate at one time) within a specified waterbody.

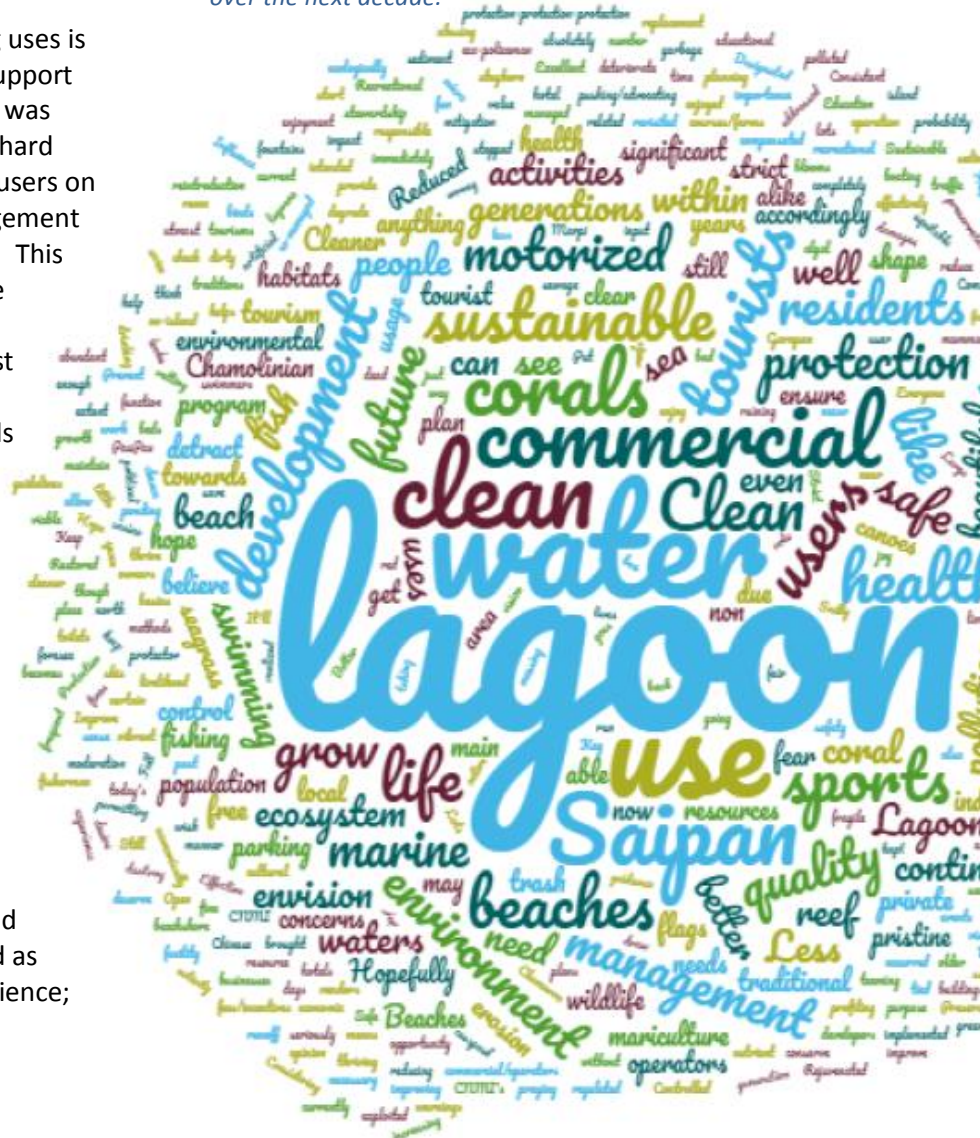
2. Protecting biological communities and improving water quality were the top two management priorities identified by survey respondents;
3. Over 60% of respondents were very concerned about water quality issues; and
4. Cleaner water and healthier coral, seagrass, and fish populations were the most popular future visions expressed by respondents.

See **Appendix C** for survey findings, including a full list of survey vision statements.

Lagoon Use Survey

Balancing multiple, at times conflicting uses is an important goal of the SLUMP. To support this effort, a short, 10-question survey was distributed (via Survey Monkey and in hard copy) to solicit perceptions from local users on the quality of user experiences, management suggestions, and visions for the future. This survey built upon the 2016 Lagoon Use Mapping Study, which presented a preliminary spatial use map of the most common activities and potential use conflicts. DCRM and Micronesia Islands Nature Alliance (MINA) helped to distribute surveys to the broader community and to members of the Hotel Association of the Northern Mariana Islands (HANMI), Marine Sports Operators Association (MSOA), and the Saipan Fishermen’s Association (SFA).

Word cloud created from survey respondent visions of how the Lagoon should be managed over the next decade.



Over 70 surveys were returned, and a number of valuable findings were revealed:

1. Motorized recreational vehicles and jetskis were the only uses reported as detracting from other users’ experience;

Lagoon User Forum

On April 25 and 26, 2017, an open Forum comprised of four separate sessions was held at the Fiesta Resort to present data on current conditions in the Saipan Lagoon and discuss strategies for ensuring sustainable Lagoon use over the next decade. There was significant representation from the marine sports operator (MSO) community and BECQ staff. Other key agencies were represented (e.g., DLNR-DFW, DPL, DPS-Boating Safety, and the Marianas Visitors Authority). On the first day, BECQ and NOAA staff delivered technical presentations on 2016 high-resolution habitat mapping; a preview of 2017 biological monitoring results; watershed pollution and land cover change; and findings from the 2016 Lagoon User Study. In addition, the Saipan Chamber of Commerce and MINA presented their visions for Lagoon management, including partnership opportunities. Approximately 60 people

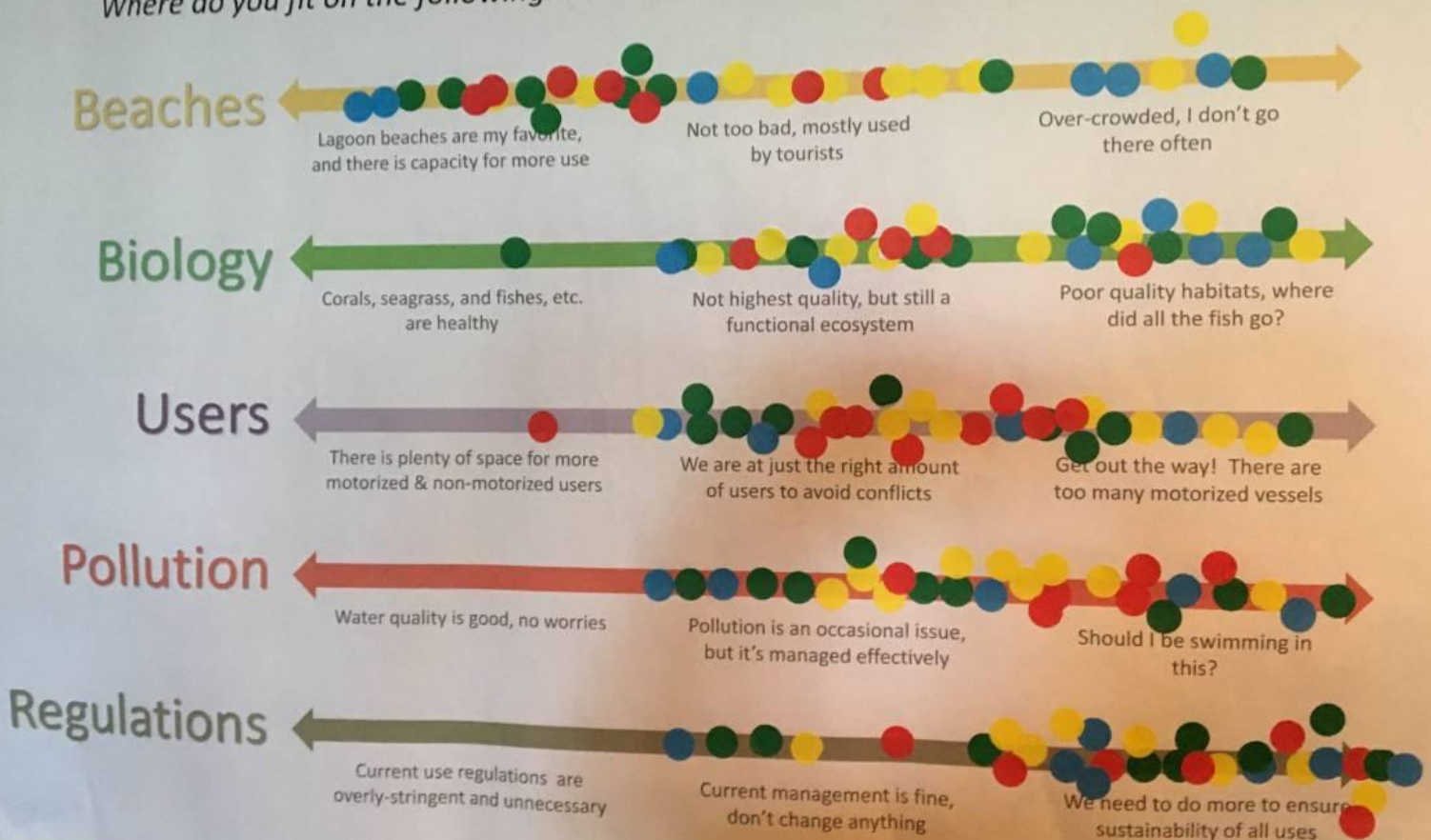
attended the first morning session. An open-house style meeting, with informal group discussions over Lagoon maps, was held that evening targeting the general public. Input was solicited from approximately 35 people in attendance. On the second day, a leadership lunch was held with invited legislators and agency heads to inform them of the SLUMP update and solicit recommendations on interagency collaboration. This was followed by a working session with approximately 30 returning participants to prioritize management strategies identified during Day 1. The working session was used to further develop rationale and implementation mechanisms for management actions to be included in the SLUMP update.

See [Appendix D](#) for a summary report, participant list, and copies of presentations.

Day 1 Forum participants placed dots along a continuum to indicate their perceptions of the Lagoon.

Saipan Lagoon Perceptions

Where do you fit on the following continuums? Place a colored dot along the line.



SLUMP Management Recommendations

Recommended actions for the 2017 SLUMP update were developed in consortium with the Technical Advisory Group based on the issues and priorities identified by stakeholders at the User Forum.

Goals

Stakeholders identified a number of key goals that should guide BECQ's Lagoon management efforts:

- ✓ **Improve user safety and quality of experience**—one of the primary goals articulated by BECQ, marine sports operators, and Boating Safety.
- ✓ **Protect resources and habitat while supporting sustainable economic development**—an objective in the forefront of BECQ's mission and a key issue expressed by stakeholders.
- ✓ **Improve water quality**—the number one management priority identified by stakeholders, and most challenging for BECQ to implement without support from other private and public sector agencies.
- ✓ **Promote education and communication**—a fundamental strategy to engage in collaborative efforts and build community consensus for implementation measures.
- ✓ **Establish a sustainable funding mechanism**—a way to support Lagoon projects which will need the buy-in of political leaders and other territorial and federal agencies.

Recommendations

The following twelve recommendations provide DCRM with a roadmap for updating policies and

permitting requirements, as well as identify opportunities for collaboration with other managers:

1. Establish designated Lagoon use areas for motorized marine sports operations
2. Update DCRM marine sports permits
3. Minimize watershed impacts on corals, especially in the northern Lagoon
4. Develop and implement a unified Lagoon users' education plan
5. Collaborate with CUC on critical wastewater infrastructure improvements
6. Improve public access infrastructure for Lagoon users
7. Encourage sustainable use of Mañagaha resources
8. Create a fishing safety equipment program
9. Continue to support BECQ's marine monitoring program
10. Evaluate and implement appropriate shoreline stabilization and erosion control projects
11. Implement stormwater management improvements
12. Establish a sustainable, dedicated funding mechanism for Lagoon use management

Table 1 shows how each of these recommendations meets the management goals identified by stakeholders.

Each recommendation is discussed in more detail below, including a rationale for why the recommendation is important, a list of priority actions to undertake, and a summary of required partners and regulatory applicability for DCRM.

Table 1. SLUMP Management Recommendations and Goals

Recommendation	User safety & quality of experience	Resource protection	Water quality improvement	Education & communication	Sustainable funding
#1 Designate Lagoon use areas.	✓	✓		✓	
#2 Update marine sports permits.	✓	✓		✓	✓
#3 Minimize watershed impacts on northern Lagoon.	✓	✓	✓		
#4 Develop and implement Lagoon user education plan.	✓	✓	✓	✓	
#5 Improve wastewater infrastructure.	✓	✓	✓		✓
#6 Improve public access.	✓	✓	✓	✓	✓
#7 Encourage sustainable use of Mañagaha resources.	✓	✓	✓	✓	
#8 Create fishermen safety equipment program.	✓	✓		✓	✓
#9 Support BECQ marine monitoring program.	✓	✓	✓	✓	
#10 Evaluate and implement appropriate shoreline stabilization and erosion control projects.	✓	✓	✓	✓	
#11 Improve stormwater management.	✓	✓	✓		
#12 Establish a sustainable, dedicated funding mechanism for Lagoon management and enhancement.	✓	✓	✓	✓	✓

Recommendation #1

Establish designated Lagoon use areas for motorized marine sports operations

Currently, marine protected areas, MSO enforcement areas, and jetski exclusion areas are delineated on maps that can be accessed via the DCRM website. These areas, such as the jetski exclusion areas, are not all visibly marked in the field with buoys. Currently, recreational jetski users (including private fleets) are not required to have a permit to operate in the Lagoon. Observations of jetskis in the restricted areas of the Lagoon were reported. Safety issues and user conflicts (e.g. motorized vessels and paddlers, parasailing in shipping channel) were a primary point of discussion among Forum participants, including MSO association representatives. There was a general consensus that clear, operational rules should be developed in collaboration with BECQ, Boating Safety, and MSOs, where appropriate.

Protecting reef health and Lagoon ecology was a priority for survey respondents and Forum participants. According to results from NOAA's 2017 habitat mapping study and BECQ's long term monitoring studies (Figure 1), certain areas of the Lagoon exhibit greater health and potential resiliency than others. For example, healthier live coral and more live *Acropora* thickets are found in the northern part of the Lagoon where currents are stronger and water quality is often measurably better. Clusters of dead, upright coral may also offer restoration opportunities. Dense *Enhalus* seagrass beds are considered areas of high benthic diversity. Additionally, the mangrove habitats near Smiling Cove, at American Memorial Park, and in Tanapag's estuaries provide juvenile fish habitat and shoreline protection. Minimizing potential impacts from marine sports activities on these areas, where practical, was a priority recommendation identified during the Forum.

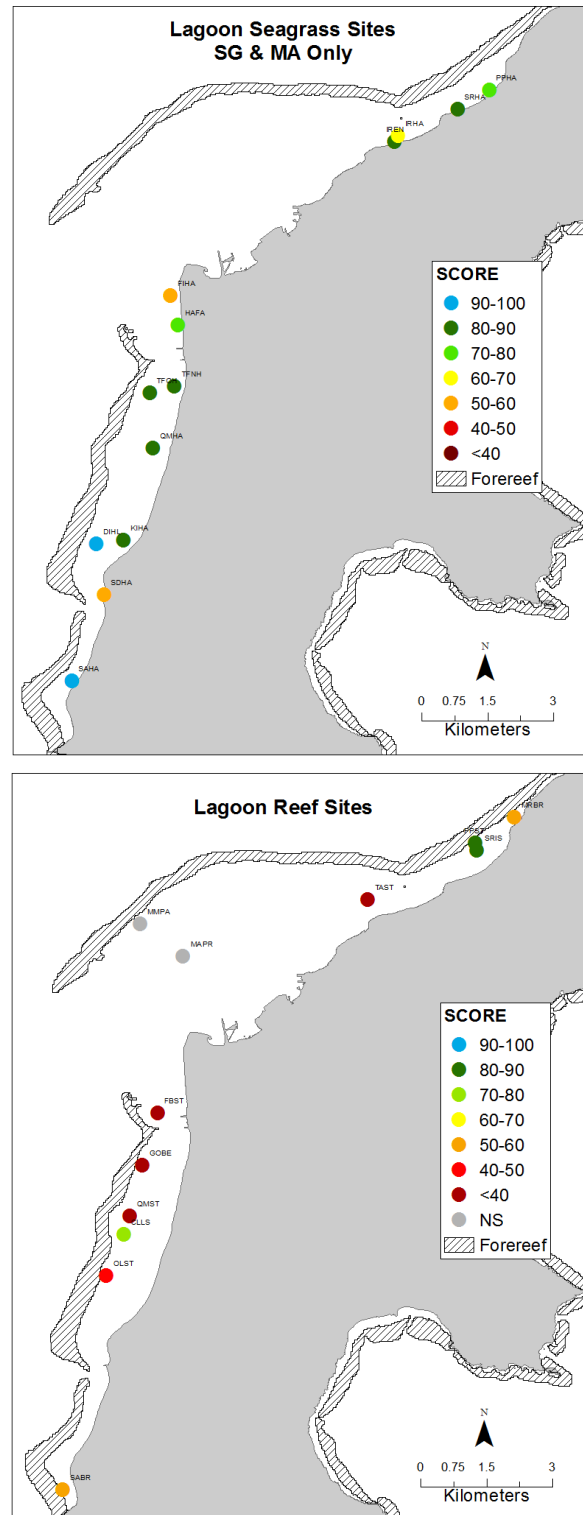


Figure 1. Preliminary results of 2017 marine biological monitoring data presented by L. Johnston during the Forum show the quality of reef and seagrass beds at study sites in the Lagoon (high score indicates higher quality).

In addition, avoiding conflicts between non-motorized and motorized activities around historic features (e.g., Sherman tanks, Heritage Trail) and traditional use areas (e.g. Proa canoeing and fishing areas) was also highlighted.

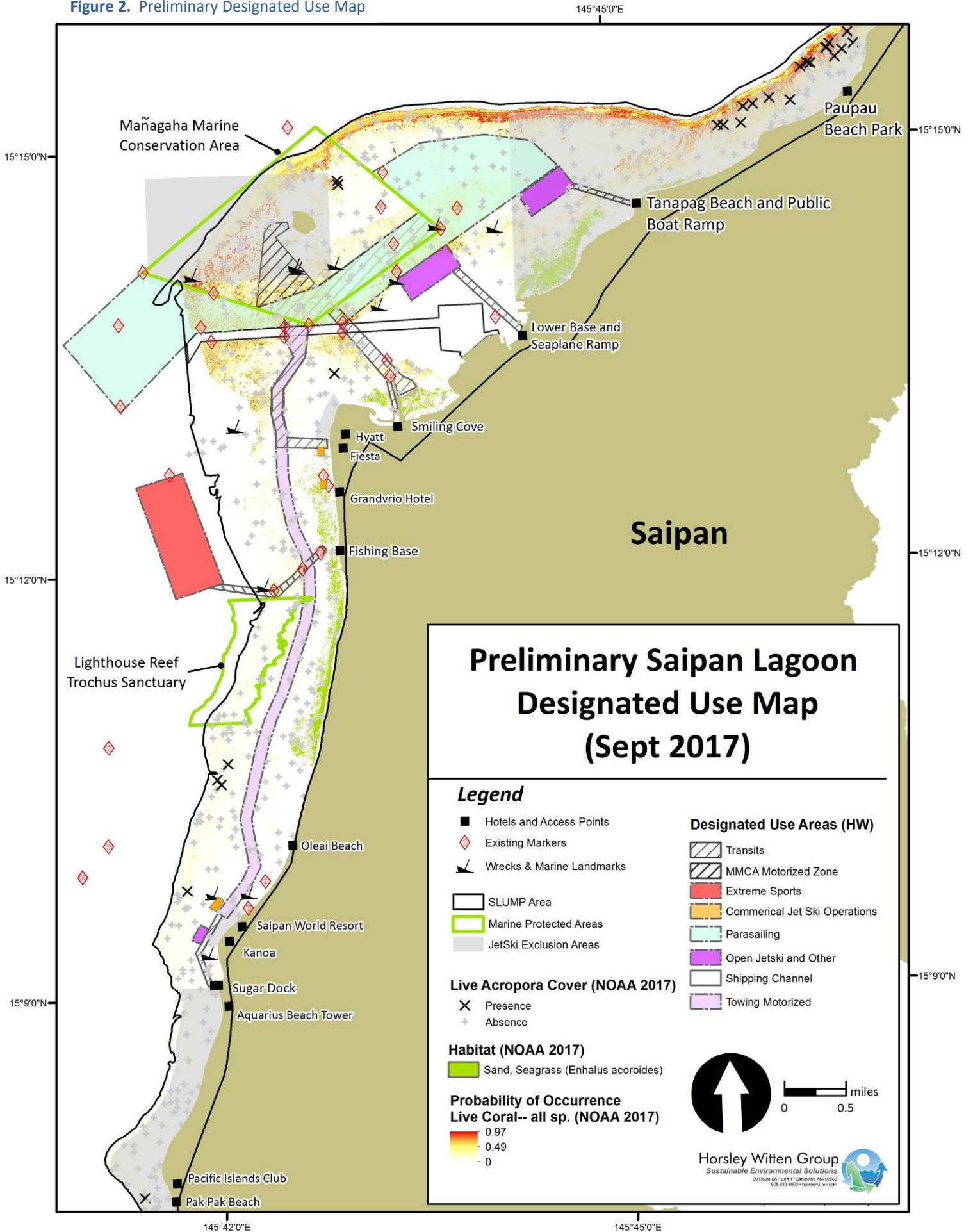
A preliminary use map was developed to address specific safety and use conflicts identified by Forum participants (Figure 2). The map shows revised locations for commercial jetski courses, parasailing, recreational jetski and other sports areas, towing operations (e.g., banana boats), as well as a designated area for extreme sports (see Table 2). The proposed use

areas are a modification of existing marine sports and enforcement maps integrated with NOAA’s habitat and depth mapping, biological monitoring data, 2016 user study maps, existing marker locations, and observations of commercial jetski operations. The intent of this draft map is to provide a starting point for further agency collaboration to formally designate and specify marine sport operational and enforcement areas. Note that a slight expansion of jetski use is proposed that overlaps with current restricted area boundaries. This is due to adequate water depths and benthic cover, however it should be discussion point with Boating Safety and DFW.

Table 2. Preliminary Designated Use Area Descriptions

Use Area	Location on Map	Comments
Commercial jetski courses	<ul style="list-style-type: none"> • 300 ft x 400 ft area for course at Grandvrio • 300 ft x 600 ft shared area at Hyatt/Fiesta and at Kanoa/World Resort 	Access to these areas would be from the respective hotel beaches. The 300 x 400 ft area is based on the sizing used for designated jetski areas on Guam.
Open jetski (non-commercial) and other MSOs, or testing of new technologies	<ul style="list-style-type: none"> • 2,500 ft x 1,200 ft area in the north (two options shown) • 400 ft x 800 ft area in the southern Lagoon 	The size and location can be adjusted, but the proposed area is based on existing buoys, depth, and avoidance of other uses, historic wrecks, non-motorized users, dive sites, and protected habitat. Access is from the Seaplane, Tanapag boat ramp, Susupe Regional Park , or Sugar Dock.
Parasailing operations	<ul style="list-style-type: none"> • Modification of existing parasailing area • Exclusion of shipping channel and use of 2005 MMCA motorized vessel zone • Extension further northeast 	Eliminates overlap of operational area (flying of parasail) within the shipping channel. Preference for operations is outside of the Lagoon when conditions are permissible. Area outside of Lagoon is adjustable.
Motorized towing corridor	Narrowing of existing towing operations (e.g., banana boats) to a 500 ft wide corridor from World Resort north to shipping channel/MMCA zone.	Avoids habitats, wrecks, and provides greater separation from non-motorized uses closer to shore (maintain 200-yard distance from shoreline). The operational corridor was shortened in the southern Lagoon to improve safety in high traffic area between Sugar Dock & World Resort.
Transit corridors	<ul style="list-style-type: none"> • 250 ft wide transit area to open jetski areas • 250 ft wide transit area from Sugar Dock to sports towing corridor • 500 ft wide transit area to MMCA from the Smiling Cove Marina 	Preferred transit areas are shown based on shoreline access locations, depth, and other uses. Assumes transit to commercial course is direct from hotel beach. In general, the towing corridor is the primary transit to Mañagaha from Micro Beach and points south. There are two proposed crossings of the shipping channel. Transit marking should utilize existing markers (e.g., shipping/small boat channel, MMCA boundary, and dive moorings) where practical.
Extreme sports and provisional testing of new technologies	2,000 ft x 5,000 ft area outside of Lagoon, south of shipping channel entrance Area can be adjusted.	Addresses concern over where emerging uses can be allowed, particularly those requiring deep water or more space (e.g., Seabreacher, Jet-o-vator, etc.).

Figure 2. Preliminary Designated Use Map



Actions

1.1 Collaborate with Department of Public Safety—Boating Safety (DPS-BS) on finalizing and adopting designated use and preferred use area maps.

Include NOAA and Coast Guard as well as other stakeholders to assist with supporting existing uses, ensure habitat avoidance, protect transit routes, and avoid commercial shipping issues. In designating areas, consider the following:

- a. Minimize the number of markers to be deployed;
- b. Establish loading/unloading areas, if necessary. Revise CNMI Administrative Code, Title 15 Chapter 15-20-205 to update outdated and inconsistent launching and landing sites for jetskis;
- c. Identify operational rules for each use (e.g., number of operators in an area at one time, speed limits, no wakes within 200 ft from swimming areas);
- d. Determine if non-motorized uses also require formal designation areas. If not, identify preferred use areas for non-motorized uses such as sailing, paddling, and board sports before finalizing designated use area maps for motorized vessels to ensure compatibility;
- e. Identify what activities, if any, are prohibited outside of specified use areas;
- f. Identify areas, if any, for preferred commercial sports operations in the MMCA (requires coordination with DPL and DFW); and
- g. Retain restrictions on jetski operation in Lake Susupe if removing, relocating, or otherwise revising restricted areas from regulations (CNMI Admin Code Title 15, Ch 15-20-105).

1.2 Develop a companion map that shows areas to avoid and protect including historical/cultural locations (e.g., Sherman tanks, Heritage Trail, landing beaches, traditional use areas) and key areas for habitat protection (Figure 3). Encourage community users as well as dive operators, NPS, and DFW

to review and comment on these locations to ensure that motorized sports users avoid these areas as much as possible, and provide additional dive moorings as needed (see Action 1.4).

1.3 Work with HANMI and NOAA to map designated swimming areas to help with monitoring and enforcement of seagrass removal regulations. Update DCRM regulations for general APC permit conditions Section 15-10-315(d)(3) on allowable seagrass removal in swimming areas to explicitly require mapping, mitigation, and reporting requirements to ensure no net loss of this important coastal resource.

1.4 Collaborate with DPS-BS, the Coast Guard, and the U.S. Army Corps of Engineers (USACE) to evaluate the number, type, and location of existing moorings.

Identify additional moorings and markers needed in the Lagoon. Lack of a sufficient number of moorings as well as lack of markers delineating restricted areas was identified by stakeholders as a concern in terms of user safety and a challenge in terms of regulatory compliance. Investigate current buoyage standards and replace/upgrade existing markers to ensure uniformity in compliance with those standards. In addition, consider where signage on use designations, speed restrictions, and warnings about vulnerable habitats could be placed to better inform Lagoon users of existing rules and rationale behind these regulations.

1.5 Provide educational materials on designated use areas, transits, and launches in the Lagoon to MSOs, residents, and visitors.

DCRM should work with the Marianas Visitors' Authority (MVA), MINA, DPS-BS, DFW, and others to provide maps of the designated Lagoon Use Areas. Where applicable, maps should be provided with issued permits (e.g., boating permits). Supporting information should clearly articulate how areas were designated and what uses are

allowed. Information should be distributed in multiple languages and use photos and images. In addition, messaging to accompany the maps should indicate that the intent is not to create new Marine Protected Areas. DCRM is authorized to preserve and maintain areas of historical and cultural significance and is mandated to prevent significant adverse impacts as well as identify underwater preservation areas to support coastal resource management objectives in the Lagoon and Reef Area of Particular Concern (NMIAC § 15-10-315(b)).

Implementation Partners

There are a number of agencies with enforcement or regulatory authority over Lagoon uses. BECQ will need to coordinate with DPS-BS and DFW, primarily. DPS-BS responsibilities relate to enforcement of designated use areas and operational rules (e.g., no wake and right of way). DFW is responsible for enforcement of uses in and around Mañagaha. The Coast Guard may also provide information on the navigational requirements of the commercial shipping channel and buoyage standards. Coordination with USACE is needed to ensure compliance with Section 10 of the Rivers and Harbor Act, which relates to permitting structures including buoys in navigable waters. The Marine Sports Operators Association (MSOA) could provide valuable input on launches and transits. NOAA can provide assistance with map development of designated use areas, and HANMI can assist with monitoring and enforcement of seagrass removal regulations.

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions.

☑ **The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3**

3. Promote more efficient resources management through: Coordination and development of resource management laws and regulations into a readily identifiable program.

4. Plan for and manage any use or activity with the potential for causing a direct and significant impact on coastal resources. Significant adverse impacts shall be mitigated to the extent practicable.

8. Mitigate, to the extent practicable adverse environmental impacts, including those aquifers, beaches, estuaries and other coastal resources while developing an efficient and safe transportation system.

15. Manage ecologically significant resource areas for their contribution to marine productivity and value as wildlife habitats, and preserve the functions and integrity of reefs, marine meadows, salt ponds, mangroves and other significant natural areas.

☑ **DCRM powers, functions, and duties, PUBLIC LAW 3-47, § 4**

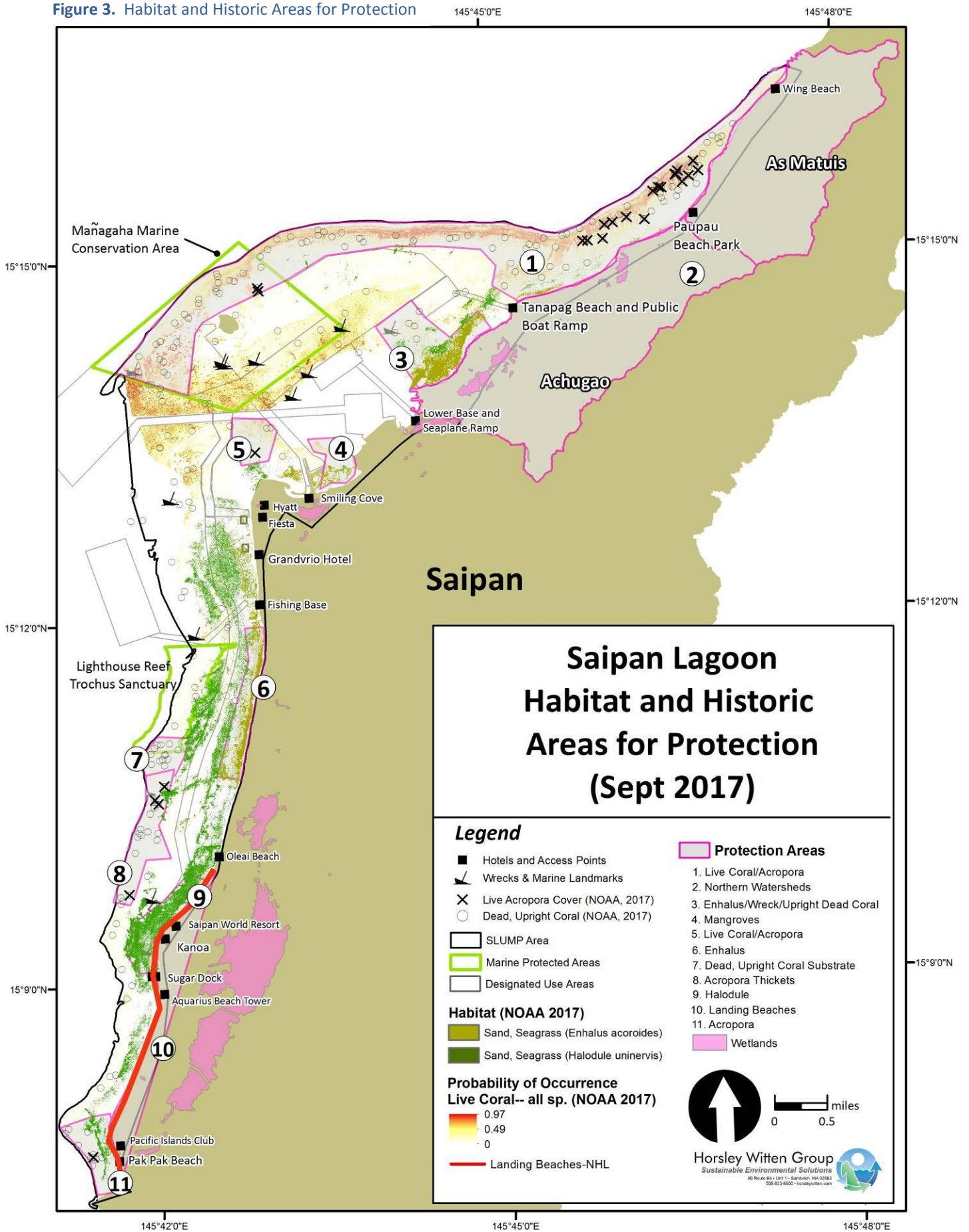
1. To coordinate the planning and implementation of the coastal resources management policies by the Commonwealth government.

11. To promote the economic development of coastal resources consistent with coastal resources management policies.

☑ **Title 15, Chapter 15-10-315 - Lagoon and Reefs APC Specific Criteria**

Management standards include prevention of activities that cause adverse impacts to reefs and corals, that Lagoon reefs shall be managed to maintain or enhance fisheries; that natural systems shall be maintained and to avoid discharges of pollutants that destroy productive habitats; that areas and objects of historic and cultural significance shall be preserved and maintained; and that underwater preservation areas shall be designated.

Figure 3. Habitat and Historic Areas for Protection



Recommendation #2

Update DCRM marine sports permits

Improving user safety is the primary motivation of marine sports operators, agencies, and other users to modify existing marine sports regulations and DCRM permitting procedures. Based on input from the public and agency staff, and the 2016 Lagoon User Study, most users indicated that there “are enough” commercial operators in the Lagoon at this time, specifically jetskis and parasailing. A review of jetski management approaches in other jurisdictions revealed that safety was one of the primary justifications for restrictions and (in some cases) outright bans, which supports the current DCRM moratorium on issuance of new operator permits. This concern was documented in a 1989 memo from the Agency Administrator to the Governor: *“It was determined through a series of public hearings and CRM Directors’ meetings that due to safety problems, jetski sites need to be limited. Uncontrolled jetski use resulted in numerous conflicts between boaters, swimmers and snorkelers in the Lagoon. Death and serious injuries resulting from jetski use elsewhere also contributed to the desire to regulate jetski use here in the CNMI.”* There is significant precedence for restricting jetski and other marine sports operations in sensitive areas, particularly where there is potential for user conflicts and safety concerns.

Actions

2.1 Continue to enforce the current cap on the number of commercial operator permits by formally setting a quota rather than continuing to extend a “moratorium.” This quota could be designed to target the number of concurrent operators (e.g., the number of jet skis operating at the same time) as opposed to fixed permit quotas for each activity. BECQ should discuss alternatives with the Marine Sports Operators Association, who may be able to propose a mutually-acceptable system for



Some of the emerging uses, such as sea breachers and jet-o-vators, if permitted, will require specific conditions for use to ensure proper operation, safety, and environmental protections.

operational caps. Designated operating areas should be established where adequate depth exists and priority habitats and user conflicts can be avoided (see Recommendation #1). NOAA is working on an analysis to illustrate priority habitat areas and Lagoon depth data. Flexibility for emerging marine sports could be met with use allowances in designated extreme sports areas and provisional use in open jetski areas.

2.2 When updating DCRM rules and regulations, consider the following:

- a. Consolidate jetski regulations in CNMI Administrative Code Title 15 Ch 15-20 with DCRM waters sports regulations, NMIAC § 15-10-1601, and Lagoon and Reefs APC Specific Criteria, NMIAC § 15-10-315.
- b. Reference designated use maps and update operational rules, launch, and transit information in the regulations. Avoid using hotel names in the regulations, as hotel ownership and names change (e.g., Hafa Adai/Grandvrio).
- c. Specify jetski course buoyage procedures and mapping requirements and other major water sports operational policies (no fly/tow zones).

2.3 Update permit conditions to include language that:

- a. Is consistent with specific provisions of Sections 101 and 102 of the 1987 Boating Safety Regulations, such as:
 - i. *No person shall operate a motorboat, aqua-plane, or watercraft of any description at a speed greater than five (5) miles per hour within 200 yards of the shore.*
 - ii. *No person shall operate a motorboat towing a person on water skis, surfboard or similar device within 200 yards of the shore.*
 - iii. *No person shall operate a watercraft or vessel of any description within a swimming zone.*
 - iv. *No person shall operate a watercraft or vessel of any description at a speed of greater than five (5) miles per hour within 200 yards of any swimming zone (Commonwealth Register. Vol 9. No 1. January 19, 1987. Page 4855).*
- b. Explicitly cautions or prevents motorized users from entering areas of habitat protection and historic/cultural significance.
- c. Includes the Designated Lagoon Use Areas and Protection Areas Maps to augment operator, tour guide, and user education.

Implementation Partners

Most of the regulations related to safety are within the purview of DPS-BS. Further Lagoon and reef preservation and restoration partnerships could be pursued with DLNR-DFW, NOAA, the Marine Sports Operations Association, and other Lagoon user groups.

Regulatory Applicability

These types of permit conditions have been implemented in other jurisdictions. For example, Guam's Recreational Water-Use

Management Plan (RWUMP) designates areas for specific uses, such as personal watercraft/jetskis to promote safety for persons and properties in and, connected with the use, operation, and equipment of vessels. Those designations and restrictions are enforceable per GAR §6100. Furthermore, Hawaii's regulations also restrict watercraft or "thrill craft" operations to designated areas and establish certain restricted protected areas. In addition, operators are required to complete a certificate course which includes:

- Local ocean safety principles and practices;
- The historical, cultural, and customary practices of Hawaii's ocean users; and
- Any rules or laws pertaining to protected species and thrill craft operation in the State (Hawaii §13-256).

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions.

The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3

3. Promote more efficient resources management through: Coordination and development of resource management laws and regulations into a readily identifiable program; Revision of existing unclear laws and regulations; Improvement of coordination among Commonwealth agencies; and Improvement of coordination between Commonwealth and federal agencies.

DCRM powers, functions, and duties, PUBLIC LAW 3-47, § 4

9. To ensure the consistency of permit decisions with coastal resources management policies and regulations provided for in 2 CMC §§ 1511 AND 1531.

10. To coordinate the permit process (§ 15-10-200 through 900; § 15-10-1600).

Recommendation #3

Minimize watershed impacts on corals, especially in the northern Lagoon

When asked to rank Lagoon Management priorities in the 2017 Lagoon User Survey, respondents ranked “Protecting biological communities and habitats” higher than four other specified management priorities. **The northern portion of the Saipan Lagoon, including Tanapag, Pau Pau and Wing Beaches, has some of the last living and most resilient coral cover remaining in the Lagoon.** That makes this portion of the Lagoon a highly significant (and sensitive) biological resource for the CNMI. It is thought that currents in this area contribute to high flushing rates and better water quality needed to support healthy and resilient reefs (pers.com., P. Houk). Maintaining water quality and habitat health in the Lagoon is a critical component of sustainable Lagoon use. There is a direct relationship with extent of watershed development and the health of aquatic systems. Currently there are relatively low levels of urbanization in the contributing northern watersheds of Achugao and As Matuis. At the time of this SLUMP update, fourteen properties in the northern Lagoon were re-zoned for “tourism” by the Zoning Office, including the large proposal in Tanapag.

Actions

3.1 BECQ should coordinate with DPL to promote land conservation strategies for this portion of the Lagoon. DPL is currently updating the agency’s Comprehensive Land Use Management Plan for Public Land (Land Use Plan) on Saipan. A recommendation for DPL’s Plan might be to consider designating permanent land conservation areas along the Lagoon’s northern shoreline and inland stream corridors to reduce watershed pollution and protect Pau Pau and Wing beach area habitats.



Scientist documenting lagoon substrate and cover data off Wing Beach, where some of the last Acropora corals in the Lagoon can be found. Credit: M. Kendall and B. Costa.

3.2 Where conservation approaches are not viable, **work with the Office of Zoning to consider options for establishing a northern Lagoon watershed overlay district with more stringent environmentally-sensitive development criteria.** For example, the hospitality industry could be required to apply “green building” techniques and meet industry standards for open space conservation and sustainable development. It is worth noting that watersheds with more than 10% impervious cover begin to exhibit signs of biological impacts, water quality degradation, and hydrologic issues (Center for Watershed Protection, 2003. *Impacts of Impervious Cover on Aquatic Systems*). Expanded stormwater management criteria for water quality and reuse, view corridor protections, vegetated buffer and setback requirements, invasives management, and open space/canopy coverage percentages should be more stringent in the northern Lagoon than in Garapan or other more urbanized watersheds.

3.3 At a minimum, DCRM could **strengthen Chapter 15-10-100 and Part 300 regulatory language regarding major and minor APC permit requirements for**

projects in the northern watersheds to incorporate environmentally-sensitive design provisions. For example, Section 15-10-305 (j) allows DCRM to impose additional conditions to control non-point source pollution, such as enhanced stormwater management and other site design practices listed above; as well as green construction techniques (e.g., reduced solid waste) and long-term operation and maintenance plans.

3.4 Develop a Conservation Action Plan (CAP) or comprehensive watershed management plan for the Northern Lagoon Watersheds, similar to the Garapan Watershed CAP. If watershed-wide planning is not forthcoming, consider engaging in growth visioning or related resource management planning at the sub-watershed and village level in areas that are experiencing increased development pressure (e.g. Tanapag and San Roque). At the outset of a CAP or watershed planning process, expectations for formal adoption and accountability measures to ensure implementation should be established.

3.5 Flag opportunities for watershed improvements that come through permitting, such as permit renewals, road improvements, and utility upgrades. For example, when DPW is planning road repairs or repaving, that is the best time to add stormwater treatment where none currently exists. Another opportunity for improvement is when operator permits are reaching expiration dates. For example, the ATV tour company that operates in the northern Lagoon area has a permit up for renewal that could prompt increased onsite stormwater treatment, better erosion control, and revegetation efforts to increase canopy cover and native plant diversity. Activities that are directly linked to non-point source pollution should be assessed in terms of direct and cumulative impacts, and efforts to avoid, minimize, and mitigate impacts should be increased to protect and enhance water quality.

Implementation Partners

In addition to community members, potential partners within the CNMI government include, DPL, Office of Zoning, CRM Agency Board for major siting projects; DLNR-DFW for terrestrial and submerged land management; BECQ-DEQ, DLNR-Parks and Recreation, DPW for solid waste management, road expansion and maintenance; Saipan Mayor's office for secondary road maintenance; as well as BECQ-DEQ and CUC for wastewater management.

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions.

The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3

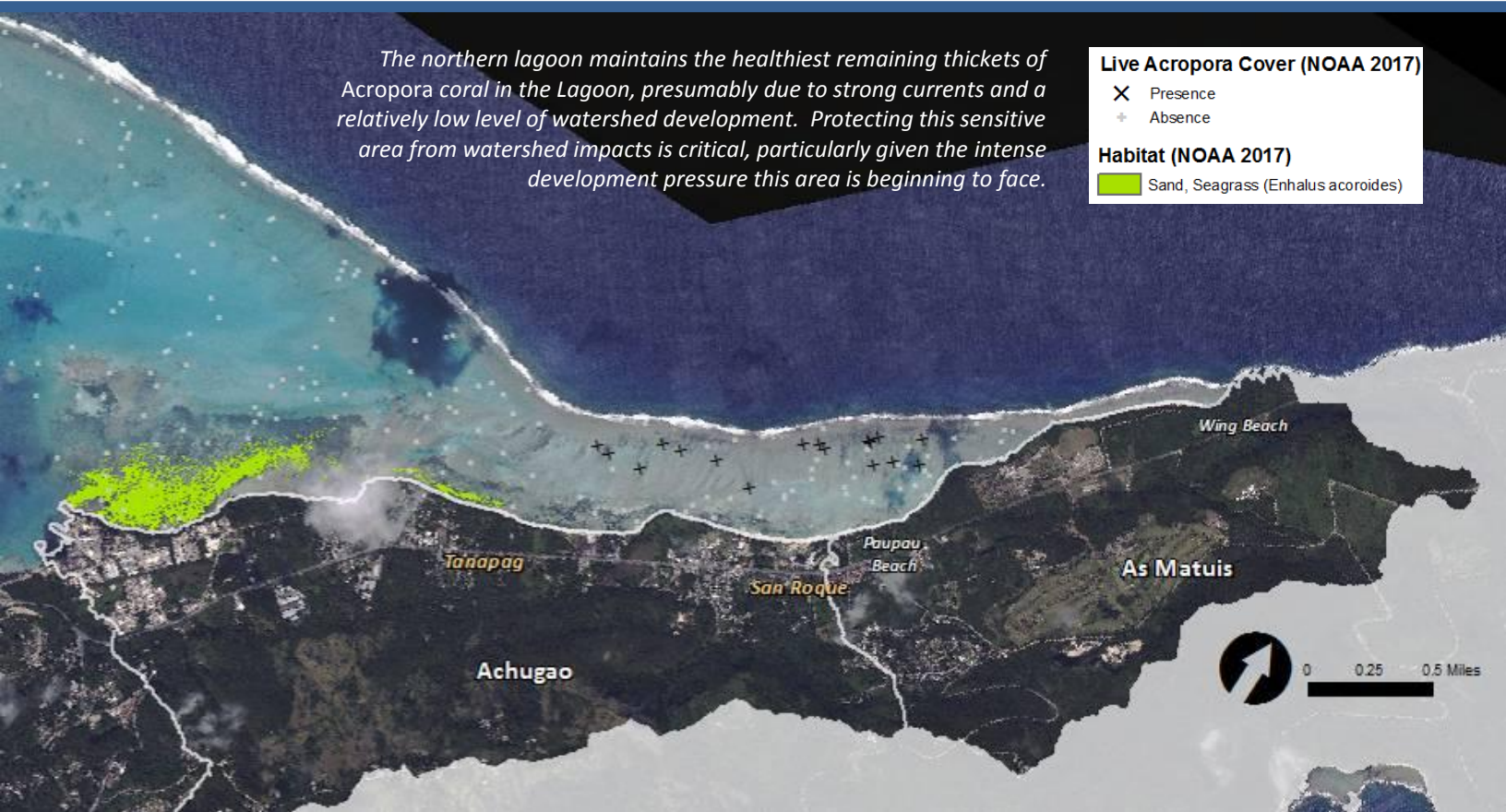
1. Encourage land-use master planning, floodplain management, and the development of zoning and building code legislation.

14. Not permit, to the extent practicable, development with the potential for causing significant adverse impact in fragile areas such as designated and potential historic and archaeological sites, critical wildlife habitats, beaches, designated and potential pristine marine and terrestrial communities, limestone and volcanic forests, designated and potential mangrove stands and other wetlands.

15. Manage ecologically significant resource areas for their contribution to marine productivity and value as wildlife habitats, and preserve the functions and integrity of reefs, marine meadows, salt ponds, mangroves and other significant natural areas.

18. Encourage preservation and enhancement of and respect for, the Commonwealth's scenic resources through the development of, increased enforcement of, and compliance with, sign, litter, zoning, building codes, and related land use laws.

- ☑ **Title 15, Chapter 15-10-100 and Part 300 - General Permit and Development Criteria**
 Section where specific criteria can be updated.
- ☑ **Title 15, Chapter 15-10-315 - Lagoon and Reefs APC Specific Criteria**
 Management standards include prevention of activities that cause adverse impacts to reefs and corals; that Lagoon reefs shall be managed to maintain or enhance fisheries; that natural systems shall be maintained and to avoid discharges of pollutants that destroy productive habitats; that areas and objects of historic and cultural significance shall be preserved and maintained; and that underwater preservation areas shall be designated.
- ☑ **Title 15, Chapter 15-10-325(b)(1)(B) - Coral Reefs APC Specific Criteria**
 Allows for the creation of underwater preserves in pristine areas or restoration projects in impacted areas.



Recommendation #4

Develop and implement a unified Lagoon users' education plan

Visitors, their guides, and residents appreciate the beauty and quality of Lagoon resources. If they are educated about use rules and regulations that promote safety as well as economic and ecological sustainability of the Lagoon, they will be more apt to follow instructions. Forum participants identified a number of key areas where user education was critical, such as: a certification program for snorkeling and diving tours, effective signage, a Lagoon Designated Use Areas Map, and improved trash management. While there are education programs administered by various agencies and organizations, there is no unified messaging for sustainable use of Saipan Lagoon. Education is a key component of increasing user safety and quality of experience, as well as creating a better understanding of the historic, cultural, and ecological resources the Lagoon has to offer.

Actions

4.1 Facilitate a meeting or host a working group with education program coordinators from BECQ, DFW, NPS, MVA, MSOA, Dive Association, SFA, Chamber of Commerce, NOAA, and MINA to identify key messaging from each organization that is applicable to sustainable use of the Lagoon. Develop an overarching Lagoon education plan with target audiences, messaging, delivery mechanism (e.g., training class, brochure, signage), and planning level cost estimates, with representatives from identified stakeholder groups and agency partners, if such coordination is practicable.

4.2 Work with MVA on expanding their pilot educational program targeting snorkeling and diving tour operators. Consider establishing a regulation (or permit



This excerpt from DFW's Mañagaha informational video is one example of existing educational material that can be incorporated into a coordinated program for Lagoon management.

condition) requiring a certification for tour operators to ensure proper safety of visitors and protection of coral reefs. DCRM, DFW, and the MSOs can continue to collaborate with MVA to incorporate habitat protective messages into their current educational program. Consider the potential for DCRM to administer the training program as a possible program task in the future.

4.3 Produce and distribute Saipan Lagoon Sustainable Use educational brochures and maps to permittees, tourists, and residents. Consider partnering with other agencies and stakeholders to leverage other outreach opportunities including signage, television / radio commercials, etc.

4.4 Work with MINA, MVA, and Chamber of Commerce to create an educational video aimed at tourists that could be shown on airplanes or at the airport in multiple languages on sustainable uses of the Saipan Lagoon. This video should include information on how to properly dispose of trash on Saipan. It was noted that the Chamber of Commerce has plans to launch an anti-littering campaign, and that plans also exist to develop an educational video.

Environmental education and best practices could be incorporated into these efforts and/or could be the focus of future outreach campaigns.

4.5 Collaborate with MVA, DLNR, DPW, and DPL, as well as members of the Litter Control Board, MINA, the business community on trash management in the Lagoon. According to a presentation delivered by MINA at the April 2017 Forum, Laly 4, Pau Pau, Sugar Dock, and Tanapag experience the worst trash issues. Recommendations for improved trash management include:

- a. Create signage with images/photos about sustainable trash disposal. This will eliminate language confusion, as many tourists do not speak proficient English or Chamorro. Use selected graphics consistently to promote island-wide understanding of litter control messages.
- b. Work with Litter Control Board, including the Mayor’s Office, other agencies, MINA (adopt a bin program), and the business community to increase the frequency of trash pickup at beaches.
- c. Consider feasibility of beach parking fees at popular beaches such as Pau Pau to generate funds to support trash management. Determine who will be the expenditure authority.
- d. Create an educational video and social marketing campaign aimed at locals that could illustrate why proper trash disposal is important to community resources. The “Our Lao Lao” campaign offers a good example of social marketing.

4.6 Consider implementing in-water/beach signage to provide information about specified Lagoon uses, species, habitat areas, and historical/cultural areas. DCRM should work with other agencies and user groups to develop signage about how not to harm the coral and consider enforcement of fines for intentional or egregious harming of coral.

Implementation Partners

DLNR, DFW, DPL, CNMI Litter Control Board, MVA, MINA, Chamber of Commerce, Marine Sports Operators Association, Northern Marianas Diving Operators Association, Saipan Fishermen’s Association, and CPA (if airport coordination is needed). The recently initiated “Imagine” Anti-Litter Campaign offers a good opportunity to collaborate.

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions.

The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3

2. Promote, through a program of public education and public participation, concepts of resource management, conservation and wise development of coastal resources.

3. Promote more efficient resources management through: Establish educational and training programs for Commonwealth government personnel and refinement of supporting technical data.

DCRM powers, functions, and duties, PUBLIC LAW 3-47, § 4

7. To establish and operate a broad and effective public education and information program;



MINA manages 20 bins at sites around the island, sponsored by local businesses and partners.

Recommendation #5

Collaborate with CUC on critical wastewater infrastructure improvements

Water quality was cited as an important concern for over 60% of survey respondents. Water quality data indicates that the majority of the Lagoon water quality assessment units are impaired for bacteria. According to the 2016 CNMI 303(d), 305(b) and 314 Water Quality Assessment Integrated Reports, all assessment areas in the Lagoon, except for around Mañagaha, fail to meet water quality standards for designated uses such as fishing and swimming (See Figure 4). For example, when bacteria levels are high people cannot swim at certain beaches. It is easy to understand why more than 60% of survey respondents indicated that water quality is important, as high bacteria levels can prevent local residents and visiting tourists from using the Lagoon.

Wastewater discharges from illicit connections, failing on-site systems, sanitary system leaks and overflows, and wastewater treatment plants are all likely contributors of bacteria and nutrients; however, there is little empirical evidence regarding the magnitude and frequency of these discharges to the Lagoon. While CUC has been diligently upgrading its infrastructure, opportunities remain to improve resiliency of coastal infrastructure while improving water quality in the Lagoon.

In March 2017, US EPA renewed the NPDES permit for Sadog Tasi WWTP. Federal permits are required to be consistent with DCRM coastal management policies, including water quality protection. Effluent monitoring reports show compliance issues with bacteria and some metals (Figure 5). Given the water quality impairments in the Lagoon, incorporating UV treatment or chlorination into the wastewater treatment process prior to discharge should be



Sewer improvements are likely one of the most cost-effective means of improving water quality in the Lagoon.

considered. Improving treatment at this facility may be especially timely. As of August 2017, two large development projects in the northern Lagoon area proposed to nearly double the amount wastewater entering the Sadog Tasi network. CUC should consider the importance of maintaining if not improving the water quality at the outfall under build out scenario. If improvements to the system are needed, these cumulative project impacts should be discussed with developers early in their permitting process. If the demand cannot be accommodated without jeopardizing CUC's NPDES requirements and 401 Water Quality certification compliance, alternative treatment options must be provided.

Actions

5.1 Promote better interagency communication between CUC and BECQ (DEQ and DCRM) on wastewater infrastructure demands, planned improvements, and water quality monitoring findings in the Saipan Lagoon.

This is particularly important as DEQ permits new wastewater management facilities, and as DCRM evaluates major and minor APC permits in the Lagoon watersheds. Review the 2015 CUC wastewater master plan to better understand

expected demands and infrastructure investments.

5.2 BECQ can continue to support CUC in enforcement, securing grant funds, and fast-tracking permitting for priority infrastructure improvements that lead to improved water quality in the Lagoon, such as use of the Clean Water State Revolving Funds. Explore joint opportunities with CUC to:

- a. Increase the number of wastewater service hookups for residences and businesses;
- b. Determine feasibility of retrofitting Sadog Tasi WWTP with disinfection mechanism prior to effluent discharge (e.g., UV treatment – See Figure 5).
- c. Quantify sewer overflows in order to determine the need for upgraded treatment.

5.3 Work with BECQ and CUC monitoring teams to better understand the bacteria concentrations in effluent discharge from the Sadog Tasi WWTP, and lend technical and analytical support at other suspected locations identified by CUC along the Lagoon shoreline that experience chronic water quality problems.

Implementation Partners

CUC, BECQ, US EPA

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions:

- ☑ **The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3**
13. Require compliance with all local air and water quality laws and regulations and any applicable federal air and water quality standards; See Title 15, Chapter 15-10-1500.

- ☑ **DCRM powers, functions, and duties, PUBLIC LAW 3-47, § 4**

1. To coordinate the planning and implementation of the coastal resources management policies by the Commonwealth government.

3. To provide for the coordination and decisions on whether federal activities affecting the coastal resources of the Commonwealth are consistent with the coastal resources policies and regulations.

- ☑ **NPDES Permit/Water Quality Certification**

The NPDES permit conditions require notification of overflows and effluent monitoring. Permit conditions are subject to BECQ water quality certification. BECQ retains the right to require a new certification in the event of changes in standards or if significant adverse impacts are observed.

- ☑ **Title 15, Chapter 15-10-315 - Lagoon and Reefs APC Specific Criteria**

Management standards include prevention of activities that cause adverse impacts to reefs and corals, that Lagoon reefs shall be managed to maintain or enhance fisheries; that natural systems shall be maintained and to avoid discharges of pollutants that destroy productive habitats; that areas and objects of historic and cultural significance shall be preserved and maintained; and that underwater preservation areas shall be designated.

Figure 4. Excerpt from BECQ 2016 Integrated Report identifying wastewater sources of Lagoon impairments.

Seg ID	Segment Name	Seg Class	Seg Size (Miles)	Cause	First Listed	Source	Comments	TMDL Priority
19B	W. Takpochao (Central)	AA	3	Enterococci, DO%, Orthophosphate, Mercury	1998 2008 2005 2010	sanitary sewer overflows (115), urban runoff (177), sedimentation (21), Impervious Surface/ Parking Lot Runoff (164)	Fair Aquatic habitat, Need new nutrient data for determination, DO% exceeds WQS	H
19A	W. Takpochao (North)	A	4.1	Enterococci, DO%, biocriteria, Orthophosphate, pH	1998 2009 2004 2004 2015	sanitary sewer overflows (115), urban runoff (177), sedimentation (21), landfills (69), municipal point source (85), unknown (140)	Sadog Tasi WWTP outfall, No new biocriteria data, Need new nutrient data for determination, pH exceeds WQS	H
20B	Achugao (South)	AA, A	1.2	Enterococci, DO%, Biocriteria, Orthophosphate	2004 2009 2006 2004	on-site treatment systems (92), sanitary sewer overflows (115), livestock grazing or feeding (143), Marina Boat Maintenance (75), urban runoff (177), sedimentation (21),	Poor Aquatic habitat, Need new nutrient data to determine	H

Figure 5. Screen capture of the current (September 2017) effluent compliance report for Sadog Tasi WWTP shows noncompliance or significant non-compliance for total Phosphorus, Nickel, Copper, and *Enterococci* (https://echo.epa.gov/effluent_charts#MP0020010/61211). Sadog Tasi exceedance reports from January to April 2017 list monthly average exceedances for *Enterococci* for all four months.

**SADOG TASE WWTP
GARAPAN, MP, 96950**

Selected Water Permit:

View by:

Specify Date Range: to

Click a cell in the summary grid to display the effluent chart(s). By default the last three years of data are presented. Use the controls above to modify the date range, view charts for a different water permit and/or filter by compliance status.

Compliance Status

- Unknown
- No Violation
- Noncompliance
- Significant Noncompliance

Ammonia, unionized (00619)		
Phosphorus, total [as P] (00665)		
Nickel, total recoverable (01074)		
Silver total recoverable (01079)		
Zinc, total recoverable (01094)		
Copper, total recoverable (01119)		
Oil and grease (03582)		
Phosphate, ortho [as P] (04175)		
Flow, in conduit or thru treatment plant (50050)		
Chlorine, total residual (50060)		
Enterococci (61211)		
Pass/Fail Static 48Hr Acute Hyalella azteca (TGA3Y)		

Recommendation #6

Improve infrastructure for public access for Lagoon users

During the April 2017 Forum, many stakeholders cited a variety of safety and maintenance improvements needed at marinas, beaches, and other Lagoon access areas. While some of these improvements do not fall under DCRM's jurisdiction, improving coastal access is one of DCRM's programmatic enhancement areas, as referenced in DCRM 2015-2020 309 Report & Strategy. Collaborating with local partners to implement these improvements will help provide safe and more equitable public access, generate positive interactions with the MSO community, and contribute to economic development for Lagoon area businesses. These activities can be conducted in conjunction with Lagoon education and outreach programs.

Actions

6.1 Take a lead role in bringing implementation partners to the table and securing grant funds for the following priority improvements:

- a. Prioritize restroom improvements, starting with high use areas such as Smiling Cove Marina, Sugar Dock, and Pau Pau beach.
- b. Repair and enhance beach barbeque areas throughout the Lagoon as many are, reportedly, in disrepair. This supports "high priority use" category (see Chapter 15-10-335) for shorelines.
- c. Increase police or security guard presence at public beaches, or consider working with villages to organize "neighborhood watches" that could increase user safety.
- d. Repair Outer Cove Marina and Sugar Dock. They are in disrepair and are unsafe for users including MSOs, tourists, and residents. DFW's Boating Access Program may be a coordination option.



Beaches, docks, and boat loading/unloading areas are key access points for Lagoon users. Maintaining safe access points is a primary objective of DCRM.

6.2 Meet with DPL and HANMI members to determine if there is a benefit to moving concessionaires off the beaches and into hotels. It was mentioned during the Forum that concessionaires have a negative impact on the beach user experience and hotel operations.

6.3 Ensure developers/hotels maintain a clearly marked, publicly-accessible passage to the shoreline, especially where public access pre-development may have been altered post-development. This might even involve new signage.

Implementation Partners

DPL, DPS, DFW, DLNR-Parks & Recreation, HANMI, USACE

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions:

- ☑ **The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3**

20. Encourage the development of recreation facilities which are compatible with the surrounding environment and land uses.

21. Encourage the preservation of traditional rights of public access to and along the shorelines consistent with the rights of private property owners.

☑ **DCRM powers, functions, and duties,
*PUBLIC LAW 3-47, § 4***

1. To coordinate the planning and implementation of the coastal resources management policies by the Commonwealth government.

☑ **Title 15, Chapter 15-10-335 - Shorelines
APC Specific Criteria**

Defines the shoreline APC as of the area between the mean high water mark or the edge of a shoreline cliff and one hundred fifty feet inland; provides management standards for projects proposed within the shoreline APC, and provides a list of considerations for DCRM agency staff to consider when reviewing a project proposed in the shoreline APC; defines use priority categories within shoreline APCs (e.g., public use beaches, traditional, cultural and historic uses, preservation of fish and wildlife habitat, etc.).

Recommendation #7

Encourage sustainable use of Mañagaha resources

Mañagaha is the number one tourist attraction in the CNMI according to visitor exit surveys. Representatives from the general public and agency staff indicated that Mañagaha is extremely crowded and cited user conflict and safety concerns among all uses. Issues with trash management on the island were also discussed. DLNR-DFW developed the 2005 Management Plan for the Mañagaha Marine Conservation Area (MMCA), which also cited crowding and safety concerns.

To address these issues, the 2005 plan identified a proposed Motorized Vehicle Management Zone specifically for the operation of “watercrafts with the use of motors on or in water, including boats and submersible vessels.” The Plan states *“Sail boating and motorized boating are common around Mañagaha, particularly in areas south and east of the island (i.e., deepest waters). Smaller boats occasionally use other portions of the conservation area, and boat travel can be extremely hazardous to swimmers and divers and also degrade the visitors’ experiences.”* Mañagaha’s concessionaire permit is currently under review by DPL, presenting an opportunity to further address concerns that have been raised, reduce conflicts, and work towards more sustainable uses of this area.

Actions

7.1 Meet with DFW and DPS-BS to review the 2005 MMCA Plan and determine which recommendations, if any, are still valid, how motorized vessel restrictions can be enforced, and if the motorized zone should be integrated into use area designations and transit routes (see Recommendation #1).



Overflowing trash barrels on Mañagaha.

7.2 MVA is conducting meetings with government agencies to evaluate options for reducing the number of daily visitors on Mañagaha, including increasing the island entry fee. Take this opportunity to discuss other water quality and habitat protection concerns related to overcrowding with DPL, DFW, and MVA. Are there other alternatives to reducing the number of visitors a day that would balance environmental protection, economic development, and public access? Consider other management strategies to improve user experience, such as banning cigarette smoking and funding conservation officer positions to enforce existing restrictions including litter law and MPA rules.

7.3 The current Concessionaire Permit held by Tasi Tours is up for renewal. **DCRM should meet with respective agencies to discuss potential opportunities to incorporate eco-friendly green business practices into the permit**, such as meeting sustainability standards for food industry, minimizing waste products, opportunities for reuse/recycling, improved wastewater management, renewable energy, etc.

7.4 The current NPDES permit for Mañagaha wastewater treatment facility is valid through July 2018. **BECQ-DEQ should review the current permit conditions and monitoring reports to determine if any improvements are needed.** The wastewater system was upgraded to advanced treatment prior to the last permit cycle.

7.5 Work with DFW and MINA to provide signage about trash management on Mañagaha (see Recommendation #4) and to provide covered trash (and possibly recycling) receptacles. Trash pick-up should be completed nightly to reduce risks of marine debris from over-full bins.

Implementation Partners

DFW, DPS-BS, DPL, MVA, MINA, BECQ-DEQ

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions:

The Coastal Resources Management Policy, LAW 3-47, § 3

3. Promote more efficient resources management through: 1) Coordination and development of resource management laws and regulations into a readily identifiable program; 2) Revision of existing unclear laws and regulations; and 3) Improvement of coordination among Commonwealth agencies.

15. Manage ecologically significant resource areas for their contribution to marine productivity and value as wildlife habitats, and preserve the functions and integrity of reefs, marine meadows, salt ponds, mangroves and other significant natural areas.

DCRM powers, functions, and duties, PUBLIC LAW 3-47, § 4

2. To review and monitor Commonwealth government activities for their consistency with the coastal resources management policies.

NPDES Permit for Mañagaha wastewater treatment

Title 15, Chapter 15-10-320 - Mañagaha and Anjota Islands APC Specific Criteria DCRM's regulations identify sanitation and navigational improvements as moderate use priorities. Unacceptable uses of Mañagaha are activities that preclude, deter, or are unrelated to the use of the island by CNMI residents.

Recommendation #8

Create a fishing safety equipment program

During the April 2017 Forum, stakeholders indicated that fishermen, particularly spear fishers, can be extremely hard to see in the Lagoon. There was general consensus that fishermen and motorboat accidents are one of the most critical safety concerns to address. Fishermen are not currently required to wear bright safety clothing or carry safety equipment such as fluorescent flags or buoys.

Actions

8.1 Work with the Saipan Fishermen's Association (SFA) and DPS-BS to develop a free equipment program for fishermen that distributes adequate, high-visibility safety equipment and clothing. It would be necessary to determine what agency or group could administer this program and what grant funding would be available to launch and sustain it; however, ensuring user safety is critical. Modest investment in such a program could save lives.

8.2 Provide a venue for fishermen safety training. Perhaps this can be part of the Lagoon education program (see Recommendation #4).

8.3 DCRM could collaborate with DFW and other agency partners to create an educational brochure to be distributed, in multiple languages, to the fishing community. The brochure should:

- a. Remind fishermen about use and operation of proper safety equipment;
- b. Provide the Lagoon Use Areas map showing potential areas for user conflicts (e.g., areas of free diving vs. spear fishing); and
- c. Describe fishing rules and regulations.



Spear fishermen are vulnerable to small boats in the Lagoon when visibility is poor and proper floats/flags not being used.

8.4 DCRM, SFA, and DPS-BS should discuss if a regulatory approach is needed that would require fishermen to wear/carry the proper safety equipment, and if so, what the enforcement mechanism would be (e.g., citations or fines).

Implementation Partners

DLNR, Boating Safety, Saipan Fishermen's Association, and potentially MSO charter fishermen.

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions:

- ☑ **The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3**
16. Manage the development of the local subsistence, sport and commercial fisheries, consistent with other policies.
- ☑ **Title 15, Chapter 15-10-315(b) - Lagoon and Reefs APC Specific Criteria**
Any project proposed for location within the lagoon and reef APC shall be evaluated to determine its compatibility with management standards as specified in the regulation.

Recommendation #9

Continue to support BECQ's marine monitoring program

Given the extensive investment in monitoring staff, equipment, and laboratory capacity over the last few years, BECQ has developed one of the best in-house monitoring programs in the region. Data generated by BECQ's monitoring program has and should continue to inform decisions about sustainable use of Lagoon resources and priority areas for targeted water quality improvements.

Actions

9.1 In addition to continued implementation of BECQ monitoring program priorities, **the monitoring program could focus on collecting the following data:**

- a. Stormwater and wastewater outfall monitoring in Saipan Lagoon (see Recommendations #5 and #11). This may involve collaboration with DPW and CUC on infrastructure mapping and illicit discharge detection and elimination.
- b. Evaluate groundwater influence on other factors (seagrass growth rate, fish counts, etc.) including seasonal influence and use of N-isotope or other means of tracing sources of nitrogen.
- c. Continue to monitor and address heavy metals in sediment offshore of storm drains identified near Gualo Rai, Garapan, and Susupe, as well as the public health risks of fish and bivalve consumption near Agingan Point (see Denton et al., 2014).
- d. Evaluate and implement monitoring recommendations in the Garapan CAP, as appropriate, including improved stream monitoring. Consider expanding CAP efforts to other Lagoon watersheds and expanding CAP approach to advance integrated watershed management planning, using water quality monitoring data as a driver of these efforts.



BECQ's Marine Monitoring program provides valuable information on the condition of Lagoon resources.

9.2 Use monitoring data collected by third parties under development or discharge permits as additional data to support Lagoon-wide studies (e.g., use data from CUC to augment BECQ monitoring data at points of concern).

9.3 Consult with the University of Guam's Water and Environmental Research Institute of the Western Pacific (WERI) about prioritizing data collection and analysis of ecological systems in Saipan Lagoon.

Implementation Partners

BECQ-DEQ, NOAA, CUC, DPW, University of Guam-WERI

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementation:

Title 15, Chapter 15-10-315 - Lagoon and Reefs APC Specific Criteria

Management standards include prevention of activities that cause adverse impacts to reefs and corals, that Lagoon reefs shall be managed to maintain or enhance fisheries; that natural systems shall be maintained and to avoid discharges of pollutants that destroy productive habitats; that areas and objects of historic and cultural significance shall be preserved and maintained; and that underwater preservation areas shall be designated.

Recommendation #10

Evaluate and implement appropriate shoreline stabilization and erosion control projects

Beach use is the most popular of the Lagoon uses as reported by survey respondents, who also perceive that beach width has been declining due to shoreline erosion. At the April 2017 Forum, many participants indicated that certain beach areas have eroded more significantly than others, and thus limit use (e.g. beach at American Memorial Park as documented by CRI interns in 2017). Significant funds have already been expended on shoreline erosion studies, such as the 2017 USACE report and Shoreline Access and Shoreline Enhancement Assessment (SASEA). Public infrastructure improvements adjacent to the shoreline (e.g., Beach Road, Fishing Base) should take shoreline stabilization concerns and needs into account. Implementation of viable shoreline projects in conjunction with infrastructure repair and redevelopment activities, where appropriate, can be more cost-effective than implementing projects on an individual-basis. Preferences are for “soft” shoreline approaches rather than hard structures (e.g., sea walls and groins) that have been shown to cause more negative impacts overtime.

Actions

To encourage implementation of appropriate shoreline stabilization projects, especially soft stabilization measures (e.g., plantings and renourishment), consider the following:

10.1 Work with the Legislature, DPW, and the Capital Improvement Project (CIP) Program to **ensure that public improvement projects and carefully planned adjacent shoreline stabilization and/or beach re-nourishment projects are implemented jointly**. This is to promote construction of viable shoreline



Residents are concerned about potential beach loss, particularly given the highly-visible dynamics at Micro Beach.

stabilization projects that have been previously identified and further evaluated. Legislative representatives and DPW staff should collaborate to ensure that the implementation of CIPs coincides with future development to maximize benefits.

10.2 Work with DPW and USACE to **secure grant funding for shoreline enhancement and stabilization studies and projects** not covered by CIP funds.

10.3 **Ensure that private applicants have considered shoreline stabilization concerns and needs as part of APC permit review**. If projects are within a certain distance of pre-identified shoreline projects, consider making implementation of shoreline stabilization part of the permit condition. Update APC permitting conditions to specify that soft shoreline enhancements must be considered as part of major siting and shoreline APC projects.

10.4 **Consider allowing shoreline stabilization projects as an option for permit mitigation alternatives** Title 15, Chapter 15-10-311. Incorporate preferred shoreline stabilization methods into Section 15-10-335 – Shorelines APC Specific Criteria. DCRM is currently working to finalize mitigation

policy guidance, and best practices should continue to be incorporated into project planning and permit conditions.

10.5 Incorporate education and outreach components into shoreline protection and climate adaptation projects

so that localized extreme weather events, such as recent floods or storms, bring a personal relevance to increase community understanding of climate change threats and increase support of adaptation and management interventions.

10.6 Collaborate with and support DFW in re-vegetation efforts at Mañagaha,

specifically the vegetative stabilization of accreted areas on the northwest side of the island.

10.7 Add a standard condition to permits requiring beach re-nourishment projects to use clean, uncontaminated sand.

Implementation Partners

BECQ-DEQ, DFW, DPL, USACE, Legislature, Capital Improvement Project (CIP) Program Administration, DPW

There may be an opportunity to partner with the Resilience Working Group or to establish a task force with representatives from various agencies that can make decisions or provide inter-agency guidance for how shoreline projects should move forward.

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions:

- ☑ **The Coastal Resources Management Policy pursuant to *PUBLIC LAW 3-47, § 3*; amended by *PUBLIC LAW 7-51 §§ 2, 3***

10. Maintain or improve coastal water quality through control of erosion, sedimentation, runoff, siltation, sewage and other discharges;

- ☑ **DCRM powers, functions, and duties pursuant to *PUBLIC LAW 3-47, § 4***

To review and monitor Commonwealth government activities for their consistency with the coastal resources management policies;

- ☑ **Title 15, Chapter 15-10-335 - Shorelines APC Specific Criteria**

Defines the shoreline APC as of the area between the mean high water mark or the edge of a shoreline cliff and one hundred fifty feet inland; provides management standards for projects proposed within the shoreline APC, and provides a list of considerations for DCRM agency staff to consider when reviewing a project proposed in the shoreline APC; defines use priority categories within shoreline APCs (e.g., public use beaches, traditional, cultural and historic uses, preservation of fish and wildlife habitat, etc.).

- ☑ **Title 15, Chapter 15-10-305 - General Criteria for CRM Permits**

Specifies what DCRM agency staff will consider all when evaluating CRM permit applications, including those for APC development permits, APC permits, and major siting permits.

- ☑ **Title 15, Chapter 15-10-505 - Specific Criteria for Major Sitings**

Specifies the criteria that DCRM agency staff will examine to evaluate a proposed project that constitutes a major siting; also lists the general criteria for all major siting and APC permits.

Recommendation #11

Implement stormwater management improvements

Water quality improvement is a priority goal for many survey respondents. Stormwater management has been a central theme in recommendations from every SLUMP report since 1985. The Garapan CAP lists many stormwater management improvement action items for DCRM and partner agencies. Unfortunately, several undeveloped parcels in Garapan that were identified previously for regional stormwater retrofits have since been developed. Redevelopment and infrastructure repair activities on Saipan provide one of the best opportunities to improve water quality in existing areas of impairment. Updating the decade old CNMI Stormwater Standards and Design Manual offers a chance to further reduce the impacts from new development.

The pending issuance of the new CNMI MS4 permit from US EPA will require developing a more proactive partnership between BECQ and DPW, the designated program authority for CNMI. The last annual program report that was submitted by DPW to US EPA was from 2012. There are a number of required program elements that DPW and BECQ will need to cooperatively address.

Actions

11.1 Proactively engage with DPW and US EPA to review new MS4 program requirements, discuss interagency collaboration, and begin to align staff and budgets before the new permit is issued. Guam's [draft permit](#) was issued in 2016 and is available for review. It is anticipated that CNMI's MS4 will be similar (personal communication with Eugene Bromely of EPA Region 9), which means that there will be a more explicit tie to impaired waters and more prescriptive program requirements.



Drain inlets and pipes, like the one shown here on Beach Rd., should be mapped by DPW and BECQ to create stormwater infrastructure and contributing drainage area maps for each outfall, track maintenance activities, and meet MS4 permit requirements.

11.2 Update the CNMI stormwater management manual (2006) post-construction standards to address projected impacts from climate change and provide enhanced treatment designs, more explicit onsite management requirements, more stringent redevelopment criteria, green infrastructure incentives, offsite mitigation, and maintenance tracking.

11.3 Coordinate with DPW to prepare GIS maps and track status of stormwater infrastructure, including outfall(s) and their piped contributing drainage areas within the Lagoon watersheds.

11.4 Update permitting conditions for redevelopment projects, repaving, and road improvements with language that encourages retrofitting of existing unmanaged impervious cover. In general, regulations and permits can be more prescriptive about long-term operational and maintenance requirements.

Implementation Partners

DPW, CUC, US EPA, BECQ-DEQ (Water Quality Section)

Regulatory Applicability

The following list of regulations and policies lend support to DCRM for implementing the aforementioned actions:

☑ **The Coastal Resources Management Policy, PUBLIC LAW 3-47, § 3**

10. Maintain or improve coastal water quality through control of erosion, sedimentation, runoff, siltation, sewage and other discharges.

☑ **DCRM powers, functions, and duties, PUBLIC LAW 3-47, § 4**

1. To coordinate the planning and implementation of the coastal resources management policies by the Commonwealth government.

☑ **NPDES and MS4 Permit Requirements**

US EPA requires stormwater programs to address six minimum measures: public participation, education and outreach, construction site management, post-construction stormwater management, illicit discharge and elimination, and pollution prevention and good housekeeping. The existing permit requires comprehensive mapping of drainage infrastructure. The new permit will likely be more prescriptive in order to be address impaired waters.

Recommendation #12

Establish a sustainable, dedicated funding mechanism for Lagoon Use Management

The resources in the Lagoon provide a significant amount of economic, environmental, cultural, and community value to residents and tourists alike. Without continued protection of vital natural resources and the built environment in the Lagoon, ecosystem services will decline along with the economies tied to those resources. For instance, if the water quality and habitat decline in the Lagoon and users are unable to swim and fish, Saipan could see a decline in revenue from recreational businesses (e.g., tour operations), as well as a drop in tourism. Because the Lagoon provides numerous recreational and business opportunities that stimulate the local economy, protecting and enhancing this resource is critical to long term economic sustainability in CNMI.

The idea of creating a dedicated funding mechanism to best manage natural resources is not new. The Republic of Palau, for example, created the [PAN Fund](#) in recognition of the value of its natural environment. The PAN Fund is a nonprofit organization that serves as a financial trustee for monies obtained from donations and other fees, including a visitor departure tax used to fund environmental programs. The PAN Fund is mandated to:

1. *Seek outside funding sources for States' conservation and sustainable development efforts;*
2. *Leverage sources of outside funding through mechanisms such as the Micronesia Conservation Trust; and*
3. *Ensure that outside funding is used for the purposes established by and required by outside donors.*

While some of the SLUMP recommendations fall within the existing DCRM programming,



Lagoon management will cost money to implement. Like any program budget, having a dedicated funding source allows for better planning and prioritizing.

other activities will require additional budget to implement. Whether by securing federal grants (e.g., coastal program funds), establishing fees, allocating money from fines, and/or collecting donations, having a dedicated mechanism that can support implementation of Lagoon management measures will be necessary. With the projected increase in tourism in CNMI, it is even more crucial to consider creating a dedicated funding source for Lagoon management.

Actions

12.1 Appeal to the Northern Marianas Commonwealth Legislature to establish a special funding source for Lagoon management. Establish a “Lagoon Management Task Force” or Board to manage the funds. Ensure that the Board is comprised of agency and non-agency representatives.

12.2 Work with Northern Marianas Commonwealth Legislative Representatives to **leverage the Micronesia Challenge funding** to protect Saipan Lagoon.

12.3 Collaborate with NGOs on grant funding opportunities. Non-profit organizations like MINA often meet more grant

funding eligibility requirements than government entities. DCRM should research grant funding opportunities that might be able to provide funds to start a dedicated fund for Lagoon management and protection. Examples of grant funding opportunities include:

- Global Green Grants Fund
- Matson Foundation
- The Harold K.L. Castle Foundation
- NOAA Grants

12.4 Explore alternative revenue mechanisms to Marine Resource

Investment Act, such as user fees, permit funds, etc. For example, DCRM could encourage MSOs to allocate a portion of their profits to the dedicated funding source for Lagoon management, once established. Because MSOs depend on the health and sustainability of Lagoon resources, MSOs have a particularly vested interest in proper management of the Lagoon. Other revenue examples include a departure tax, portion of hotel tax, portion of enforcement actions and mitigation fees, etc.

12.5 Collect fees for private boat and yacht docking, parking, and anchoring within the Lagoon. This can be achieved in conjunction with Action 1.4 to establish consistent moorings and buoys. Other jurisdictions have implemented fees for

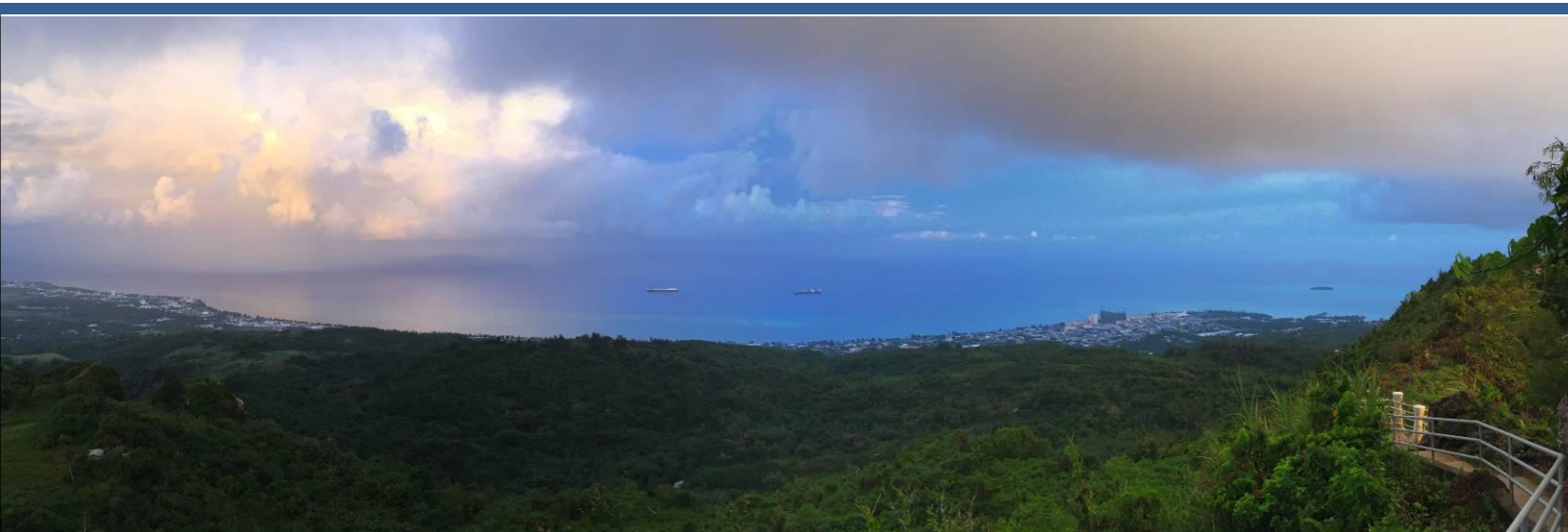
anchoring/parking including Kaunakakai Harbor in Molokai Hawaii and the U.S. Virgin Islands.

12.6 Work with Chamber of Commerce, HANMI, and large retailers to **investigate opportunities for public-private partnerships** related to water quality improvements. Public private partnerships have become increasingly useful in funding stormwater retrofitting of urban centers in the US.

Implementation Partners

Legislature, MINA, HANMI, Chamber of Commerce

Saipan Lagoon as seen from Mt. Topachao, April 2017





The Saipan Lagoon offers a little something for everyone. Without our dedicated commitment to sustainable Lagoon management for all uses, we risk losing the very thing we value most.

Next Steps

Following the review of this SLUMP update, the next steps for DCRM agency staff are to:

- 1. Circulate the report** to Forum participants as well as other government agencies, MSOs, and general Lagoon users.
- 2. Host a follow-up meeting** of implementation partners to further discuss the recommendations, agree to overall island-wide priorities, and begin coordination as required for successful implementation.
- 3. Prioritize these recommendations** internally based on urgency, feasibility, and alignment with projects and efforts already underway. Certain complementary actions from across the recommendations may be grouped together into strategic streamlined tasks, which can then be assigned to the relevant agency Section or flagged for funding.
- 4. Incorporate management recommendations** that advocate for a change in approach into Standard Operation Procedures and, ultimately, Agency regulations and policies.
- 5. Refer to the SLUMP** early and often for guidance when considering Lagoon use, permits, and resource management decisions on all scales.

2017 SLUMP
Appendix A

State of the Lagoon Report

State of the Lagoon Report

in support of the
2017 Saipan Lagoon Use Management Plan Update



August 2017

Prepared for: CNMI Bureau of Environmental and Coastal Quality, Division of Coastal Resources Management

Prepared by: Horsley Witten Group, Inc. and Hofschneider Engineering Corporation



HOFSCHEIDER ENGINEERING CORPORATION

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Appendices

Appendix A: Saipan Lagoon Map Library

Appendix B: New, Pending, and Potential Development in SLUMP and Contributing Watersheds

Appendix C: Summary of reef resiliency recommendations from Maynard et al. (2015b)

Appendix D: Garapan Watershed Conservation Action Plan Strategic Workplan Summary

1.0 Introduction

This report summarizes relevant information from previous studies and mapping on the existing condition of the Saipan Lagoon. This report documents the quality of lagoon resources, provides information on coastal dynamics, characterizes potential climate change and watershed threats, and summarizes the diversity of lagoon uses. In addition, relevant recommendations from these studies and from previous lagoon management plans are summarized. The information reviewed was provided primarily from the Bureau of Environmental and Coastal Quality (BECQ). In addition, background material and input was provided by the Planning Advisory Team (PAT), a group of representatives from BECQ, Horsley Witten Group (HW), Hofschneider Engineering Corporation (HEC), and the National Ocean and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). An emphasis was placed on obtaining the most up-to-date information and data. GIS data was provided by BECQ and NOAA. Original field data collection was not a part of this effort.

1.1 Purpose

This report is not intended as an exhaustive analysis, but rather as a consolidated review of key information needed to support future lagoon use management decisions. The CNMI BECQ Division of Coastal Resources Management (DCRM) developed the Saipan Lagoon Use Management Plan (SLUMP) as a strategy for better managing the lagoon and its diversity of resources and users. The first SLUMP was drafted in 1985, with updates completed in 1997 and 2012. Since the original SLUMP and subsequent updates, there has been an expansion of user demands on lagoon resources and additional data on these uses and lagoon condition has been gathered including (but not limited to): high resolution habitat mapping, updated biological monitoring report, a climate vulnerability assessment, a lagoon hydrodynamics study, and a coastal user mapping project, to name a few. This report contains reference information for subsequent meetings with agencies, marine operators, and other lagoon users to update the SLUMP with a goal of ensuring the sustainable use of the Lagoon's natural, economic, and recreational resources.

1.2 The Lagoon & Report Organization

Saipan Lagoon is located on the west coast of Saipan, the largest and most populated island in the Commonwealth of the Northern Mariana Islands (CNMI). The lagoon is a 12.4 square mile shallow, semi-enclosed body of water bordered by a barrier coral reef on the west side of the island, spanning approximately 15 shoreline miles from Wing Beach to Agingan Point (**Figure 1.1**). The lagoon varies in width from a few hundred yards on the south and northern ends to over 2 miles near Mañagaha Island and can be divided into a northern, central, and southern section (see Damlamian & Krüger 2010) based on location and geomorphology.

The SLUMP area encompasses the entire lagoon, a 150-ft wide shoreline strip above ordinary high water, and inland areas seaward of the nearest coastal road (**see Appendix A, Map 1**).

TANAPAG LAGOON is over 7 sq. miles extending from Wing Beach to Point Muchot. Bound to the northwest by a barrier reef where the reef crest is essentially at sea level. The southern portion is denoted by a dredged shipping channel, turning basin, and commercial dock with a depth ranging from 39 - 49 feet. Northern Tanapag lagoon is generally shallower with depths ranging from around 3 to 13 feet. The Tanapag lagoon section includes the Mañagaha Marine Conservation Area (MMCA).

GARAPAN LAGOON extends between Point Muchot and Sugar Dock. In general, the lagoon in this central section is mostly shallow, with large areas <3.3 ft. To the north, the Garapan lagoon is slightly deeper (13 ft at Garapan Dock), is more open to the ocean, and is characterized by patch reefs. There are two deeper channels (approx. 10 ft deep) at Garapan Dock and at Sugar Dock. The Garapan lagoon section includes the Lighthouse Reef Trochus Sanctuary.

CHALAN KANOA LAGOON extends south of Sugar Dock to Agingan Point, is less than 1 sq. mile, and is shallow (averaging less than 3.3 ft deep). This area is bound on the west by a continuous coral reef and on the north by the channel at Sugar Dock. The southern boundary is sharply delineated by Agingan Point.

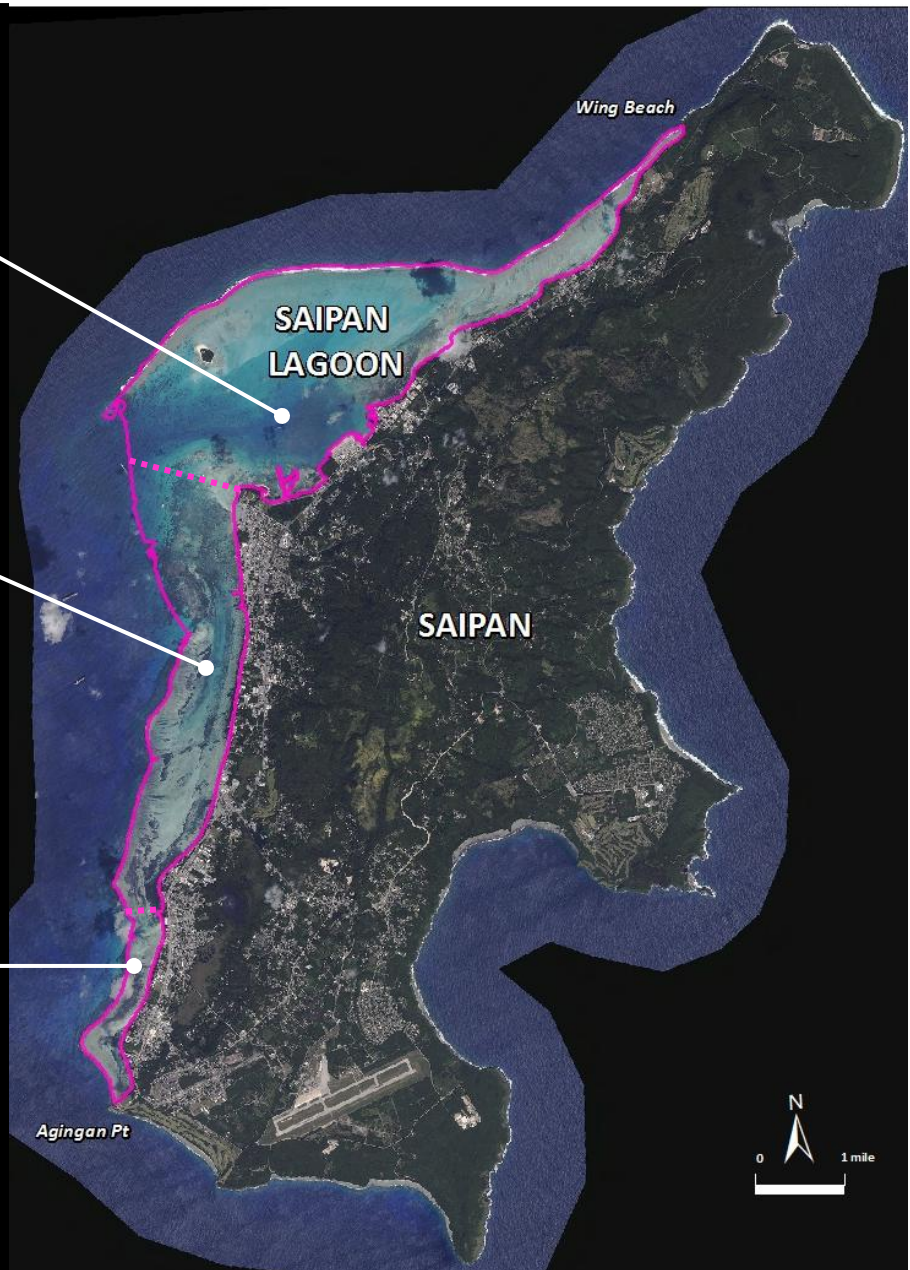


Figure 1.1: Saipan Lagoon Area Map. (Lagoon statistics from Damlamian & Krüger, 2010).

The coral reefs (i.e., backreefs, patch reefs, reef flats, and small fringing reef) and seagrass beds within the lagoon provide significant habitat for a wide variety of fishes and other marine organisms. Habitat mapping and biological monitoring have shown negative trends in the size and quality of these habitats and biota over time (Houk & van Woosik 2008, Houk & Camacho 2010, Kendall et al. 2017, Johnston et al. 2017). In addition, water quality monitoring show impairments for one or more parameters (e.g., bacteria, dissolved oxygen, phosphate,

mercury). See **Section 2** of this report for more information on the ecological quality of the lagoon.

More information on hydrology and coastal dynamics of the lagoon has been gathered since the last SLUMP update, including a number of studies on shoreline erosion. See **Section 3** of this report for updates on bathymetry, currents, and shoreline erosion.

The contributing drainage area is over 17 square miles and divided into four major watersheds: Susupe, West Takpochao, Achugao, and As Matuis (see **Appendix A, Map 1**). The lower, coastal elevations of these watersheds are relatively densely-developed, with numerous residential communities, beach resorts/hotels, commercial and industrial areas (i.e., Garapan center, Smiling Cove marina, CPA Seaport, the old Puerto Rico dump (now a park), and CUC facilities), as well as beach parks and cultural sites (i.e., American Memorial Park, Kili Beach Park, Beach Road pedestrian path). See **Section 4** of this report for information on watershed conditions and threats.

The lagoon is an incredibly valuable resource for residents and for tourists. Snorkelers, SCUBA divers, beach goers, paddlers, history buffs, and boaters of a wide variety come to the lagoon to enjoy its clear, calm waters and, in doing so, support the local economy. The lagoon is also an important resource for fishermen and port-related commerce. Expanding recreational and commercial use opportunities, including for a number of new emerging uses, requires an evaluation of current permitting and use restrictions. There is currently a moratorium on all new marine sports. See **Section 5** of this report for information on the resource uses and the impact of increasing demand and user conflicts.

A changing climate brings additional pressures on lagoon resources. See **Section 6** for information pertaining to reef resilience, community vulnerability, and flooding/coastal hazards.

Section 7 provides an overview of the current regulatory provisions related to lagoon management, as well as a summary of recommendations from previous SLUMPs. Fishing restrictions, use permits, marine protection areas, and development regulations all play a part in lagoon resource protection.

1.3 Informing the SLUMP Update

Table 1.1 summarizes recommendations from the original SLUMP, and additional management recommendations of subsequent updates to assist in determining which management strategies have not been implemented or are no longer preferred. A number of recommendations relevant to the lagoon were also offered in the reports and studies summarized in this report. **Table 1.2** summarizes these recommendations and is intended to stimulate discussions at the beginning of the SLUMP update process. This table of recommendations should not be interpreted as the preliminary direction for the SLUMP update.

Table 1.1 Summary of Recommendations from Previous SLUMPs (from Castro, 2017).

SLUMP Date	Key Recommendations	Implementation
1985	1. Amendments to Saipan’s proposed Zones and Land Use Districts, as well as to the rules and regulations to be promulgated thereto.	Completed
	2. Regulations governing shoreline setbacks; property coverage ratios; property setback height limitations; and shoreline fencing.	Completed
	3. Landscaping guidelines for property development.	Not completed
	4. Regulations for shoreline landfilling, diking and dredging.	Completed
	5. Regulations for constructing shoreline structures.	Not completed
	6. Beach restoration improvements.	Completed
	7. Water facilities planning for future shoreline uses.	Not completed
	8. Wastewater facilities planning for future shoreline uses.	Completed
	9. Design criteria for stormwater drainage facilities.	Not completed
	10. Planning criteria for evaluating development impacts on infrastructure.	Completed
	11. Recreation use zones for the lagoon.	Not completed
	12. Water safety information program.	Completed
1997	1. Water zoning to accommodate all lagoon users, including “traditional” uses, under multiple-use concept.	Not completed
	2. Better communication among GCNMI permitting agencies.	Completed
	3. Designation of marine preserves/sanctuaries in the lagoon.	Completed
	4. Mandatory connection of wastewater generators wherever public sewer service is available.	Completed
	5. Interception and retention of stormwater runoff at sites located upstream of lagoon discharge points.	Discussed
	6. Stormwater Drainage Master Plan for Garapan and Chalan Kanoa.	Discussed
	7. Clarification of the policy regarding public notice requirements about lagoon water quality.	Completed
	8. Enforcement of regulations for jet ski, watercraft and diving operations.	Completed
	9. Formal development policy for Managaha	Discussed
2012	1. The CRM Office will coordinate all recreational management activities in the area.	Completed
	2. DLNR will be responsible for fish and wildlife resources.	Completed
	3. DPS will be responsible for MWRC safety, search and rescue operations, surface and underwater use, and rules governing MWRC use. Officers will have jurisdiction to enforce the rules and regulations of the Plan.	Completed
	4. The CRM Office will oversee the promulgation of rules to address management needs of the Plan.	Completed

Table 1.2 Summary of Recommendations from Referenced Reports and Studies

Source	Recommendation	Status/Comments
Biology		
Proactive Species Conservation: Assessment FY08 Final Report (DCRM, 2010)	1. Despite being listed as Species of Concern by CNMI’s Division of Fish and Wildlife, no regulations are currently implemented to manage either <i>C. undulatus</i> or <i>B. muricatum</i> . A past slot-limit regulation for both taxa is no longer in effect. The suggestion of minimum size restrictions appears to be non-contentious with a majority of interviewed fishers. A complete ban of fishing for <i>B. muricatum</i> would be supported- at least for a limited time period, possibly up to five years. A complete bans on fishing for <i>C. undulatus</i> would have low support.	
HW from review of SOL materials	2. Further assessment of the invasive striped catfish and continued monitoring for crown of thorns.	
Mattos, 2015	3. Implement High priority recommendations for lagoon habitat and fisheries: 1) Understand algae preference by herbivorous fish; 2) Evaluate health of wetlands and mangroves periodically and implement management plans	
Shoreline Change		
Fletcher et al 2007	4. Further document the erosion rate of the eastern side of Mañagaha, and the overall shape of the island (post-2007) to determine how to move forward with a plan to address erosion. Fletcher (2007) had specific recommendations for how to address coastal change on the island of Mañagaha to improve the visitor experience and save bird nesting habitat, but the plan of action depends on how the island has changed since 2007.	Suggest bringing DLNR/DFW in on this issue as it has some implications for Mañagaha management, visitor use, etc.
USACE, 2004	5. If erosion control was deemed necessary at American Memorial Park, the USACE recommended a sand backpassing system to move sand from the rapidly accreting area in the marina to the eroding beaches on the point; this type of solution would require additional sand transport study	
USACE, 2014	6. Given the high probability of storm damage, a second phase of their shoreline study be conducted for the section of Beach road from the “13 Fishermen” memorial to the Route 31-33 interchange, including: identifying suitable shore protection alternatives, preparation of conceptual plans, and estimating associated costs- to include looking at bike path	Underway, Pending completion
Greene and other Planning Advisory Team members	7. At American Memorial Park, further information on any recent human-induced or natural changes to sand supply are needed in order to more fully understand why the shoreline has been experiencing ongoing change. Using this information, along with the DSAS analysis and the current vector maps, management options for American Memorial Park may be evaluated.	Many of these coastal change issues may be addressed in upcoming USACE study of Saipan’s west shoreline, set to be available in the spring of 2017. The study includes historical shoreline
	8. Predictions of how future shoreline erosion is expected to impact key recreational beaches is needed to assess potential impacts to access, recreation, and resource use.	
	9. Evaluate results of the pending USACE study of Beach Road and other areas of Saipan’s west coast to determine which, if any, of the recommended erosion management options could be implemented.	

Source	Recommendation	Status/Comments
	Improvement plans for Beach Road, Route 33, are pending, but do not currently incorporate shoreline change considerations. Is there a way to do this?	change for “problem areas” and conceptual plans for “soft” and “hybrid green/gray” erosion control measures.
	10. Continued vegetative stabilization on Mañagaha, protect from visitors.	Check with BECQ enforcement and DPL.
Users		
APEC, 2016 User Study	<ol style="list-style-type: none"> 11. Ground truth specific underwater features such as wrecks, reefs and habitat boundaries, and sandbars to ensure that the GIS layers created correlate to the features in the lagoon (e.g., specific shipwrecks as dive sites, specific depths for certain motorized boat activities). 12. Conduct broader public survey and interviews to provide BECQ-DCRM with additional user information regarding use patterns, access points, and concerns and opinions on the condition of the lagoon. This additional data could better inform new management practices or regulations as use and development pressures continue to increase. 13. Prioritize and protect the specific areas where users go that are based around unique biological, cultural, or historical features. 14. Prioritize water quality initiatives since "clear waters" and "high visibility" where the most common lagoon characteristics commercial vendors reported that draw customers. 15. Continue frequent stakeholder involvement. 	
MMCA Plan, 2005	16. Adopt regulations to establish 5 management zones and goals of MCCA plan	
HW, from review of SOL materials	<ol style="list-style-type: none"> 17. For the MMCA, compile an update on the status of the proposed management zones and for the five management goals identified in the 2005 Plan. 18. Have/should bike path users input been evaluated or incorporated SLUMP recommendations? Overlay bike path and shoreline erosion info. 19. Evaluate potential for aquaculture in lagoon- from a user conflict and water quality perspective 20. Expand evaluation of jet ski management research to include new emerging users -“Aqua-park”, Seagrass removal (for swimming areas), DUKW tour operators, proposed “jet-o-vators” / expanded “sea walker” activities, in-water “dining”, dredging for expanded transportation/access, underwater sculpture park(s), etc. 21. Revisiting use zones based on priority areas for protection (habitat, attractions, coral thickets, dense sea grass); designate use areas as opposed to restricted areas. 22. Expand restrictions on operational capacity to reduce overcrowding, including number of daily visitors to Mañagaha. 23. Increase capacity for enforcement of existing use regulations and prohibitions. 24. Evaluated potential to direct more uses outside the lagoon without sacrificing safety. 	

Source	Recommendation	Status/Comments
Planning Advisory Team	<p>25. Quantify damage from non-motorized boards and vessels (e.g., surfboards, windsurfing boards, kayaks, canoes, etc.) is this an issue in the lagoon?</p> <p>26. Add more recreational boater capacity by restoring Outer cove marina that was closed due to typhoon impacts, less boater access/docking capacity</p>	
Pollution/Water Quality		
Arriola et al., 2016 303(d) Integrated Report	27. Insufficient monitoring data is available to fully evaluate water quality impairments for many stream, lake, and wetland assessment units. Increase capacity of monitoring program to collect more samples or alter protocols to address challenges (i.e., dry streams)	
	28. Need a Fish Monitoring and Advisory Program for the CNMI that would be tasked with providing timely public fish consumption advisories.	
	29. Need to retain dedicated and skilled staff to develop and/or implement other water quality surveillance programs.	
	30. Complete known wastewater repairs/upgrades: Complete upgrade the San Antonio (A-16) Lift Station located in Susupe South to meet peak demand flows (CUC estimates completion by March 2017); Repair sewer line at Sugar Dock beach area; Determine cause of Enterococci exceedances and other non-point source pollution near the S1 Lift station at DPW Channel Bridge, especially during rain events; Complete renovation of SR1 Lift Station located south of the Kensington Hotel (CUC estimates completion by June 2017).	
	31. Address presence of heavy metals in sediment offshore of storm drains identified near Gualo Rai, Garapan, and Susupe, as well as the public health risks of fish and bivalve consumption in the Agingan Point area due to lead contamination.	
	32. Identify sources for known groundwater contamination locations on Saipan, but most have not been definitively linked to an identifiable source. Follow up on previous studies of volatile organic compounds (VOCs) in groundwater found detections exceeding maximum contaminant levels localized in four areas (San Antonio, As Lito, Lower Base, and Puerto Rico).	
Mattos et al., 2015 Garapan CAP	<p>33. Implement the Surface Water Quality Assurance Monitoring Plan created for BECQ in 2013 by collecting water and sediment samples at designated stream sites to evaluate possible land-based sources of pollution and to isolate affected watershed segments</p> <p>34. Measure volume/velocity of stormwater (explore options with John Riegel/CUC), urgency is high because of climate change predictions of increased rainfall</p> <p>35. Fill open positions in Water Quality program for data collection and analysis</p> <p>36. Complete stream inventories to identify sources of pollution</p> <p>37. Establish standard practices for maintenance of public infrastructure; Clean and maintain all stormwater drainages including improving, cleaning drainages, clearing open ditch areas, ponds and drainages and cut overgrown vegetation</p>	High priorities from Garapan CAP

Source	Recommendation	Status/Comments
	<p>38. There are a number of priority recommendations for reducing trash</p> <p>39. Reduce “red flags” at monitoring stations through better enforcement/IDDE</p> <p>40. Implement a number of specific retrofit projects, sewer improvements, and unpaved road stabilization projects to reduce turbidity, including establishing an interagency working group to evaluate maintenance options for all unpaved roads. Incorporate stormwater treatment and climate considerations in Beach Rd. renovations.</p> <p>41. Require existing and new building structures proposal to be equipped with centralized with solid waste and effluent containment. i.e., outside centralize trash bin & grease catchment/containment</p>	
HW, from review of SOL materials	42. Delineate each outfall catchment (what is draining to each coastal, stream, and wetland outfall). From this, there will be better capacity to identify individual properties that are significant sources of pollution/hotspots, track illicit discharges, and identify what areas in the watershed are currently managed or unmanaged by BMPs .	An outfall map is needed. BECQ to delineate.
	43. Assign land use categories for unlisted parcels in the parcel database to allowing for simple pollutant load models to be used to predict current or future watershed contributions (particularly under changing precipitation patterns and future growth/zoning scenarios).	BECQ intern working on this.
	44. Better quantify contributions of nutrient and bacteria loads from non-stormwater discharges. Limited information appears available on the performance of onsite wastewater systems, leaks in the sanitary system, illicit connections, % of unconnected residents and businesses within the sewer service area, and on manure management. Has there been a study?	
	45. What is known about groundwater contributions to Lagoon? Follow up on groundwater contaminate studies found in San Antonio, As Lito, Lower Base, and Puerto Rico, all of which are within the SLUMP area. Complete a study of nearshore underwater groundwater seeps as source of nutrients and bacteria to the lagoon to help identify locations of potential water quality degradation.	
	46. Evaluate relevant sections of zoning, stormwater, and wastewater regulations. Look for opportunities where improvements can be made for water quality (e.g., sewer hook up requirements, more stringent redevelopment standards for stormwater, better pre-treatment criteria prior to infiltration to reduce nitrogen).	
	47. Continue to promote community efforts, like recent successful campaign in Achugao, to promote proper domestic and animal wastewater management for low income land owners.	
	48. Revisit wetland and stream protection regulations and conservation opportunities to improve watershed resiliency.	
	49. Enforce pollution prevention plans for NPDES Multisector permits for Smiling Cove marina, all businesses within the industrial/port district, and other sites with known NPDES discharge permits	
Denton, 2012, 2014	50. Continue to monitor and address presence of heavy metals in sediment offshore of storm drains identified near Gualo Rai, Garapan, and Susupe, as well as the public health risks of fish and bivalve consumption in the	

Source	Recommendation	Status/Comments
	Agingan Point area due to lead contamination.	
Okano & Okano, 2016	51. Greater attention to groundwater for management actions. Influence of groundwater on other factors (seagrass growth rate, fish counts, etc) should be assessed. Use N-isotope or other means of tracing sources of nitrogen. Evaluate influence of season.	
Climate Change		
Greene and Skeele (2014)	52. Focus adaptation efforts on the resources/infrastructure that may be most vulnerable to climate change impacts (see Table 6.2). 53. Establishment and growth of shoreline vegetation to ameliorate erosion particularly along Beach Road pathway and at Micro Beach (i.e., “living shorelines”); 54. Encouraging strategic landscaping along threatened beaches; 55. Promoting rotational use of non-permanent structures for beach-side recreation facilities; 56. Upgrades to freshwater infrastructure and well facilities, as well as changes to withdrawal rates and pumping depths; 57. Streamlining coastal adaptation with land use policy, such as: Setback requirements that are adjusted to reflect varying degrees of vulnerability; Revising flood hazard zones to incorporate vulnerable areas and provide guidance for development; Promoting parks and other green spaces in vulnerable areas; Offering incentives for voluntarily adopting flood-resistant building codes; Prioritizing capital improvement projects in less vulnerable areas 58. Implementing green infrastructure and other innovative stormwater technologies to manage flooding;	
HW from review of SOL materials	59. Better predictions on specific physical and thermal impacts on localized biological communities from climate change. 60. Reassess depth to groundwater requirements for infiltration practices, on site wastewater, and wells given increased salinity/rising water tables.	Upcoming monitoring report will include bleaching impacts to corals in the lagoon.
Enochs et al 2015	61. Prioritize sites for protection that have OA-tolerant coral species and, if any coral restoration work is proposed, select corals that are less sensitive to future OA conditions.	
Maynard et al (2012, 2015)	62. Invest resources in protecting high resilience sites, given that those sites have the best chance of surviving under future climate change and anthropogenic impact scenarios. Prioritize sites with greater coral diversity and low macroalgae cover, improve overall water quality by reducing nutrient and sediment inputs to reefs, and protect herbivorous fish populations particularly in those areas vulnerable to coral bleaching (e.g., by supporting/enforcing the existing gillnet and scuba-spear bans). 63. Agingan Point and Oleai Rocks are strong candidates for fishing pressure studies, focused enforcement presence or area-based management (i.e., marine protected area status) because they have high resilience, but have high fishing access. These sites also have very high coral diversity which could benefit dive and snorkel operators. 64. Given their high resilience, high coral cover and medium anthropogenic stress scores, Agingan Point, Point	Most sites outside of lagoon, not particularly applicable to SLUMP.

Source	Recommendation	Status/Comments
	<p>Break Reef, Wing Beach, Lighthouse Reef, and Elbow Reef should be considered for protection during management planning. These sites could also be important for dive and snorkel operators.</p> <p>65. The report identified the seven most vulnerable sites, which had low scores for bleaching resistance, low herbivore biomass, and high fishing access based on wave exposure; six of these most vulnerable sites are located within the SLUMP area (Fishing Base Staghorn, Marianas Resort, Quartermaster Staghorn, Achugao, Pak Pak Beach, and Wing Beach). According to the study, these sites should be given special attention during management and conservation planning.</p> <p>66. The Marianas Resort, Quartermaster Staghorn, and Fishing Base Staghorn sites are also critical nursery habitats for fish and could be the focus of community monitoring programs, such as CoralWatch, and active restoration using cultured corals given their vulnerability and accessibility.</p>	
Houk et al., 2015	67. Maintaining diverse herbivorous fish populations is likely to support resilience. Examples of ways to do this include: supporting and enforcing the existing gillnet and scuba-spear bans; and regulating night-time spearfishing, exports, size-to-capture, and catch quotas.	
Mattos, 2015	68. Implement climate change-specific components of marine monitoring work	
Other	69. Education and outreach should be components of climate adaptation projects and should be made relevant to current events (such as recent floods or storms in the region) to increase community understanding of climate change threats and increase support of adaptation and management interventions.	

2.0 Lagoon Ecology

Benthic habitat, water quality, and information on biological communities, including invasive species is presented below.

2.1 Benthic Habitats

The habitats of the lagoon have experienced a general decline over the last 50 years. Houk and van Woesik (2008) reported that between 1940 -2003, 20% of the lagoon changed from seagrass, staghorn, or other substrate to sand. Prolonged periods of abnormally high sea surface temperatures have resulted in coral bleaching and mortality in lagoon reef habitats. Houk and van Woesik (2008) also noted that algae cover in the lagoon increased in the same timeframe, most likely the result of water quality and fishing impacts. While direct evidence linking fish biomass/abundance to changes in algal cover in the Lagoon has not been established, marine communities can shift in response to nutrient enrichment, and other water quality impairment (see Arriola et al., 2016). Green and Skeele (2004) state that shallow, nearshore habitats have been affected by sediment, nutrients and pollutants from anthropogenic, land-based sources. For example, the extent and health of *Halodule* seagrass beds have been correlated with the density of development in upland watersheds, where degraded seagrass habitats are situated offshore of more intensely developed areas (Houk and van Woesik, 2008).

Bottom habitat substrate and cover were mapped in 2005 by NOAA (using 2001 IKONOS imagery) and again in 2008 (**Figure 2.1**) by Houk and van Woesik. See **Appendix A, Map 2** for the Houk and van Woesik habitat map, dated 2006.

This past year, NOAA began developing a new habitat map based on 2016 WorldView imagery and over 275 ground-truthing stations within the lagoon (Kendall et al., 2017). Products of this effort include satellite derived depths, 28 habitat predictors, station videos and photos, 12 probability maps for cover and substrate, and a habitat map showing seven habitat categories (**Figure 2.2**). NOAA reports an overall accuracy of 86% (range of 80-100% across types) in the data. Live Coral (Staghorn Acropora) was very rare in the Lagoon, occurring at only 4% (13/292) of the GV sites. The three Staghorn Acropora species occurred more frequently north of Tanapag, with over half (8/13) of the occurrences offshore of Pau Pau Beach.

Due to the limited extent of live coral located in the ground validation, it was determined that distinguishing between live coral and upright dead coral would be challenging, so these categories were combined. Interactive maps, reports, and GIS are available at <https://maps.coastalscience.noaa.gov/biomapper/biomapper.html?id=saipan>

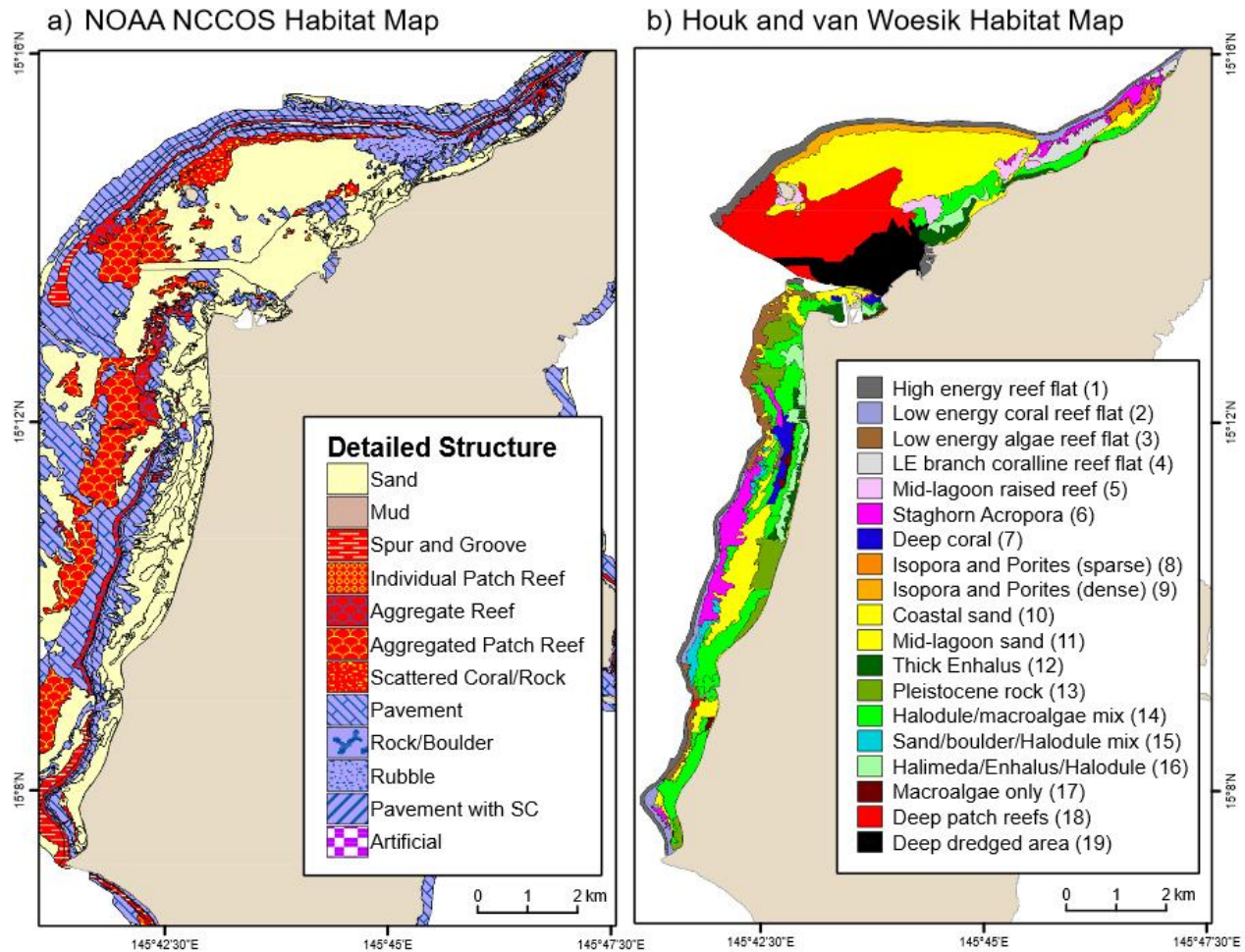


Figure 2.1: Lagoon features mapped from IKONOS satellite imagery taken in March 2001 by: a) NOAA NCCOS in 2005 and b) Houk and van Woesik 2006- 2008 (from Kendall et al., 2017).

Given the difficulties associated with comparing habitat maps over time (different cover categories, spatial resolution, etc.), comparisons may be better derived at site specific locations or through aerial image comparisons. NOAA identified five locations of notable habitat change in the lagoon during the mapping process: North Sugar Dock, Red Beach, Garapan/Memorial Park, Tanapag, and Northeast of Mañagaha (Figure 2.3).

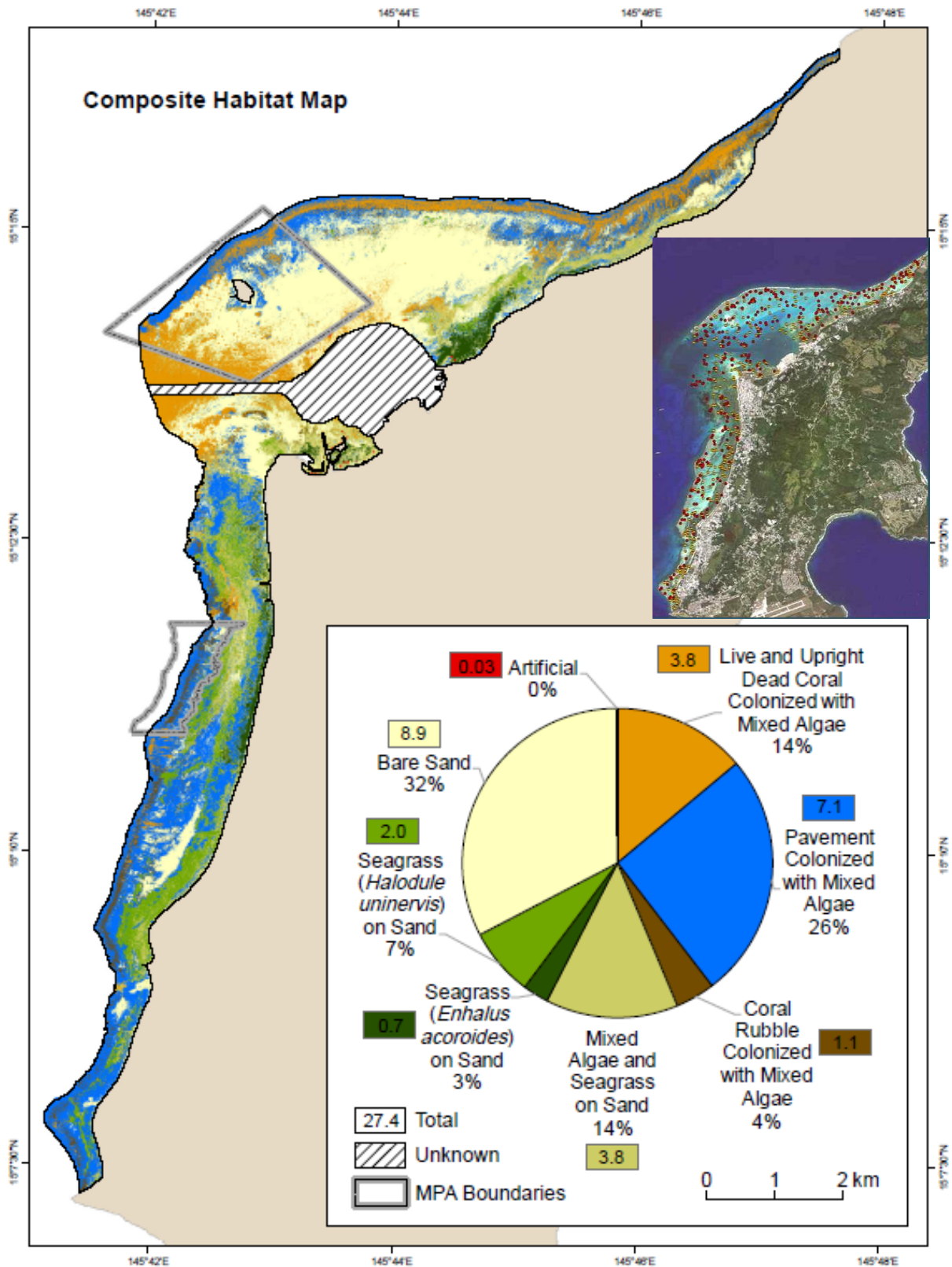


Figure 2.2: NOAA 2016 Combined Habitat Map with inset showing location of ground-truthing and accuracy assessment sites over 2016 WorldView (from Kendall et al., 2017)

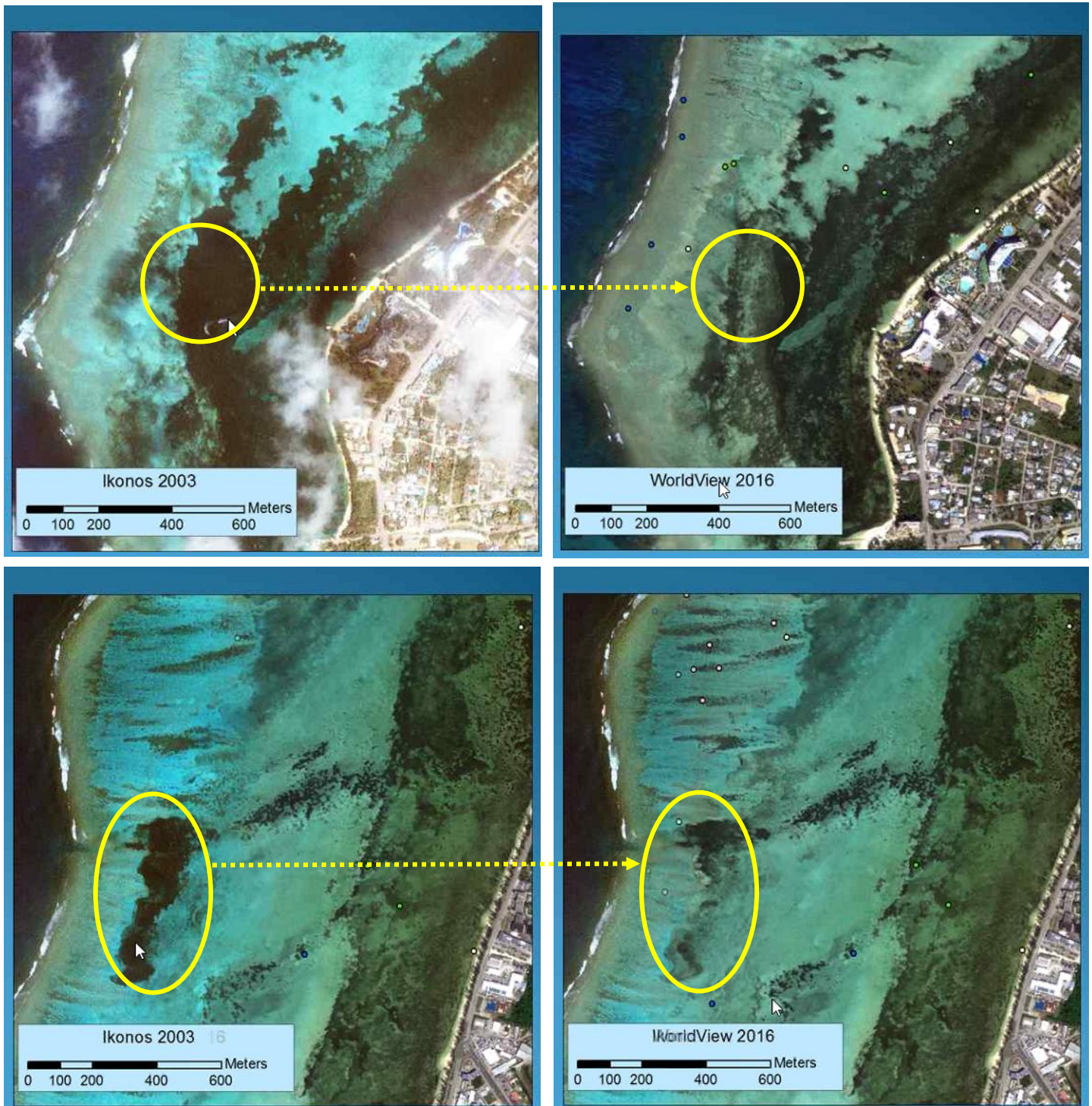


Figure 2.3: Example areas of habitat change between 2003 and 2016 identified by NOAA. (Top) Notable decline in *H. uninervis* and increased sand movement between 2003 and 2016 north of Sugar Dock. (Bottom) *H. uninervis* loss and loss of staghorn corals at Red Beach.

2.2 Biological Communities

A limited summary of information on the status of marine benthic communities is provided below based primarily on information derived from BECQ's Marine Monitoring Program efforts to document population information for various species of coral, fish and other organisms present in the lagoon.

In a presentation by Johnston at the April 2017 SLUMP Forum, the monitoring effort has identified specific areas within the Lagoon of particular concern and areas of resilience. Monitoring data can be used to inform management targets and communicate the status of marine resources with stakeholders and funders. Some of the management needs discussed included:

- Protection via regulations (northern lagoon)
- Prioritization of water quality improvement projects (Garapan)
- Additional monitoring & research (Sugar Dock)
- Improvement/implementation of BMPs
- Active restoration
- Planning (SLUMP)

Seagrass

The Marine Monitoring Program (MMP) maintains 13 long-term seagrass monitoring sites within the lagoon to assess the health of these ecosystems and to understand change. At each location, the MMP team assesses benthic cover, invertebrate assemblages, and overall diversity. Using this field data, they then calculate a score for each site based on: seagrass cover, macroalgae cover, invertebrate abundance, and invertebrate diversity. Values for each parameter are normalized by dividing the maximum value at that site across time (the "site score") and the maximum value across all sites in the same habitat measured during the current survey period (the "habitat score"). The overall score is then the average of the site score and the habitat score.

Overall scores for seagrass monitoring sites from 2015-2016 are shown in **Figure 2.4** for seagrass monitoring sites. The State of the Reef Report will be completed by MMP in 2017 and will include a full summary and analysis of the monitoring data, as well as a discussion of change in the habitats over time. A snapshot of the results, as seen in **Figure 2.5**, compares relatively healthy seagrass sites like Kilili Halodule (KIHA) off Kilili Beach Park (overall score 75) versus less healthy seagrass sites like Fiesta (FIHA) off Garapan.

Seagrass habitats appear to be in decline in many areas. For example, a comparison of satellite data from 2004 and 2016 in the vicinity of Sugar Dock clearly shows a significant decrease in the density of seagrass beds (**Figure 2.6**). This comparison of seagrass habitats over time is part of a larger long-term habitat analysis being completed by NOAA (see Kendall et al., 2017).

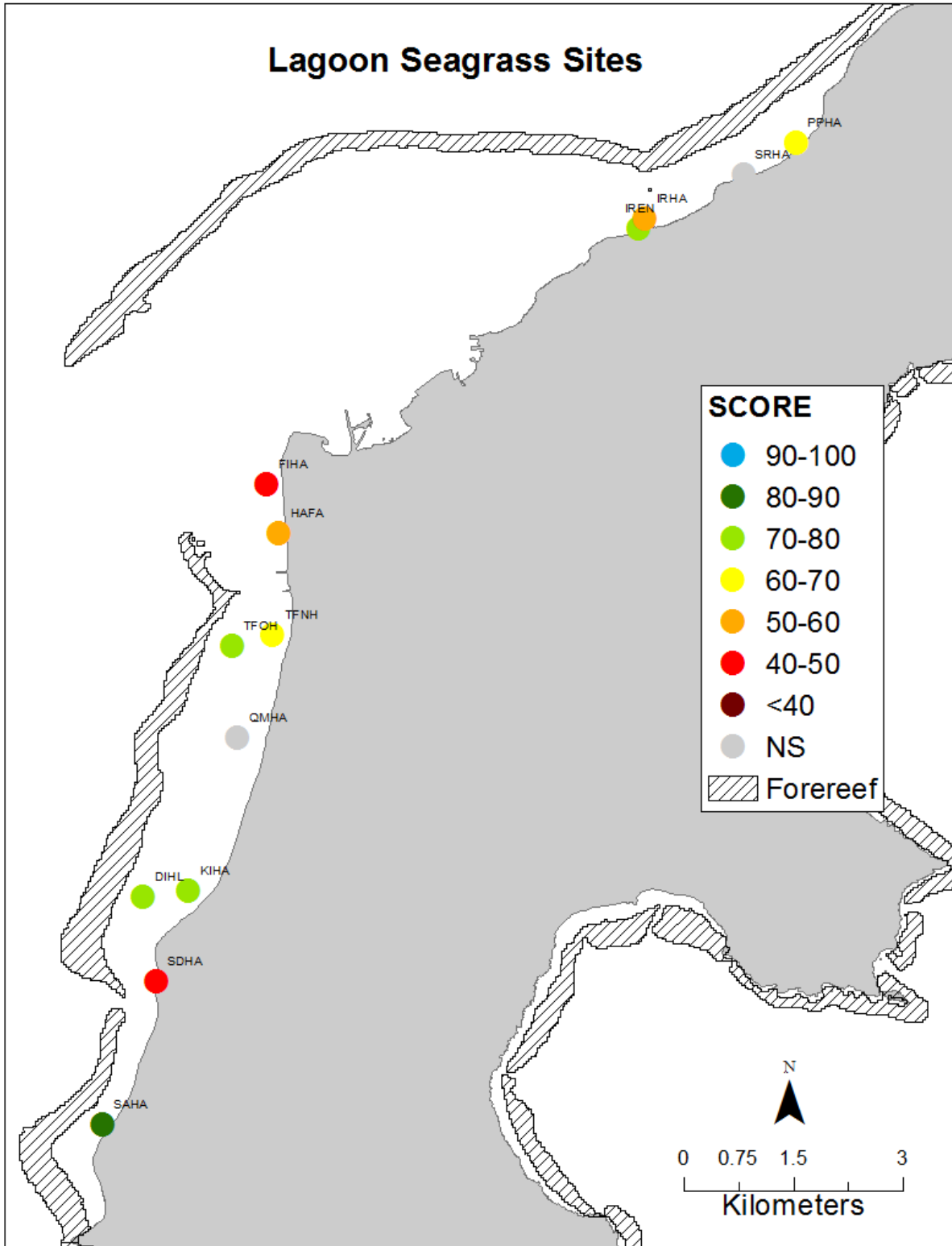
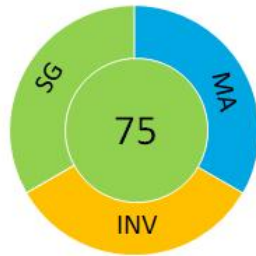
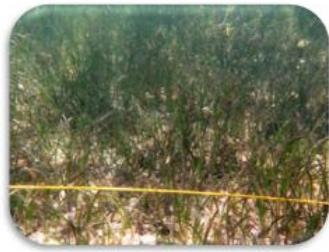
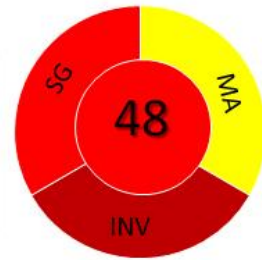
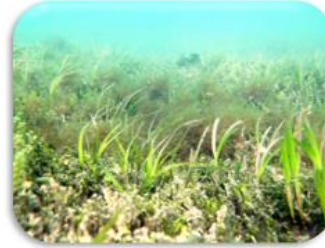


Figure 2.4: Marine Monitoring Program scores for long-term seagrass monitoring sites based on the 2015-2016 sampling event (from Johnston, et al., 2017).

Kilili Halodule (KIHA)



Fiesta (FIHA)



■ Overall score ■ Habitat ■ Site

■ Overall score ■ Site (temporal) ■ Habitat (spatial)

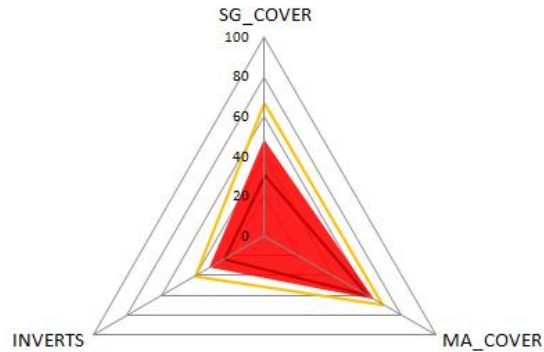
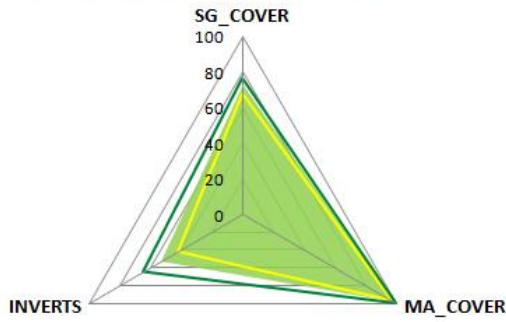


Figure 2.5: Examples of MMP results for a relatively healthy seagrass site (KIHA, left) and a struggling seagrass site (FIHA, right) (from Johnston et al., 2017).

b) 2004 IKONOS



c) 2016 WorldView II

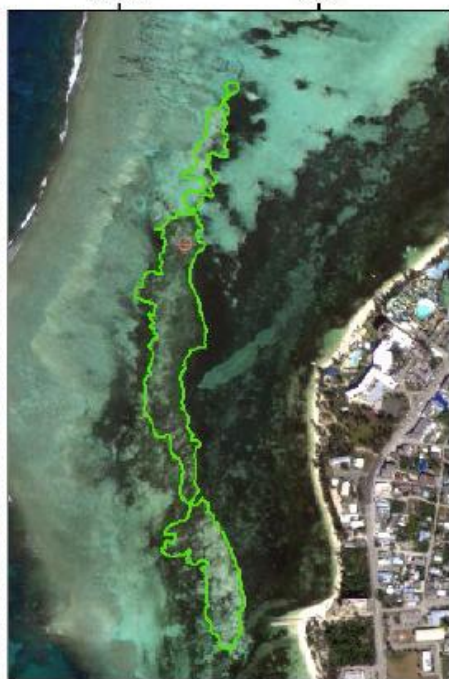


Figure 2.6: Visual comparison of seagrass beds from 2004 (left) to 2016 (right) in the area offshore and north of Sugar Dock showing overall decrease in density (Kendall et al., 2017).

Camacho (2016) studied *Halodule uninervis* beds and associated macroalgae canopies in the lagoon over a 10-year period looking at seasonal and temporal dynamics to better understand the environmental drivers of seagrass and macroalgal growth. **Figure 2.7** shows locations of study sites. Blue-green algae canopies were associated with cooler and dryer winter months with an inverse relationship between sea-surface temperatures (SST) and coverage. Warmer and wetter summer months were associated with red algae canopies, which were positively correlated with rainfall. This pattern was predominant in the central lagoon and became less significant moving north and south along the coast, presumably where groundwater interactions and limestone characteristics outweighed watershed development. When seasonal dynamics are accounted for, the persistence of macroalgal canopies through time was most closely related to watershed size and land development. Interestingly, Camacho found that macroalgal canopies in the northernmost region of the lagoon represents a disturbance-mediated system, whereby macroalgal buildup occurs during summer months, but are removed by wave action during winter.

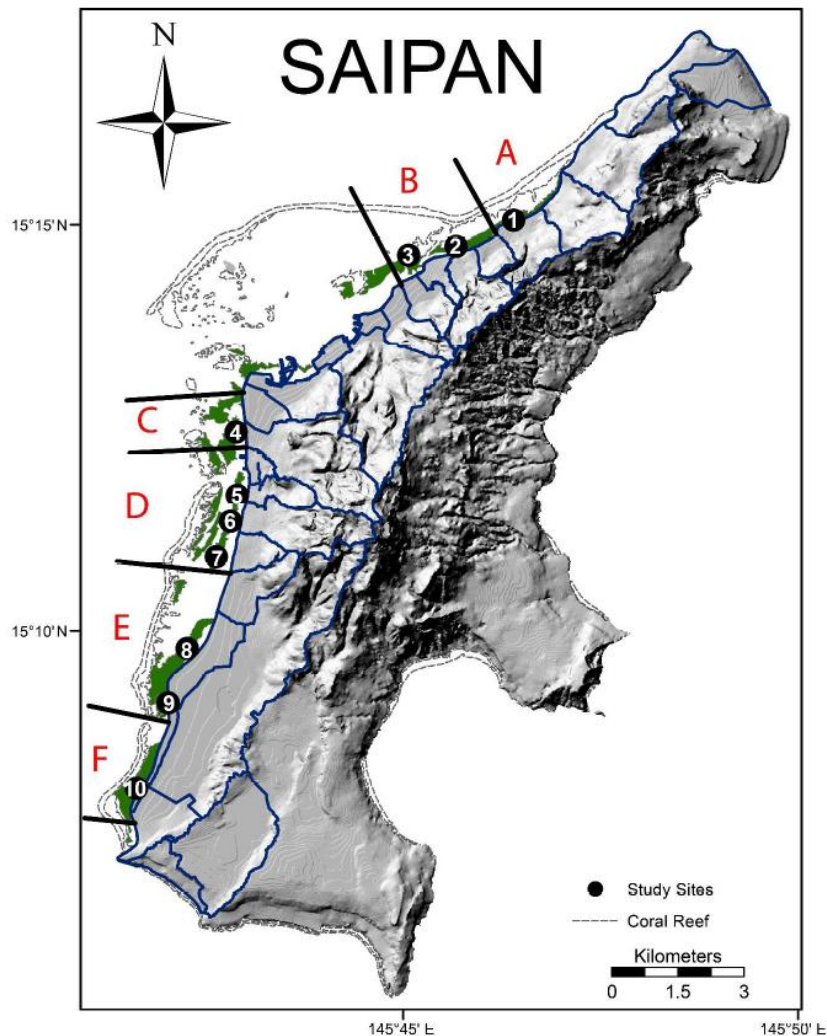


Figure 2.7: Location of seagrass monitoring sites from Camacho (2016) study

Coral Reefs

In addition to their seagrass sites, MMP has 12 long-term coral reef sites within the lagoon to assess the health of these ecosystems and to understand change. As with the seagrass sites, the MMP team assesses benthic cover, invertebrate assemblages, and overall diversity. Using this field data, they then calculate a score for each site. For coral reefs, the scoring process is based on: coral species richness, coral cover, crustose coralline algae cover, magroalgae cover, invertebrate abundance and invertebrate diversity. Values for each parameter are normalized by dividing the maximum value at that site across time (the “site score”) and the maximum value across all sites in the same habitat measured during the current survey period (the “habitat score”). The overall score is then the average of the site score and the habitat score. Overall scores for the coral reef monitoring sites from 2015-2016 are shown in **Figure 2.8**. The State of the Reef Report will be completed by MMP in 2017 and will include a full summary and analysis of the monitoring data, as well as a discussion of change in the habitats over time. In general, coral mortality has been high within the lagoon, particularly for staghorn coral. For example, at the Quartermaster Stag site (QMST), the overall score was only 39 (**Figure 2.9**). However, some promising sites have shown resilience for coral reefs, including the Pau Pau Stag site (PPST) in the northern part of the lagoon (overall score 88, **Figure 2.9**).

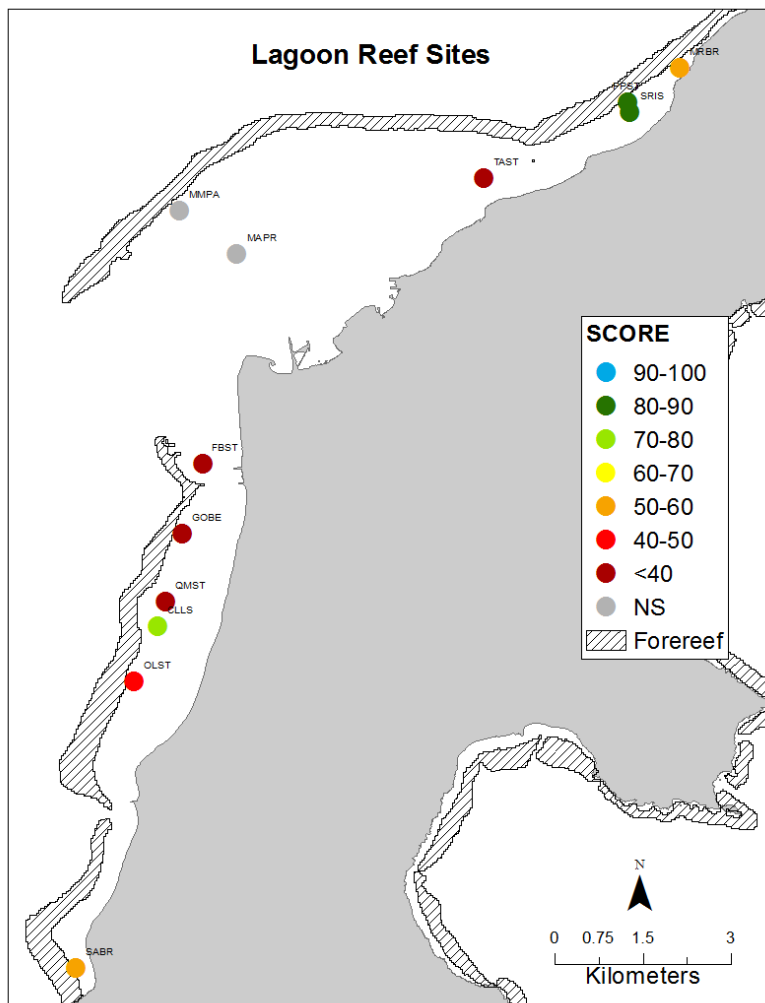
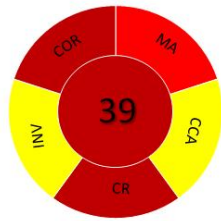
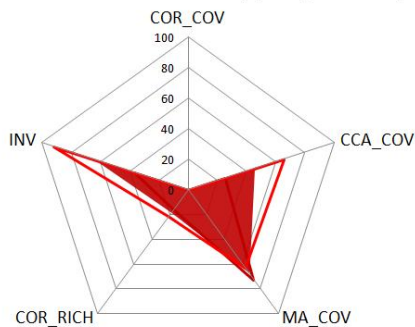


Figure 2.8: Marine Monitoring Program scores for long-term seagrass monitoring sites from the 2015-2016 sampling event (from Johnston et al., 2017).

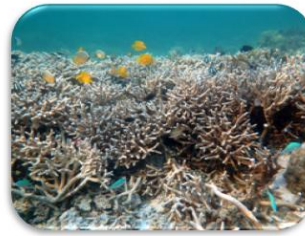
Quartermaster Stag (QMST)



■ Overall score □ Habitat (spatial) □ Site (temporal)



Pau Pau Stag (PPST)



■ Overall score □ Habitat (spatial) □ Site (temporal)

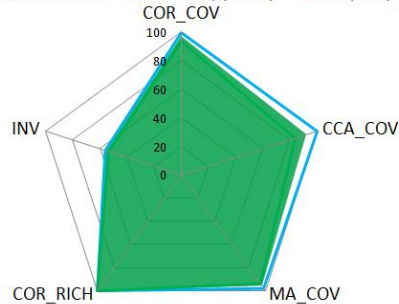


Figure 2.9: Examples of MMP results for a coral reef site with significant staghorn mortality (QMST, left) and with relatively healthy staghorn reefs (PPST, right) (from Johnston, et al., 2017).

Communities Outside Garapan

As part of the Garapan CAP, a subset of BECQ Marine Monitoring Team data was compiled to characterize the overall benthic health off of Garapan. An overall habitat ranking of “fair” was determined based on trends in the number of coral colonies, invertebrate density, seagrass cover, and % accreting benthic substrate over time (**Figure 2.10**).

Coral colony size class distribution rated as “fair,” the relatively high presence of colonies from 2-8 cm in size shows an increase in coral recruitment. Relative and overall densities of measured marine invertebrates change significantly over time. Density of edible shells and grazing urchins are rated as “poor” while sea cucumbers are rated as “fair.” In 2015, the average density of invertebrates at the site increased significantly, indicating a positive trend. A decline in % sea grass cover since 2012 at two sites outside major stormwater drainages was shown. Seagrass habitat ranked “fair” based on percent cover and ratio of seagrass to macroalgae. Percent coverage of reef-accreting substrate (e.g., coral, coralline crustose algae, and branching coralline algae) conducive to coral recruitment rated as “poor,” contributing to an overall benthic habitat rating of “fair.”

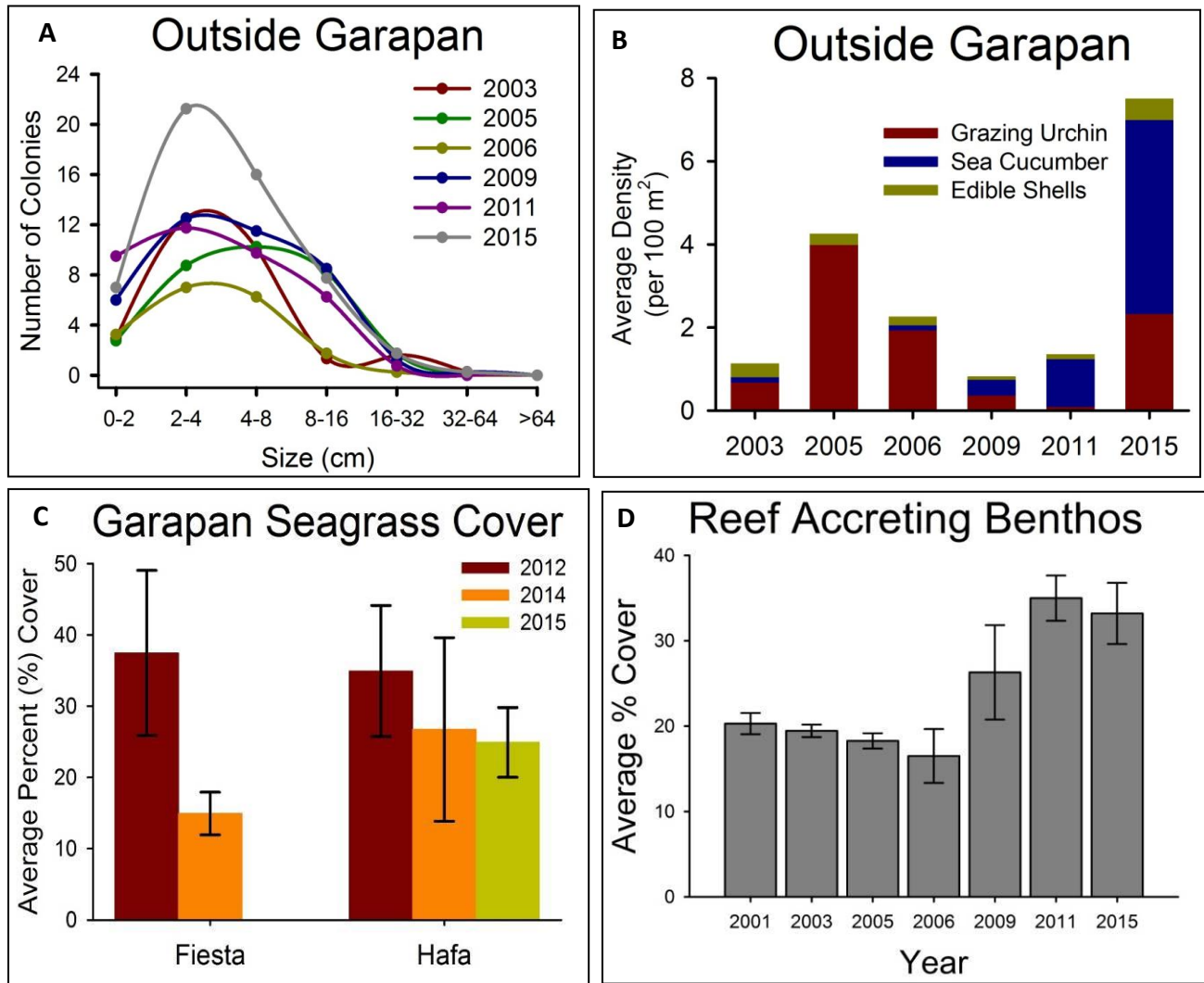


Figure 2.10: BECQ MMP data for sites off of Garapan as shown in the updated Garapan CAP (Mattos, 2015). A) Coral colony size distribution; B) benthic invertebrate density; C) seagrass cover; D) reef accreting substrate.

Fish

The Saipan Lagoon is considered an important nursery ground for some juvenile fishes, such as *Cheilinus undulatus* (humphead wrasse), as supported by findings from a 2008-2010 study by DCRM on the status and habitat specificity of *C. undulatus* and *Bolbometopon muricatum* (bumphead parrotfish). The study loosely correlated staghorn coral and backreef coral/rubble habitats with juvenile *C. undulatus* (DCRM, 2010). Despite being listed as Species of Concern by CNMI's Division of Fish and Wildlife, no regulations are currently implemented to manage either *C. undulatus* or *B. muricatum*. The DCRM report also states that a past slot-limit regulation for both taxa is no longer in effect. Further, the suggestion of minimum size restrictions appears to be non-contentious with a majority of interviewed fishers. A complete ban of fishing for *B. muricatum* would be supported- at least for a limited time period, possibly up to five years. A complete bans on fishing for *C. undulatus* would have low support.

Houk (2015) and Maynard et al. (2015) suggest that while habitat and water quality improvements are necessary, fisheries management may be the most successful strategy to improve fish populations.

Invasive and Disruptive Species

Invasive species, and other species that can be disruptive to ecosystems under certain conditions, are a threat to reefs and other sensitive ecosystems for a variety of reasons, including predation and competition for habitats and/or food supplies, as well as, in some cases, danger to people. Preventing the spread of invasive/disruptive species and their effects on ecosystems is also referred to as “marine biosecurity.” Two invasive/disruptive species have been identified in the Saipan Lagoon: the striped catfish and the crown-of-thorns starfish.

Invasive species are a threat to reefs and other sensitive ecosystems for a variety of reasons, including predation and competition for habitats and/or food supplies, as well as, in some cases, posing danger to people. The study of invasive species and their effect on native ecosystems is also referred to as “marine biosecurity.” BECQ staff indicated that the invasive striped catfish (*Plotosus lineatus*, also referred to as the striped eel catfish), is potentially an emerging threat in the Saipan Lagoon (**Figure 2.11**). According to the CNMI Division of Fish and Wildlife (DFW), the first documented presence of the striped catfish was in the *2005 Sportfish Restoration Research Program Annual Report*. No assessments on the impacts of this species have been conducted in CNMI. DFW has provided information to the public on the dangers of handling the species (DFW, 2016). The striped catfish has been found to be an invasive threat in other areas and has extremely venomous spines on the first dorsal fin and both pectoral fins; these spines are dangerous and can be fatal to humans in rare cases (Taylor and Goman, 1986).

Crown-of-thorns starfish (*Acanthaster planci*), a stony coral predator, is native to reefs in the Indo-Pacific region (**Figure 2.11**). It can be an important species in a healthy coral ecosystem because it eats faster growing corals, allowing slower growing corals to develop. Cyclic outbreaks of crown-of-thorns starfish, however, pose a significant threat to many reefs, including the Great Barrier Reef. These outbreaks occur approximately every 17 years (Great Barrier Reef Marine Park Authority, 2017). One study found that crown-of-thorns predation was responsible for a decline in coral cover of almost 25% over the last 30 years on the Great Barrier Reef (De’ath et al., 2012). Crown-of-thorns starfish are not a current threat in the CNMI; yet, the species should continue to be monitored.



Figure 2.11:
Invasive species of interest for the Saipan Lagoon. (Left) Striped catfish (Photo by Matt Dowse). (Right) Crown-of-thorns (Photo by Charlie Shuetrim)

2.3 Water Quality Assessment

The 2016 CNMI 303(d), 305(b) and 314 Water Quality Assessment Integrated Report states that the majority of Saipan Lagoon is designated as Class AA waters per the 2014 CNMI Water Quality Standards, meaning the waters should remain in their natural pristine state with an absolute minimum of pollution or alteration of water quality (Arriola, et al., 2016). Designated uses for the lagoon's coastal waters include: propagation of aquatic life, fish consumption, recreation including whole body contact, and aesthetic enjoyment. Class A waters, which are protected for aquatic life, recreation (limited body contact), and aesthetic enjoyment, are limited to the Port "Industrial" area. This area contains the seaport, marinas, Lower Base wastewater treatment outfall, as well as the Agingan Point municipal wastewater treatment plant outfall on the southern tip of Saipan. The Integrated Report lists coastal and freshwater surface waters that are not meeting water quality thresholds for designated uses based on BECQ's water quality monitoring program. Additional data used by BECQ for the assessment include measures of coral reef and seagrass communities; studies on heavy metals in bivalves, fish, and sediment by the University of Guam's Water and Environment Research Institute (UOG-WERI), and a 2008 stream survey conducted by CNMI DFW.

For the 2016 round of water quality assessment for the lagoon, the 2016 Integrated Report indicates the following:

- All of the assessment units within Saipan Lagoon, with the exception of Mañagaha (Segment 23), are impaired for one or more parameters, including dissolved oxygen, pH, bacteria, phosphorous, or mercury (see **Table 2.1** and **Appendix A Map 3**).
- All segments failed to meet the "Recreation" designated use because of bacterial contamination (*Enterococci*), likely sourced from human and animal waste, including from feed lots, overflows and leaks from wastewater collection systems, and runoff from densely populated areas.
- The "Aesthetic Enjoyment" designated use was met for all lagoon water body segments; this designation and use assessment was based on professional opinion of the staff and MVA Tourist Exit Survey results.
- Most segments within the lagoon failed to attain the "Propagation of Aquatic Life" use due to exceedances of the dissolved oxygen criteria, pH, or previous exceedances of the nutrient phosphate. No new nutrient sampling was conducted for the lagoon sites.
- Researchers from UOG-WERI documented elevated levels of mercury in fish that exceeded EPA limits for unrestricted fish consumption from Hafa Adai Beach and Micro Beach areas (Segment 19B, Central W. Takpochao). The primary source of mercury enrichment was found to be an old medical waste incinerator upstream of these beaches. This research flags the Central W. Takpochao water body segment as not attaining the designated use for "Fish Consumption."
- Of the six biological monitoring stations for coral, most are rated as "good." In 2010, the West Takpochao station #9 rated "poor," but has improved to "fair" more recently. For sea grasses, West Takpochao station #19c appears to be the only station showing a decline in

quality (See **Tables 2.2** and **2.3** and **Appendix A, Map 4**). The upcoming monitoring/state of the reef report will have better information on the status of the corals and seagrasses in the lagoon.

- Water quality assessment results for freshwater systems were predominantly inconclusive due to insufficient data. The visual sanitary surveys and stream assessment by DFW found that streams in the Central W. Takpochao watershed (Segment 19B) were impaired for introduced species and mercury in biota. Lake Susupe (located within Segment 18A and 18B) is impaired for introduced species, dissolved oxygen, and bacteria.
- Waters that are impaired due to a specific pollutant(s) are required to develop a Total Maximum Daily Load (TMDL) to determine how much of that pollutant needs to be removed (and how much is allowable) in order to maintain the waterbodies designated use. Waters needing a TMDL are assigned a CALM category 5 in **Table 2.1**. Waters assigned a CALM category 4c are impaired, but not for a specific pollutant, therefore do not require a TMDL. Some streams, lakes, and wetlands do not have data to evaluate conditions.

To illustrate poor water quality conditions in the West Takpochao coastal assessment units, Maitos (2015) provides **Figure 2.9**, showing the percentage of “red flags” from BECQ water quality stations in the Garapan area between 2006 and 2015. Red flags indicate measured levels of bacteria that exceed microbiological water quality standards.

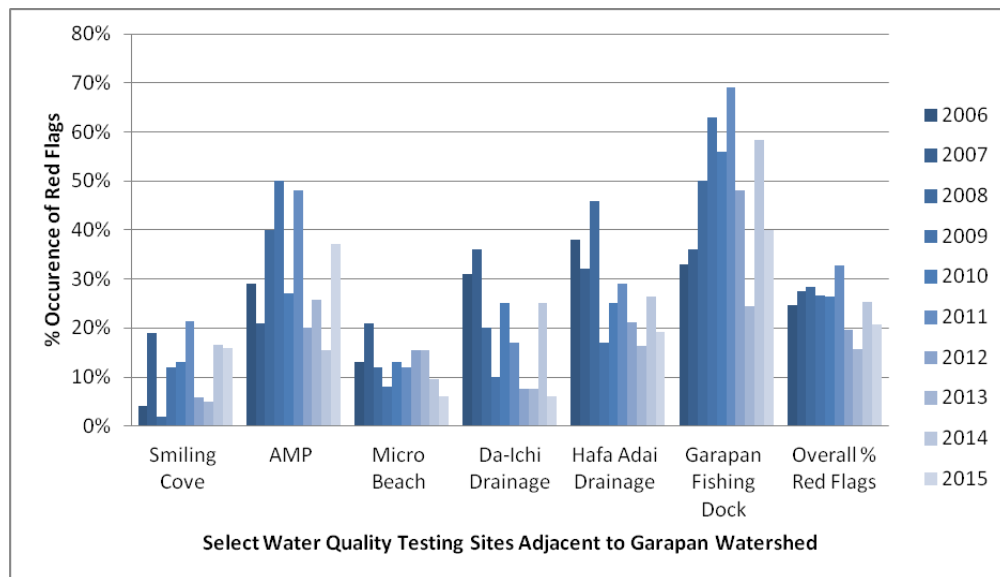


Figure 2.9: Percent of samples each year with microbiological violations at sites adjacent to Garapan (Maitos, 2015). Data and graph provided by the BECQ Water Quality Surveillance Laboratory

Arriola et. al, (2016) recommends that a Fish Monitoring and Advisory Program for the CNMI be established that would be tasked with providing timely public fish consumption advisories. The authors highlight the benefit of having a robust water quality monitoring program to effectively assess CNMI waters, and identify the continued need to retain dedicated and skilled staff to develop and/or implement other water quality surveillance programs.

Table 2.1: Water Quality Impairments for Saipan Lagoon (adapted from Arriola et al. 2016).

Unit	ID	Segment (mi/ac)	CALM	Priority	Impairment	Possible Source of Impairment/Comment
Susupe	18A (North)	1.5	5	M	DO%, Phosphate, <i>Enterococci</i>	None provided
	18B (South)	3.1	5	M	DO%, Phosphate, <i>Enterococci</i>	Overflows and leaks from sewage collection system, especially San Antonio Lift Station (upgrade in progress)
	18WET	454.8*	4c	--	None listed	Alteration in wetland habitat, non-native aq. plants, flow regime alterations, Dredging/filling/loss of wetlands
	18LAKE	45.2	5	L	DO%, pH,, <i>Enterococci</i>	Introduction of non-native species, limited biota data indicating heavy metal, water parameters effected by rainfall
	18STR	2.1	--	--	--	Not flowing/assessable
West Takpochao	19A (North)	4.1	5	H	pH, DO%, Phosphate, <i>Enterococci</i>	Runoff from industry and marinas, boat repair activities, closed Puerto Rico dump, failing wastewater collection systems
	19B (Central)	3.0	5	H	DO%, Phosphate, Mercury, <i>Enterococci</i>	Hospital incinerator site (now closed), “many” bacteria sources; fish consumption issue
	19C (South)	1.2	5	M	DO%, pH, Phosphate, <i>Enterococci</i>	Urban runoff and failing wastewater collection systems
	19STR	7.1	5*	M	Non-native species, mercury, <i>Enterococci</i>	Habitat alterations, Sanitary sewer overflows, Piggeries, heavy metals in drainages, urban runoff, concrete conveyance for channels; limited monitoring data
	19WET	61.4	4c	--	None listed	Water hyacinth and hydraulic alternations in AMP wetland; Alteration in wetland habitat, non-native aq. plants, flow regime alterations, wetlands loss
Achugoa	20A (North)	1.7	5	M	<i>Enterococci</i> , Phosphate	Overflowing manhole cover in drainage, insufficient pump at SR1 lift station (repaired)
	20B (South)	1.2	5	H	DO%, Phosphate, <i>Enterococci</i>	Boat repair and painting activities, sewer overflows, on-site wastewater treatment systems, urban runoff, roaming livestock in uplands
	20STR	6.3	2	--	--	Segment with recent community effort to clean up wastewater, animal waste (feral pigs), and outdoor kitchens, as well as repaired sewer lines. Not enough data to determine if impaired.
	20WET	61.1	4c	--	None listed	None provided
As Matus	21		5	L	DO%, <i>Enterococci</i>	Overflows of public wastewater collection system, grazing cattle
	21STR	0.5	2	--	--	No monitoring data, visual field assessments
Mañagaha	23	0.6	3*	L	Phosphate	Previously had <i>Enterococci</i> exceedances. Island has public restrooms with showers, septic system and leaching field. Leach field upgraded in 2014.. No new nutrient data. Listed as “fair” for habitat.

* Discrepancies exist in tables presented in Appendix of Integrated Report.

Table 2.2: Nearshore coral reef biological criteria data (adapted from Table IX-4.1, Arriola et al. 2016).

Site No.	Seg ID	Segment Name	Benthic Substrate Ratio Trends	Coral Diversity Trends	Aquatic Life Use Support (ALUS) Rank				
					2008	2010	2012	2014	2016
8	18a	Susupe (North)	No data available this reporting period	No data available this reporting period	No ranking in previous reports	Good	Good	Good	Not sampled during this reporting period
9	19b	West Takpochao	No significant change during this reporting period	Significant increase during this reporting period	No ranking in previous reports	Poor (due to known water quality causes)	Fair	Not sampled during this reporting period	Fair
11	19b	West Takpochao	No significant change during this reporting period	No significant change during this reporting period	No ranking in previous reports	No ranking in previous reports	No ranking in previous reports	Good	Good
15	21	As Matuis	No data available this reporting period	No data available this reporting period		Good	Good	Good	Not sampled during this reporting period
12	23	Managaha	Significant decrease during this reporting period	No significant change during this reporting period	Good	Good	Good	Good	Good
13	23	Managaha	No data available this reporting period	No data available this reporting period	No ranking in previous reports	Good	Good	Not sampled during this reporting period	Not sampled during this reporting period

Table 2.3: Nearshore seagrass biological criteria data (adapted from Table IX-4.4, Arriola et al. 2016).

Site No.	Seg ID	Segment Name	Description of Benthic Categories	Aquatic Life Use Support (ALUS) Rank				
				2008	2010	2012	2014	2016
53	18a	Susupe (North)	Seagrass abundance significantly greater than algae	No ranking in previous report	Fair	Fair	Fair	Good
55	18b	Susupe (South)	Seagrass abundance significantly greater than algae	No ranking in previous report	No ranking in previous report	No ranking in previous report	Fair	Good
56	18b	Susupe (South)	Seagrass abundance significantly less than algae	Good	Not sampled during this reporting period	Not sampled during this reporting period	Fair	Fair
57	18b	Susupe (South)	No data available this reporting period	Good	Not sampled during this reporting period	Good	Fair	Not sampled during this reporting period
N/A	19a	West Takpochau (North)	No data available this reporting period, site discontinued	Poor (due to known water quality causes)	Not sampled during this reporting period	Not sampled during this reporting period	Not sampled during this reporting period	Not sampled during this reporting period
42	19b	West Takpochau (Central)	Natural seasonal changes apparent, standing crop of algae and seagrass statistically similar	Not sampled during this reporting period	Not sampled during this reporting period	Not sampled during this reporting period	Fair	Fair
43	19b	West Takpochau (Central)	Natural seasonal changes apparent, standing crop of algae and seagrass statistically similar	Not sampled during this reporting period	Not sampled during this reporting period	Not sampled during this reporting period	Fair	Fair
46	19c	West Takpochau (South)	Seagrass abundance significantly greater than algae	Poor (due to known water quality causes)	Poor (due to known water quality causes)	Poor (due to known water quality causes)	Not sampled during this reporting period	Fair

Site No.	Seg ID	Segment Name	Description of Benthic Categories	Aquatic Life Use Support (ALUS) Rank				
				2008	2010	2012	2014	2016
49	19c	West Takpochau (South)	No data available this reporting period	Good	Good	Not sampled during this reporting period	Poor (due to known water quality causes)	Not sampled during this reporting period
36	20a	Achugao (North)	No data available this reporting period	Poor (due to known water quality causes)	Fair	Good	Good	Not sampled during this reporting period
37	20a	Achugao (North)	Natural seasonal changes apparent, standing crop of algae and seagrass statistically similar	No ranking in previous reports	No ranking in previous reports	No ranking in previous reports	Fair	Fair
38	20a	Achugao (North)	No data available this reporting period	Poor (due to known water quality causes)	Not sampled during this reporting period	Poor (due to known water quality causes)	Fair	Not sampled during this reporting period
39	20a	Achugao (North)	No data available this reporting period	No ranking in previous reports	No ranking in previous reports	No ranking in previous reports	Fair	Not sampled during this reporting period
41	20b	Achugao (South)	Natural seasonal changes apparent, standing crop of algae and seagrass statistically similar	Poor (due to known water quality causes)	Poor (due to known water quality causes)	Poor (due to known water quality causes)	Not sampled during this reporting period	Poor (due to known water quality causes)
34	21	As Matuis	Seagrass abundance significantly greater than algae	Good	Not sampled during this reporting period	Good	Poor (due to known water quality causes)	Poor (due to known water quality causes)

3.0 Coastal Dynamics

Saipan Lagoon is located on the leeward side of the island, characterized predominantly by trade winds from the northeast through the southeast nearly 80% of the year. The north-south island alignment in relation to wind and wave patterns has contributed to the development of the wide, shallow lagoon and barrier reef. In general, the beaches bordering the lagoon receive low wave energy, are narrow, and are composed of fine- to medium-grained calcareous sand. Infrequent typhoons and tropical cyclones have the most dramatic influence on coastal change for the lagoon (USACE, 2004).

3.1 Bathymetry

NOAA Coast Survey has nautical charts for CNMI, and a detailed chart covering the Garapan and Tanapag Lagoon Area (<https://www.nauticalcharts.noaa.gov/mcd/Raster/index.htm>). The best bathymetric data for the Lagoon is derived from multi-beam surveys, but this is limited to the port area, turning basin and shipping channel. NOAA PIRBMC has 5m resolution bathymetry for the Lagoon, and there is also a PacIOOS dataset, which is derived from a combination of LiDAR, Multi-Beam, and Ikonos imagery. NOAA is in the process of preparing depth maps as part of the recent habitat mapping project (Figure 3.1). In general, the lagoon depth ranges between 3-13 ft, and 40-50 ft in the shipping channel (Damlamian & Krüger 2010).

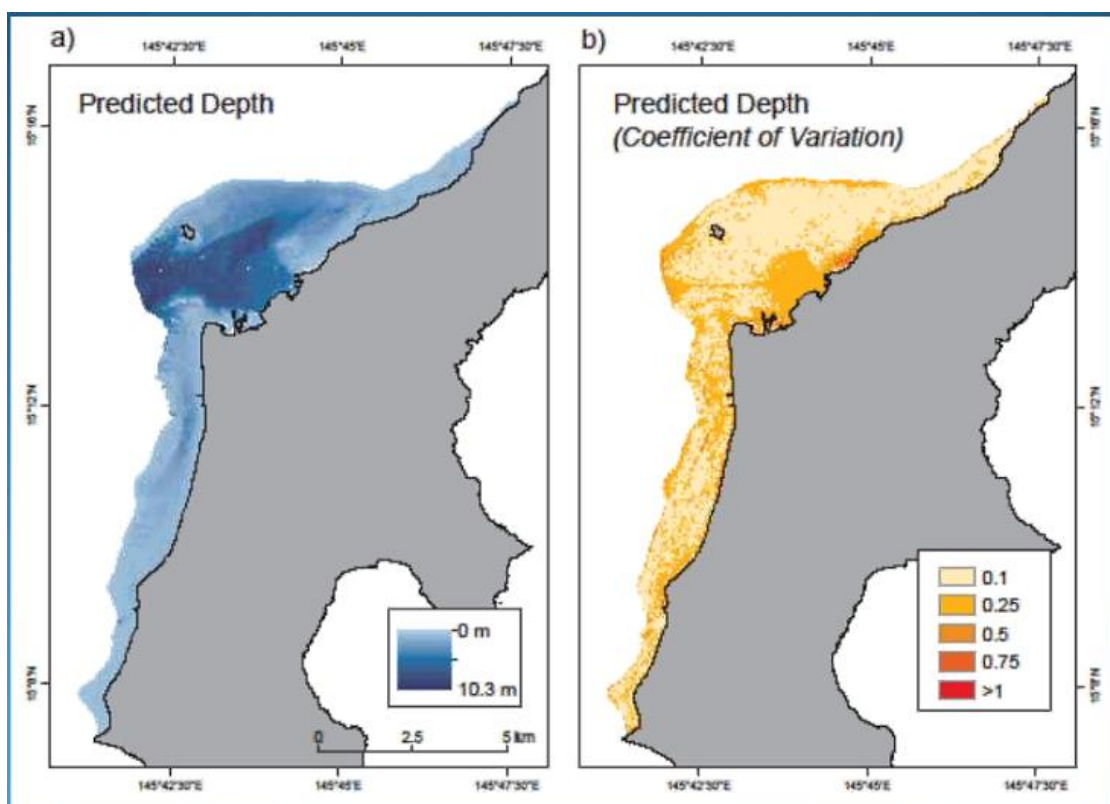


Figure 3.1: Mapping of Lagoon Depth (excerpt from NOAA presentation Habitat Mapping Project)

3.2 Hydrodynamics

A hydrodynamic model was completed in 2010 to describe circulation patterns in the lagoon and to predict pollutant dispersal and sediment transport (Damlamian and Krüger, 2010). The model focused on three areas (Tanapag in the north, Garapan in the central section, and Chalan Kanoa in the south) under two seasonal scenarios:

- Scenario 1 – high wave height with a northeast wave and wind regime representative of conditions from October to March.
- Scenario 2 – low wave height with a westerly wave and wind direction representative of conditions from April to September.

Lagoon Circulation

The hydrodynamic model results reveal complex patterns of wave and wind-driven currents in the lagoon that are influenced by seasonal changes, tides, and other factors. Overall, the dominant flow direction in the lagoon is from north to south during October to March, while flow is more complex and generally slower during April to September (**Table 3.1**). **Figure 3.2** shows composite images of the dominant near bed currents for the entire lagoon for each model scenario.

Table 3.1: Description of dominant near bed current pattern in Saipan Lagoon (adapted from Damlamian and Krüger, 2010).

Section	October to March (Scenario 1)	April to September (Scenario 2)
Tanapag lagoon	Strong waves refract around the north of Saipan and break on the barrier reef, causing water to flow across the reef into the lagoon. Currents generally enter at the north of the lagoon and flow <i>south</i> , either out through the shipping channel or past Point Muchot into the Garapan lagoon. Influx of water through the shipping channel only occurs at spring low tides under Scenario 1, and there is an eddy present in front of the port.	Weaker wave and wind patterns reduce the amount of water flowing over the reef, and more flows in through the shipping channel. A counter-clockwise eddy forms whereby the current from shipping channel travels north along the coast and the water moving over the northwest reef crest moves south along the outer lagoon. During peak high tide, southward currents dominate in the Tanapag lagoon
Garapan lagoon	Receives southward moving currents from the Tanapag section and generally has a south-directed current field.	Dominant flux is inward and southward, despite reduced influence of waves. Wind stress presumably plays an important role due to shallowness, including outward flushing of the surface layer through the Garapan Dock and Sugar Dock channels. There is a south-directed current field during high tides.
Chalan Kanoa lagoon	Subject to wave induced currents, as well as water flowing in through the Sugar Dock channel. Most of the water passing through Garapan lagoon enters the Chalan Kanoa lagoon via the dominant southward current. Water is then flushed out across the reef near Agingan Point as it hits that southwest barrier.	The patterns are quite different because the lower influx of water from Garapan lagoon cannot overcome water coming in the lagoon from the Sugar Dock channel. As such, exchange between Garapan and Chalan Kanoa is insignificant during this time. In addition, a northward current is created by refraction of waves around Agingan Pt.

Oct- Mar (Scenario 1)

Apr- Sept (Scenario 2)

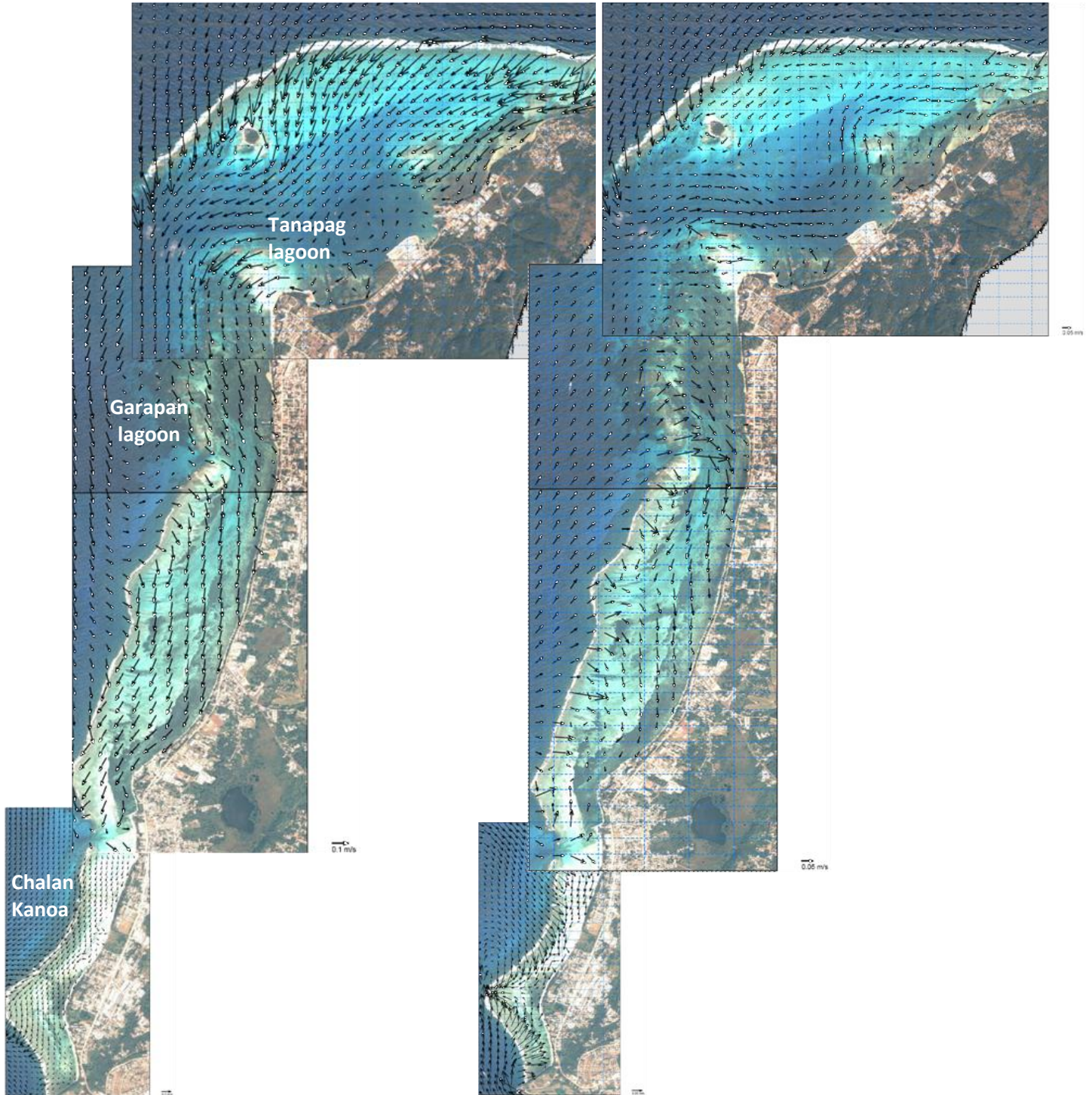


Figure 3.2: Snapshot of dominant near bed current pattern in Saipan Lagoon (from Damlamian & Kruger, 2010). Note that the scale for magnitude of current vectors is not the same for all images.

Pollutant Dispersal

The 2010 hydrodynamic model was used to show how pollutants discharging from the Sadog Tasi WWTP outfall are likely to disperse during the two scenarios. Model results showed how the plume coming out of the outfall diffused through the lagoon over time, and how the most common constituents (nitrate, total nitrogen, orthophosphate, total phosphorous, unionized ammonia, copper, nickel, zinc, and TRC) behave with respect to their specific maximum daily concentration allowed by the discharge permit.

Overall results indicate that the Saipan Lagoon has good flushing from October to March (Scenario 1) when compared to the lower energy time of April to September (Scenario 2). This model indicates that the residence time of water in the lagoon is longer in April to September and impacts from outfall pollutants will be greater at that time. Also, the model predicted pollutant concentrations in the Mañagaha Marine Conservation Area to be below limits set by CNMI water quality standards. From October to March, the discharge plume is partially driven south into the Garapan lagoon area (**Figure 3.3**). At much diluted pollutant concentrations, there is reportedly not a significant impact to the Mañagaha Marine Conservation Area. During the April to September, the model showed the plume extending in the Mañagaha Marine Conservation Area at concentrations of 0.35% (**Figure 3.4**).

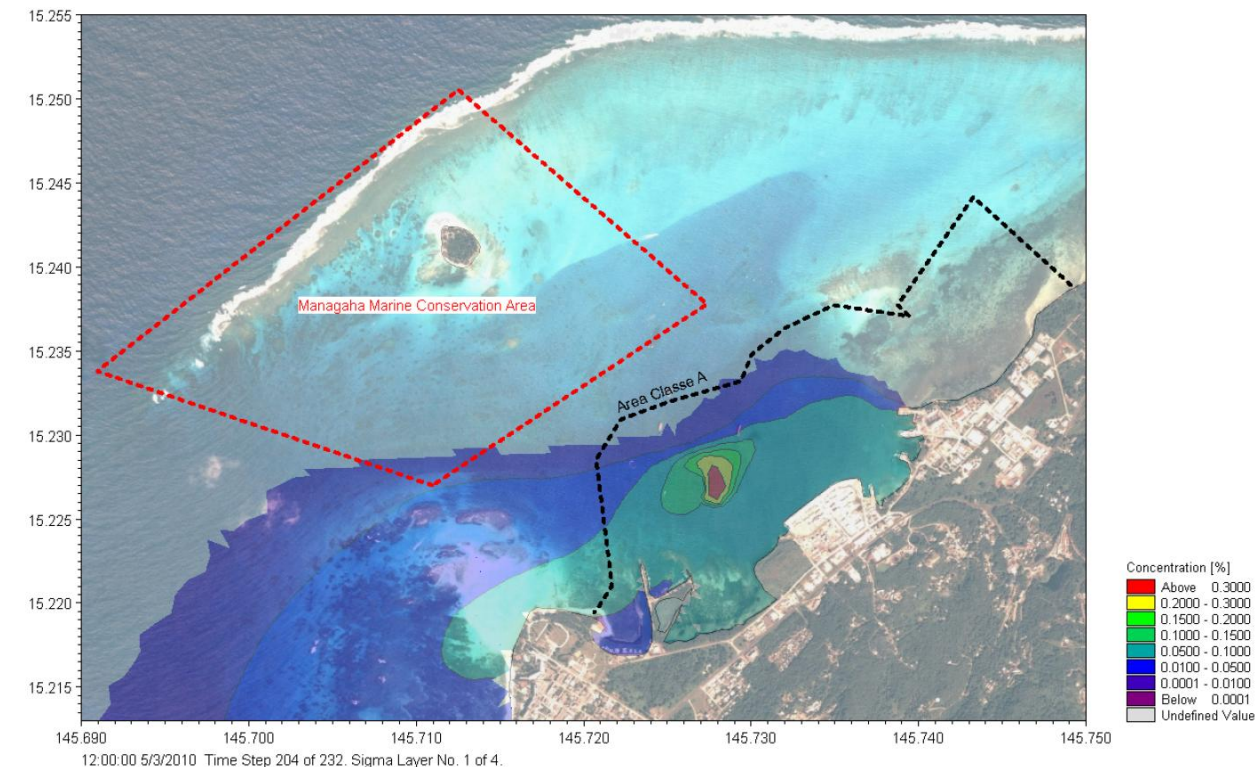


Figure 3.3: Snapshot of plume in Tanapag lagoon during Scenario 1 (October to March), using an initial source concentration of 100% (Damlamian & Kruger, 2010).

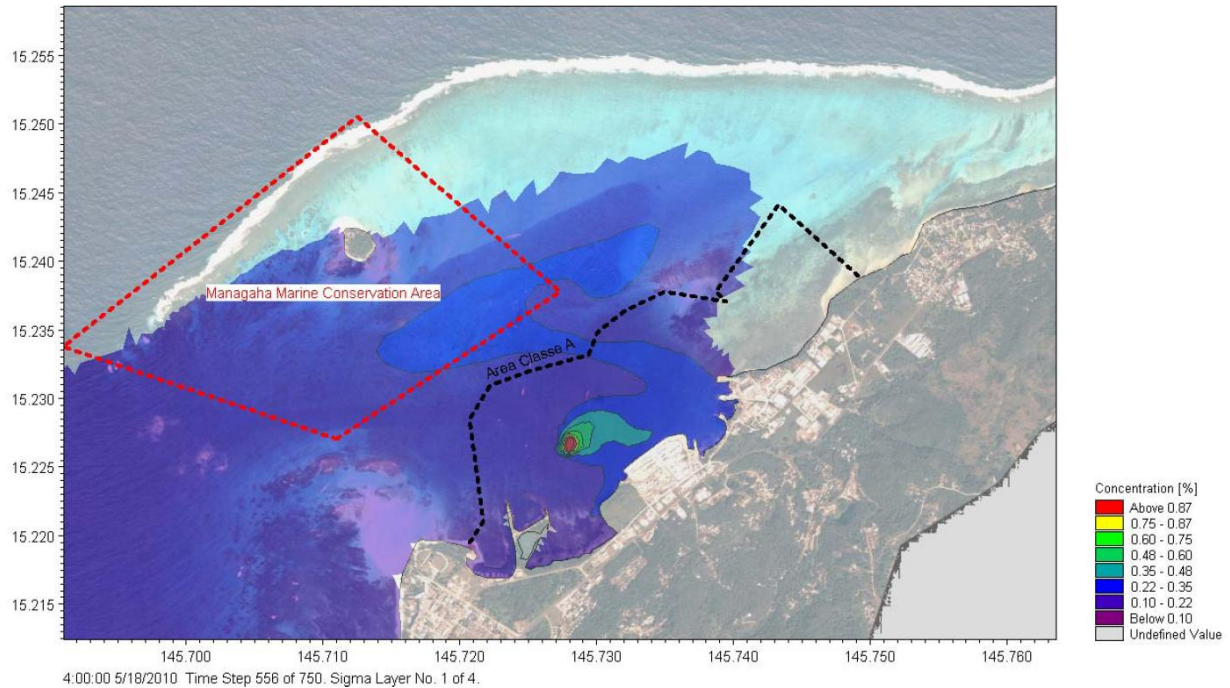


Figure 3.4: Snapshot of plume in Tanapag Lagoon during Scenario 2 (April to September), using an initial source concentration of 100% (Damlamian & Kruger, 2010).

3.3 Shoreline Erosion

Beach morphology shifts naturally in response to seasonal changes, storms events, and fluctuations in sand supply. Engineered shoreline modifications and dredging can also impact sediment transport mechanisms and accelerate shoreline erosion. For a broad understanding of shoreline conditions, the "[Saipan's Misbehaving Beaches](#)" interactive web mapping application shows general beach morphology conditions along the west side of Saipan. This information was compiled by NOAA Coral Reef Initiative interns in June/July 2014 and includes a map and photos and narrative descriptions at specific locations (**Figure 3.5**). Several coastal change "hot spots" have been identified by BECQ that may impact beach access, public safety and enjoyment of the lagoon's beaches and coastline, including Mañagaha Island, American Memorial Park, North San Jose to Susupe Point, and Sugar Dock. A summary of what is known about erosion and shoreline change at each of these locations is discussed below.

Mañagaha Island

Mañagaha Island is a small, sandy cay in the lagoon that is one of the largest tourist destinations in the area. Fletcher et al. (2007) claim that erosion has been a chronic problem on the island since 1996, when WWII debris (ship wrecks and a pier) were removed. The debris appears to have modified wave and current patterns around the island and contributed to its previous stability. Since the debris removal, sand has been eroding from the eastern shore and accreting on the north/northwest shore (**Figure 3.6**). Pre-1996 shoreline change data indicates that structure removal may not be the only driver of shoreline change (per com. E. Derrington).

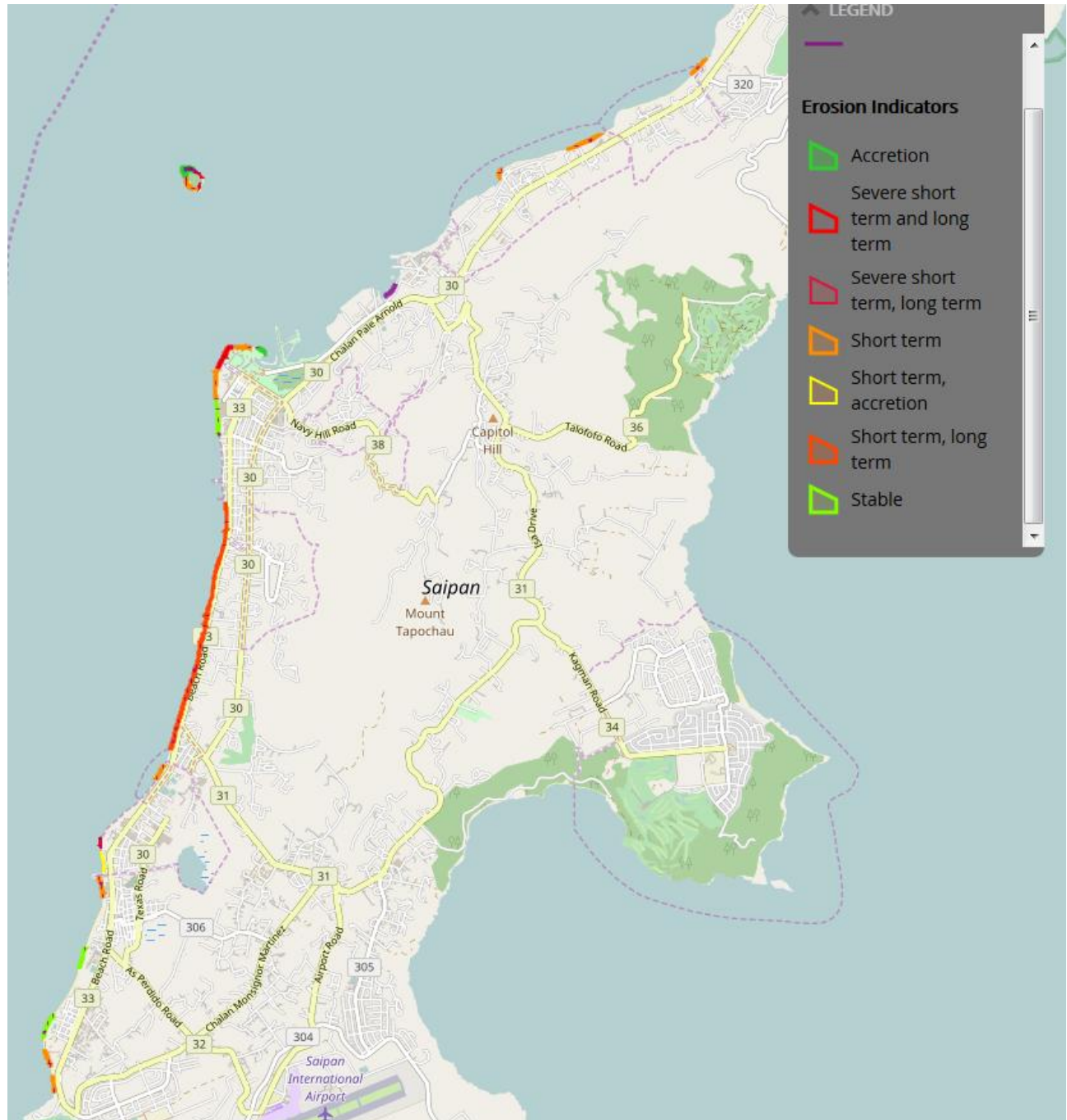


Figure 3.5: Screen capture from [Saipan's Misbehaving Beaches](#) online mapping tool.

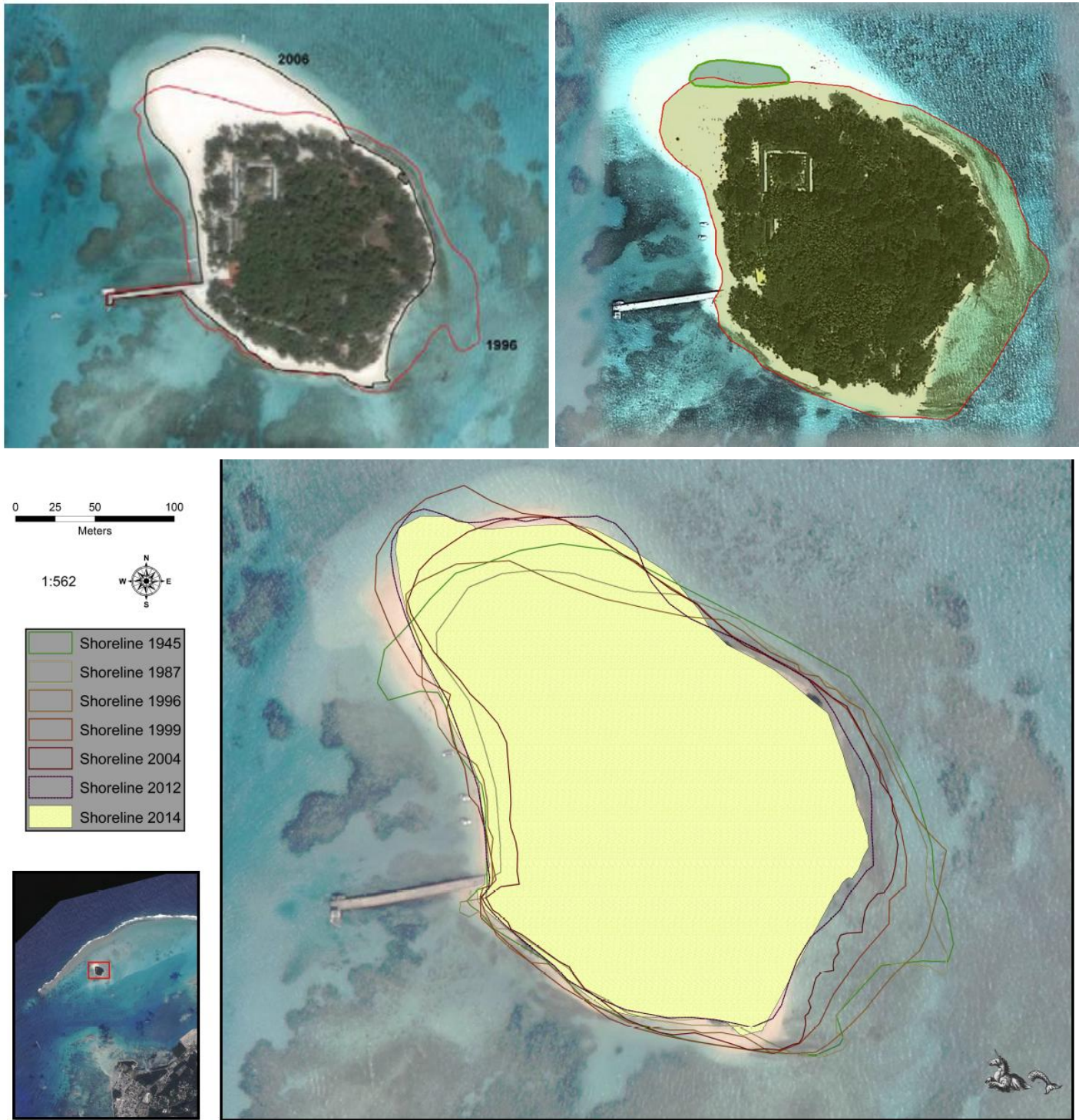


Figure 3.6: (Top left) Shoreline change on Mañagaha Island from 1996 to 2006 (Fletcher et al. 2007); (Top right) 1996 to 2014 DCRM map showing trend of erosion on the east side of the island, and accretion to the west, and planting target area to stabilize accretion. Considering this general shift in the island's position, it is imperative that zones of accreted beach/land be stabilized, especially along the northwest side of the island; (Bottom) 1945-2014 (BECQ, 2017).

Regardless, the erosion in the east has led to collapse of trees and has uncovered buried metal and concrete debris, both of which are unsightly and unsafe for visitors. In addition, the erosion threatens bird nesting habitat, particularly for the Wedge-tailed shearwater (Fletcher et al., 2007), which has implications for DLNR/DFW’s management of the island and visitor use.

A more updated shoreline change map from BECQ shows trends between 1945-2014 (**Figure 3.6**), which show that the sediment transport process around Mañagaha has been moving sand prior to 1996 with general accretion on the west and erosion on the east side. Planting zones for stabilization of the accreted areas on the west are shown in **Figure 3.6**.

Fletcher et al. (2007) stated that local choppy seas created by easterly trade winds across Tanapag lagoon, along with tides, are the primary energy source causing the movement of sand from the east to the west side of the island. This is somewhat inconsistent with the vector maps from 2010 Saipan Lagoon hydrodynamic model, showing sediment transport is dominantly from the north-northeast to the south-southwest, bending around the island from October to March, then switching to a more east to west flow from April to September (**Figure 3.7**). In reality (at least between 1996 and 2006), the beach is eroding on the east side of the island and the spit to the north is accreting. Sand has also built up on the south side of the solid pier and a corresponding deficit of sand on the north side of the pier (see **Figure 3.6**).

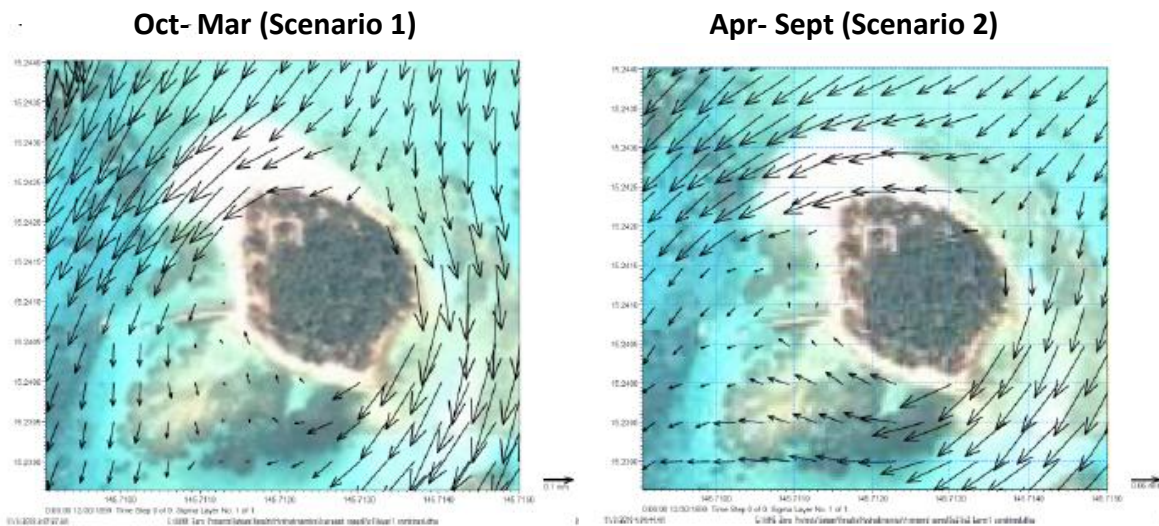


Figure 3.7: Residual current vector maps for Mañagaha Island, which can be used to estimate sediment transport direction and relative strength (Damlamian & Krüger 2010).

Fletcher et al.’s 2007 study of Mañagaha Island erosion included a number of options to address the problem based on findings after a proposed two-year monitoring period:

1. If the eastern erosion slows or stops over those two years, then the island is likely trying to reach a new equilibrium after debris removal. In that case, leave the shoreline alone and construct an elevated pedestrian walkway to protect nesting habitat.

2. If the erosion rate was constant or increased, do one or more of the following:
 - a. bring in a structural engineering firm to analyze the situation in more detail;
 - b. install a temporary groin system oriented in the approximate location of the former debris; and/or
 - c. install a sand bypass system to pump sand from the accreting northwest side of the island to the eroded section.

According DCMR, none of the recommendations outlined in Fletcher et al. 2007 have been implemented on Mañagaha. BECQ Enforcement map from 2015 shows areas where mitigation plantings may help stabilize the spit in response to the general landform migration from East to West. Vegetation has been allowed to grow on the open, sandy “spit” to the northwest, and small dunes are “reportedly” forming (per com., R. Greene, BECQ).

American Memorial Park

The Garapan shoreline area (i.e., American Memorial Park, Micro Beach and beachfronts of the Fiesta and Hyatt Resorts) experienced significant coastal change in recent years and was the subject of a 2004 study by USACE and by Greene (2013) using the USGS Digital Shoreline Analysis System to quantify shoreline change.

The results of the 2013 study confirmed beach erosion along the west shore of American Memorial Park and accretion to the northeast of the park (Figure 3.8). The area of “fast” erosion at American Memorial Park considered to be “at risk” has resulted in minor losses to infrastructure and recreation and further impacts are expected. In addition, there is a “fast” accreting area to the northwest extending into the marina (Greene, 2013 and USACE, 2004), which could also be problematic in terms of access to the marina for commerce and recreation.

Greene (2013) noted the importance of continued study of coastal processes to get a better understanding of how to adapt. The hydrodynamic model by Damlamian and Krüger (2010) shows residual current vector maps and sediment transport constraints at several locations (Figure 3.9). The model results show sediment transport is generally from the east to west along the north-facing side of the point, bending around the point and then moving from north to south along the west facing side of the point. This pattern does not appear to change seasonally, but is stronger from October to March. The current vectors slow appreciably in the embayment, which may be responsible for the build-up of sand. Stronger currents bending around the point could be responsible for erosion at American Memorial Park, and then diminished current vectors could explain the area of accretion south of American Memorial Park.

The 2004 USACE study indicated that sand movement was likely occurring from the eroding section of the point towards the east, where it is accreting in the marina. This west to east sediment transport pattern is not supported in the hydrodynamic model results. Further information is needed on any natural or human-induced changes to sand supply in this area in order to more fully understand why the shoreline has been experiencing ongoing change.

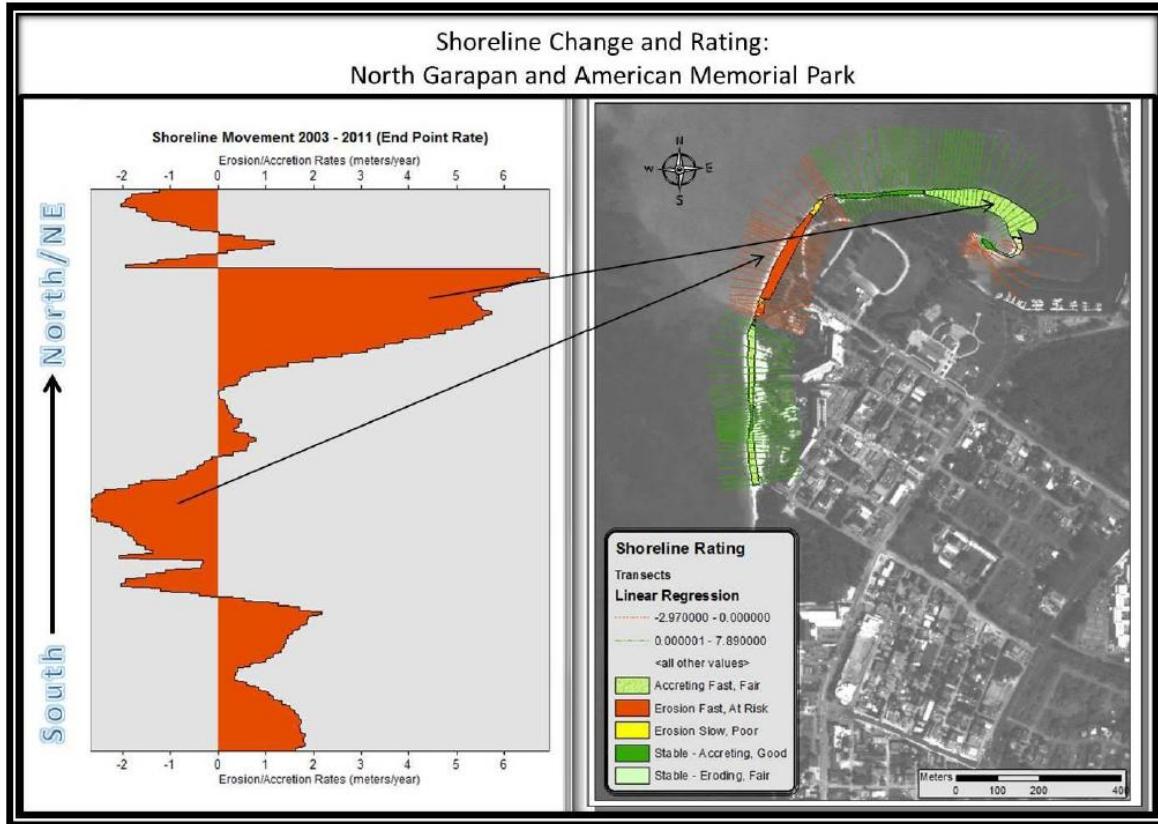


Figure 3.8: Results of shoreline change analysis for American Memorial Park from 2003-2011 (from Greene 2013).

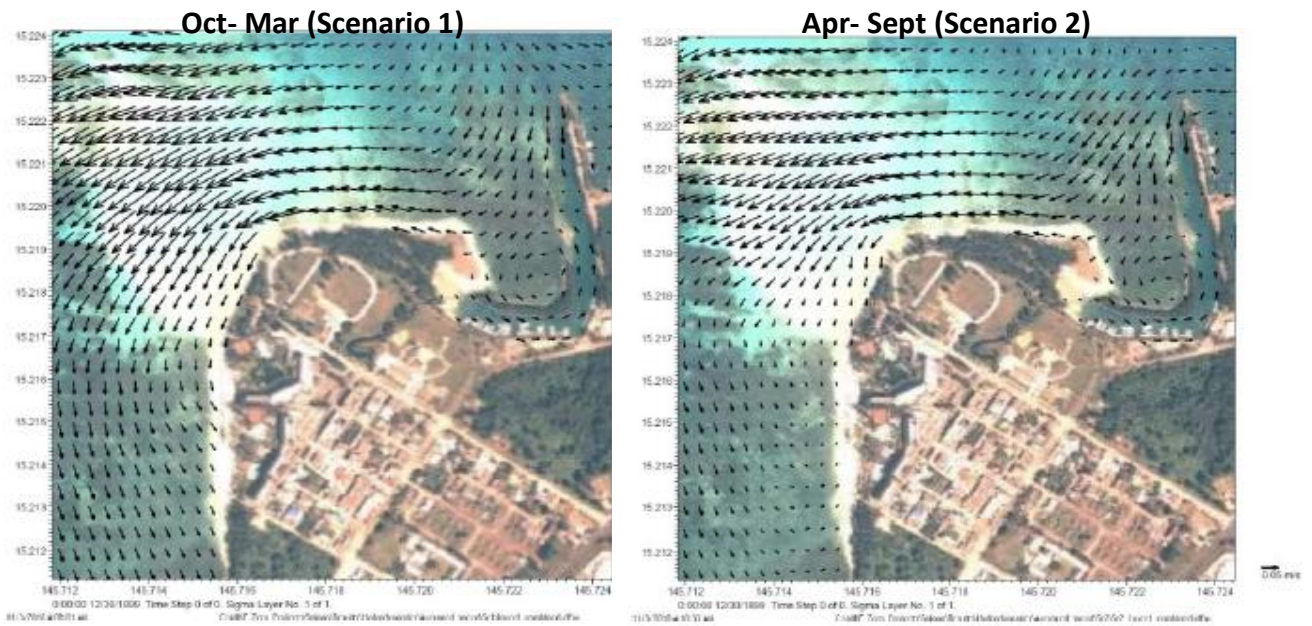


Figure 3.9: Residual current vector map for American Memorial Park that can be used to estimate sediment transport direction and relative strength (Damlamian and Krüger 2010).

Using this information, along with the DSAS analysis and the current vector maps, management options for American Memorial Park may be evaluated. The USACE recommended against hard armoring here because of potential impacts to adjacent segments of the coast and inevitable beach loss in front of any armoring. A “no action” option was presented as viable because only a few structures were threatened. If erosion control was deemed necessary, the USACE recommended a sand backpassing system to move sand from the rapidly accreting area in the marina to the eroding area; this type of solution would require additional sand transport study (USACE, 2004).

North San Jose to Susupe Point

During the 2004 USACE analysis of shoreline change from North San Jose to Susupe Point, they noted several structures and beaches that were impacted by erosion:

- Near North San Jose, the concrete pathway built over the sand is at an elevation of about 8 feet and evidence of erosion in the area suggested wave run up to an elevation of 10 to 11 feet, indicating that the walkway is vulnerable to storm wave damage.
- Further south, the same pathway approaches the water and a gabion wall and series of convex, concrete retaining walls were constructed on the seaward side of the path to protect trees and the pathway itself. There is evidence of erosion scarps well inland of these protection structures, indicating these structures are subject to storm waves. The beach in front of the structures was stable according to the 2004 study and no infrastructure was threatened, therefore no action was recommended. Beach nourishment was also feasible, but would require continued maintenance.
- In the Susupe Point region, evidence of erosion was noted, including large debris (i.e., boulders, concrete) on the beach that was likely from previous shoreline stabilization projects, and exposed roots of trees. Temporary sandbags were recommended if necessary. No structures were threatened, therefore no action was recommended; beach nourishment was also feasible, but would require continued maintenance.

A subsequent study by the USACE in 2014 assessed shoreline change along Beach Road from the “13 Fishermen” memorial to Chalan Monsignor Guerrero Road (the Route 31-33 intersection) (USACE 2014). Beach profile data from 2002 and 2014, as well as aerial photo analysis from 2006, 2012, and 2014, found that this stretch of shoreline has been relatively stable (to slightly erosive) over the time period analyzed. However, the stable shoreline does not preclude the possibility of road damages due to wave runup, shoreline erosion, and overtopping because the road within the study area is generally within 60 to 100 feet of the shoreline. This damage is most likely to occur during tropical cyclones; data analyzed during the study found that Saipan has a great likelihood of being impacted by at least one typhoon every year (a typhoon has sustained wind speeds equal or greater to 64 knots (74 mph)) (USACE 2014).

Given the high probability of storm damage, the USACE recommended that a second phase of their study be conducted for the section of Beach road from the “13 Fishermen” memorial to

the Route 31-33 interchange, including: identifying suitable shore protection alternatives, preparation of conceptual plans, and estimating associated costs. The plans will be developed to protect Beach Road from undermining due to wave and current impacts. In addition, drainage and runoff issues associated with destabilization of the road shoulder will also be investigated. Protection of the existing pedestrian walkway will be incorporated into the plans where appropriate (USACE 2014). According to DCRM, this second phase of the Beach Road study is underway and results available in the spring of 2017 (per com. Erin Derrington, DCRM).

Sugar Dock

Shoreline change in the Sugar Dock area in recent years has been noted and documented by BECQ. Shoreline analysis has shown that the overall shoreline accreted to the north and south of Sugar Dock between 1976 and 2016 (Greene, 2016). The most notable coastal change has been the build-up of sand on the north side of Sugar Dock. In 2003, this dock was converted from a structure that allowed flow to pass underneath it, to a solid concrete dock. The dock was essentially converted to a groin. After 2003, progradation of the shoreline on the north side of the dock is evident. Some erosion was documented further north of the dock, though this may be related to short-term loss due to the active 2015 El Niño typhoon season (**Figure 3.10**).

The dominant sediment transport direction has been assumed to be from north to south in this part of the Saipan Lagoon, which would explain the build-up of sand against the north side of the solid Sugar Dock since 2003 (Greene, 2016). Residual current vectors from the 2010 hydrodynamic model also show a general north to south trend in sand transport as well from October to March with some additional input from the west through the break in the forereef (**Figure 3.11**). From April to September, however, the sediment transport exhibits a stronger influx through the reef break, followed by transport north and south away from that influx (Damlamian and Krüger, 2010).

Despite a northward sediment transport direction in the reef flat area, the nearshore current vectors are diminished north of Sugar Dock, which may explain why sediment has not been substantially lost from that area during the April to September timeframe. The influx of sediment through the forereef break may explain why the beach is accreting to the south of Sugar Dock. In past years, sand has been borrowed from this area and deposited at eroding areas near American Memorial Park. In addition, sand had been removed from the area recently due to construction of condominiums and the displaced sand was deposited on adjacent beaches (per com. DCRM).

Many of these coastal change issues may be addressed in upcoming an USACE study of Saipan's west shoreline, set to be available in the spring of 2017. The study is supposed to include historical shoreline change for "problem areas" and conceptual plans for "soft" and "hybrid green/gray" erosion control measures. Meanwhile, improvement plans for Beach Road, Route 33, are pending, but do not currently incorporate shoreline change considerations.

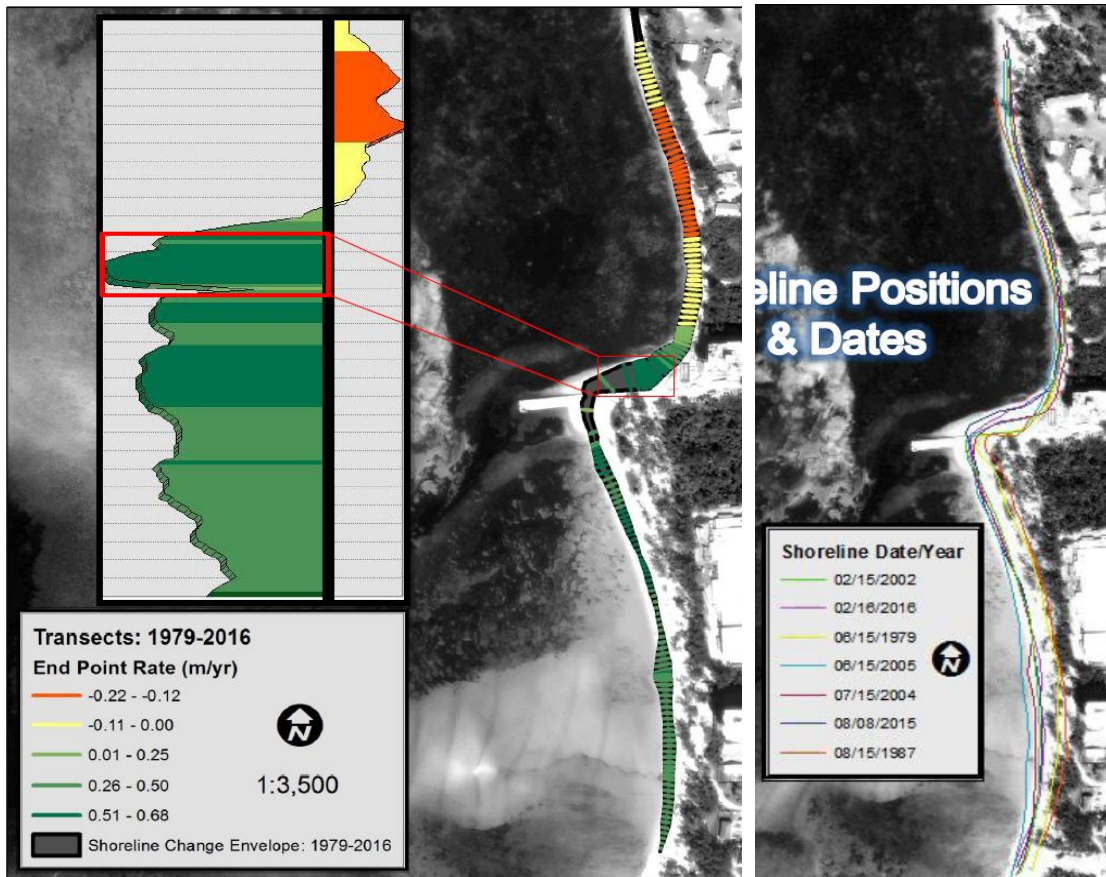


Figure 3.10: Shoreline change analysis for the Sugar Dock area from 1976 to 2016 (from Greene 2016).

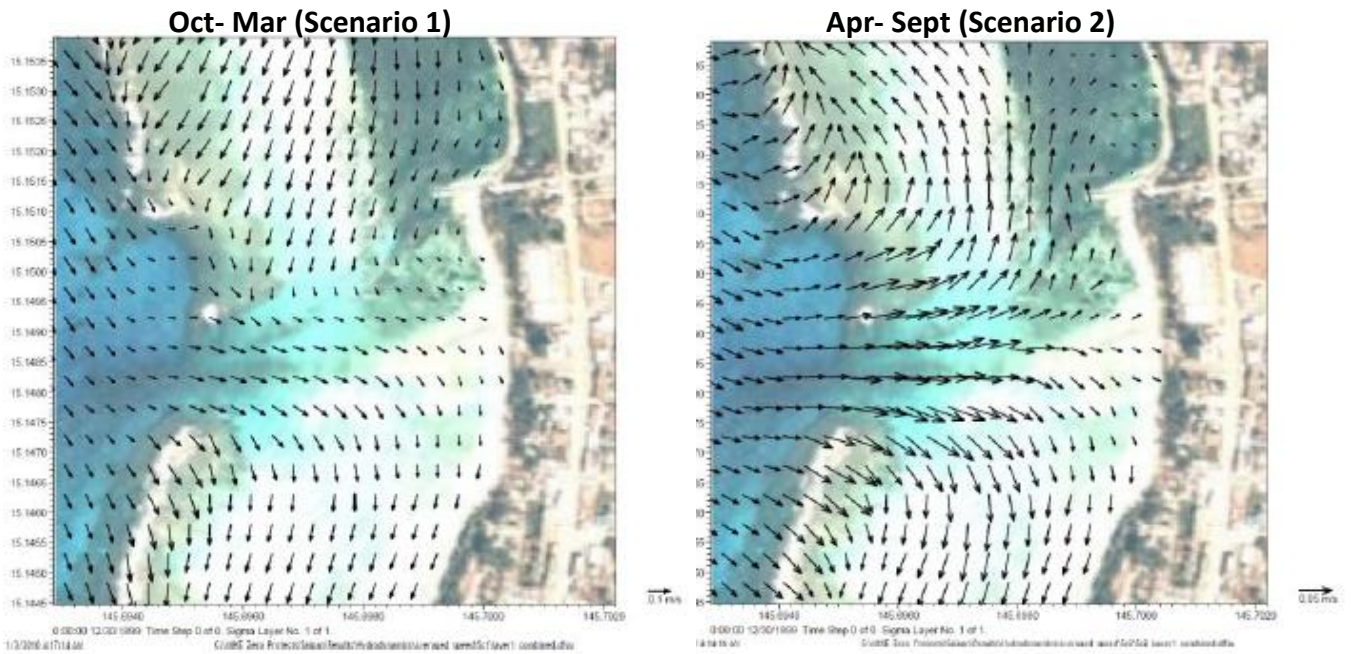


Figure 3.11: Residual current vectors for the Sugar Dock area used to estimate sediment transport direction and relative strength (from Damlamian and Krüger 2010).

4.0 Watershed Conditions

Four watersheds (plus Mañagaha Island) make up the 17 square mile contributing drainage area of the Saipan Lagoon: Susupe, West Takpochao, Achugao, and As Matuis (see **Appendix A, Map 5**). It should be noted that the watershed boundaries used in this report have since been updated by BECQ using LIDAR data and are available on the DCRM GIS portal. As a result the mapping and analysis for this report did not incorporate the new data. **Figure 4.1** shows the slight changes in watershed boundaries in the new 2017 delineations.

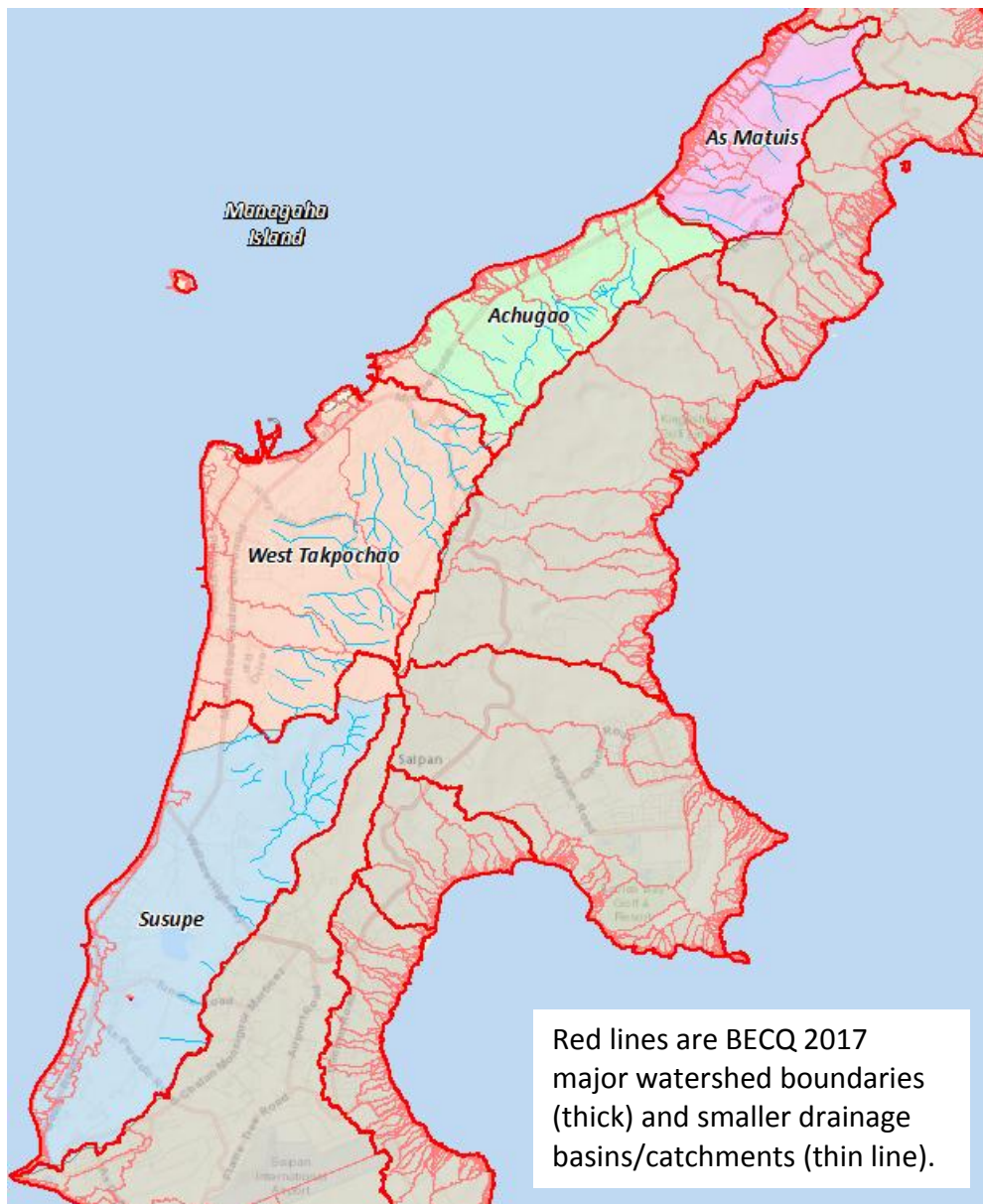


Figure 4.1: Watershed map showing updated 2017 drainage areas (in red) over the former boundaries for the Saipan Lagoon watersheds (color-shaded). Maps in this report were developed prior to release of the 2017 data.

While only the immediate area seaward of Beach Road and Middle Road is considered within the SLUMP boundary, many of the water quality and ecological issues found within the lagoon may be linked to land-based sources of pollution stemming from alterations to the natural hydrology and land cover in these watersheds. **Tables 4.1** and **4.2** summarize watershed characteristics.

Table 4.1: Watershed Characteristics

Watershed	Notable Features	
Susupe	<ul style="list-style-type: none"> • 5.7 sq mi; highly developed; 18% impervious cover (IC) • Villages- Afetnas, San Antonio, Chalan Kanoa, Chalan Piao, Susupe, Oleai, As Terlaje, Chalan Laulau, Chalan Rueda, and portions of Papago, Gualo Rai, Finasisu, As Perdido, Koblerville • Mostly sewerred along coast (part of Agninan WWTP district, small section of northern most shoreline goes to Sadog Tasi) • Beach Hotels- PIC, Grand, Diamond, World resort, Aquarius Towers 	<ul style="list-style-type: none"> • 4.6 shoreline/4.2 beach miles • Beaches/parks-Lally, Kiliili, San Isidro, Chalan Piao, Pak Pak, Jose, Civic Center • Beach Landings National Historic Landmark • Saipan’s only lake; wetland and pothole complex well studied for fauna, invasives, and potential for water supply; lake listed as impaired • Sugar Dock
West Takpochao	<ul style="list-style-type: none"> • 6.5 sq mi; densely developed, 16% IC • Garapan Tourist District and portion of Industrial/Port District • Villages- Garapan, Gualo Rai, I Liyang, Fanangagan, As Falipe, Maturana Hill, Chalan Galaide, Navy Hill, As Palacios, As Rabagau, , Lower Base, Sadog Tasi, and portions of Capital Hill and Tapochao • Mostly sewerred; Sadog Tasi WWTP • Puerto Rico Dump, CPA port, 2 power stations • 8.3 shoreline/4.3 beach miles 	<ul style="list-style-type: none"> • Beach Hotels- Hyatt, Fiesta, Hafa Adai, new Grand Marianas • Beaches/parks-Beach pathway, Fishing base, Chalan Laulau, Garapan, Micro Beach, American Memorial Park, Carolinian Utt Park, Fiesta/Hyatt • Smiling Cove and Outer Cove marinas, lower base seaplane ramp • Hospital, Gualo Rai • High density of injection wells • Garapan CAP
Achugao	<ul style="list-style-type: none"> • 2.7 sq mi, dense development along shoreline, pristine upper watershed; 10% IC • Villages- Tanapag, As Mahetog, Achugao, San Roque, and portions of Askina and Nansu • Most development along middle road is sewerred (Sadog Tasi WWTP) • Hotels- Aqua Resort, Nikko, Plumeria • Abandoned shopping mall; Dogas Dump; Tanapag meeting hall • 2.9 shoreline/2.5 beach miles 	<ul style="list-style-type: none"> • Beaches/parks- Tanapag • Intermittent streams, pristine waterfalls; Agatan stream assessment completed; little known about wetland complex; stream restoration https://www.youtube.com/watch?v=ZmmHEOLF-ZY • Community-based NPS educational and outreach campaign for bacteria loading • Hashers and hikers in upper watershed
As Matuis	<ul style="list-style-type: none"> • 2.1 sq mi; least developed; <7% IC • Marianas Country Club (golfcourse) • Villages- As Matuis, Matansa, and Marpi • Hotels- Mariana Resort and Spa 	<ul style="list-style-type: none"> • 2.1 shoreline/1.0 beach miles • Beaches/parks- Paupau, Wing Beach Green sea turtle nesting; no driving on beach “Jewel of Sapian”

Table 4.2: Watershed Statistics by Data Source*

	Achugao	As Matuis	Susupe	West Takpochao	Mañagaha
Total Area (BECQ watersheds)					
Acres	1,745	1,333	3,625	4,175	15
Sq. mi	2.7	2.1	5.7	6.5	0.02
Acres impervious cover					
NOAA CSC 2005-QuickBird	174.6	103	658	684	0.48
% watershed IC	10%	8%	18%	16%	3%
USFS 2005 IKONOS	119.4	87.3	573.0	527.6	0.2
% watershed IC	7%	7%	16%	13%	1%
Stream miles					
Waterlines (BECQ 2007 0.5 m LIDAR)	6.1	3.3	7.6	17	-
hydrolines (BECQ, USGS DRGs)	6.4	0.5	2.1	7.7	-
Wetland acres					
USFS 2005 IKONOS (wetland plus water)	0.7	3.5	94.1	3.8	-
USFW and BECQ	60.8	3.3	489.2	60.7	-
Arriola et al., 2016	61.1	0	454.8	61.4	-
Length of Shoreline (Arriola et al., 2016)					
Shoreline miles	2.9	2.1	4.6	8.3	
Beach miles	2.5	1.0	4.2	4.3	

*analysis completed prior to BECQ release of 2017 revised watershed boundaries and drainage basins

4.1 Land Cover

Changes in land cover can have a substantial impact on watershed function. Natural vegetation is replaced with roads, roof tops, parking lots, buildings, or compacted soils during urbanization. This results in less canopy interception of rainfall, reduced infiltration and evapotranspiration by plants, and more surface runoff. Surface runoff can erode areas of exposed soil (badlands), stream channels, unpaved roads; damage infrastructure; and contribute to increased flooding. Runoff often conveys pollutants to downstream waterbodies and can cause fluctuations in salinity, water levels, as well as increased water temperatures. In general, impacts to water quality, aquatic biota, stream morphology, and hydrologic functions are observed in watersheds with 10% or greater impervious cover (IC) (CWP, 2003).

NOAA Coastal Change Analysis Program (C-CAP) QuickBird analysis in 2005 generated an impervious coverage map for Saipan (see **Appendix A, Map 6**), which results in 1-3% higher impervious cover estimates for each watershed when compared to a 2006 USFS land cover analysis using similar data source, but different algorithms (see **Table 4.3**). In general, the C-CAP data is more accurate with impervious cover, but the USFS is better with vegetative classes.

Susupe and West Takpochao watersheds exceed the 10% impervious threshold using both data sources. Given this, the water quality impairments of coastal, wetland, and stream assessment segments in these two watersheds are not surprising. Additionally, the history of land cover alteration and intensive land uses of pre- and post-war Saipan (i.e., large-scale agriculture, industrial development, and deforestation) suggests that legacy sediments and contaminants may likely complicate anticipated pollutant loading from current land use conditions (Denton et al., 2014).

Appendix A, Map 7 shows watershed land use based on 2010 parcel data. Given that the majority of parcels do not include a listed classification, this particular land use data is less informative than the land cover data developed by USFS using 2005 IKONOS imagery (see **Appendix A, Map 8**). **Table 4.4** summarizes a breakdown in land cover types for each watershed, and **Table 4.5** provides a percentage breakdown of the major land cover categories.

Table 4.4: Acres Land Cover/Vegetation by Watershed (USFS derived from 2005 IKONOS)*

Land Cover Class	Acres				
	Achugao	As Matuis	Susupe	W.Takpochao	Managaha
Agroforest	0.4		7.0	3.7	
Agroforest – Coconut	20.7		147.6		
Barren/Sandy Beach/Bare Rocks	7.0	16.1	12.9	5.8	4.5
Casuarina Thicket			4.4		2.7
Cropland	0.4	2.9	2.6	1.8	
Leucaena Leucocephala (Tangantangan)	199.8	471.3	59.8	65.1	
Mixed Introduced Forest	903.0	294.1	1,719.4	2,697.2	7.6
Native Limestone Forest	40.4			126.2	
Other Shrub and Grass	147.0	108.1	415.0	219.8	
Savanna Complex	195.6		99.0	21.5	
Strand		0.7			
Urban and Built-up	119.4	87.3	573.0	527.6	0.2
Urban Vegetation	105.8	347.4	481.3	488.7	0.9
Water	0.7	3.5	65.3	3.8	
Wetland			28.8		
Total	1,740.2	1,331.5	3,587.4	4,161.3	15.9

*analysis completed prior to BECQ release of 2017 revised watershed boundaries and drainage basins

Wetlands located along the coast or at lower watershed elevations often play a role in runoff management by intercepting and detaining flows before they are discharged to the coastal waters (see **Appendix A, Map 5**). Wetlands functioning in this capacity can be considered a valuable factor in watershed resiliency. **Table 4.6** shows a breakdown in wetland type for each of the four watersheds based on USFW and BECQ data.

Table 4.5: % Major Land Cover/Vegetation by Watershed (USFS derived from 2005 IKONOS)**

Type	Achugao	As Matuis	Susupe	W.Takpochao	Managaha
Agroforest	1%	0%	4%	0%	0%
Forest	54%	22%	48%	68%	48%
Shrub/grass/sav/tangantagan	31%	44%	16%	7%	0%
Impervious Cover	7%	7%	16%	13%	1%
Urban vegetation	6%	26%	13%	12%	5%
Total	100%	98%	98%	100%	55%

* Grouping of land cover types into major categories. Not all categories shown, which is why not all total 100%

**analysis completed prior to BECQ release of 2017 revised watershed boundaries and drainage basins

Table 4.6: Wetland Acres by Watershed (USFW and BECQ)*

Wetland Type	Achugao	As Matuis	Susupe	West Takpochao
Constructed		3.0		0.3
Estuarine and Marine Deepwater	0.1		0.9	0.3
Estuarine and Marine Wetland		0.0	0.1	7.4
Freshwater Emergent Wetland	55.5		344.2	27.7
Freshwater Forested/Shrub Wetland	5.0		134.3	22.9
Freshwater Pond	0.2	0.3	9.8	2.1
Lake			43.1	
Total	60.8	3.3	489.2	60.7

*analysis completed prior to BECQ release of 2017 revised watershed boundaries and drainage basins

Future changes in land use/land cover can often be projected using zoning maps to assume a maximum build out scenario. A 2013 zoning map is shown in **Figure 4.2**; however, this was not provided in GIS.

Appendix B was compiled showing proposed, pending, and recently constructed development projects in the lagoon watersheds and inland section of the SLUMP area.

Saipan Zoning Districts Commonwealth of the Northern Mariana Islands

Updated: July 15, 2013
Village Commercial, Mixed Commercial,
and Industrial Zones

*This is not the official zoning map. For the
official Saipan Zoning Map, contact the
CNMI Zoning Office at (670) 234-9662 or view it
online at www.zoning.gov.mp*

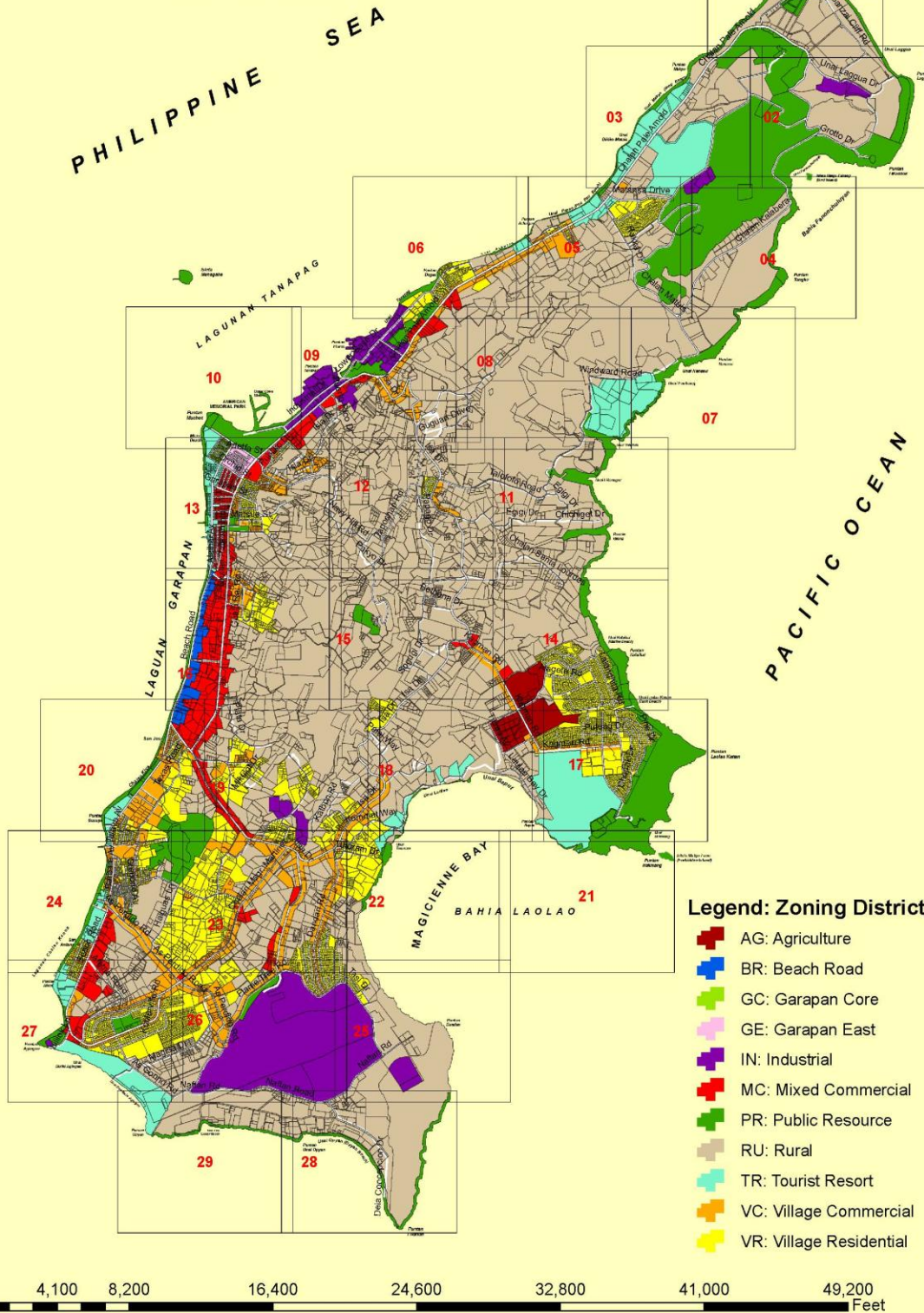


Figure 4.2: 2013 Saipan zoning map.

4.2 Infrastructure

The location of wastewater, drinking water, and stormwater infrastructure reflects population and land cover density. **Appendix A, Map 8** is a map of population density by community. Note that population estimates are not provided on a watershed basis.

Wastewater

There is an extensive sanitary sewer system along the coast and in the densely developed portions of the lagoon watersheds. Commonwealth Utilities Corporation (CUC) maintains thorough inventory of over 30 pump stations, main and lateral lines, treatment facilities, and other structures within their system. There are two waste water treatment plants (WWTPs) handling wastewater from the lagoon watersheds: Agingan in the south and Sadog Tasi to the north. A package system is located on Mañagaha and operated by the island concessionaire. **Appendix A, Map 10** shows the locations of main infrastructure and the sanitary sewersheds contributing to the two WWTPs. The Agingan WWTP discharges outside of the lagoon. The Sadog Tasi discharge outfall is inside the lagoon, just north of the shipping channel. The plume from the Sadog Tasi outfall was modeled by Damlamian and Krüger (2010) to better understand dispersal patterns (see **Section 3**).

According to the discharge permit, the Mañagaha Island wastewater plant was significantly upgraded in 2007 to a FRP Johkasou treatment package plant. This is an advanced treatment system capable of achieving up to 95% removal for biochemical oxygen demand (BOD5) and total suspended solids (TSS). It consists of a membrane separation activated sludge process, flow equalization-denitrification, submerged type aerated activated sludge with flocculation, nitrification tank with membrane separation, settling, and ultraviolet disinfection of the treated effluent. Discharge is into a leach field. It serves a daily population up to 1,050 and receives only domestic sewage with a design flow of 0.005 MGD.

According to the discharge permit, the Sadog Tasi WWTP serves a population of approximately 20,000 people, receiving domestic wastewaters from “the Central System,” dairy wastes from Coca-Cola factory two to 3 times a year, septage from privately-owned septic tanks, and fats, oil and grease from various grease traps. The average reported flow rate is 2.9 MGD, with a maximum allowable flow rate of 3.2 MGD. The treatment plant underwent major renovations during 2010-2011 to replace bubble diffuser system with floating mechanical aerators, as well as rehabilitation of mechanical components. The WWTP is currently designed to achieve secondary treatment via influent screening, grit removal, diffuser system, aerated treatment using activated sludge, clarifiers, and dewatering by belt filter press. There is no disinfection component. Treated wastewater is discharged through the Saipan Lagoon outfall, approximately 1,200 feet offshore into Tanapag Harbor. The outfall is a welded HDPE pipe with the diffuser system at a depth of about 49 feet. Dried sludge cake is hauled to nearby landfill.

The Sadog Tasi WWTP NPDES discharge permit was recently renewed. Review of the EPA ECHO website for the Sadog Tasi showed current non-compliance in April 2017 with bacteria, flow (maybe from lack of data?), and significant non-compliance for nickel and copper. Personal

communication with EPA Region 9 (Peter Kozelka in April, 2017) indicated that the new permit incorporated an increased dilution credit (88:1 from 77:1) for bacteria, nutrients and metals based on a BECQ –approved mixing study. This increased dilution credit will likely change compliance going forward for some parameters (e.g., orthophosphate and metals), however, because the facility does not currently disinfect, there may still be issues with bacteria, on situation specific basis. **Figure 4.3 and Table 4.6** shows current compliance issues in September 2017 still in effect for phosphorous, bacteria, nickel, and copper parameters.

No additional information was reviewed regarding: the condition of the sanitary sewer network; the number or performance of onsite systems, including private package plants; or the number of livestock or confined animal feeding operations.

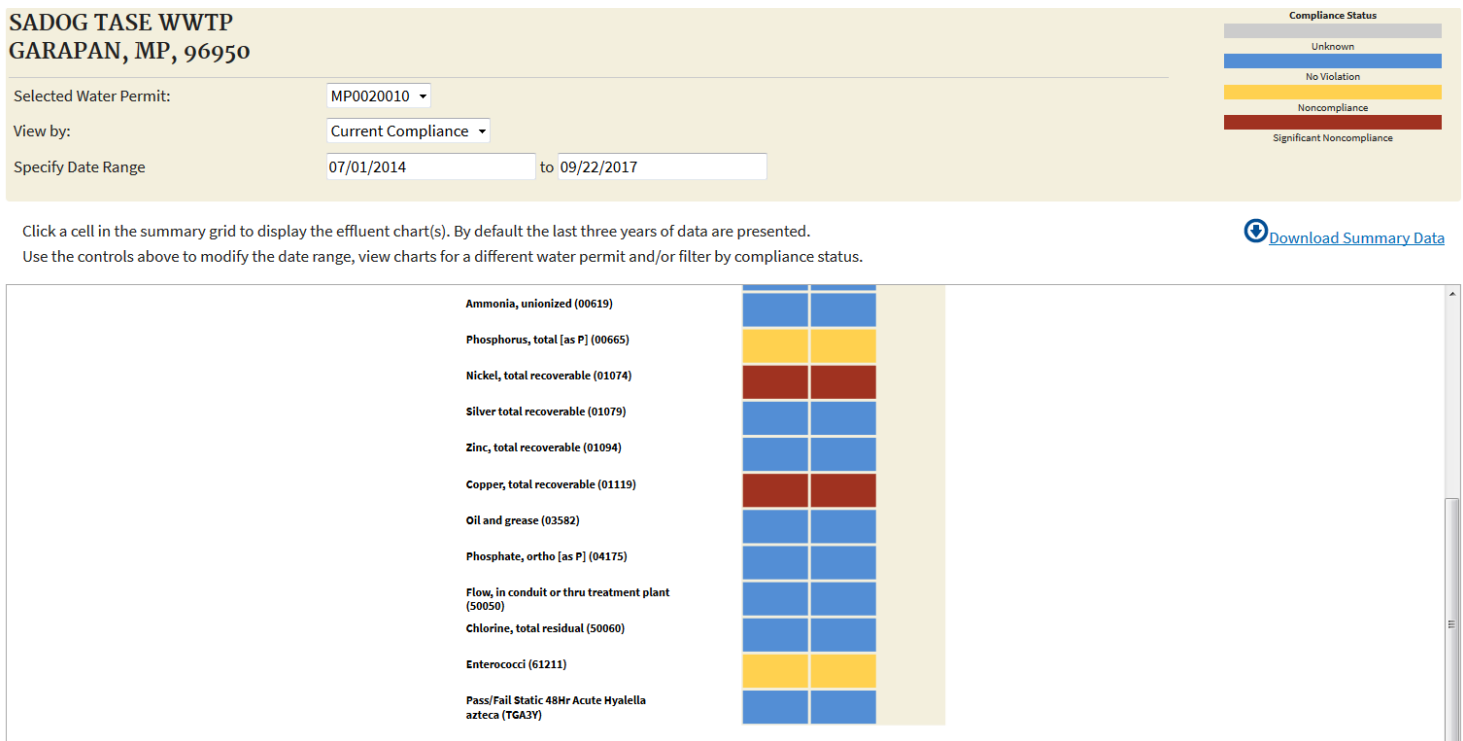


Figure 4.3: Current (September 2017) effluent compliance report for Sadog Tasi WWTP
(<https://echo.epa.gov/effluent-charts#MP0020010/61211>)

Drinking Water

The water distribution network (i.e., lines, wells, tanks) is shown in **Appendix A, Map 11**. In addition to the main lines, it includes a breakdown of well types, including injection wells. There are 14 injection wells, presumably Class V, located near the coast. CNMI has three classes of groundwater protection, with the lowest/least restricted located along the coastline. No information on the drinking water system or wells were reviewed for this report.

Table 4.6. Sadog Tasi Exceedance Report from Jan –April 2017 time period.

Exceedance Details											
Date	Outfall	Parameter	Average Daily Flow (MGD)	Limit Type	DMR Value	Limit Value	% Exceedance	Load Over Limit (lb/period)	Days per Period	Days with Exceedances	
01/31/2017	001	61211 – Enterococci	0	MO AVG	22,823 CFU/100mL	2,230 CFU/100mL	923	0	31	31	
01/31/2017	001	61211 – Enterococci		DAILY MX	24,196 CFU/100mL	4,474 CFU/100mL	99999		31		
02/28/2017	001	00310 – BOD, 5-day, 20 deg. C		MO AVG	32 MG/L	30 MG/L	7		28	30	
02/28/2017	001	00310 – BOD, 5-day, 20 deg. C		HI WK AV	46 MG/L	45 MG/L	2		28		
02/28/2017	001	00530 – Solids, total suspended		HI WK AV	57 MG/L	45 MG/L	27		28	7	
02/28/2017	001	61211 – Enterococci	0	MO AVG	24,196 CFU/100mL	2,230 CFU/100mL	99999	0	28	28	
02/28/2017	001	61211 – Enterococci		DAILY MX	24,196 CFU/100mL	4,474 CFU/100mL	99999		28		
03/31/2017	001	00665 – Phosphorus, total (as P)		MO AVG	2.4 MG/L	2 MG/L	20		90	30	
03/31/2017	001	01119 – Copper, total recoverable		MO AVG	0.0091 MG/L	0.0024 MG/L	279		90		
03/31/2017	001	01119 – Copper, total recoverable		DAILY MX	0.0091 MG/L	0.0048 MG/L	90		90		
03/31/2017	001	01119 – Copper, total recoverable	0	MO AVG	0.054 KG/D	0.045 KG/D	20	1.79	90	90	
03/31/2017	001	61211 – Enterococci	0	MO AVG	24,196 CFU/100mL	2,230 CFU/100mL	99999	0	31	31	
03/31/2017	001	61211 – Enterococci		DAILY MX	24,196 CFU/100mL	4,474 CFU/100mL	99999		31		
04/30/2017	001	61211 – Enterococci	1.474	MO AVG	30,245 CFU/100mL	2,230 CFU/100mL	1256	10,339,126	30	30	
04/30/2017	001	61211 – Enterococci		DAILY MX	48,392 CFU/100mL	4,474 CFU/100mL	99999		30		

Stormwater

In CNMI, DPW is the lead agency for implementing the NPDES MS4 program related to stormwater, but has a memorandum of agreement with BECQ to coordinate on program implementation. The MS4 permit was issued in 2006. The last annual report submitted to EPA on the MS4 program was dated 2012. EPA expects to issue a revised permit in 2017-2018 (per. com., Eugene Bromely).

The stormwater drainage network is presumably not as well mapped as the other utilities, however DPW may have more complete mapping information that could be shared with BECQ. Catch basins, outfalls, drain lines, and existing treatment practices have been mapped within Garapan Tourist District (see **Appendix A, Map 12**). A preliminary inventory of existing stormwater BMPs was started by Horsley Witten Group based on facilities observed during a stormwater training in 2016. The mapping data containing information on over a dozen individual facilities was provided to BECQ. Lack of maintenance on the drainage system, and leaking sanitation lines were found in Garapan to contribute to water quality issues at outfalls into the lagoon (HW, 2015). It is also apparent that outfall locations have been mapped south of Garapan, and in some cases, have been used as monitoring stations (Denton et al., 2014 and Arriola et al., 2016). New watershed and drainage area mapping by BECQ may also incorporate outfall locations. **Figure 4.3** shows a map of shoreline outfall locations south of Garapan, for example. The shoreline assessments and the realignment of Beach Road offer a good opportunity to update drainage mapping for a significant portion of the SLUMP area.

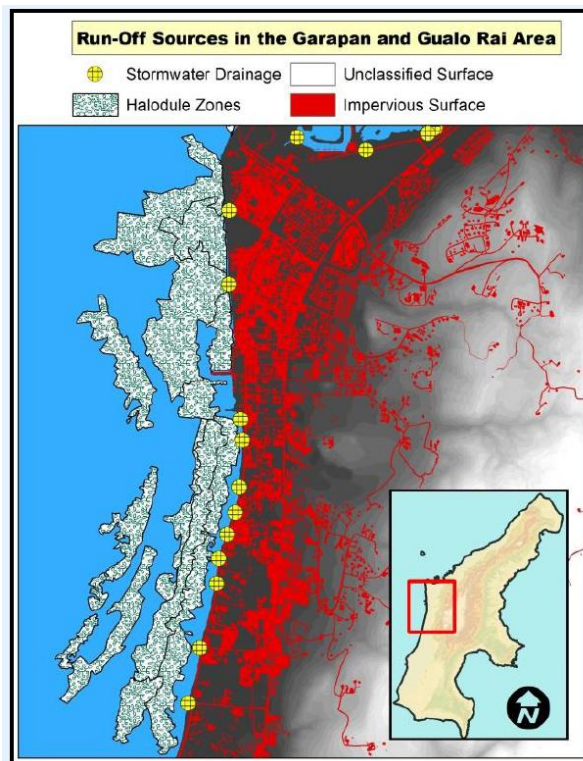


Figure 4.3: Map of seagrass beds and stormwater outfalls (taken from Skeele 2014, unreferenced source, presumably from Denton et al., 2014 study)

Post-construction stormwater design standards for recharge requirements vary based on the underlying geology. Water quality treatment requirements vary based on the surface water classifications. Redevelopment standards differ from new development.

Other

Other infrastructure to consider are the electric, phone, and other utilities within the inland SLUMP, including those associated with the port and industrial district, which include the landfill, two power stations (one CUC), and numerous diesel back above-ground storage tanks (ASTs).

The CPA-operated Port of Saipan includes a number of significant infrastructure features, including (from <http://www.cpa.gov.mp>):

- 2,600 linear feet of berthing space,
- 22-acre container yard,
- Water line and an underground fuel line protected by a concrete vault,
- An underground sewage removal system,
- Backup generator for port operations area,
- Dockside lights for nighttime operation,
- Refrigerated containers outlets with backup power source,
- Seawater Fire Fighting System,
- The channel, turning basin, and berthing areas have been widened and deepened to a uniform 40 feet in order to comfortably welcome medium to deep draft vessels into port (with further expansion proposals periodically proposed),
- Two fuel storage facilities at the Saipan seaport,
- Bulk cement company,
- Three freight forwarding companies and three shipping agents,
- Sunset cruises,
- Improved navigational aids and repositioned harbor buoys to mark the safest route into port with the assistance from the U.S. Coast Guard, and
- Two car rental companies available at the seaport for our inter-island travelers.

4.3 Sources of Pollution

Land use is often used as an indicator of watershed health and downstream water quality. Maynard et al. (2012) used watershed size and land cover to estimate nutrient and sediment inputs to generate a watershed impact score as part of a reef resiliency study (**Figure 4.4**). For the resiliency study, nutrient input was assumed to be directly proportional to watershed size, and sedimentation was based on the percentage of land made up by barren land/urbanized vegetation/highly developed land cover.

Direct discharges such as wastewater plants, reverse osmosis discharges, and municipal drainage systems are required to obtain an NPDES permits. A list of the wastewater discharges to the Lagoon and Saipan's MS4 stormwater permit are listed in **Table 4.7**.

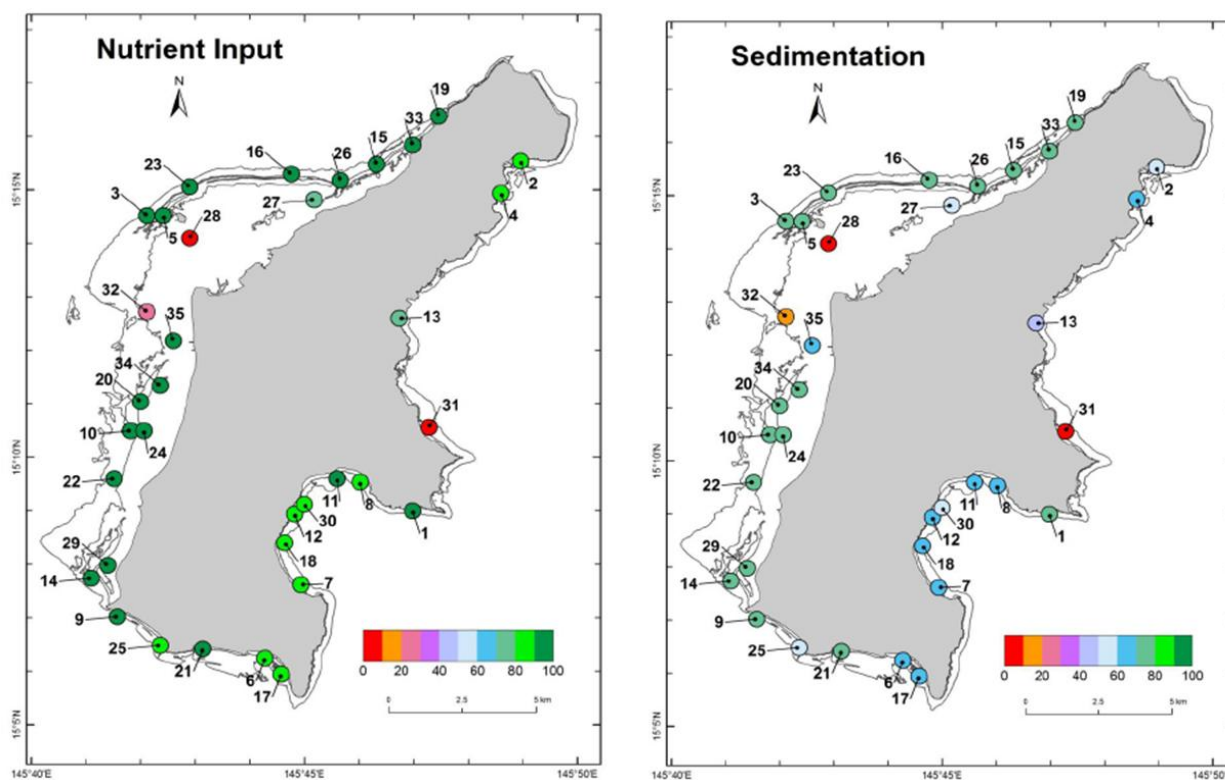


Figure 4.4: Predicted relative nutrient input and sedimentation scores at survey sites based on watershed size and land cover (Maynard et al., 2012), where low scores (red/orange) indicate high nutrient or sediment input. Note that numbered labels are for site identification and are not related to water quality.

Table 4.7. List of NPDES permits (CWA) for Saipan Lagoon.

Permit # / Effective Dates	Permit Name / Location	Documents
MP0020371 08/01/2013 —07/31/2018	Tasi Tours and Transportation, Inc./ Managaha Island WWTP Saipan, MP	Permit (PDF) (11 pp, 182K) Standard Conditions (PDF) (v.2011, 15 pp, 178K) Public Notice (PDF) (2 pp, 50K) Fact Sheet (PDF) (11 pp, 150K)
MP0020397 09/01/2011 —08/31/2016	Mobil Oil Mariana Islands, Inc., Saipan Terminal Saipan, MP	Permit (PDF) (37 pp, 400K) Standard Conditions (PDF) (v.2011, 15 pp, 178K) Fact Sheet (PDF) (27 pp, 2.0M) Response to Comments (PDF) (9 pp, 100K)
MPS040000 09/22/2006 —09/21/2011	Commonwealth of the Northern Mariana Islands/Island of Saipan MS4 Saipan, MP	Permit (PDF) (24 pp, Scanned 1.2M) Standard Conditions (PDF) (v.2002, 12 pp, 115K) Fact Sheet (PDF) (20 pp, 162K)
MP0020010 05/01/2017 —4/30/2022	Sadog Tasi WWTP Saipan, MP	Permit (PDF) (37 pp, 720 K) Fact Sheet (PDF) (19 pp, 424 k)
MP0020028 05/01/2017 —4/30/2022	Agingan STP Saipan, MP	Permit (PDF) (37 pp, 755 K) Fact Sheet (PDF) (18 pp, 356 k)

Potential Sources of 303(d) Impairments

More specific consideration of land-based sources of pollution within each of the watershed areas is presented in the 303(d) listing (refer to **Table 2.2**) from the CNMI Integrated Report (Arriola et al, 2016). The report indicates that the most common sources of water quality degradation to the lagoon are related to: stormwater runoff from existing roads and development causing sedimentation, failing wastewater infrastructure, and wastewater associated with free roaming feral and domesticated animals from small and medium sized subsistence farmers.

According to the Integrated Report, erosion and sedimentation from improperly designed secondary crushed coral roads is a special concern as a primary non-point source of coastal turbidity. Fill material washes out during the rainy season, then workers refill it during dry season, perpetuating a negative cycle. Construction of environmentally sound roads is imperative. For example, the Cross Island Roadway Reconstruction Project (Route 31/Isa Drive) on the east side of the island has improved water quality already. However, more roadways require attention across the island, especially Mt. Takpochao Road whose runoff impacts western watersheds that drain to the lagoon (Arriola, et al., 2016).

Illicit and permitted wastewater discharges are another significant source of water quality degradation, including failing wastewater infrastructure (Arriola, et al., 2016). Several issues with sewer infrastructure were identified in the Integrated Report and are in varying stages of resolution, as described below:

- San Antonio (A-16) Lift Station located in Susupe South (Segment 18B) requires an upgrade to meet peak demand flows. According to CUC, the San Antonio lift station is still under construction with an anticipated completion date of March 2017 (pers. com. CUC). The project was originally delayed by Typhoon Soudelor. Enterococci exceedances still occur at this site.
- Sugar Dock beach area sewer line needs repair. Enterococci exceedances at Susupe South Watershed (Segment 18B) due to this degraded infrastructure are a high priority (Arriola, et al, 2016).
- S1 Lift station at DPW Channel Bridge, which had been found to have frequent overflows, was renovated in 2015 and reportedly works properly (Achugao North, Segment 20A). However, Enterococci exceedances continue, especially during rain events, and may be due to mangrove wetland upland of this location. There is a need to watch site for overflows and non-point source pollution (Arriola, et al., 2016).
- In 2013, raw sewage was reported in the Dogas Stream outlet of the Achugao Watershed (Segment 20). Sanitary surveys were completed and two forgotten manholes were found in the stream one of which was a gravity feed that was still in service. CUC sealed off the manholes (Arriola, et al., 2016). A successful community effort has also taken place in Achugao Watershed to promote proper domestic and animal wastewater management for low income land owners, as documented in a [community outreach video](#).

- SR1 Lift Station located south of the Kensington Hotel (formerly the Palms Resort) in Segment 20A, North Achugao had an overflowing manhole cover. This sewer overflow was noted by BECQ as a cause of impairment for this assessment unit (see **Table 2.2** and **Appendix A, Map 4**). The pump was insufficient for the flow and was replaced by CUC. According to CUC, the SR1 lift station is currently being renovated with an estimated completion date of June 2017 (pers. com. CUC). **Figure 4.5** shows the location of the SR1 lift station and area manholes in the Achugao watershed.

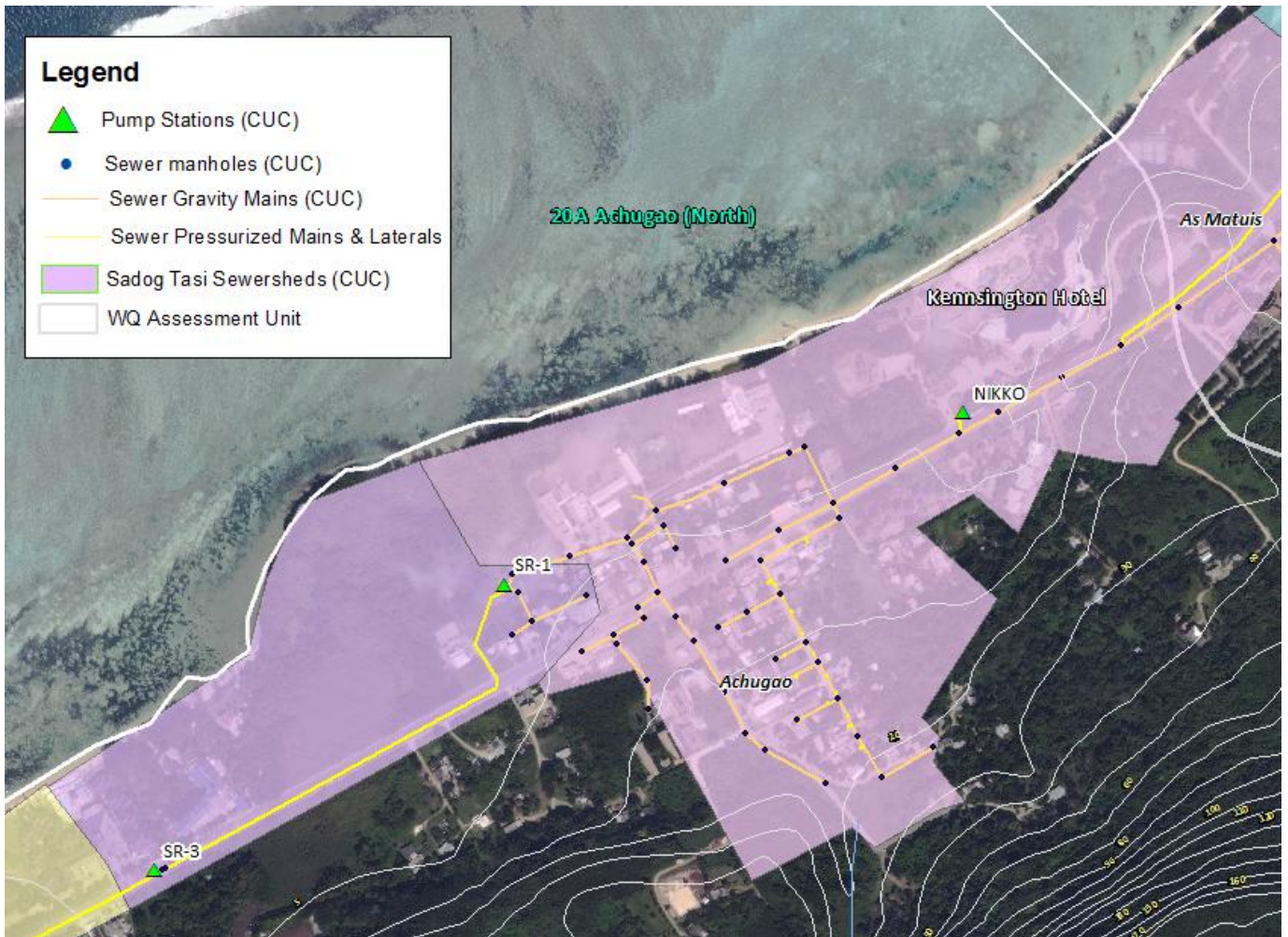


Figure 4.5: Sewer infrastructure in the North Achugao Assessment Unit

Waste from feral and domesticated animals is another major source of water quality degradation within the SLUMP area (Arriola et al., 2016). Adoption of the 2014 Water Quality Standards gave BECQ staff the authority to give a Notice of Violation to any individual to enforce discharges of animal or human wastewater closer than the mandated setback to a waterbody (refer to CNMI Water Quality Standards, Part 14.2). Additionally, community efforts have recently led to the remediation of three streams in the Achugao Watershed, which had formerly seen impaired water quality due to disposal of human and animal waste as well as

outdoor kitchen waste directly into streams. The results of this cleanup are documented in a [community outreach video](#).

In addition to the updated Water Quality Standards, water quality issues are being addressed on Saipan through Conservation Action Plans (CAPs), such as the Garapan Watershed CAP (Mattos, 2015). The Garapan Watershed CAP includes a strategic work plan to prioritize actions to improve watershed and lagoon quality (including water quality and ecological conditions). The 2012-2013 Garapan CAP was adopted by BECQ and the DFW as a framework for collaboration between a number of agencies and community groups and has, reportedly, had significant implementation success (e.g., sewerline repairs, drainage cleanouts, education programs, expansion of marine monitoring, fertilizer reduction, feral animal control program, etc).

In particular, the CAP highlights a number of contributing factors to polluted runoff and development threats including:

- Natural disturbance (Climate change factors)
- Land-based sources of pollution (pesticides, agrochemicals, animal waste, household and industrial chemicals, heavy equipment leaks (oil and lubricant), failed/improper sewage systems, unpaved roads, trash burning, illegal dumping, channelized stormwater (high volume), poor construction practices, land clearing, unsustainable development, inadequate zoning regulations)
- Lack of awareness/education
- Lack of enforcement (training, money, personnel, resources)
- Lack of or weak legislation/regulations
- Lack of resources
- Lack of federal enforcement and prosecution
- Lack of regulatory coordination
- Poor/weak social accountability
- Lack of transparency/communication with public and inter-agency throughout permitting/review process
- Political will/influence
- Conflicting regulations and uses (zoning)

The Garapan Watershed CAP has a comprehensive list of recommendations (and responsible parties) that are relevant to improving conditions in Saipan Lagoon ranging from engineering projects to educational and regulatory suggestions for reducing turbidity, eliminating trash, removing invasives, managing feral animals, and improving monitoring data. See **Appendix D** for recommended action summary tables from the updated CAP. Some of the high priority recommendations include, but are not limited to:

- Implement the Surface Water Quality Assurance Monitoring Plan created for BECQ in 2013 by collecting water and sediment samples at designated stream sites to evaluate possible land-based sources of pollution and to isolate affected watershed segments.

- Measure volume/velocity of stormwater (explore options with John Riegel/CUC), urgency is high because of climate change predictions of increased rainfall.
- Fill open positions in Water Quality program for data collection and analysis.
- Complete stream inventories to identify sources of pollution.
- Establish standard practices for maintenance of public infrastructure; Clean and maintain all stormwater drainages including improving, cleaning drainages, clearing open ditch areas, ponds and drainages and cut overgrown vegetation.
- There are a number of priority recommendations (educational, regulatory, and activities) for reducing trash.
- Reduce “red flags” at monitoring stations through better enforcement/illicit discharge detection and eliminations.
- Implement a number of specific retrofit projects, sewer improvements, and unpaved road stabilization projects to reduce turbidity, including establishing an interagency working group to evaluate maintenance options for all unpaved roads. Incorporate stormwater treatment and climate considerations in Beach Rd. renovations.
- Require existing and new building structures proposal to be equipped with centralized with solid waste and effluent containment. i.e., outside centralize trash bin & grease catchment/containment.

Sediment Contamination

According to Arriola et al. (2016), heavy metals (e.g., mercury, copper, lead, cadmium, zinc, etc.) have been documented by UOG-WERI in 2004-2005 for fish in the Central West Takpochao lagoon area (Segment 19B), which led to non-attainment for the Fish Consumption designated use. Recent research by the same group has focused on heavy metal contamination both in the lagoon and on land due to urban runoff, waste disposal, and World War II artifacts and explosives.

Denton et al. (2014) evaluated the presence of heavy metals in surface sediments within the southern portion of Saipan Lagoon from Garapan to San Antonio Sediment. Sediment samples were collected from 22 storm drain discharge points and along perpendicular shoreline transects extending seaward from 16 of the outfalls. They found elevated levels of zinc, mercury and lead in sediment samples from all storm drain outfalls, while half showed some degree of copper enrichment. In general, metal enrichment diminished with increased distance from shore. Exceptions included pockets of metal enrichment (especially mercury) that is likely due to exploding ordinance and ammunition from World War II. Elevated mercury could possibly affect fisheries resources. Further, they specifically noted the following (refer to **Figure 4.6** for site locations):

- Sediment from a site near Gualo Rai (Site 11) showed enrichment in all eight metals analyzed (cadmium copper, iron, mercury, manganese, nickel, lead, and zinc), which may be attributed to a car dealership and vehicle service area located directly across the highway.
- Extremely high enrichment for zinc was found at Site 3 in Garapan, which is a drain located 30 m south of a public boat ramp.
- The Site 20 outlet was the only discharge for Susupe Village and sediment showed elevated levels of zinc and copper.
- Extremely high enrichment for lead was found at Site 22, which is a drain located 370 m north of the Agingan Point former dumpsite area. The elevated lead footprint near this dumpsite covered an area of approximately 100,000 m². At this location, it was determined that contamination could induce adverse biological effects in sensitive species at this site (levels for copper and lead exceeded threshold effect levels). There are many residents that harvest fish and bivalves at this location. The public health risks of these activities need to be addressed.

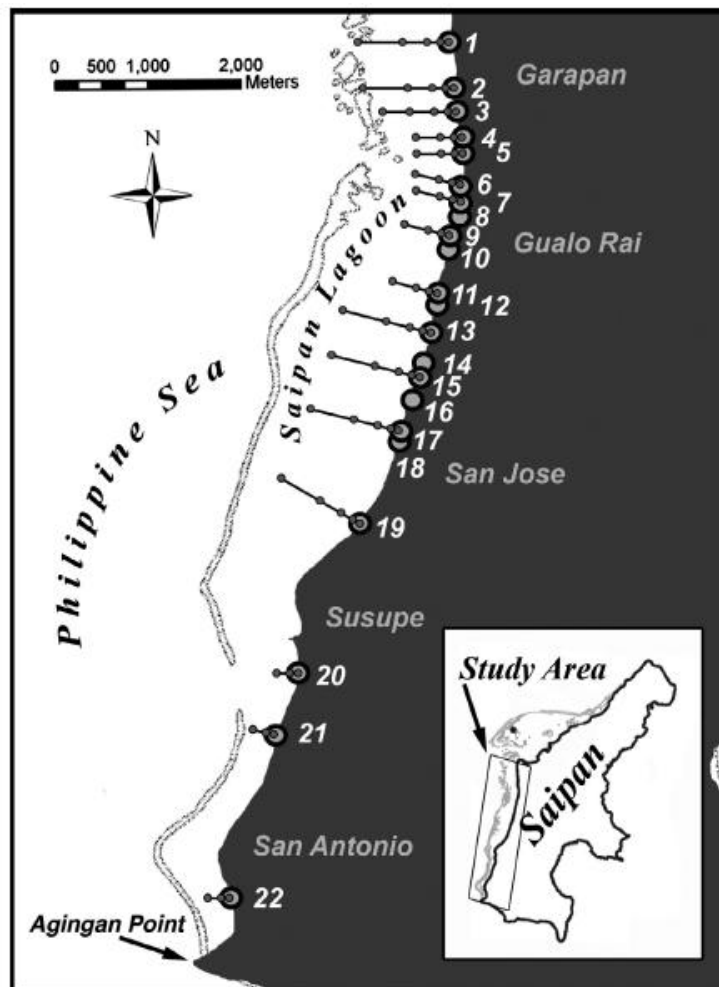


Figure 4.6: Map of outfall locations used in Denton et al. (2014).

A subsequent study examined the heavy metal contamination impact of predominantly land-based dump sites from World War II on Saipan soils and sediment (Denton et al., 2016). The vast majority of dump sites are on the east side of the island. However, two locations, the Dogas Dump near Tanapag (Sites 34 and 35) and the Agingan Point former ammunition dump (Sites 1 and 2) show impacts to SLUMP area sediment and water quality (**Figure 4.7**).

ID	Site Description	Sample Type
1	Agingan Point: former ammunition dump, general waste repository, and ocean disposal tipping point	Surface soil
2	Agingan Point: directly below cliffline tipping point	Subtidal sediment
34	Dogas Dump: aircraft parts, UXO, bitumen drums, construction waste: downstream of impacted area	Stream sediment
35	Dogas Dump: aircraft parts, UXO, bitumen drums, construction waste: upstream of impacted area	Stream sediment

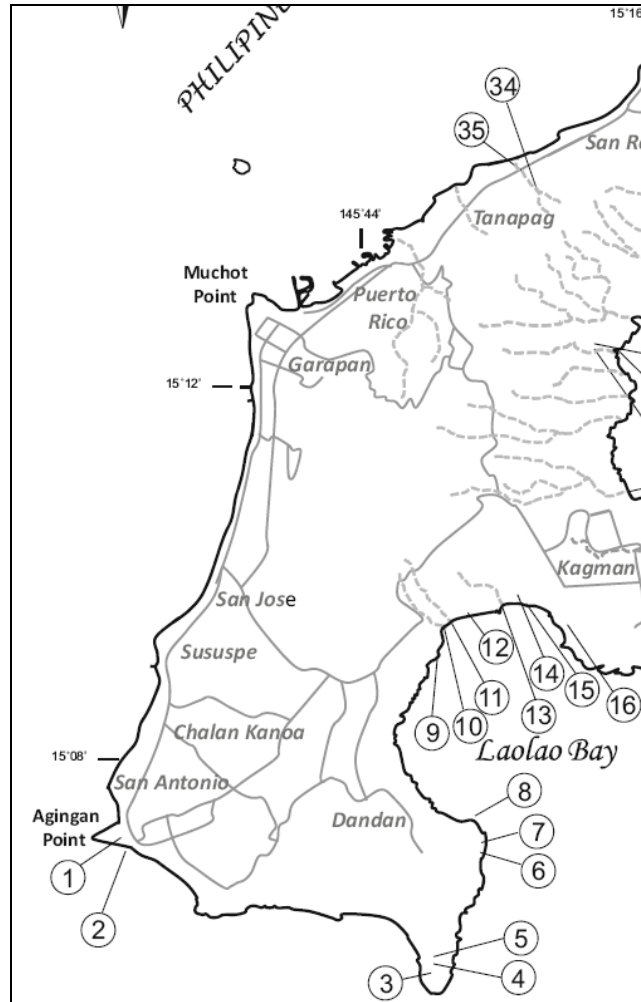


Figure 4.7: Site locations and sample descriptions for WWII dump site study (from Denton et al., 2016).

The Dogas Dump is listed as having aircraft parts, unexploded ordinance, bitumen drums, and construction waste (Denton et al., 2016). Stream sediment was collected from upstream and downstream of the dump. No heavy metal values exceeded the Saipan screening levels used for the study, but exceedance of U.S. Environmental Protection Agency (EPA) eco-screening levels were found for cadmium, copper, lead and zinc at the Dogas Dump site. The Agingan Point former ammunition dump is at the southern extreme of the SLUMP that was used as a former ocean disposal tipping point. As such, the submerged sediment directly below the cliff line was sampled as well. The clifftop sampling point exceeded Saipan soil screening levels and EPA eco-screening levels for copper, lead, and zinc. The submerged sampling location at

Agingan Point exceeded Saipan screening levels for lead, and exceeded EPA eco-screening levels for copper, mercury, lead, and zinc. In particular, lead levels in sediments below Agingan Point were exceedingly high (Denton et al., 2016).

Recently, BECQ completed the Mañagaha Island Cleanup and Restoration Project to remove contaminated debris and soil through an EPA Brownfields grant (BECQ, 2016). In 2015, 42 cubic yards of suspect pesticide-impacted soil, 23 rusted drums, and 17 discarded marine batteries were removed from two areas on Mañagaha Island and disposed of properly at the Marpi Landfill. No unexploded ordinance was found during the operation. The buried drums had likely been filled with sand during WWII. Soil samples were collected from around the excavation sites and no contaminants of concern were detected. The excavation sites were then restored such that they could be used as future turtle nesting sites (<http://www.deq.gov.mp/article.asp?secID=8&artID=230>).

Groundwater Contamination

Groundwater in Saipan's freshwater aquifers will eventually mix with coastal waters in the lagoon; therefore, groundwater can have an impact on lagoon use and management if it carries contaminants. According to Arriola et al. (2016), there are several known groundwater contamination locations on Saipan, but most have not been definitively linked to an identifiable source. Suspected sources of groundwater pollution on Saipan include: underground storage tanks, landfills, septic tanks, pipelines and sewer lines, salt water intrusion, and small-scale manufacturing and repair shops. Arriola et al. (2016) further states that previous studies of volatile organic compounds (VOCs) in groundwater found detections exceeding maximum contaminant levels localized in four areas (San Antonio, As Lito, Lower Base, and Puerto Rico), and that follow up studies are still being evaluated.

The greatest potential threat to lagoon water quality from groundwater is most likely excess nutrients and bacteria emerging in nearshore, underwater seeps, which are suspected of contributing to periodic algal blooms and DO deficits in the lagoon (Arriola, et al., 2016). Excess nutrients and bacteria enter groundwater predominantly through failing septic systems and sewer lines, as well as through surface water contaminated by animal waste. Several studies have been conducted to understand nutrient and bacteria concentrations in well water, none of which have documented significant exceedances of the 10 mg/L drinking water standard for nitrate and only a few bacteria detections (Arriola et al., 2016).

A recent investigation by the CNMI Watershed Working Group examined groundwater and surface water impacts on nearshore biological communities in the lagoon (Okano & Okano, 2016). The study divided the lagoon into three sections (north, mid, and south) and selected one site for each section that had high groundwater input, one site for each section with high surface water input, and one randomly selected reference site for each section (**Figure 4.8**). Water quality parameters were measured monthly at each site for one year, and benthic communities were assessed via transect surveys. Analysis of the data provided the following preliminary results:

- Sites of high groundwater input have lower salinity than high surface water and reference sites.
- Sites with lower salinity have greater total nitrogen and nitrate/nitrite concentrations.
- Trends show that total nitrogen was highest in the mid section. Further analysis shows that groundwater sites are driving this trend. Every sample from site 6 (Fishing Base, mid section, high groundwater) exceeded water quality standards for nitrogen.
- Turbidity is greatest in the mid section.
- Sites with lower salinity have greater intertidal algal cover, greater algal diversity, lower seagrass: algae ratio, and greater algal diversity within nearshore seagrass beds.
- Trends show that seagrass: algae ratio was lowest in the mid section; further analysis shows this is highly significant at the reference sites.
- Sea cucumber numbers are most abundant at surface water sites and least abundant at groundwater sites. Lowest sea cucumber numbers are found in the mid section.

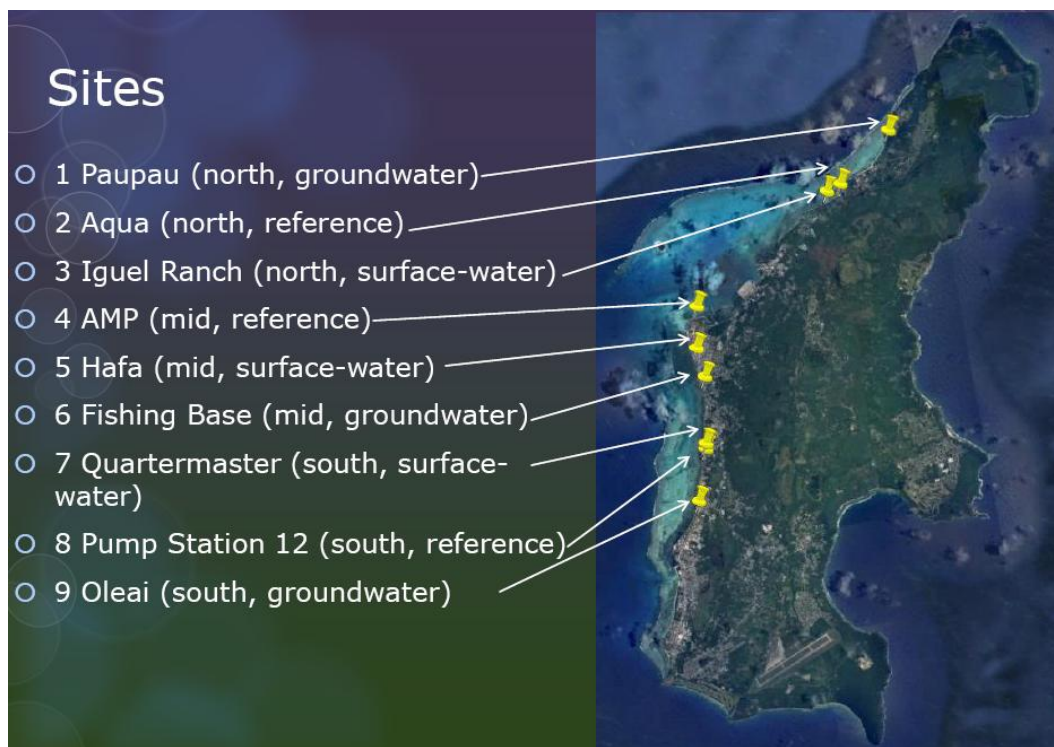


Figure 4.8. Sites for 2016 groundwater and surface water impacts study (Okano & Okano, 2016)

This preliminary work concluded that groundwater has a greater influence on nearshore biological communities than surface water in the lagoon. In addition, the study showed the influence of groundwater results in compromised water quality and nearshore biological communities. The mid section of the lagoon had the poorest water quality relative to the northern and southern sections (Okano & Okano, 2016).

In terms of drinking water for Saipan, salt water intrusion is arguably the most significant ground water contamination issue (Arriola, et al., 2016). The water supplied by CUC is in compliance with all EPA regulated contaminants, but it is unpalatable due to high salt (chloride) concentrations. As such, most people on Saipan do not drink the water provided by the utility; instead they drink locally-produced bottled water or rain water. The high chloride concentration in the public water supply is due primarily to salt water intrusion, which occurs because older wells are screened into the freshwater/saltwater transition zone or are near the bottom of the freshwater layer. In addition, the wells have close spacing and are pumped at relatively high rates, causing the wells to draw saline water from below the overlying freshwater lens (Arriola, et al., 2016). Chloride concentrations in these well range from just beyond the Secondary MCL of 250 mg/l to as high as 2,000 mg/l and above (Carruth, 2003). CUC is developing a groundwater management plan to take high chloride wells and high pump rate wells off-line. CUC is also assessing their well depth relative to sea level, well spacing, and pumping rates for newer wells constructed since approximately the year 2000 (Arriola, et al., 2016).

5.0 Lagoon Uses

The waters of Saipan Lagoon are used by a wide variety of people and industries for pleasure, employment, sustenance, and transportation. To address the possibility for conflicts between these various users, and to and inform the SLUMP update, BECQ commissioned a *User Survey and Mapping Report* for the Saipan Lagoon (APEC, 2016). This assessment included a survey and participatory mapping workshop with lagoon users to identify and map the myriad activities that take place in the lagoon. Uses in the lagoon were grouped into three broad categories: recreational, commercial, and extractive (**Table 5.1**).

Table 5.1: Uses in the Saipan Lagoon for the *User Survey and Mapping* (adapted from APEC, 2016).

Recreational Uses	Commercial Uses	Extractive Uses
<ul style="list-style-type: none"> • Recreational SCUBA diving • Recreational snorkeling & free diving • Swimming (inc. wading and playing in water) • Paddling (inc. outrigger paddling, stand-up paddling, kayaking) • Surface board sports (inc. surfing, wind surfing, kite boarding) • Recreational motorized boating (inc. waterskiing, jetskis, parasailing) • Sailing (inc. mooring of sailboats) • Beach use (inc. BBQs, sunbathing, walking, shell collecting, wildlife viewing, camping) 	<ul style="list-style-type: none"> • Commercial SCUBA diving (inc. SNUBA, Seawalker/helmet diving) • Commercial snorkel tours (permitted & unpermitted) • Commercial parasailing • Commercial banana boating & other boat towing activities • Commercial jetski • Commercial transit & dinner cruises (inc. commercial cruise ships, commercial yachts, commercial submarines) • Commercial shipping (inc. mooring/towing/anchoring of commercial ships/vessels) 	<ul style="list-style-type: none"> • Hook & line fishing (both onshore and boat-based) • Spearfishing (both onshore and boat-based) • Throw net/talaya fishing (both onshore and boat-based) • Gillnet/chenchulu/tekken fishing (permitted & unpermitted, both onshore and boat-based) • Harvesting/gleaning (collecting or harvesting of other marine plants or animals, both onshore & boat-based)

The results of this survey effort were combined and geo-referenced to generate maps showing the “general” and “dominant” footprint of each use in the lagoon. “General” use includes areas in which the use is known to occur with some regularity, regardless of frequency or intensity. “Dominant” areas are subsets of the general use areas which are used by most users most of the time. “Heat maps” were then created to represent relative high and low use areas through the lagoon by overlapping uses within each use category (i.e., recreational, commercial, and extractive). **Appendix A, Map 13** shows the resulting heat maps for each dominant use and for all combined uses.

APEC (2016) identified two areas of concentrated use by all users (recreational, commercial and extractive): (1) the lagoon area between the Smiling Cove to Lower Base shoreline out and around Mañagaha; and (2) the waters around the two northernmost Sherman Tanks. *User Survey* respondents identified calm, clear, shallow waters, and proximity to development of the lagoon as key attractions (APEC, 2016). At the same time, respondents identified a number of

threats to the lagoon's use, including water quality, overcrowding, too many commercial boats, and too much shoreline development. Given these findings, APEC recommends prioritizing and protecting the specific areas where users go that are based around unique biological, cultural, or historical features as part of overall lagoon management planning. Also, they recommend pursuing water quality improvement initiatives, since "clear waters" and "high visibility" were the most common lagoon characteristics commercial vendors reported that draw customers.

5.1 Recreational Uses

Recreational uses are thought to be the most prevalent use in the lagoon, but also the most poorly documented. Recreational uses include any activity that is not a commercial enterprise (i.e., no payments are exchanged) and also does not involve the removal of a lagoon resource (such as fish). As shown in **Appendix A, Map 13**, the most concentrated "dominant" recreational use areas (areas used by most users most of the time) include the lagoon area around Wing Beach, Tanapag Beach, Mañagaha Island, near and offshore of American Memorial Park/Micro Beach, the Sherman Tanks (Sugar Dock), and offshore of the Pacific Islands Club. Descriptions of the various recreational uses in the lagoon are provided below.

- SCUBA diving, while popular on Saipan, is not common in the lagoon due to shallow depths and lack of shore access points. More diving occurs on the deeper reef outside of the lagoon. The most heavily used recreational dive site is accessed via a reef cut at Wing Beach during low wave conditions, generally in June. Using boats, recreational divers may sometimes dive the wrecks and reefs on the north of the shipping channel that are popular with commercial dive operators.
- Recreational snorkeling and free diving is most common in areas with clear water, interesting reef features, and/or easy shore access, including: Wing Beach, Paupau Beach Park, MMCA, the Sherman Tanks off the Oleai shoreline, Micro Beach, Susupe Beach, and Pakpak Beach Park. Knowledgeable snorkelers avoid areas close to known outfalls and areas with heavy motorized boat traffic.
- Swimmers follow a similar pattern to snorkelers, but generally stay closer to shore near larger hotels and around Mañagaha Island. Several hotels and Mañagaha have designated swimming areas marked by buoys. Swimming for exercise is common around the two northernmost Sherman Tanks, and at Paupau Beach Park, Kili Beach Park, and Oleai Beach. Competitive swimming races are held at American Memorial Park, the Pacific Island Club, and between Mañagaha and Micro Beach across the shipping channel.
- Outrigger paddling is most common out of Kili Beach Park. Sprint training occurs around Kili Beach Park, as well as from Oleai Beach south to Kanoa Resort and the southernmost Sherman Tank. Long distance training occurs across most of the lagoon. Stand up paddling (SUP) is increasing in popularity and occurs throughout the lagoon as well, with SUP users embarking from Wing Beach, Paupau Beach, and along the Tanapag shoreline. SUP is also popular at Hyatt Regency and Fiesta Hotel out to a partially

submerged wreck. SUP users gather between Sugar Dock and Aquarius to catch small waves, and, at certain times, between Paupau and Micro Beach or out to Mañagaha.

- Kite and wind surfing occur primarily off Hyatt Regency and Micro Beach and sometimes as far out as Mañagaha and the forereef. Kite surfing can also take place in the southern lagoon by Sugar Dock and Aquarius Beach. Instruction occurs at the Hyatt Regency, around the Sherman Tanks, and at the Pacific Islands Club.
- Use of recreational motorized boats, parasailing, and jetskis is concentrated around boat ramp access points, including: Sugar Dock, Fishing Base, Smiling Cove, Lower Base and Tanapag. Many boats are used for transportation out to Mañagaha Island or through one of the three channels out of the lagoon (the main shipping channel, the lighthouse shipping channel just south of Fishing Base, and at Sugar Dock). Towing activities (e.g., waterskiing, tubing) occurs in designated areas in the deeper waters of the central lagoon by Mañagaha and the shipping channel, and in the deeper area south of Fishing Base. Recreational jetski use sometimes occurs in the deeper areas off Oleai and Kili Beaches.
- Recreational sailing is focused in the central part of the lagoon between Smiling Cove and Mañagaha, with some boats going out the shipping channel to sail in the open ocean; sailboats are generally kept in slips at Inner Cove. Tourists sometimes use smaller catamarans in the areas in front of the Pacific Islands Club, Kanoa and World Resort (around the Sherman Tanks), the Fiesta Resort, and the Hyatt Regency.
- Beach use is common along almost the entire lagoon shoreline, with dominant use focused at beach parks, hotels, and locations with amenities/parking. Heavily used beach areas include: Mañagaha Island, Wing Beach, Paupau Beach Park, the shoreline by the Tanapag public boat ramp, the picnic areas in Lower Base, the entire American Memorial Park and Micro Beach shoreline, the beaches in front of Hyatt Regency, Fiesta, and Grandviro hotels, the Beach Road bike path from 13 Fishermen south to Oleai Beach, Kili Beach Park, the beaches in front of World Resort and Kanoa Resort, Susupe Beach Park, Sugar Dock and Aquarius Beach, the beach in front of Pacific Islands Club, and Pakpak Beach Park. **Appendix A, Map 14** shows the dominant heat map for beach use. **Appendix A, Map 15** shows beach access points.

5.2 Commercial Uses

Almost all commercial uses are driven by tourists from off the island and include any activity conducted in exchange for payment, except for fishing which is considered an extractive use. There are commercial fishing outfitters (i.e., sport-fishing tours), but they generally operate outside of the lagoon. As shown in **Appendix A, Map 13**, the most concentrated “dominant” commercial use areas (areas used by most users most of the time) include the lagoon area between Mañagaha and American Memorial Park and the area around the Sherman Tanks. Descriptions of the various commercial uses in the lagoon are provided below.

- Commercial SCUBA tours primarily depart from Smiling Cove and visit areas in the north central part of the lagoon. The most common commercial dive sites are: WWII plane wrecks throughout the area, WWII Chinsen (or “landing craft”) shipwreck, Eagle Ray City, and Sea Cucumber City. Helmet diving operators visit similar sites, in addition to areas around lighthouse channel just south of Fishing Base. Dive certification courses generally use the northwest side of Mañagaha, a shore access point by 13 Fisherman Memorial, and just offshore Sugar Dock.
- Commercial snorkel operators most commonly use the area from the Mañagaha pier out around the northern part of the island. Boat-based operators also visit the WWII Japanese Zero plane wreck and other wrecks near Mañagaha if conditions are safe. Another dominant commercial snorkel location is the staghorn reef offshore Fishing Base. Snorkeling in front of hotels is also common, including: Pacific Islands Club, Kanoa Resort, World Resort, Aqua Resort, and Marianas Resort. Tour operators such as Marianas Trekking stop at Paupau Beach or Wing Beach for snorkeling. Unpermitted commercial snorkeling was also noted as part of the *User Survey and Mapping Report*, mostly by taxi drivers who take tourists to snorkeling locales such as Paupau Beach or Wing Beach.
- Commercial parasailing is a very popular activity that requires water deeper than six feet. Inside the lagoon, commercial parasailing is only permitted between the boat ramps at Smiling Cove and Lower Base out to Mañagaha, predominantly south and southwest of Mañagaha (outside of the MMCA). Other operators transit out through the main shipping channel to open water. Many parasailing packages include a transfer between Saipan and Mañagaha.
- Commercial boat towing activities, such as banana boating, take place in water at least five feet deep and occur between pick up points at Smiling Cove, the Hyatt Regency, the Fiesta, World Resort, and Kanoa Resort out to Mañagaha Island. Many banana boat packages include a transfer between Saipan and Mañagaha.
- Commercial jetskiing occurs around three-buoy courses that operators set out for their customers and only in the central part of the lagoon between Sugar Dock and Tanapag. This is regulated by jetski exclusion zones (see **Appendix A, Map 15**). In particular, jetski use is prevalent offshore of the Hyatt Regency and Fiesta Resort and around the two northernmost Sherman Tanks.
- Large ferries shuttle guests to and from Mañagaha, with the most popular pick up points at Charlie Dock, Smiling Cove, the Hyatt/Fiesta beach, the Grandviro Hotel, Fishing Base, and the beach by Kanoa Resort. Dinner cruises operate in and around Smiling Cove to Mañagaha and around Tanapag where waters are deep enough. These vessels require water greater than eight feet and generally avoid the commercial shipping lane. Commercial cruise ships rarely visit Saipan; when they do, they are limited to the commercial shipping lane and port.

- Similarly, commercial shipping is limited to the shipping channel that leads to the port at Lower Base (see **Appendix A, Map 15**). Tide, winds, and other factors influence when commercial shipping vessels can enter or exit the lagoon.
- Marine Sports Operator (MSO) Permits on Saipan are issued by the Division of Coastal Resource Management and cover the following activities: motorized activities including jetskis, banana boat operators, parasailing, waterskiing / wakeboarding, Seawalker/helmet diving); SCUBA tour operators; snorkel tour operators; “hydro bob” operators; and DWK tour operations. DCRM maintains a list of these MSO permits along with vessel identification numbers, areas of operation, and permit expiration dates. **Table 5.2** summarizes the number of permits issues for the Saipan Lagoon for each use and the number of vessels for each activity.

Table 5.2: Summary of Marine Sports Operator Permits for the Saipan Lagoon.

Activity	Total Number of Permits in Saipan Lagoon per Activity	Total Number of Vessels Permitted in Saipan Lagoon per Activity ^(1,2)
Jetski	11	40
Banana Boat	19	36
Parasailing	11	25
SCUBA Tours	45	18
Snorkeling Tours	19	22
Seawalker / Helmet Dive, HydroBob	5	7
Marine Sports Activities	15	14
Waterski/Wakeboard	4	7
DWK Tour	2	3

Notes:

1) In some instances the same vessel may be used for more than one permitted activity (e.g., the same boat is registered to tow banana boat riders and to run snorkeling tours) so this table double-counts those vessels.

(2) In order to calculate the number of vessels per activity, it was assumed that the “No./Serial #/Reg.” columns in the DCRM MSO Permit list provide unique vessel identification numbers.

The Mariana Visitors Authority (MVA) collects exit surveys from departing tourists. As part of this survey, tourists are asked about their secondary reasons for visiting the CNMI. Results from the 2015 exits surveys (**Figure 5.1**) show that the climate, ocean and beach were by far the most significant secondary reason for visiting the islands, with 75% of the 4,034 respondents selecting this choice. Snorkeling (37%), nature activities (20%) and SCUBA diving (14%) were also commonly selected. This data suggests that the CNMI’s natural resources are significant to tourism.

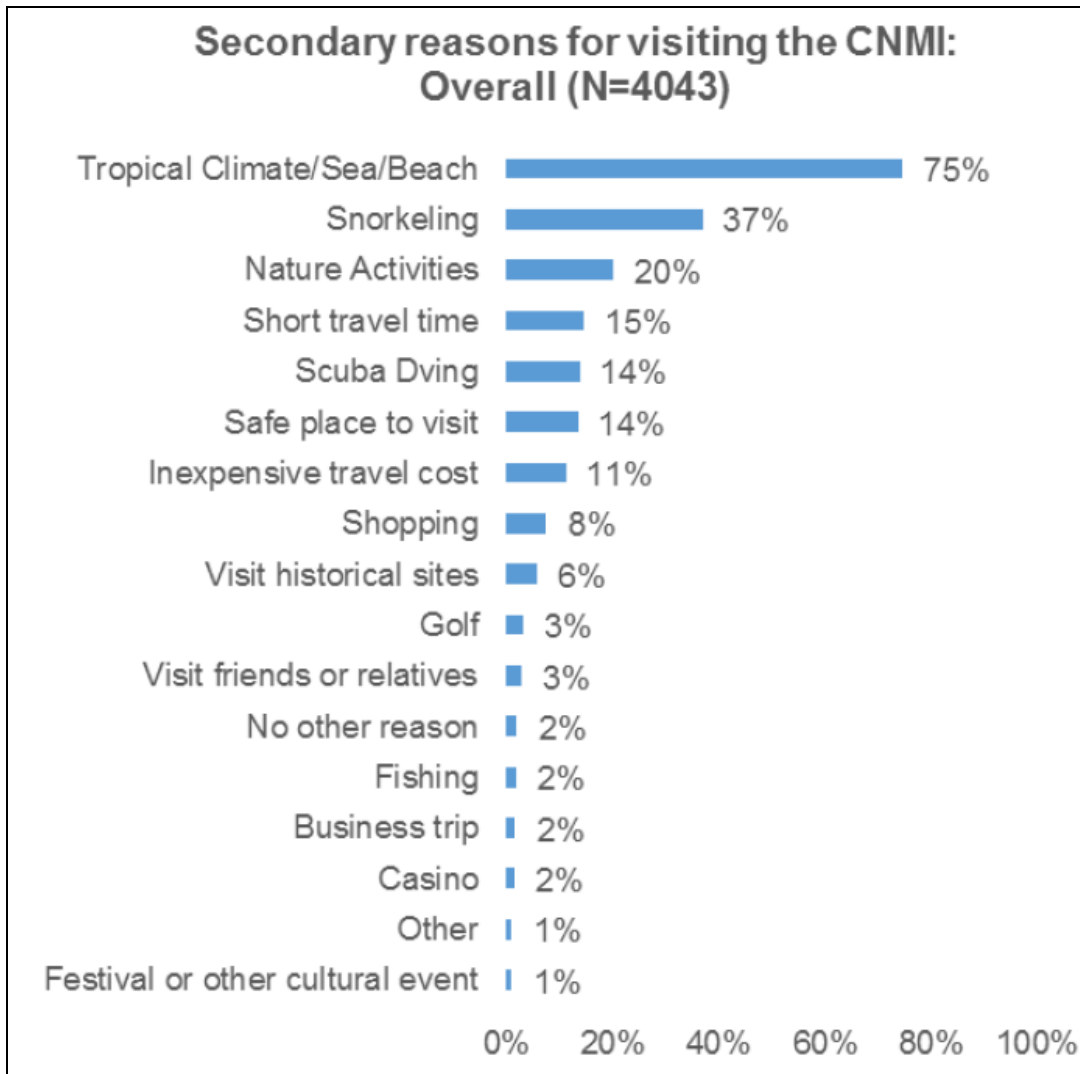


Figure 5.1: Exit survey data on secondary reasons for visiting the CNMI. Data from the Marianas Visitors Authority for 2015 (from Arriola, et al., 2016).

The MVA data also surveyed departing visitors on the optional tours they participated in while visiting the CNMI (**Figure 5.2**). In 2015, a significant percentage (61%) of the 2,555 respondents toured Mañagaha. Snorkeling (46%), island tours (28%), jungle tours (24%), and water sports on the beach (23%) also ranked high on the list. As with the data showing secondary reasons for visiting the CNMI, this data emphasizes the importance of the islands’ natural resources to the tourism industry.

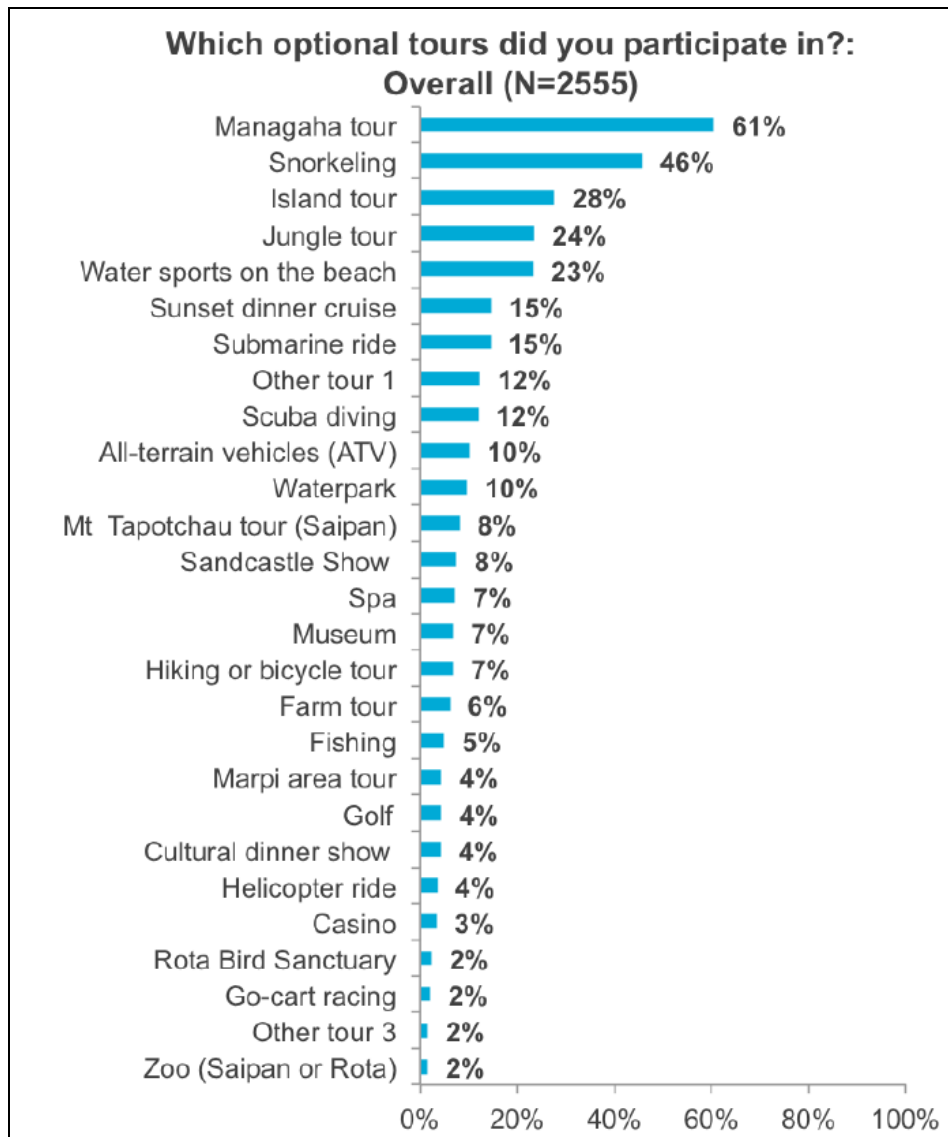


Figure 5.2: Exit survey data on optional tours that tourists took during their visit. Data from the Mariana Visitors Authority for 2015 (from Arriola, et al., 2016).

5.3 Extractive Uses

Extractive uses in the lagoon include the removal of any resources, such as fish, marine plants, and invertebrates. Extractive uses are predominantly subsistence in nature; almost all commercial fishing (e.g. sport fishing) occurs outside of the lagoon. As shown in **Appendix A, Map 13**, the most concentrated “dominant” extractive use areas (areas used by most users most of the time) include the lagoon area around Wing Beach, along the fringe reef north and east of Mañagaha, and offshore of Fishing Base. As summarized in *User Survey and Mapping Report* for the Saipan Lagoon (APEC, 2016), descriptions of the various extractive uses applicable to both on-shore and boat-based activities in the lagoon are provided below.

- The entire lagoon is used for hook and line fishing to some degree. Popular areas of hook and line fishing include: the offshore area from Aqua Resort to Tanapag out to the reef area where the Lady Carolina is grounded, just inside the barrier reef from Aqua out to the MMCA buoy, shipwreck areas in front of the Hyatt (though conflict with jet skis and other boats is possible), from Fishing Base out to the lighthouse and in the lighthouse channel, the cut in the reef offshore of Oleai, Sugar Dock for casting, and the cut through the reef by Agingan cliff.
- Spearfishing also occurs throughout the lagoon dependent on water depth and other factors; however, some potential areas of spearfishing are avoided due to water quality issues. Dominant spearfishing locations include the entire back reef area from Paupau to the shipping channel and from the lighthouse channel to the Sugar Dock channel. Other patches of spearfishing occur in the Tanapag lagoon area and around some of the larger patch reefs in deeper areas.
- Throw net (talaya) fishing occurs along easily accessible shoreline areas and the entire forereef, particularly from Aqua to the MMCA buoys. This type of fishing requires a DFW permit.
- Surround or trap nets (chenchulu), and gillnets/tekken are prohibited by DFW except by rare issuance of a special permit that has strict restrictions on net size, amount of fish allowed, and location. If this type of fishing does occur, it is dominantly near Paupau Beach Park, and the Tanapag and San Roque area out to the channel.
- Harvesting or gleaning of marine plants and animals can occur throughout the lagoon, but is dominant around Wing Beach and along the back reef in specific sections, including north of the shipping channel, in and around the lighthouse channel, and north of the Sugar Dock channel. Specific species are targeted at each of the dominant locations identified as part of the User Survey.

5.4 Archeological and Historical Resources and Hazards

Several historical sites of significance to WWII are present in the SLUMP area, including shipwrecks, sunken aircraft, and other vehicles. These sites have been recognized for their historical significance and tourism value through the Battle of Saipan WWII Maritime Heritage Trail, an underwater “tour” of various WWII wrecks (see www.pacificmaritimeheritagetrail.com and **Appendix A, Map 16**). Shipwrecks and other submerged wrecks are protected under Public Law 3-39 from unauthorized disturbance, excavation, or removal of artifacts. They are also protected under the U.S. Federal Sunken Military Craft Act (Public Law 108-375, 10 U.S.C. 113 Note and 118 Stat. 2094-2098). Snorkelers and SCUBA divers frequently visit the wrecks along the Battle of Saipan WWII Maritime Heritage Trail to get a unique perspective on the history of Saipan. In addition, the wrecks, some of which are not fully submerged, are used as navigation aids (e.g., the Sherman Tanks, Korean Freighter). Many of these wrecks are within the Mañagaha Island Marine Conservation Area, a no-take area that is described further in **Section 7**.

The CNMI Historic Preservation Office in the Department of Community and Cultural Affairs is responsible, under Public Law 3-39, for promoting the preservation and protection of all significant historic and archaeological properties in the CNMI and for educating the public about their cultural heritage and historic preservation. Mañagaha Island is culturally significant because it is the burial site of Carolinian Chief Aghurubw, who established the first Carolinian settlement on Saipan during the Spanish colonial period. A monument to him is present on the island. Mañagaha is therefore sacred to the Carolinian community, where they perform Firowrowa ceremonies, the traditional practice of burning personal possessions of the dead. In addition, the island is home to at least 28 species of medicinal plants, many of which are thought to have been established and cultivated by early Carolinians (Schroer, 2005).

The beaches on the west coast of Saipan from a point just south of Garapan to Agingan Point were designated in 1985 collectively as a National Historic Landmark through the National Park Service (NPS) for their significance as landing beaches in WWII (see **Appendix A, Map 16**). The designation, “encompasses the reef and the lagoons that U.S. landing forces crossed in the invasion of Saipan; the portions of the landing beaches possessing integrity; and the surviving Japanese fortifications on Agingan” (NPS, 1985).

The NPS American Memorial Park at Point Muchot honors the American and Marinas people who gave their lives during WWII. The park provides information to visitors on the role of Saipan in WWII and has various memorials. In addition, the 133-acre park is an important recreational and community resource, with beaches, sporting areas, picnic sites, playgrounds, walkways, and a 30-acre wetland and mangrove forest.

In addition to these historical and archaeological resources, there are coastal hazards that are the result of the island’s military history. The most significant hazard is the potential presence of submerged unexploded ordinance that poses a safety hazard at many sites around the island, including within the lagoon. As shown on **Figure 5.3**, the areas just offshore of American Memorial Park and offshore of San Roque have been identified as potential area of submerged unexploded ordinance within the lagoon.

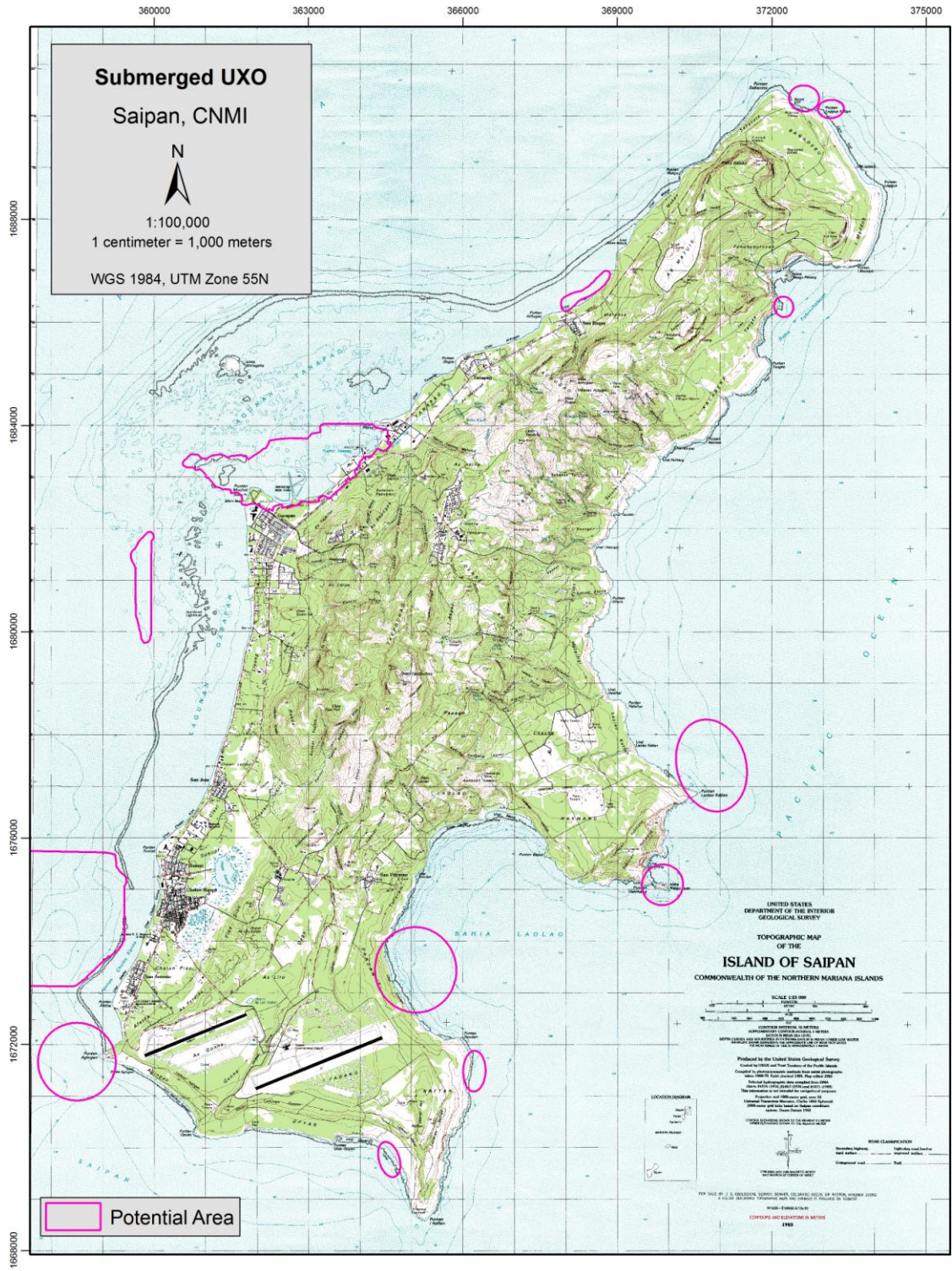


Figure 5.3: Potential areas of submerged unexploded ordnance (UXO) in the coastal waters of Saipan.

5.5 Boating Access

DFW operates the Boating Access Program to serve fishermen and recreational boaters by providing safe, easy access to the lagoon and beyond. The Boating Access Program operates and maintains the following facilities within the SLUMP area (see **Figure 5.4** and **Appendix A, Map 15**): Smiling Cove marina and boat ramp; Outer cove Marine (not operational due to typhoon impacts); Sugar Dock boat ramp; Tanapag boat ramp; Fishing Base boat ramp; and Lower Base boat ramp.



Figure 5.4: (LEFT) Public boat ramp at Lower Base in Tanapag. (RIGHT) Public marina at Smiling Cove near American Memorial Park in Garapan.

6.0 Impacts of Climate Change

Climate change is a significant stressor on the ecological health of the Saipan Lagoon and the people who rely on its resources for recreation, employment, or sustenance. For example, rising sea surface temperatures and uptake of carbon dioxide can lead to coral bleaching and ocean acidification, respectively; both of which inhibit growth of calcifying organism such as coral and coralline algae. These same temperature changes can shift species dominance, and can lead to outbreaks of invasive or nuisance species. In addition, changes in ocean currents and sea level can, over time, force species that depend on certain light and water conditions to migrate or decrease in number (Pörtner, et al., 2014). All of these biological changes can affect the tourism industry and subsistence fishing by degrading reefs and the species that depend on reef habitats (Greene and Skeele, 2014).

More information/data on recent impacts of bleaching in the lagoon will be provided in the upcoming state of the reef/monitoring report.

Climate change can also impact wave and weather patterns (Pörtner, et al., 2014). While the majority of wave energy impacting Saipan comes from the east-northeast, the rainy season can bring tropical cyclones and strong, long-lasting winds out of the west that can lead to significant erosion and inundation on the lower plains of the west coast. Despite the barrier reef along the outer lagoon, water enters the lagoon through the various channels and higher sea levels during storms can overtop the reef. This can cause increased wave energy within the lagoon and increase storm surge at the coast, which can lead to tourism impacts, coastal inundation, erosion hazards, structural damage to reefs, and water quality issues for both the lagoon and freshwater drinking supplies (Greene and Skeele, 2014).

Recent scientific literature suggests that tropical cyclone tracks are shifting poleward, which may decrease exposure for the CNMI to tropical cyclones. Despite fewer tropical cyclones for the CNMI, the intensity of those cyclones that do develop is predicted to increase. Climatologists also predict an overall decrease in atmospheric circulation, which would lead to fewer landings for tropical cyclones in the area of Saipan. The average conditions on Saipan may shift to be more similar to existing rainy season conditions; however, these conditions may not necessarily be more severe. (Kossin et al., 2016; Colbert et al., 2015; Cai et al., 2015). Increased rainfall, or changes in rainfall patterns, could cause more sediment and pollutants to enter the nearshore zone via land-based runoff.

Several recent studies on Saipan have addressed the various impacts of climate change, and how resilient reefs, shorelines, and communities are to the associated changes, such as increased sea surface temperatures and shifts in wave and weather patterns. Taken together, these studies provide insight into how the lagoon is likely to change over time and inform the sustainable use of lagoon resources.

6.1 Coastal Flooding and Inundation

FEMA current flood hazard zones are shown in **Appendix A, Map 17**. The CNMI Climate Change Working Group (CCWG) recently completed a community-based vulnerability assessment with the primary objective of identifying the social, physical, and natural features on Saipan that are most susceptible to the impacts of climate change (Greene and Skeele, 2014). Their assessment focused on the climate change impacts of projected sea level rise and rainfall patterns, and included the development of sea level rise models and coastal flooding maps, components of which are accessible using the [CNMI Climate Change Impact Viewer](#).

Figure 6.1 is an example of mapping from the CNMI Climate Impact Viewer that shows the extent of coastal flooding and inundation in the Tanapag Harbor area that would result from the storm surge of a 10-year storm (10% chance/year) in 50 years. The land uses and infrastructure that would be impacted include roads, the CPA Seaport, and CUC Power Plant. Flooding may also be experienced in tourist facilities, residential areas in Garapan and Tanapag, and Garapan Elementary School.



Figure 6.1: CNMI Climate Impact Viewer showing expected extent of coastal flooding north of Garapan in 50 years for the 10-yr storm (6.5 ft sea level change, with 1.6 feet from sea level rise and 4.9 from storm surge).

The 2014 report suggests “moderate-very high” hazard levels on Saipan’s west side shoreline. It also summarizes general impacts on infrastructure. For example, wastewater systems will be susceptible to “hydrologic complications” at lift stations and back-ups from coastal inundation. An outbreak of water-borne health consequences from such a scenario would expose Saipan’s hospital to significant risk.

6.2 Community Vulnerability Assessment

The CCWG held stakeholder workshops to inventory and qualitatively map Saipan’s vulnerable resources and conducted a quantitative evaluation of social vulnerability among Saipan’s villages. The “resources of concern” identified by stakeholders and the community as part of the vulnerability assessment included the following categories:

- Beaches and shoreline;
- Marine habitat and corals;
- Land cover, terrestrial habitat, and wetlands; and
- Critical and non-critical infrastructure.

The first two categories, beaches and shorelines and marine habitats and corals, are the most relevant to this SLUMP review because they are located physically within the lagoon. However, land cover, terrestrial habitat, wetlands, and critical and non-critical infrastructure are also important to the SLUMP process because of potential secondary water quality impacts.

A social vulnerability index was created for Saipan based on 22 social factors (e.g., income, building materials). The 2014 report states that the communities on the west coast of Saipan are generally more vulnerable to climate change, with particularly vulnerable areas around San Antonio and Chalan Kanoa. The lowest social vulnerability scores are found in the Capitol Hill area (see **Appendix A, Map 18**). A cumulative vulnerability rating (1= low, 5 = high) for Saipan focus areas was created by combining three indexes including community vulnerability assessment, coastal inundation, and social vulnerability. Results are summarized in **Table 6.1**, but they identify Garapan and the Lower Base Area as having the highest cumulative vulnerability.

Table 6.2 provides the overall vulnerability rating for each of seven focus areas examined in the vulnerability assessment and summarizes the specific resources of concern identified within each focus area.

Recommendations by Greene and Skeele (2014) for adapting Saipan’s natural and built environments) include:

- Establishment and growth of shoreline vegetation to ameliorate erosion particularly along Beach Road pathway and at Micro Beach (i.e., “living shorelines”);
- Encouraging strategic landscaping along threatened beaches;

- Promoting rotational use of non-permanent structures for beach-side recreation facilities;
- Upgrades to freshwater infrastructure and well facilities, as well as changes to withdrawal rates and pumping depths;
- Streamlining coastal adaptation with land use policy, such as:
 - Setback requirements that are adjusted to reflect varying degrees of vulnerability
 - Revising flood hazard zones to incorporate vulnerable areas and provide guidance for development
 - Promoting parks and other green spaces in vulnerable areas
 - Offering incentives for voluntarily adopting flood-resistant building codes
 - Prioritizing capital improvement projects in less vulnerable areas
- Implementing green infrastructure and other innovative stormwater technologies to manage flooding events;

A companion study to the vulnerability assessment addressed public knowledge and perception of climate change in the CNMI (Skeele & Okano, 2014). The community knowledge survey was aimed at identifying gaps in knowledge or misconceptions about climate change, correlating demographics and climate change knowledge, exploring how a better understanding of climate change affected residents’ emotions about the subject, and finding out where residents got information related to climate change. Many people expressed concerned about sea level rise, “disappearing islands,” floods, and typhoons. However, the study results demonstrated that confusion or uncertainty remained among those in the CNMI about climate change. Therefore the study recommended that education and outreach should be components of climate adaptation projects and should be made relevant to current events (such as recent floods or storms in the region).

Table 6.1: Summary of vulnerability ratings for focus areas on Saipan (Greene and Skeele, 2014).

Focus Area	Community VA Rating	Coastal Inundation Vulnerability	Social Vulnerability	Cumulative Vulnerability
San Antonio Area	2	2	4	2.7
Susupe-Chalan Kanoa Area	3	2	3	2.7
Beach Road - Oleai to Fishing Base	4	3	3	3.3
Garapan Area	5	5	2	4.0
Lower Base Area	5	5	3	4.3
Tanapag Area	2	4	3	3.0
Lao Lao and Kagman Area	2	1	2	1.7
Managaha Island	5	5	N/A	N/A

Table 6.2: Vulnerability rating and resources identified as vulnerable to climate change impacts for seven focus areas within or adjacent to the Saipan Lagoon (adapted from Greene & Skeele 2014).

Focus Area (North to South)	VA Cumulative Vulnerability Rating ⁽¹⁾	Resources of Concern			
		Beaches and Shoreline	Marine Habitats and Corals	Land Cover, Terrestrial Habitat & Wetlands	Critical and Non-Critical Infrastructure
Tanapag Area	3.0	<ul style="list-style-type: none"> boat ramp and pala palas 			<ul style="list-style-type: none"> entire village of Tanapag Santa Remedio Church private residences north of village
Lower-Base and Port Facilities	4.3	<ul style="list-style-type: none"> mangroves 			<ul style="list-style-type: none"> port, ship channel and turning basin Sewer lift station, two power plants, Lower-Base WWTF DLNR & DFW offices Puerto Rico dump
Mañagaha Island	5.0 ⁽²⁾	<ul style="list-style-type: none"> entire shoreline (erosion and accretion) 	<ul style="list-style-type: none"> MMCA thermal stress on nearby reefs 		
Garapan Area	4.0	<ul style="list-style-type: none"> recreational facilities of Hafa Adai, Fiesta, and Hyatt resorts American Memorial Park Smiling Cove and Outer Cove Marinas 		<ul style="list-style-type: none"> wetlands within American Memorial Park 	<ul style="list-style-type: none"> entire village of Garapan Fishing Base jetty and open space area Fiesta and Hafa Adai drainages and culverts Hafa Adai, Fiesta, and Hyatt resorts lift stations along main that borders American Memorial Park (esp. Navy Hill Rd at Middle Rd) Commonwealth Health Center
Oleai Beach to Fishing Base	3.3		<ul style="list-style-type: none"> Lighthouse Reed and Trochus Sanctuary 		<ul style="list-style-type: none"> Beach Path, Beach Road & coral roads connecting Beach Rd (inc. Gualo Rai Rd)
Susupe and Chalan-Kanoa	2.7	<ul style="list-style-type: none"> shifting shoreline from Susupe Beach Park to Aquarius Beach Towers 		<ul style="list-style-type: none"> Susupe wetland system flooding 	<ul style="list-style-type: none"> most of Chalan Kanoa and Susupe village, including west of Beach Rd Saipan Grand Hotel, World Resort Low-lying As Terlaje Rd Marianas High School, Ada Gym
Southwest Saipan (San Antonio Area)	2.7	<ul style="list-style-type: none"> erosion at Pacific Islands Club beach 		<ul style="list-style-type: none"> Susupe wetland system flooding 	<ul style="list-style-type: none"> residential parcels and Hopwood Jr. High on west side of Beach Rd sewer main along Beach Rd, lift station at southern end WWTP at Agingan Pt

Notes: (1) Cumulative vulnerability rating based on a combination of the community-based participatory assessment, the coastal inundation vulnerability assessment, and the social vulnerability index. Scale is 1-5, with 5 being the highest vulnerability.

(2) Mañagaha vulnerability rating based on only community-based participatory assessment and the coastal inundation vulnerability assessment (both of which were 5).

6.3 Reef Resilience

Coral reef “resilience” is the capacity of a reef to resist or recover from degradation, such as that caused by climate change, and to maintain ecosystem functions (Maynard et al., 2015a). Reef resilience has been the focus of recent research as marine resource managers attempt to address climate change impacts, such as increased coral bleaching events, more frequent typhoons that cause structural damage to reefs, and ocean acidification, as well as anthropogenic impacts (e.g., increased fishing pressure and land-based sources of pollution).

Maynard et al. (2012) compiled the results of a significant effort to assess coral reef resilience to climate change, specifically for the Island of Saipan. The study was the first field-based implementation of a method to evaluate relative reef resilience based on nine variables (coral diversity, bleaching resistance, recruitment, herbivore biomass, macroalgae cover, temperature variability, nutrient input, sedimentation, and fishing access). Thirty-five sites around Saipan were evaluated; 20 of these sites are within the SLUMP area (14 forereef and 6 lagoon locations), stretching from Wing Beach in the north to Agingan Point in the south.

Overall reef resilience scores for sites around Saipan were calculated based on the nine variables described above. The lagoon and forereef contain three sites with “low” resilience, 6 sites with “medium” resilience, and 11 sites with “high” resilience (**Figure 6.2**). In general, sites within the lagoon had lower resilience than those at the forereef. The study also evaluated the relative anthropogenic stress by averaging scores for nutrient input, sedimentation, and fishing access (as a proxy for fishing pressure). The SLUMP area contains 3 sites with “high” anthropogenic stress, 15 sites with “medium” anthropogenic stress, and 2 sites with “low” anthropogenic stress.

Maynard et al. (2012) provided some overall recommendations for reef management. For example, they suggested investing resources in protecting high resilience sites, given that those sites have the best chance of surviving under future climate change and anthropogenic impact scenarios. The study also suggested prioritizing sites with greater coral diversity and low macroalgae cover, improving overall water quality by reducing nutrient and sediment inputs to reefs, and protecting herbivorous fish populations particularly in those areas vulnerable to coral bleaching (e.g., by supporting and enforcing the existing gillnet and scuba-spear bans). Site-specific recommendations for management from Maynard et al. (2012) include:

- Reducing anthropogenic stress to the extent possible at the sites with the highest resilience potential. They also suggested that sites with greater coral diversity and low macroalgae cover deserve special consideration from managers as these may be high tourism value sites. Actions taken to improve water quality on reefs will affect the resilience of the most number of sites.
- Expenditure of limited resources on strong (high resilience) sites over weak (low resilience) sites under existing climate change conditions is preferred.

- Agingan Point and Oleai Rocks are strong candidates for fishing pressure studies, focused enforcement presence or area-based management (i.e., marine protected area status) because they have high resilience, but have high fishing access. These sites also have very high coral diversity which could benefit dive and snorkel operators.
- Given their high resilience, high coral cover and medium anthropogenic stress scores, Agingan Point, Point Break Reef, Wing Beach, Lighthouse Reef, and Elbow Reef may be considered for protection during management planning, although they are outside of the Lagoon. These sites could also be important for dive and snorkel operators.
- The report identified the seven most vulnerable sites, which had low scores for bleaching resistance, low herbivore biomass, and high fishing access based on wave exposure; six of these most vulnerable sites are located within the SLUMP area (Fishing Base Staghorn, Marianas Resort, Quartermaster Staghorn, Achugao, Pak Pak Beach, and Wing Beach). According to the study, these sites should be given special attention during management and conservation planning.
- The Marianas Resort, Quartermaster Staghorn, and Fishing Base Staghorn sites are also critical nursery habitats for fish and could be the focus of community monitoring programs, such as CoralWatch, and active restoration using cultured corals given their vulnerability and accessibility.

In 2015, Maynard et al. (2015a, 2015b) broadened the original 2012 study to include other islands in the CNMI. Because there was a larger number of sites, the relative resiliency scores at some sites changed from the 2012 scores. The 2015 study included individual site summaries for each reef location, including the 20 sites around the Saipan Lagoon, which are summarized in **Appendix C**. The 2015 study also served to strengthen the idea that expenditure of limited resources on strong (high resilience) sites over weak (low resilience) sites under existing climate change conditions is preferred. In addition, the 2015 study concluded that herbivore average functional group biomass was a primary driver in resilience potential across the CNMI; therefore management actions to maintain diverse herbivorous fish populations is likely to support resilience (Maynard et al., 2015a; 2015b).

This conclusion is further supported by a study of marine conservation strategies across Micronesia, which found that fishing pressure was a primary factor in ecosystem condition for the majority of islands and reef habitats (Houk et al., 2015). They recommended prioritizing management actions based on herbivore size and diversity, to best benefit ecosystem services in the face of climate change. Potential targeted management policies might include: regulating night-time spearfishing, exports, size-to-capture, and catch quotas (Houk et al. 2015).

Another climate change-associated threat that managers will have to contend with is the overall acidification of the ocean. The ocean absorbs a large proportion of atmospheric CO₂ emissions, resulting in decreases in seawater pH decreases and subsequently, the ability for organisms, such as corals, to sustain and build calcium carbonate skeletons. A recent study

looked at benthic community composition (coral relative to macroalgae) along a CO₂ gradient at Maug Island, CNMI, which has naturally-high CO₂ (and therefore low pH) levels due to volcanic vents in the vicinity of the coral reef habitat (Enochs et al., 2015). The site was selected as proxy for end of the century ocean conditions under current ocean acidification (OA) projections, allowing researchers to get an understanding of which species can tolerate future pH conditions. Ocean acidification is driven by CO₂ levels in the atmosphere and can therefore not be significantly impacted by SLUMP management. However, the study notes that understanding how specific taxa and reef assemblages respond to lowering pH can be useful to reef managers. For example:

- Some coral species were found in higher abundance near vents (e.g., *Leptastrea purpurea*) and are potentially OA-stress tolerant. Other species (e.g., *Goniastrea edwardsi*) were found in lower abundance than at the control site and may be more sensitive to OA stress; and
- Calcifying algae communities were also less abundant and less diverse near the vent when compared to the control site, and therefore may not be OA-tolerant.

Enochs et al. (2015) postulate that managers should prioritize sites for protection that have OA-tolerant corals and, if any coral restoration work is proposed, selection should weight towards of the most resilient coral species.

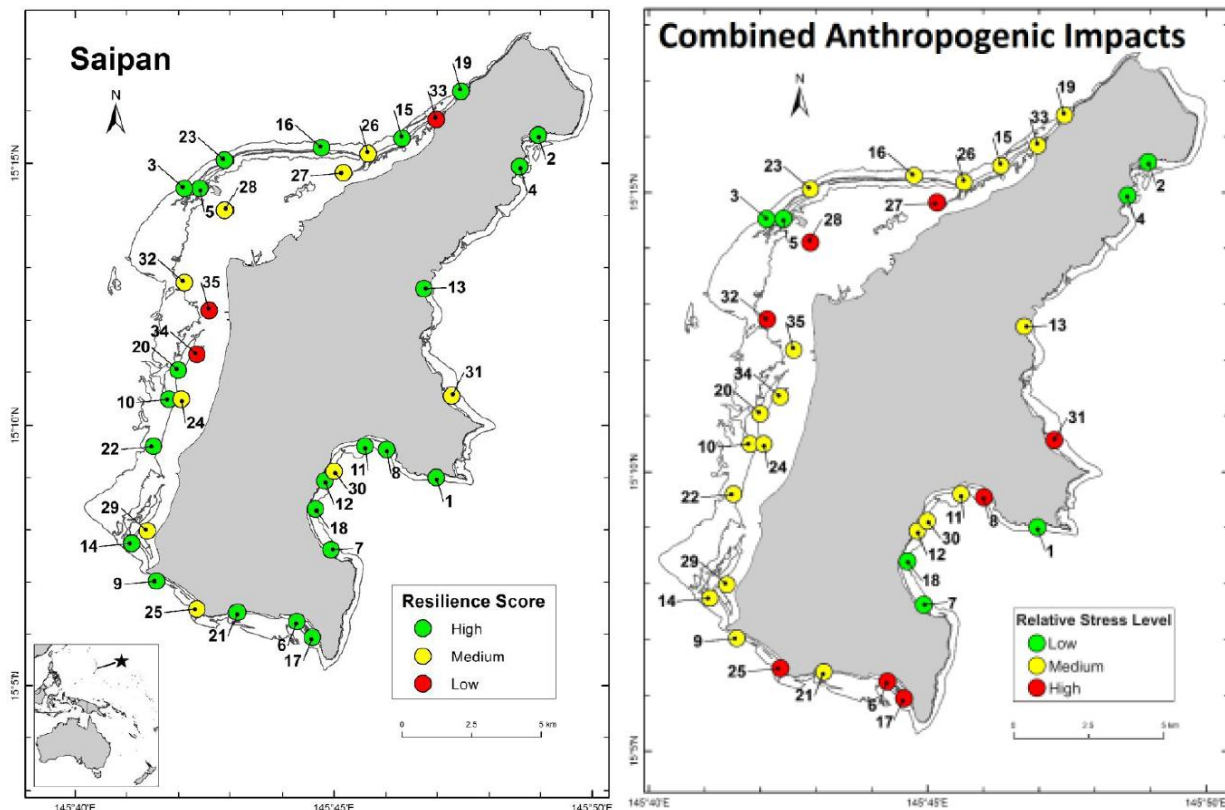


Figure 6.2: (Left) Overall reef resilience scores for study locations around Saipan. (Right) Relative anthropogenic stress levels based on nutrient input, sedimentation, and fishing access. From Maynard et al. (2012).

7.0 Management of the Lagoon

Lagoon use regulations and policies revolve primarily around user permits and fishing restrictions, marine protected area designations, permitting for activities impacting Areas of Particular Concern, and the SLUMP, which was formally recognized by the legislature and has been updated a number of times since its original inception. In response to a rapidly growing of tourism and commercial marine sports industry, BECQ placed a moratorium on new marine sports operations until additional information could be gathered to better evaluate the capacity of the lagoon to accommodate additional users.

7.1 SLUMP Retrospective

The 2017 SLUMP update builds on a plan that was originally laid out in 1985 by Duenas and Swavely, Inc., following a zoning/land use study conducted in 1984 by the Commonwealth that established the boundaries for the lagoon use management area. The 1985 SLUMP presented original and previously collected data about the lagoon, as well as specific plans, programs, policies and project recommendations for managing various lagoon uses and resources. In addition, the 1985 SLUMP provided a set of maps and lists of activities, land uses, and lagoon and shoreline characteristics.

The 1985 SLUMP was updated in 1997 (Duenas & Associates, Inc. 1997) to focus on planning and management issues relevant to that time. The 1997 update conducted a needs assessment and presented planning and management recommendations for water use zoning, development of Mañagaha Island, marine resources, marina improvements, coastal parks and recreation areas, permitting and land use planning, and stormwater runoff and lagoon water quality. The 1997 SLUMP also presented surveys of sea cucumber and fish in the lagoon, an early-generation GIS map, and a public awareness program.

A second update of the SLUMP was completed in 2012 by Tetra Tech, primarily to address user conflicts associated with motorized water recreational craft/personal watercraft (MWRC/PWC), which were become increasingly common. The 2012 update provides little in the way of additional research on the lagoon, but does provide a list of the type of activities conducted by individual commercial operators, as well as regulatory recommendations for MWRC/PWC use.

The following is a summary of the recommendations presented in the prior SLUMPs grouped into categories.

Personal Water Craft/Motorized Water Recreational Craft

The 2012 SLUMP provides a number of overarching regulatory recommendations, including:

- Update terminology in CNMI regulations to match federal definitions for PWC, navigation aids, etc.;
- Clarify that vessel operations requirements extend only to lagoon, not territorial- wide;
- Define ingress and egress corridors to outer reef margin on the SLUMP map for PWC;

- MPAs are least suitable areas for MWRC; most suitable areas are already being used; recommend allowing emergency use of MWRCs in prohibited areas by safety/response personnel;
- Expand designated SLUMP area; and
- Create standard operating procedures for how various agencies will administer different policies, programs, enforcement, etc within the SLUMP. For example, the CRM Office will coordinate all recreational management activities in the area and will oversee the promulgation of rules to address management needs of the Plan; DLNR will be responsible for fish and wildlife resources, DPS will be responsible for MWRC safety, search and rescue operations, surface and underwater use, and rules governing MWRC use.

More specific criteria for PWC/MWRC operations were also recommended in the 2012 update, including, but not limited to:

- Operating hours are limited to 1 hr after sunrise to 1 hr before sunset;
- Dinner boat cruises must operate after PWC/MWRC hours and within defined dinner boat course;
- Establish 5 mile per hour/no wake areas;
- Responsibility for who sets markers-Vendors place removable markers on permanent anchors, as approved by CRM;
- Prohibited operators (i.e., Sea planes);
- Seasonal restrictions to allow for fishing;
- Fees, permits, and age restrictions; and
- Setbacks- Can't fish within 100 ft of jet ski course; can't windsurf within 100 ft of shoreline or within 100ft of dive flag, etc.

Recommendations were not provided on limiting the number of PWC/MWRC that can be in the lagoon or course at the same time or on a daily basis. It is unclear if there is a cap on the number of commercial permits or individual licenses, or on how many courses can be created.

Water Use Zones

The 1997 SLUMP presented a map of "Proposed Water Use Zones" developed for the purpose of enhancing the safety of watercraft users in the lagoon, as well as to assure that all water oriented activities are fully accommodated in the lagoon. The map was developed based on six 'prerequisite conditions:"

- Provide at least one area in the lagoon for each commercial and public recreation pursuit;
- Restrict shipping channel and Tanapag Harbor turning basin to vessel transiting;
- Protect and establish underwater attractions such as wrecks and designate marine parks;
- Protect sensitive underwater marine resources (hard corals, seagrass beds, fish breeding areas);

- Provide areas immediately offshore from hotels for swimming, snorkeling and wading; and
- Establish a north-south fairway for watercraft to transit between the Tanapag channel and the Agingan area.

The 1985 SLUMP recommended the development of recreation use zones for the lagoon as well, specifically the designation of Public Recreation Zones along the shoreline of the Saipan Lagoon. The Maps in Section III of the 1985 SLUMP, though difficult to decipher, identify locations where existing activities take place within and around the Saipan Lagoon, and proposed locations for certain additional activities. However, these are not delimited as use zones in the sense of a traditional zoning map. The 1985 SLUMP also recommended the establishment of water recreation zones in shallow waters in front of Micro Beach, Puntan Susupe and Mañagaha Island to eliminate the congestion and public safety hazards of multiple uses in these areas.

Marine Protected Uses

The 1997 SLUMP included, by reference, two biological surveys completed for sea cucumbers and fish resources, along with a habitat map. This information was presented in a report, submitted separately as a Work Product of the 1997 SLUMP, entitled *Saipan Lagoon Use Management Plan, Survey of Sea Cucumbers and Fish in the Saipan Lagoon, Northern Mariana Islands* (June 1997). No recommendations were included in the 1997 SLUMP with regard to marine resources.

Mañagaha Island

The 1997 SLUMP included a set of recommended development policies for Mañagaha Island and nearshore waters, including:

- Minimize permanent structures;
- Solid water disposal at approved site on Saipan only;
- Maintenance of all existing structures and manmade features;
- Restriction against all motorized watercraft and anchoring within 100 meters of shoreline;
- Staffing by Two Park Rangers as GNMI employees;
- Restriction against facilities within 150 feet of the high water mark of a sandy beach, except at the area of covered picnic table open to public use;
- Discontinuation of outbound shuttle and Mañagaha Island activities upon declaration of Typhoon Condition II or public safety risk conditions;
- Island wide cultural event scheduling by the GNMI on no more than 2 days per calendar year, with at least 30 days notice to all concessionaires; and
- Prohibited activities and developments: fueling facility, solid waste disposal, overnight activities, destruction or taking of plants, vegetation and historical, cultural resources.

The 1997 SLUMP also included a set of conditions, reflecting the recommendations above, to be applied to the Master Concession for Mañagaha, which was bid out in 1998 (it is worth noting that the bid period is coming up again). While primarily geared toward safety and services on the island, the conditions also include tasks to conduct an island-wide archaeological survey and develop the “Mañagaha Marine Preserve and Underwater Trail” per the Mañagaha Island Marine Park Management Plan (Pacific Basin Environmental Consultants, 1985).

Marinas

- Moorings for commercial boats operating in the lagoon. There had been a dire need for additional moorings in the 1990s. However, just prior to the 1997 SLUMP, the Outer Cove Marina Project was approved for construction, which was intended to address this need. Since that time, use of the Outer Cove marina has been heavily restricted due to typhoon impacts, therefore, the majority of launches are still through Smiling Cover/Fishing Base.
- Recreational Boating Facilities. With the development of the Outer Cover Marina, more slips (approximately 15) at the existing Smiling Cove Marina would become available for recreational boats as commercial boats transition to Outer Cover Marina. The 1997 SLUMP recommended that the Smiling Cove Marina be improved and the 15 new available slips be dedicated to recreational boats.
- Boat Haul-Out Facilities. The 1997 SLUMP recommended that the government lease suitable coastal property for the construction of a permanent haul-out facility for all boat types, to address the severe need for such permanent facilities at the time of the SLUMP.
- Harbor of Refuge. There was no boaters’ harbor of refuge to safely wait out a typhoon or severe weather, so the 1997 SLUMP recommended a consultant study to determine how to improve both Smiling Cove and Outer Cover Marinas to convert them both to harbors of refuge.

Coastal Parks and Recreation Areas

- Transfer of existing beach parks to Division of Parks and Recreation (DPR). The 1997 SLUMP supported this transfer from Division of Public Lands (DLNR) to DPR to ensure that parks remain as parks and are not converted to other uses. House Resolution No. 10-33 (May 24, 1996) sought to address this issue, but had not been acted upon because the lands need to first be surveyed and mapped.
- Saipan Lagoon Shoreline Park and Recreation Plan. There had been increased user stress on the beach park facilities in the 1990’s as a result of population growth and visitor use. The 1997 SLUMP recommended the development of a Saipan Lagoon Shoreline Park and Recreation Plan as a facilities plan to identify and plan for necessary upgrades for existing parks facilities and a new beach park at Afetna Beach. A basic scope of work for the development of this plan was included in the SLUMP. This

recommendation built on similar recommendations in the 1985 SLUMP which had not yet been implemented.

- Adopt-A-Park Program. The 1997 SLUMP recommended developing an adopt-a-park program to support the ongoing needed maintenance at DPR public parks, and provided basic guidelines for such a program.
- The 1985 SLUMP recommended the development of a shoreline bicycle route from Wing Beach to Unai Afetna, ranging from stabilized roadway shoulders to new bikeways exclusively for bikers.
- The 1985 SLUMP also included in this category a recommendation that CNMI develop a soil erosion and sedimentation control manual; the SLUMP included a scope of work for this project.
- The 1985 SLUMP also recommended the development of regulations for what was categorized as beach restoration activities, including dredging, diking and landfilling along coastal areas, structures located in near-shore and beach strand ecological zones, and mining along the coastal strands.

CRM Permitting and Land Use Planning and Regulation

- Performance Standards for Permits. The 1997 SLUMP recommended the development of an island-wide economic development plan so that the permit process for development and uses could be aligned with a broader vision for the island, rather than undertaken as individual activities. It also recommended that more objectivity be instilled into the permit decisions through the adoption and use of more detailed standards. At the time of the 1997 SLUMP, the 1993 Saipan Zoning Law (Public Law #6-32, as amended by Public Law #7-41 and Public Law #8-10) and Comprehensive Land Use Plan had been suspended, so the SLUMP recommended that standards from that law and plan be adopted and applied by the CRM. The specific performance standards recommended for use were Article Six “Site Landscaping and Bufferyard Performance Standards,” Article Seven “Parking, Loading and Road Access Requirements,” and Article Eight “Signs and Lighting.” This recommendation was carried over in the 2012 update.
- Future Use of Puerto Rico Dumpsite. The Puerto Rico dumpsite was slated to close in 1998, and the 1997 SLUMP recommended a study to evaluate the extent of cleanup needs and reuse opportunities for the site. The dumpsite is well situated for access for the tourism industry as well as seaport uses. The dumpsite has been closed and converted to a park.

The 1995 SLUMP recommended land use regulations along the shoreline. These included:

- Shoreline setback (0-35 feet, 35-75 feet, 75-100 feet and over 100 feet) in which the types and heights of structures would be limited.
- Lot coverage limits and minimum open space requirements in the Commercial and Resort zones.

- Setback and building height limitations in the Commercial and Resort Zones.
- Regulation of allowable fencing (height, width, location, use, and materials) within 75 feet of the mean high water line.

Stormwater Runoff and Lagoon Water Quality

The 1997 SLUMP had a significant focus on improving stormwater management and incorporating stormwater treatment practices to remove pollutants from runoff, a change from the traditional drainage approach which had been entirely focused on collecting and disposing of runoff as quickly as possible. The 1997 SLUMP recommendations included:

- Develop a drainage infrastructure master plan, which would include water quality best management practice (BMP) design and construction standards, and would include the planning, design and construction of regional or watershed scale drainage systems.
- Conduct studies of urban runoff to characterize the water quality in urban runoff, investigate the potential for contamination of groundwater by infiltration of urban runoff, and establish baseline data for the effectiveness of stormwater BMPs in removing pollutants. The SLUMP references several studies done by Zolan et al. in Guam in the late 1970s as good examples of the type of assessment that should be performed in Saipan.
- Develop requirements for the use of water quality BMPs to treat stormwater runoff from new developments, beginning with commercial and industrial developments and eventually expanding over a 5-year period to address other land uses.

The 1997 SLUMP did not address the water quality in the lagoon itself, but instead focused solely on stormwater. A stormwater standards and design manual was developed in 2006 that includes post construction water quality and recharge criteria (among other standards) for new development and redevelopment projects, as well as standards for erosion control during construction.

Infrastructure Planning

The 1985 SLUMP recommends several scopes of work to improve infrastructure planning in Saipan, including:

- Updating the water facilities plan;
- Updating the wastewater facilities plan;
- Developing storm drainage design criteria manual; and
- Developing stormwater and infrastructure planning criteria to assess impacts from future development.

As described earlier, the 1997 SLUMP builds on the storm drainage design criteria manual recommendation with the recommendation to establish stormwater water quality BMP requirements.

Energy Facilities Planning

The 1985 SLUMP included a set of recommended criteria for siting different types of energy facilities along the Saipan Lagoon shoreline, including conventional oil fired energy facilities, coal fired energy facilities, biomass fueled energy facilities, and solar salt gradient energy facilities.

7.2 Designated Conservation Areas

Within the SLUMP boundary, there are two designated conservation areas: Mañagaha Marine Conservation Area (MMCA) surrounding Mañagaha Island and the Lighthouse Reef Trochus Sanctuary south of Garapan Dock (see **Appendix A, Map 15**). These conservation areas were designated for different reasons and therefore provide different levels of restriction for use and protection of marine life.

Mañagaha Marine Conservation Area (MMCA)

Mañagaha Island is a 10-acre island located 1.6 miles offshore of the Tanapag Harbor area, and is surrounded by a shallow, high quality lagoon environment. This area is important for its cultural history, its ecosystem function, and its economic value as a tourist attraction. Hundreds of visitors use Mañagaha Island most days of the year. Given this intense use and the rich natural resources, management of this area has been of utmost importance.

The MMCA was created with the enactment of CNMI Public Law 12-12, The Mañagaha Marine Conservation Act of 2000, to protect the historical, cultural, and natural resources of the island and surrounding waters. The act designated the MMCA through management programs to ensure that the area continues to support marine life and provide recreational and educational uses for locals and visitors (CNMI 2000). The MMCA is managed under the guidelines of the 2005 *Management Plan for the Mañagaha Island Marine Conservation Area* (2005 MMCA Plan) that describes: 1) existing conditions within the MMCA; 2) mandates and responsibilities of management agencies; 3) uses; 4) management plan goals; 5) and the objectives, and strategies, and implementation of those strategies.

The MMCA is quadrilateral in shape and includes roughly 1,235 acres within the northern Tanapag section of the lagoon (roughly 12% of the entire Saipan Lagoon) (see **Figure 7.1** and **Appendix A, Map 15**). The island itself remains uninhabited but has important flora and fauna, including nesting habitat for the rare wedge-tail shearwater. The marine environment MMCA is characterized by shallow water with reef flat, patch reefs, sand flats and rubble zones, all of which is protected on the west by a barrier reef. At least 240 species of stony coral, 31 species of soft coral and sea fans, 100 species of fish, and green sea turtles inhabit the MMCA.

The MMCA also contains several WWII-era wrecks, bunkers, and other relics that are used as dive and snorkel sites. In addition, the island is the burial site of Chief Aghurubw, who established the first Carolinian settlement on Saipan during the Spanish colonial period. At least 28 species of medicinal plants are present on the island, many of which are thought to have been established and cultivated by Carolinian inhabitants.

Visitor services on the island include a pier, public shelters, a trail, and commercial buildings to provide food services, restrooms, showers, visitor information areas, vendor sales, equipment rentals, offices, and storage. Temporary recreational structures are also present such as a beach volleyball court, a swimming area marked with buoys, a trampoline and a portable rock climbing wall. There is a US Coast Guard light used for marine navigation on the island. Every five years, there is competitive bidding for exclusive rights to operate the recreational concessions on Mañagaha Island; the selected concessionaire must abide by a set of conditions about use and care of the island.

The MMCA is a “no-take” area. No harvesting or catching of fish or other marine life or other natural resources is allowed, except as approved for scientific research, education, or cultural practices. In addition, no motorized or non-motorized watercraft is permitted within the MMCA except as allowed by regulation for enforcement, scientific research, recreation, educational purpose, or the transport of people to and from the island. The DFW may prohibit activities that have a significant negative impact on the MMCA, and they can assess fines to violators.

The 2005 MMCA Plan discusses proposed “management zones” to be established (Schroer, 2005), including a Motorized Vehicle Zone to limit the area where motorized boats can be used, a Commercial Facility Zone to contain commercial operations, and a potential “No Entry Zone” to protect specific resources, such as bird nesting sites (see **Figures 7.1** and **7.2**). As of 2005, regulations to establish these management zones had not been developed or implemented.

The 2005 MMCA Plan also outlined five management goals:

- Develop and promulgate regulations and permit fees, and develop visitor use guidelines.
- Dedicate staff and resources to implement plan and to enforce regulations.
- Survey and monitor natural, cultural, and historic resources, as well as visitor uses to assess their status over time.
- Provide outreach to visitors about the MMCA resources and their potential impacts on those resources.
- Annually evaluate the effectiveness of the MMCA management and regulations.

At this time, it is unclear the extent to which the implementation strategies outlined in the management plan have been enacted to achieve these stated goals. An update on the status of these management goals would help to guide the SLUMP process as it pertains to the MMCA.

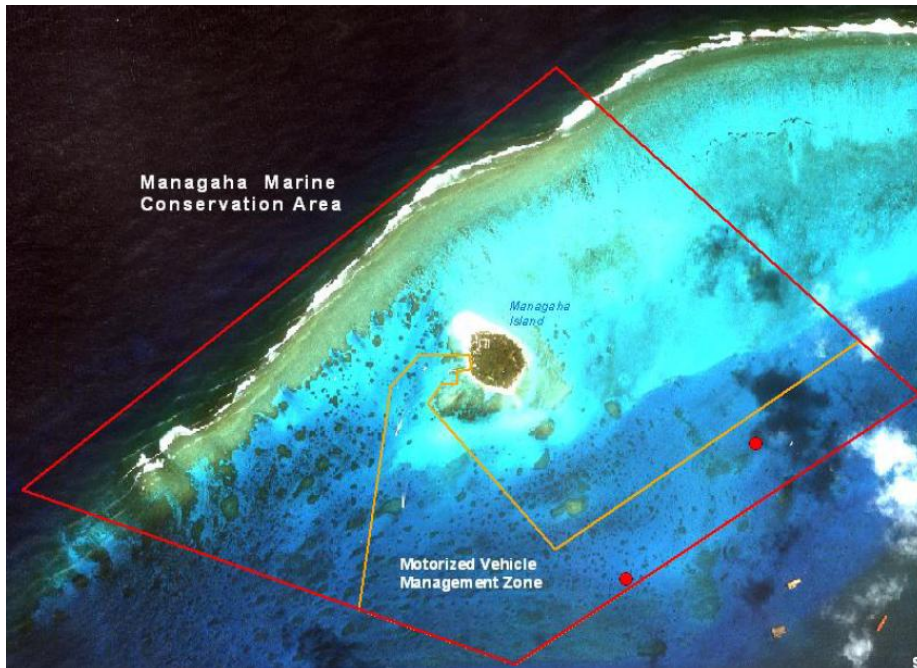


Figure 7.1: 2005 proposed Motorized Vehicle Management Zone for the MMCA (Schroer 2005).

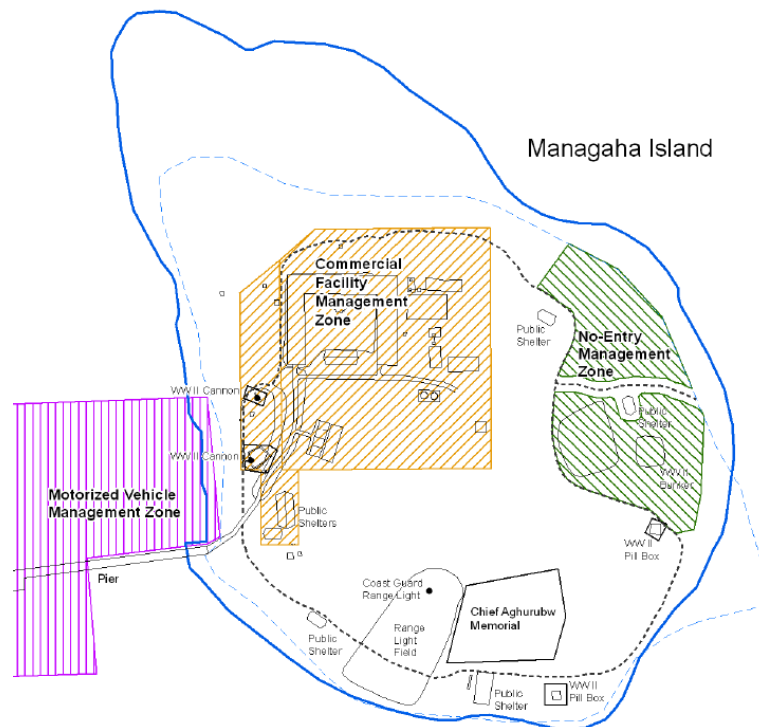


Figure 7.2: 2005 proposed management zones for Mañagaha Island (Schroer 2005).

Lighthouse Reef Trochus Sanctuary

The topshell trochus (*Trochus niloticus*) is a species of sea snail with a striped shell that grows to be roughly two to six inches in diameter and lives in fringing reef and reef flat environments, including the Saipan lagoon and fringing reef. The trochus is a food source and was introduced to Saipan in 1938. Overharvesting of the trochus led to a 1981 CNMI-wide moratorium on harvesting this species and to the establishment of the Lighthouse Reef Trochus Sanctuary.

The Lighthouse Reef Trochus Sanctuary is a quadrilateral area extending from the lighthouse that marks the Garapan Channel south for one mile (see **Appendix A, Map 15**). The sanctuary extends from the inshore edge of the reef to the 40-foot depth contour. The only rule within the sanctuary is a prohibition on harvesting trochus. The CNMI-wide moratorium is still in effect (§85-30.1-415), but the Sanctuary exists to provide a protected area for trochus growth and reproduction should the moratorium be lifted in the future.

7.3 Regulations and Permitting

Primarily, regulations and permitting most relevant to SLUMP are the marine sports permitting under DCRM and the fishing regulations under the Division of Fish and Wildlife (DFW). Parks and Recreation and the Department of Public Safety have rules for beach park use and boating safety, respectively that are also relevant. For example, Sections 101 and 102 of the 1987 Boating Safety Regulations, list specific provisions related to the operation of watercrafts near the lagoon shoreline and designated swimming areas:

- *No person shall operate a motorboat, aqua-plane, or watercraft of any description at a speed greater than five (5) miles per hour within 200 yards of the shore.*
- *No person shall operate a motorboat towing a person on water skis, surfboard or similar device within 200 yards of the shore.*
- *No person shall operate a watercraft or vessel of any description within a swimming zone.*
- *No person shall operate a watercraft or vessel of any description at a speed of greater than five (5) miles per hour within 200 yards of any swimming zone (Commonwealth Register. Vol 9. No 1. January 19, 1987. Page 4855).*

In addition, the 2005 Management Plan for the Mañagaha Marine Conservation Area, prohibits the operation of “watercrafts with the use of motors on or in water, including boats and submersible vessels” outside of the mapped Motorized Vehicle Management Zone.

Regulations guiding shoreline and upland development (e.g., zoning, stormwater, wastewater) involve a host of other agencies (BECQ, DFW, DPW, DPL, MPLA, CUC, Army Corps, EPA, USFWS, etc.), and were not thoroughly reviewed at this time. For example DLNR and DPL have an interest in the management of Mañagaha island, including revegetation and shoreline stabilization. Commercial shipping regulations are likely beyond the scope of the SLUMP.

DCRM regulations include: CNMI Administration Code (AC) 15-10 Coastal Resources Rules and Regulations (currently being updated), which sets standards for the DCRM program in implementing its responsibilities; and CNMI AC 15-20, Jet Ski Rules and Regulations, which specifically regulates use of jet skis in the lagoon. DFW is responsible for conserving, protecting and enhancing the fish, game and wildlife resource of the CNMI for the benefit of its citizens. DFW established the Non-Commercial Fish and Wildlife Regulations (CNMI AC 85-30.1) to set standards for implementing their responsibilities.

Marine Sports Operator Permits

CNMI AC 15-10-1600 gives DCRM the right and responsibility to permit all commercial water sports activities in the CNMI. DCRM does this through the issuance of Marine Sports Operator (MSO) permits. MSO permits are issued for the following activities: jet skis; banana boat operators; parasailing activities; SCUBA tour operators; snorkel tour operators; seawalker, DWKs, and hydro bob operators; other marine sports activities; and waterskiing/wakeboarding. There is currently a moratorium on new MSO permits pending guidance from the 2017 SLUMP update. All jet ski operations are further regulated under CNMI AC 15-20, which:

- Sets up exclusion areas (applicable to both commercial and recreational jet skiing),
- Defines launching and landing locations,
- Sets requirements for the use of marked courses in areas of the lagoon adjacent to the launching and landing locations, and
- Mandates hours of operation (8 am to 6 pm).

For water skiing, CNMI AC 15-2-301 states that waterskiing is not allowed in the Mañagaha jet ski exclusion area. In addition, DCRM has set up defined areas of the lagoon for parasailing and banana boating (**Figures 7.3 and 7.4**, and **Appendix A, Map 15**). There appear to be some minor differences between the 2005 map (Figure 7.4) and the current map (Figure 7.3). It is not clear if there is similar legislation that defines these use areas. In addition, according to Public Law 3-61, it is unlawful to drive a car or motorcycle on a public beach in the CNMI.

Fishing

DFW manages recreational fishing in the SLUMP area largely through gear and harvest restrictions. Almost all commercial fishing operations occur outside of the SLUMP area (APEC, 2016). Recreational fishermen must obtain a Fishing, Harvesting, and Hunting Permit from DFW for some activities prior to extracting resources from the SLUMP area, including use of certain nets, scientific research, importation, collection of dead coral to produce calcium carbonate (afuk), and aquarium collection. **Table 7.1** summarizes the types of fishing that are allowed and prohibited in the SLUMP area, as well current moratoriums, no-take zones, and other restrictions.

DCRM Permitted Marine Activities

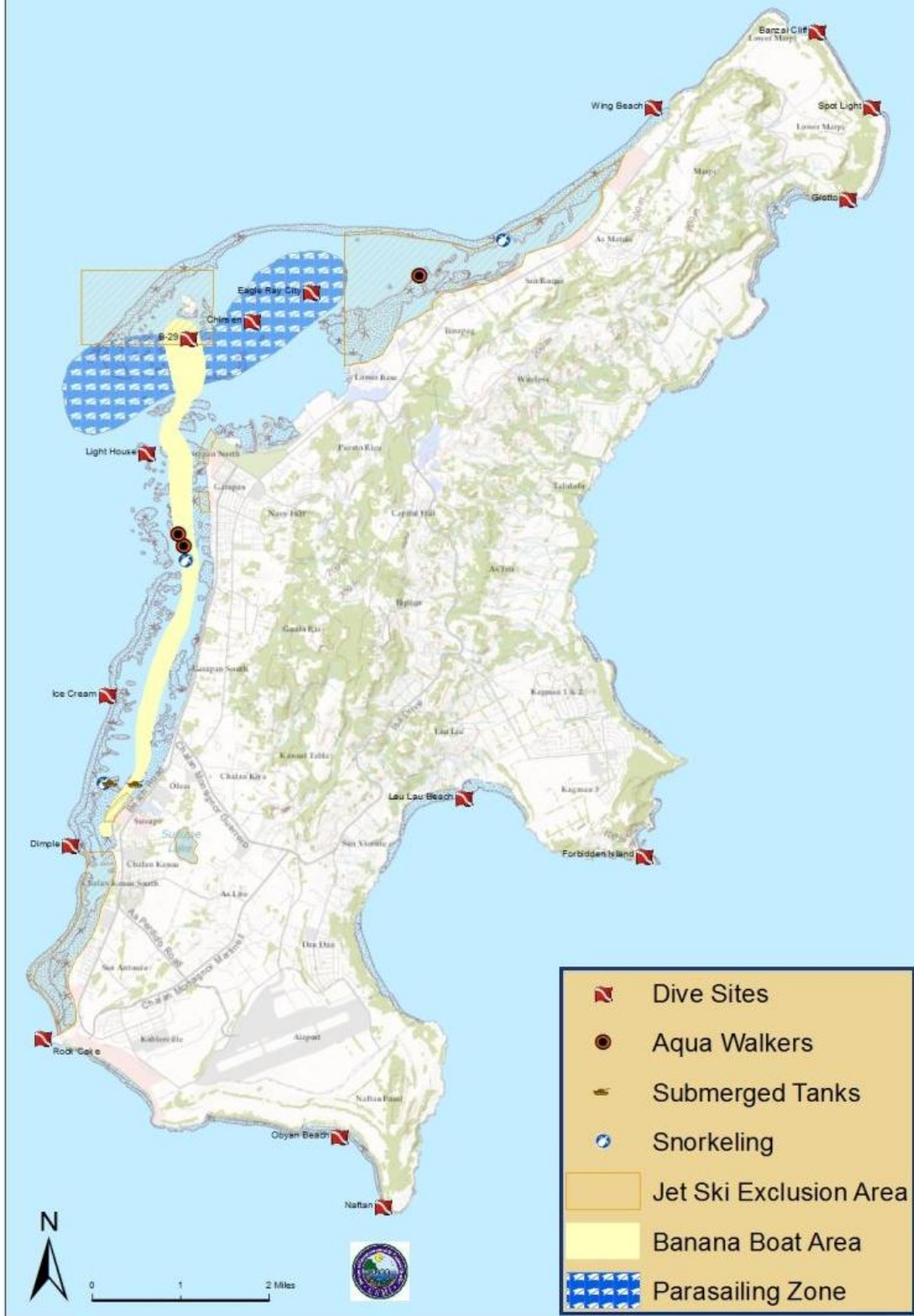


Figure 7.3: Current map of DCRM permitted marine sports areas (www.crm.gov.mp/sec.asp?seclD=24).

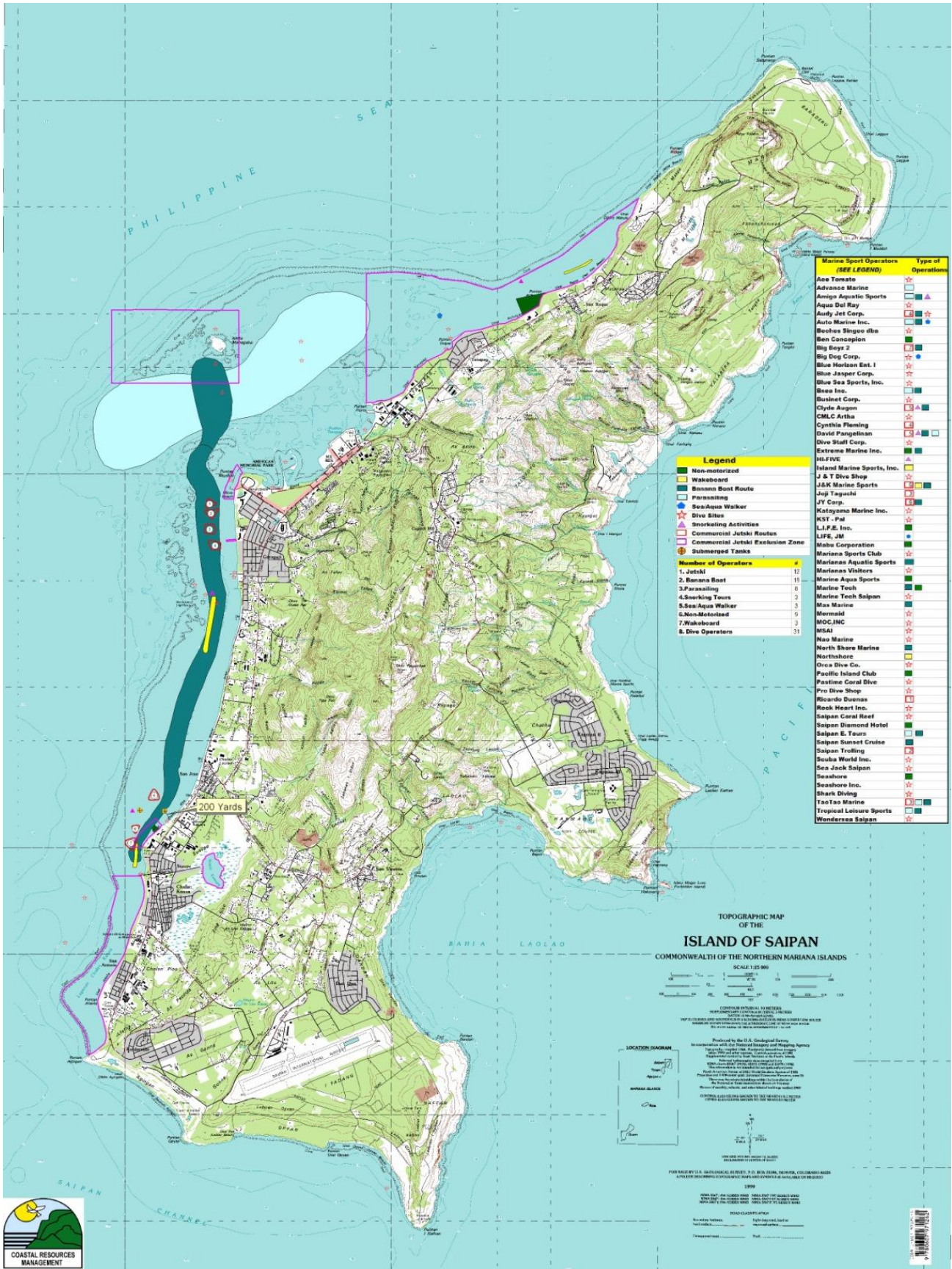


Figure 7.4: 2005 CRM marine sports zones in the Saipan lagoon (from 2012 SLUMP). Note use areas identified south of Wing Beach.

Table 7.1: Summary of fishing restrictions for the SLUMP area.

Allowable Fishing Methods	Prohibited Fishing Methods	Fishing Moratoriums	No-Take Zones	Other
Throw net (talaya), cast net, scoop net, landing net (permit required)	Drag net/beach seine (chenchulun and lagua), trap net (chenchulun managam), surround net (chenchulun umesugon), gill net (tekkeng) CNMI Public Law 12-14; § 85-30.1-420	Coral (except by permit for scientific research or for manufacture of calcium carbonate by collection of dead coral (afuk)) NMIAC §85-30.1-410	Mañagaha Marine Conservation Area §85-30.1-450	Lobster harvest requirement: -hand caught only -must be at least 3” from ridge between 2 largest spines to rear edge of carapace -no lobsters with eggs -no lobsters that have been stripped of eggs §85-30.1-425
Hand reel, rod and reel, spear fishing, gleaning (harvesting by hand), trolling, bottom fishing, cliff fishing	Explosives, poisons (e.g., cyanide, bleach, Derris, Saponin), electric shocking devices, SCUBA-assisted fishing, Hookah CNMI Public Law 12-14; §85-30.1-401	Trochus (<i>Trochus niloticus</i>) §85-30.1-415	Lighthouse Reef Trochus Sanctuary (trochus only) §85-30.1-415	Aquarium fish: -for personal use only -may not be sold or exported -permit required -poisons not allowed -caught with certain hand nets or barbless hook & line §85-30.1-445
		Non-commercially grown seaweed, sea grass, sea cucumber or other edible echinoderms CNMI Public Law 15-41; §85-30.1-420		Import and introduction: -permit required -must comply with CITES -no non-native species -no introduction of amphibians or reptiles or harmful invertebrates §85-30.1-501; §85-30.1-505

Citizen Reporting of Violations

DCRM has set up an “app” for smartphones, and corresponding website, called [Reef Report](#) that allows citizens to easily and anonymously report a violation of rules and regulations related to coastal resources. This enables citizens to be the eyes and ears of DCRM and other regulatory agencies for reporting problems such as illegal fishing, pollution, trash and debris, and illegal activities (e.g., driving on the beach). With the app, users can take a photo of the problem, map their location, and report the issue to DCRM. The *Reef Report* promotes a sense of ownership and environmental stewardship for citizens of Saipan, especially in young people who would be more apt to use this type of technology.

Development in the Coastal Zone

Any development project that is located wholly or partially within an Area of Particular Concern (APC) must have a valid permit with DCRM. An APC is defined at CNMI AC 15-10-020(h) as, “a delineated geographic area included within DCRM jurisdiction that is subject to special management because of its unique and important environmental properties, and is subject to specific criteria permit evaluations.” There are five APCs in the CNMI:

1. Shoreline APC: The area between the mean high water mark (MHW) or cliff line and 150 feet inland;
2. Lagoon & Reef APC: The area extending seaward from the MHW to the outer slope of the reef;
3. Wetlands & Mangrove APC: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.
4. Port & Industrial APC: Those land and water areas surrounding the commercial ports of Saipan, Tinian, and Rota; and
5. Coastal Hazards APC: Those areas identified as a coastal flood hazard zones (V & VE) in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps.

There are three types of DCRM permits for development:

- *Temporary permits for emergency repairs* during or immediately after an environmentally destructive event, such as a typhoon, tsunami, storm, earthquake, shipwreck, or oil/hazardous material spill. This type of temporary permit is only issued if the proposed repair is necessary to prevent immediate damage or injury to people, structures, vessels, or the environment. Repair is limited to the existing structures.
- Permits for *major sitings* are projects that may directly or significantly affect coastal resources, and may include projects situated outside of the APCs that could still effect an APC (e.g., water quality impacts).
- *APC permits* are for minor development or standard APC activities that are more extensive than minor development but less extensive than a major siting within “Areas of Particular Concern” as outlined above.

For all major siting and APC permits, the applicant must demonstrate that the project will not have a significant adverse impact on the coastal environment or its resources. Adverse impacts, defined at §15-10-020(c), include:

- Water quality impacts that would impair biological resources,
- Accumulation of toxins that would threatened humans or aquatic life,
- Disruption of “ecological balance” in coastal waters,
- Addition of man-made structures whose impacts are largely unknown,
- Disruption or burial of bottom communities, and
- Interference with traditional fishing activities.

If adverse impacts are likely to have a significant negative impact on coastal resources within an APC, avoidance, minimization, and mitigation of impacts is required. Specific criteria for each APC must also be met to obtain a permit (§15-10-315 to §15-10-345). In addition, §15-10-350 has requirements for shoreline setbacks, building height, lot coverage density, and parking in applicable APCs.

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8. Wetlands & Mangrove APC: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.
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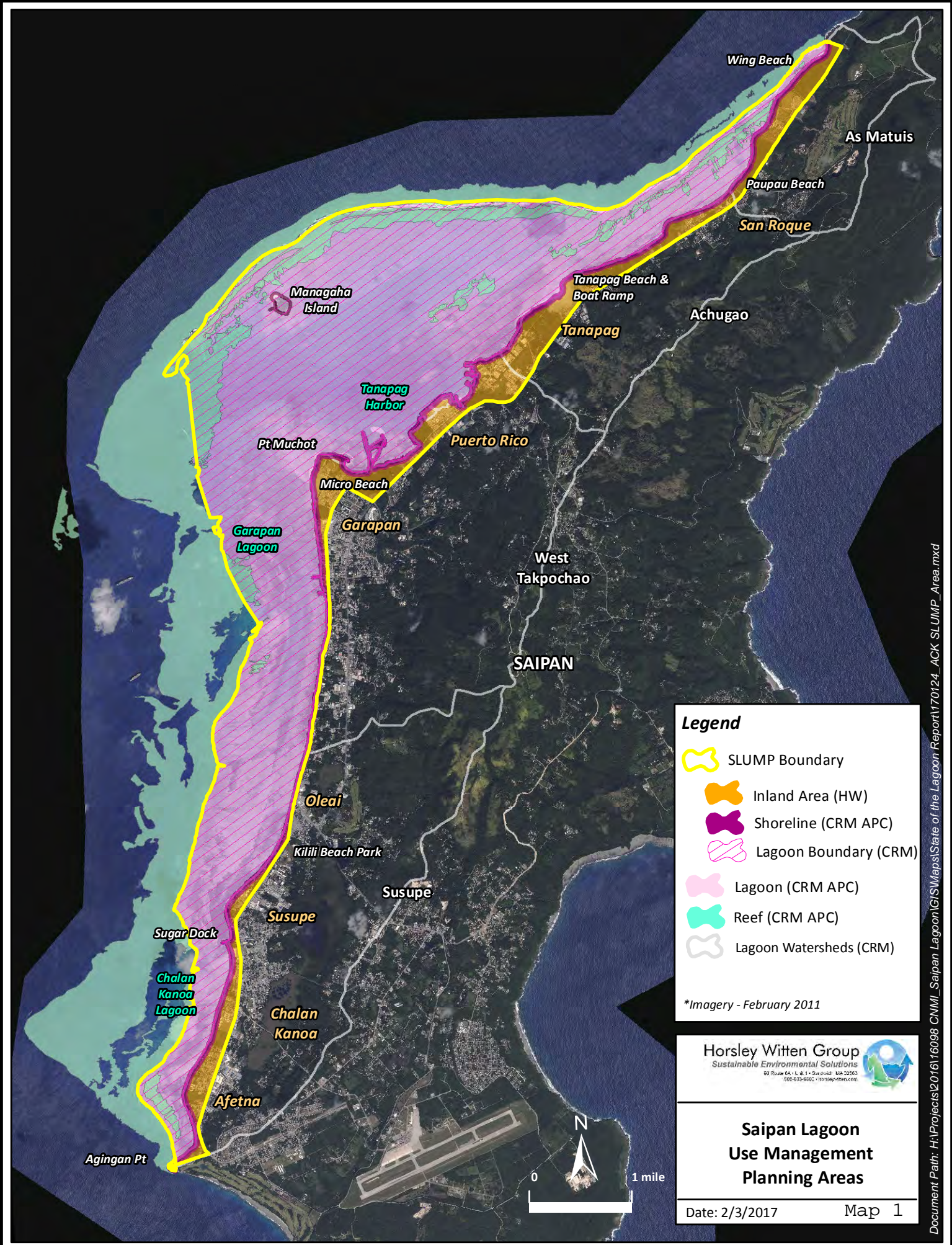
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Appendix A

Saipan Lagoon Map Library



Legend

- SLUMP Boundary
- Inland Area (HW)
- Shoreline (CRM APC)
- Lagoon Boundary (CRM)
- Lagoon (CRM APC)
- Reef (CRM APC)
- Lagoon Watersheds (CRM)

**Imagery - February 2011*

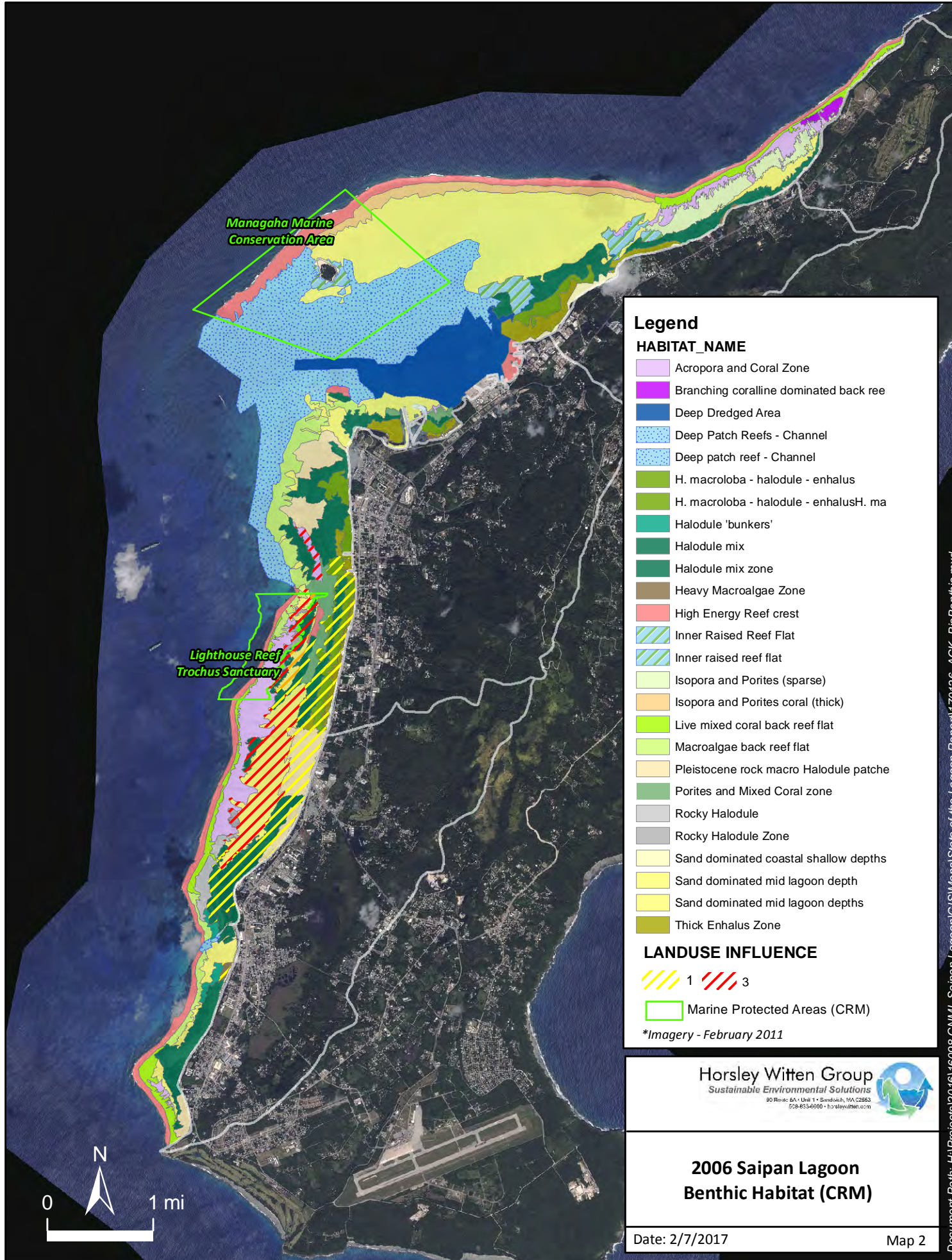
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**Saipan Lagoon
 Use Management
 Planning Areas**

Date: 2/3/2017 Map 1

Document Path: H:\Projects\2016\16098 CNM - Saipan Lagoon\GIS\Maps\State of the Lagoon Report\70124_ACK SLUMP_Area.mxd



Legend

HABITAT_NAME

- Acropora and Coral Zone
- Branching coralline dominated back reef
- Deep Dredged Area
- Deep Patch Reefs - Channel
- Deep patch reef - Channel
- H. macroloba - halodule - enhalus
- H. macroloba - halodule - enhalusH. ma
- Halodule 'bunkers'
- Halodule mix
- Halodule mix zone
- Heavy Macroalgae Zone
- High Energy Reef crest
- Inner Raised Reef Flat
- Inner raised reef flat
- Isopora and Porites (sparse)
- Isopora and Porites coral (thick)
- Live mixed coral back reef flat
- Macroalgae back reef flat
- Pleistocene rock macro Halodule patches
- Porites and Mixed Coral zone
- Rocky Halodule
- Rocky Halodule Zone
- Sand dominated coastal shallow depths
- Sand dominated mid lagoon depth
- Sand dominated mid lagoon depths
- Thick Enhalus Zone

LANDUSE INFLUENCE

- 1
- 3
- Marine Protected Areas (CRM)

*Imagery - February 2011

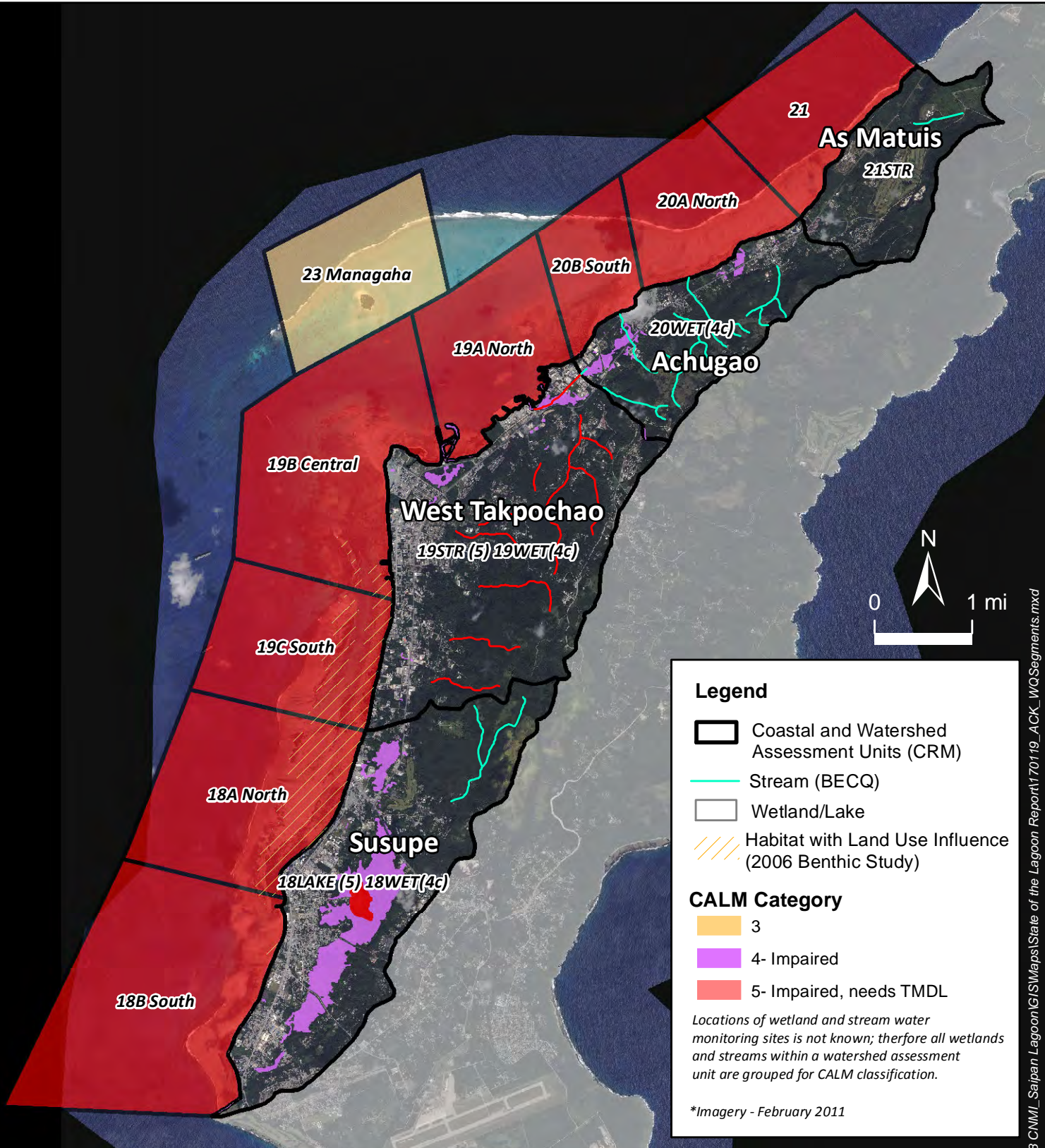
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**2006 Saipan Lagoon
 Benthic Habitat (CRM)**

Date: 2/7/2017

Map 2

Document Path: H:\Projects\2016\16098 CNM\ Saipan Lagoon\GIS\Maps\State of the Lagoon Report\70126_ACK_BioBenthic.mxd



Legend

- Coastal and Watershed Assessment Units (CRM)
- Stream (BECQ)
- Wetland/Lake
- Habitat with Land Use Influence (2006 Benthic Study)

CALM Category

- 3
- 4- Impaired
- 5- Impaired, needs TMDL

Locations of wetland and stream water monitoring sites is not known; therefore all wetlands and streams within a watershed assessment unit are grouped for CALM classification.

**Imagery - February 2011*

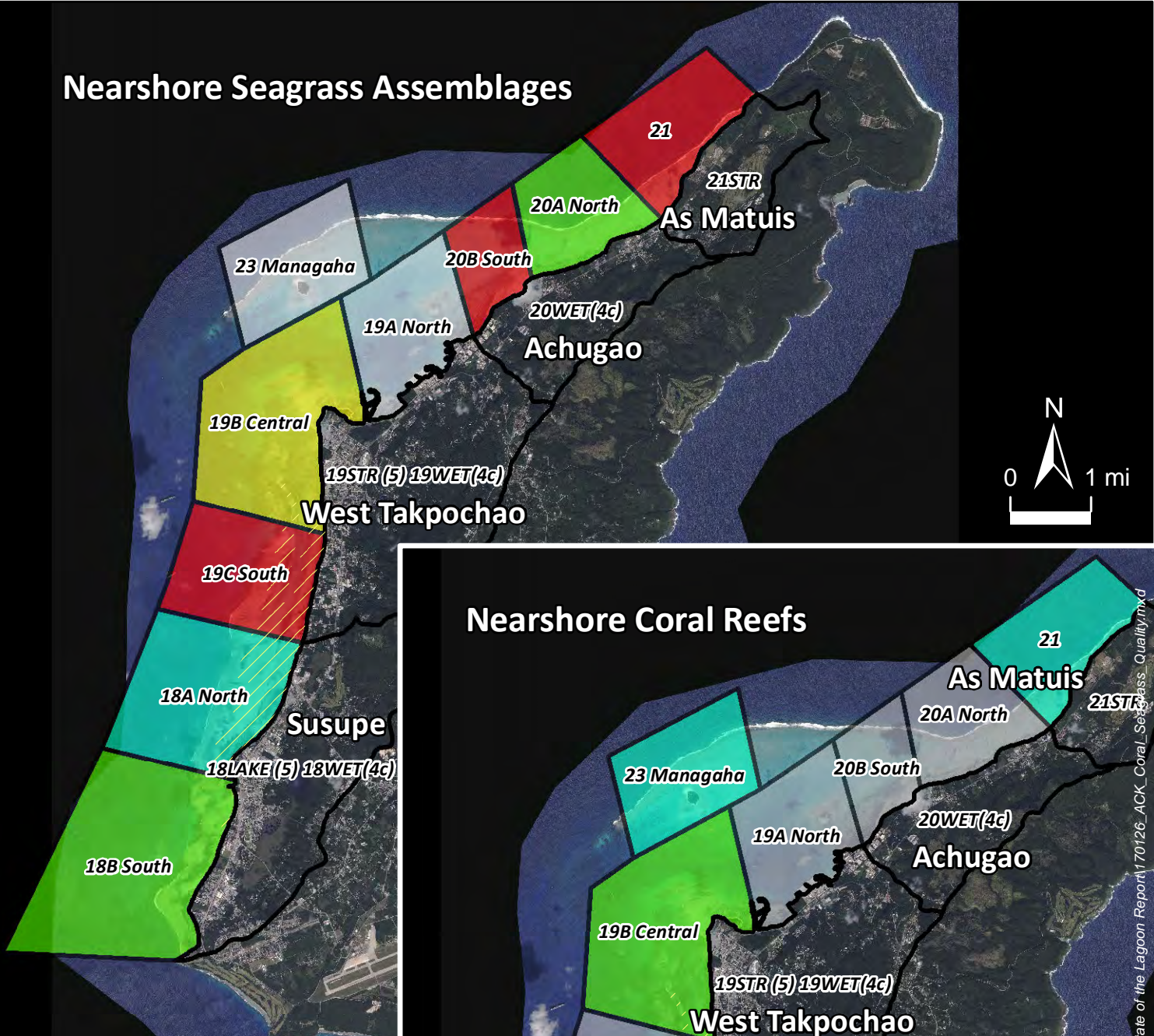
CALM Assessment Category	
1	All designated uses are supported, no use is threatened
2	Available data and/or information indicate that some, but not all of the designated uses are supported.
3	There is insufficient available data and/or information to make a use support determination
4a	A TMDL to address a specific segment/pollutant combination has been approved or established by EPA.
4b	A use impairment caused by a pollutant is being addressed by the state through other pollution control requirements.
4c	A use is impaired, but the impairment is not caused by a pollutant.
5	Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed. (A use is threatened if a waterbody is currently attaining WQs, but is expected to not meet WQs by the next listing cycle.)

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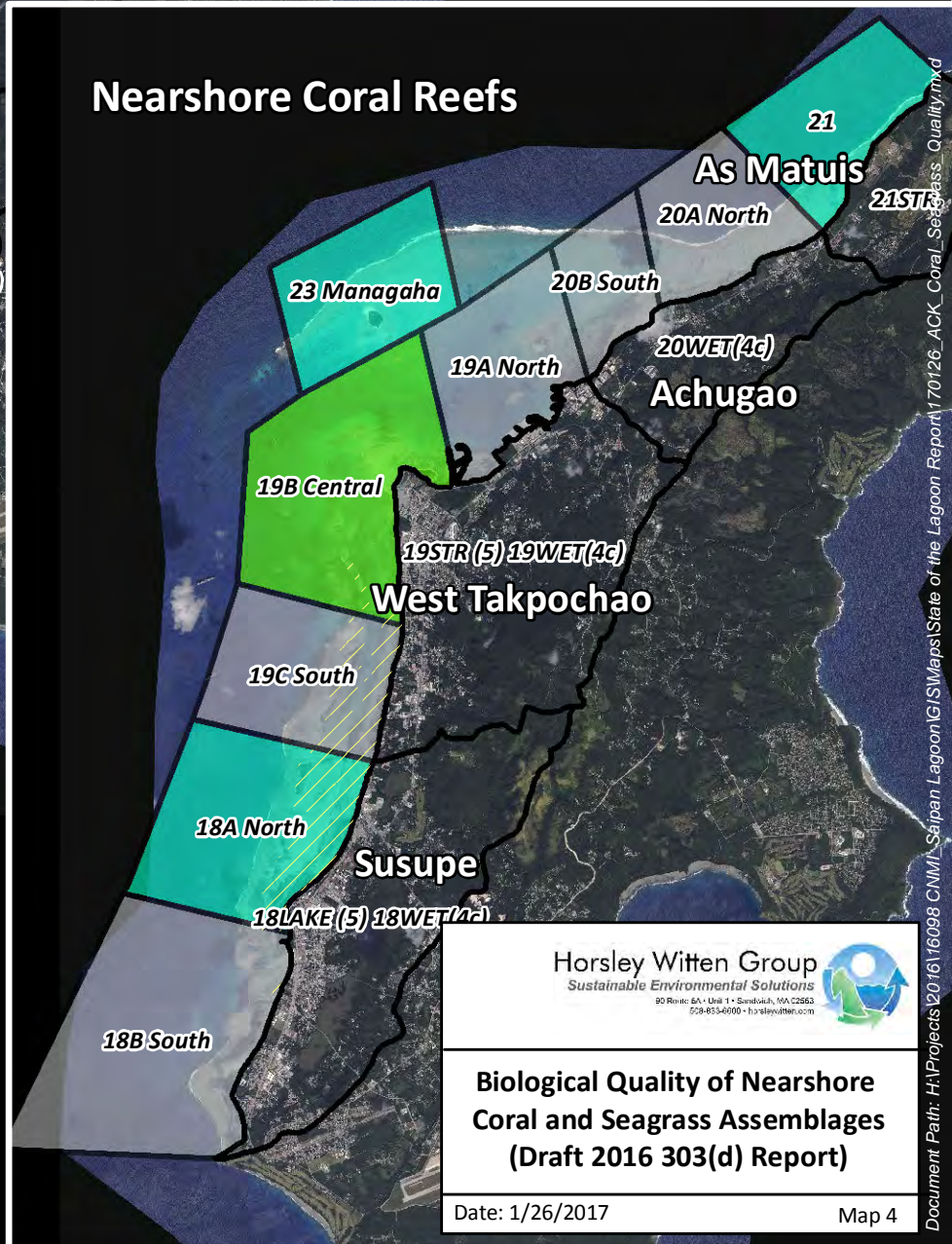
**Impaired Surface Waters
(Draft 2016 303(d) Report)**

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Nearshore Seagrass Assemblages



Nearshore Coral Reefs



Legend

- Coastal and Watershed Assessment Units (CRM)
- Habitat with Land Use Influence (2006 Benthic Study)

ALUS Rank 2014-2016

- No Data
- Poor
- Fair
- Fair/Good
- Good

Locations of coral and seagrass monitoring sites is unavailable; therefore, data is presented by assessment unit.

*Imagery - February 2011

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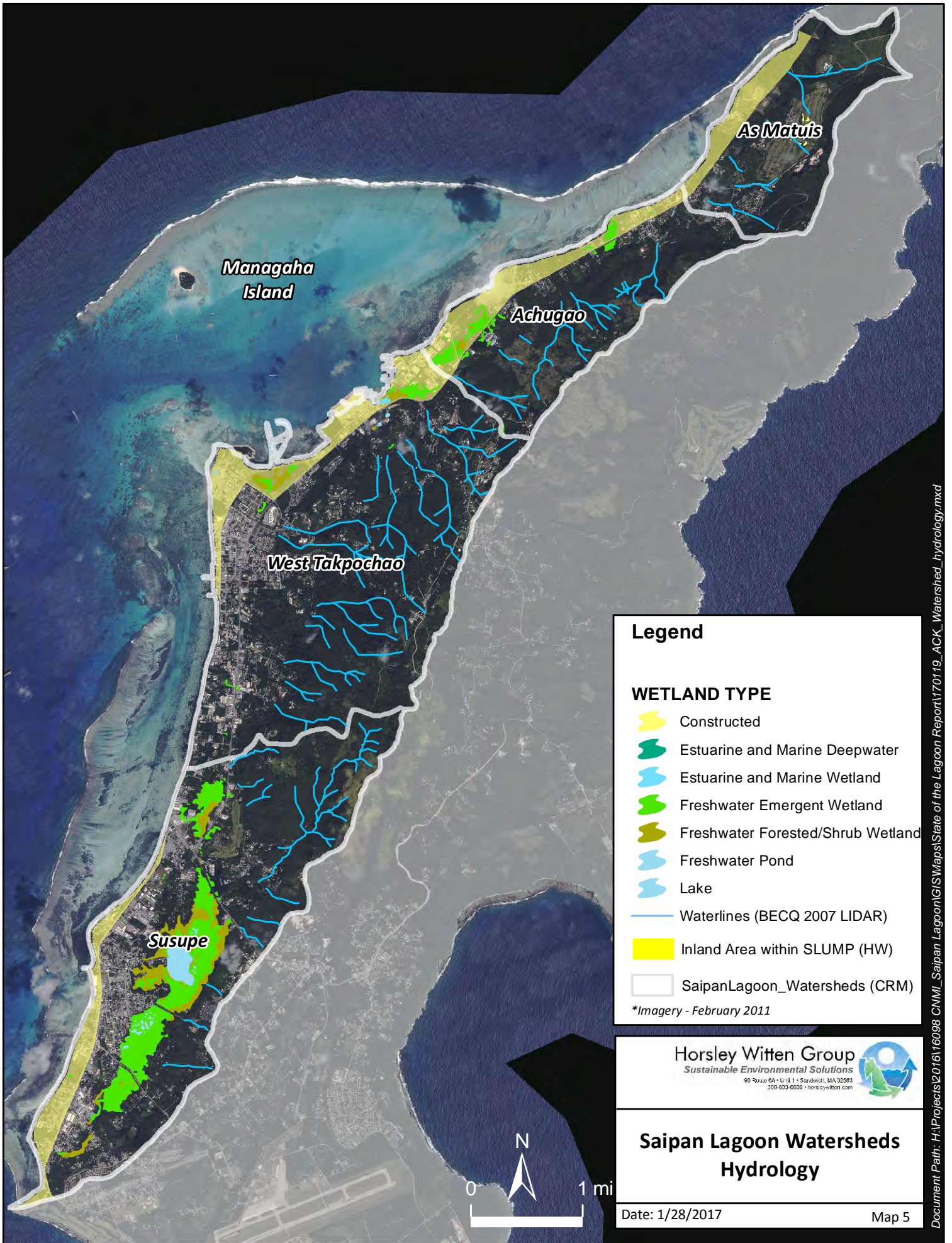


Biological Quality of Nearshore Coral and Seagrass Assemblages (Draft 2016 303(d) Report)

Date: 1/26/2017











Map 4

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Legend

WETLAND TYPE

-  Constructed
-  Estuarine and Marine Deepwater
-  Estuarine and Marine Wetland
-  Freshwater Emergent Wetland
-  Freshwater Forested/Shrub Wetland
-  Freshwater Pond
-  Lake
-  Waterlines (BECQ 2007 LIDAR)
-  Inland Area within SLUMP (HW)
-  SaipanLagoon_Watersheds (CRM)

*Imagery - February 2011

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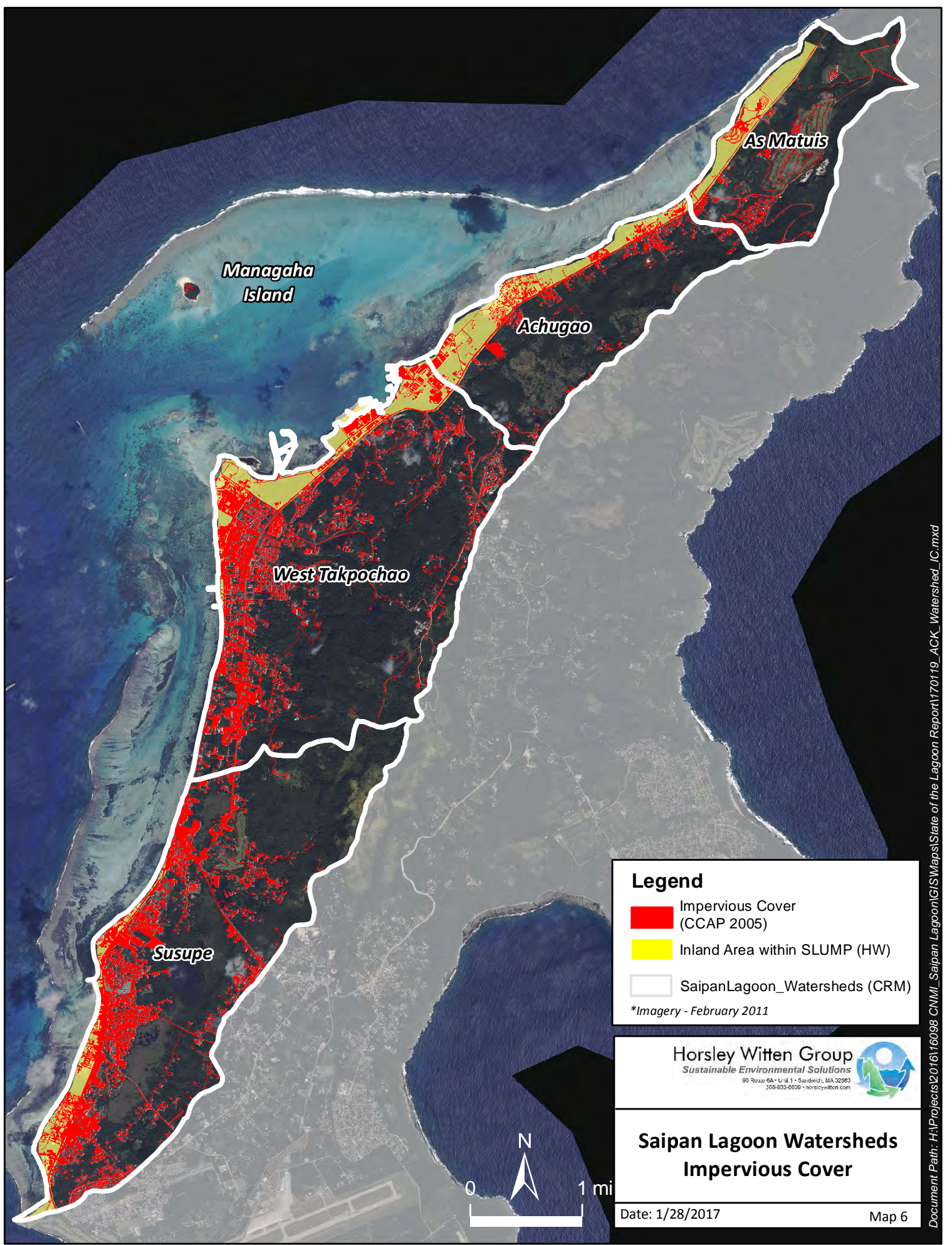


**Saipan Lagoon Watersheds
Hydrology**

Date: 1/28/2017

Map 5

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Managaha Island

As Matuis

Achugao

West Takpochao

Susupe

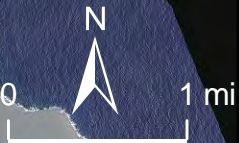
Legend

- Impervious Cover (CCAP 2005)
- Inland Area within SLUMP (HW)
- SaipanLagoon_Watersheds (CRM)

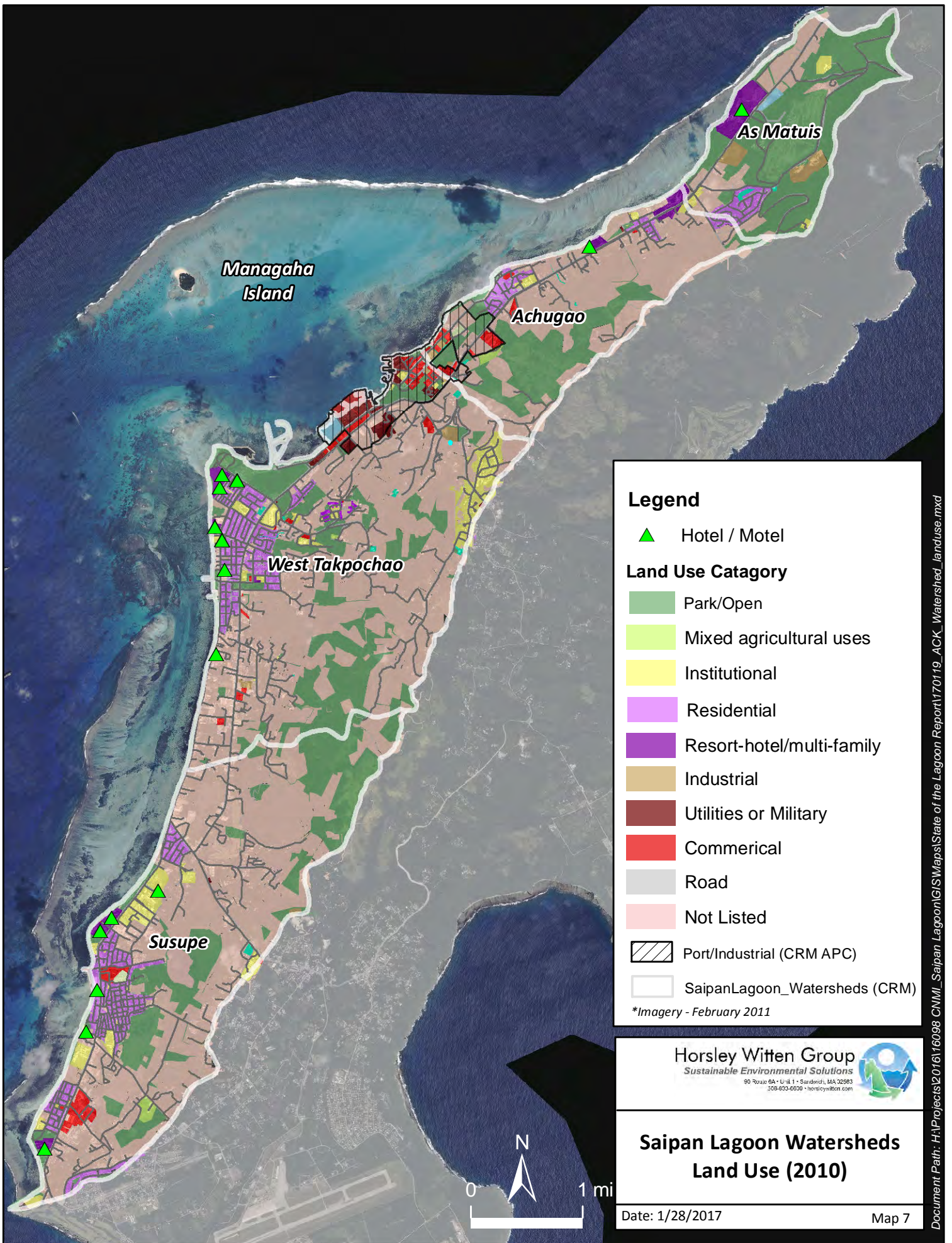
**Imagery - February 2011*

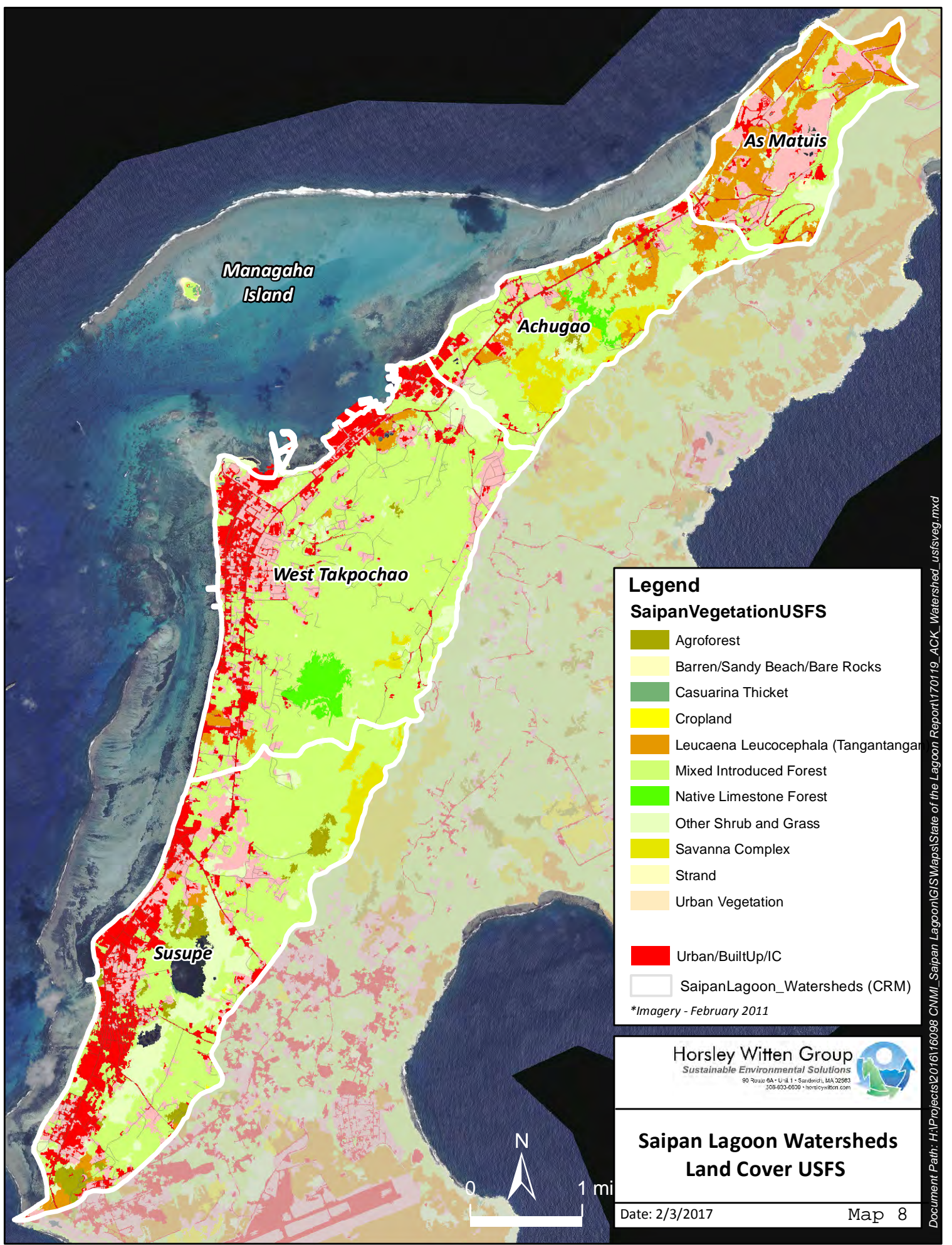
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**Saipan Lagoon Watersheds
 Impervious Cover**



Document Path: H:\Projects\2016\16098 CNMI_Saipan_Lagoon\GIS\Maps\State of the Lagoon Report\170119_ACK_Watershed_IC.mxd





Legend

SaipanVegetationUSFS

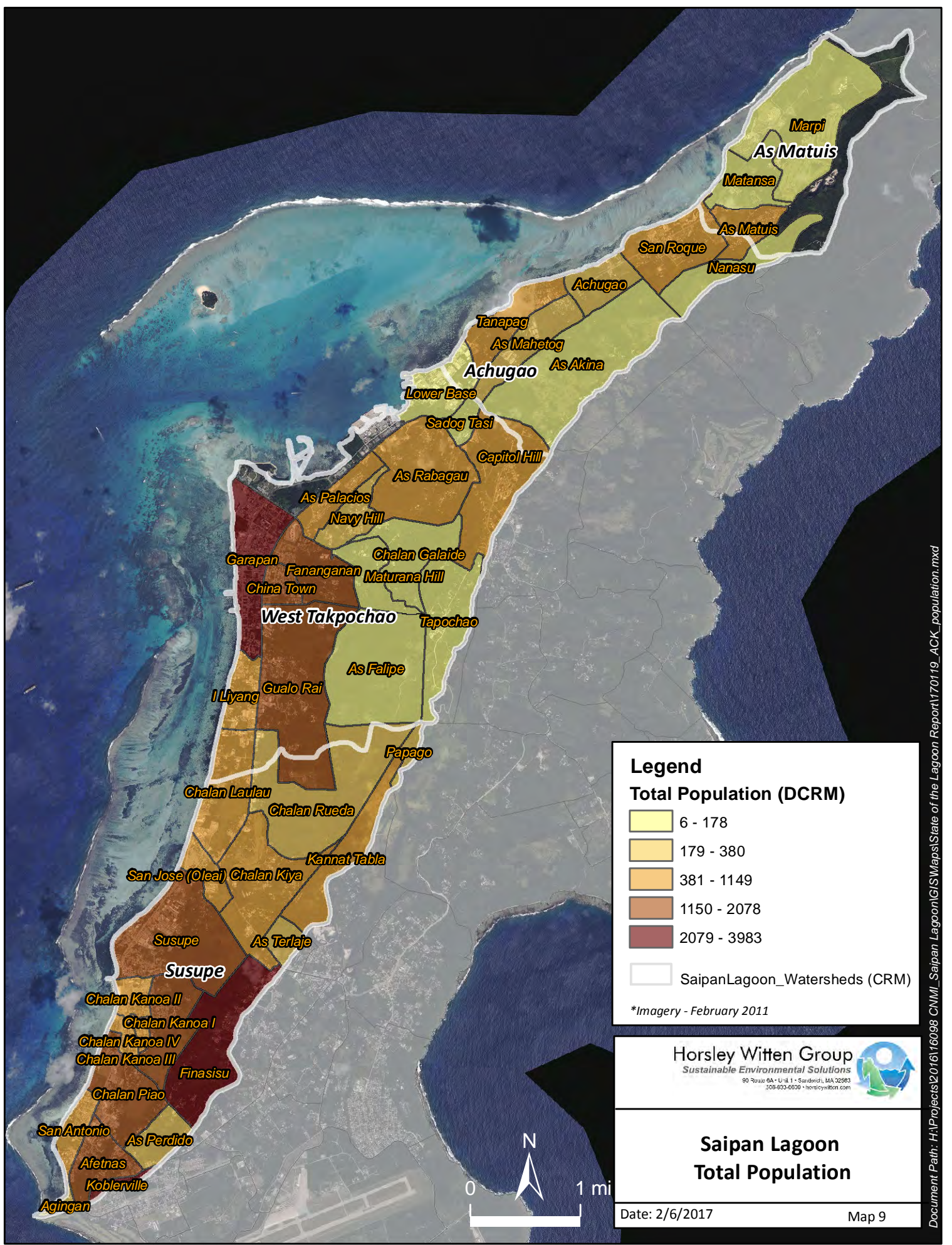
- Agroforest
- Barren/Sandy Beach/Bare Rocks
- Casuarina Thicket
- Cropland
- Leucaena Leucocephala (Tangantangan)
- Mixed Introduced Forest
- Native Limestone Forest
- Other Shrub and Grass
- Savanna Complex
- Strand
- Urban Vegetation
- Urban/BuiltUp/IC
- SaipanLagoon_Watersheds (CRM)

**Imagery - February 2011*

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**Saipan Lagoon Watersheds
 Land Cover USFS**

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Legend

Total Population (DCRM)

- 6 - 178
- 179 - 380
- 381 - 1149
- 1150 - 2078
- 2079 - 3983
- SaipanLagoon_Watersheds (CRM)

*Imagery - February 2011

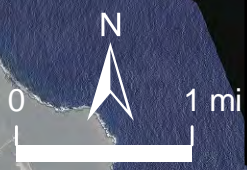
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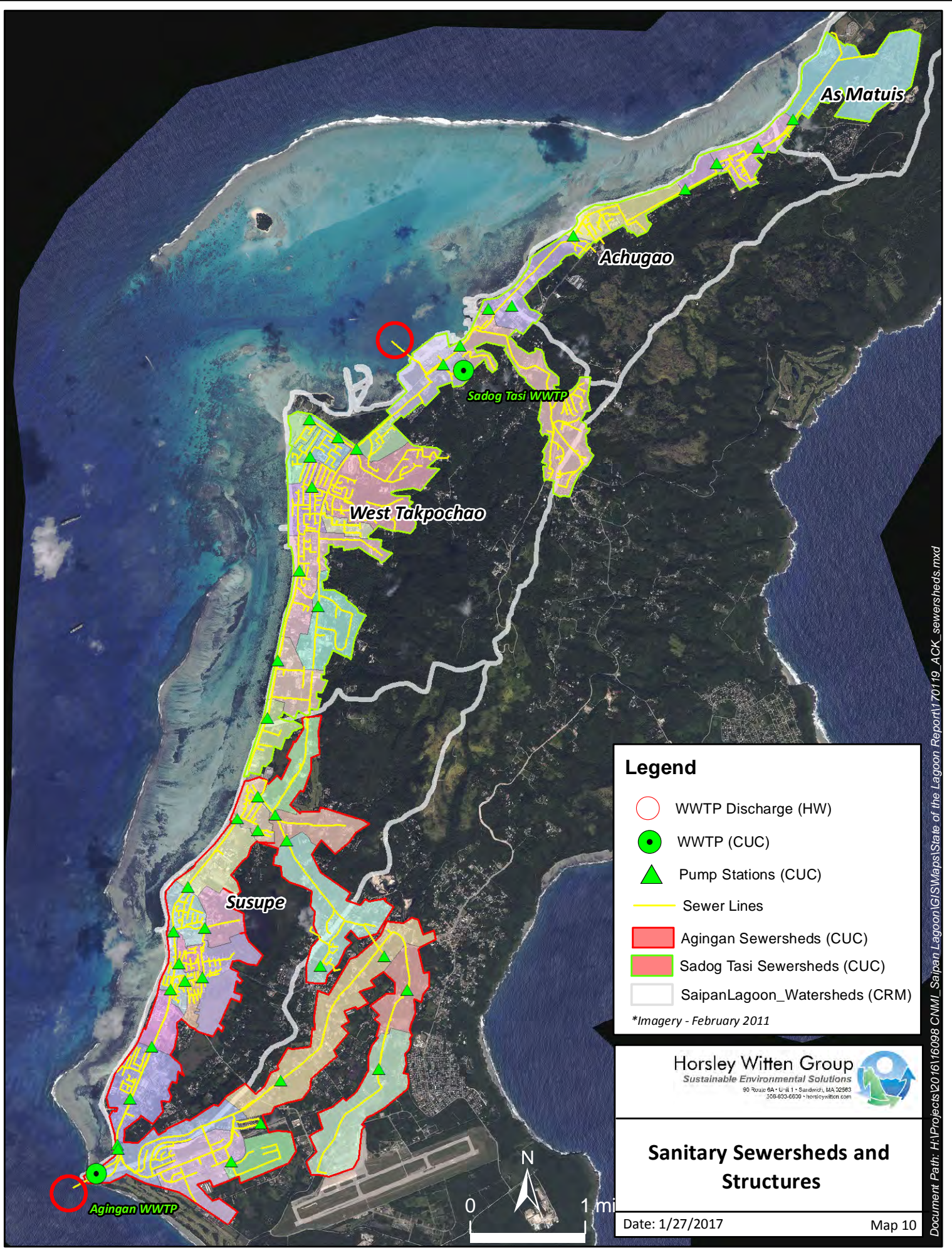


**Saipan Lagoon
Total Population**

Date: 2/6/2017

Map 9





Legend

- WWTP Discharge (HW)
- WWTP (CUC)
- ▲ Pump Stations (CUC)
- Sewer Lines
- Agingan Sewersheds (CUC)
- Sadog Tasi Sewersheds (CUC)
- SaipanLagoon_Watersheds (CRM)

**Imagery - February 2011*

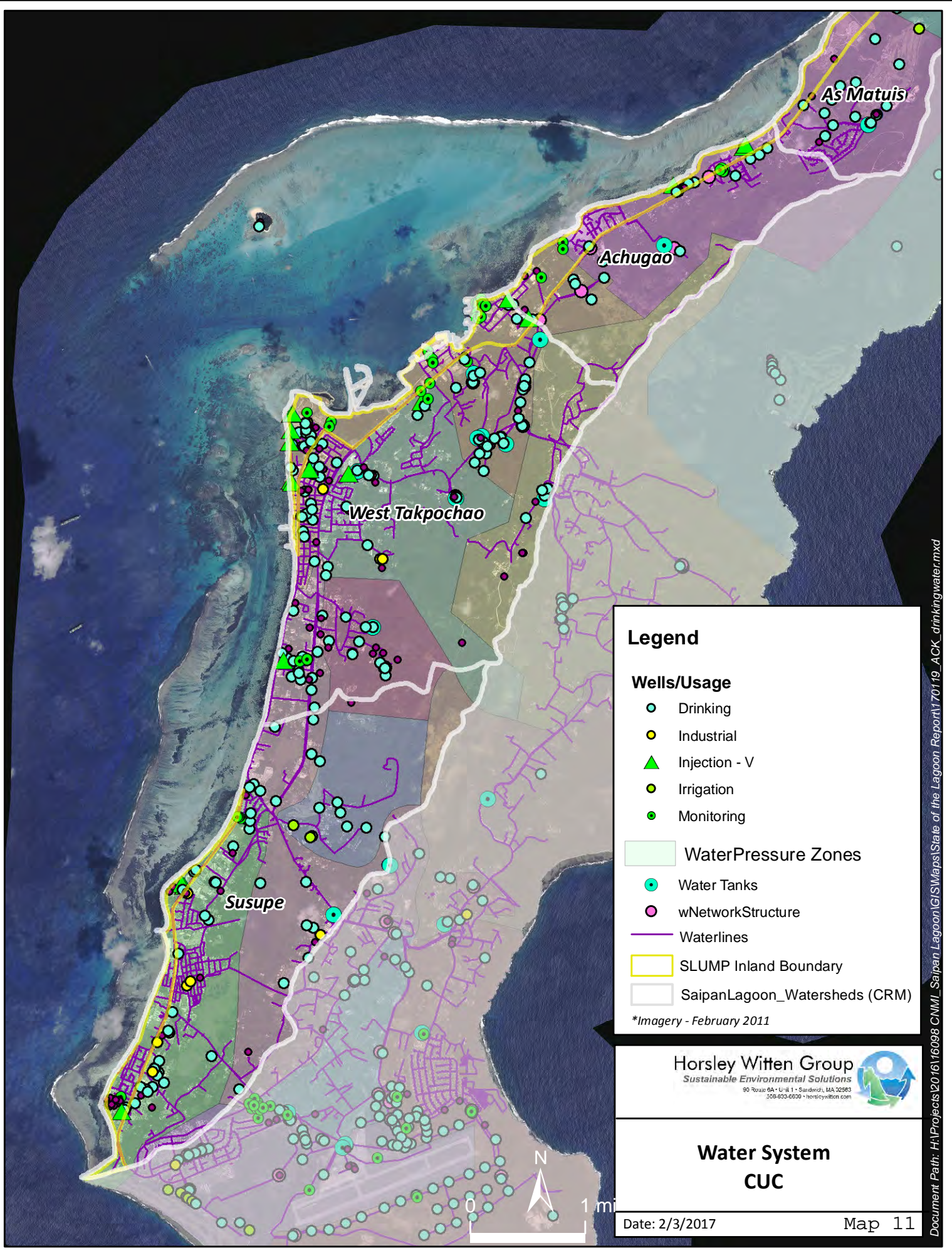
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Sanitary Sewersheds and Structures

Date: 1/27/2017 Map 10

Document Path: H:\Projects\2016\16098 CMM\Saipan_Lagoon\GIS\Maps\State of the Lagoon_Report\170119_ACK_sewersheds.mxd



Legend

Wells/Usage

- Drinking
- Industrial
- ▲ Injection - V
- Irrigation
- Monitoring

Water Pressure Zones

● Water Tanks

● wNetworkStructure

— Waterlines

SLUMP Inland Boundary

SaipanLagoon_Watersheds (CRM)

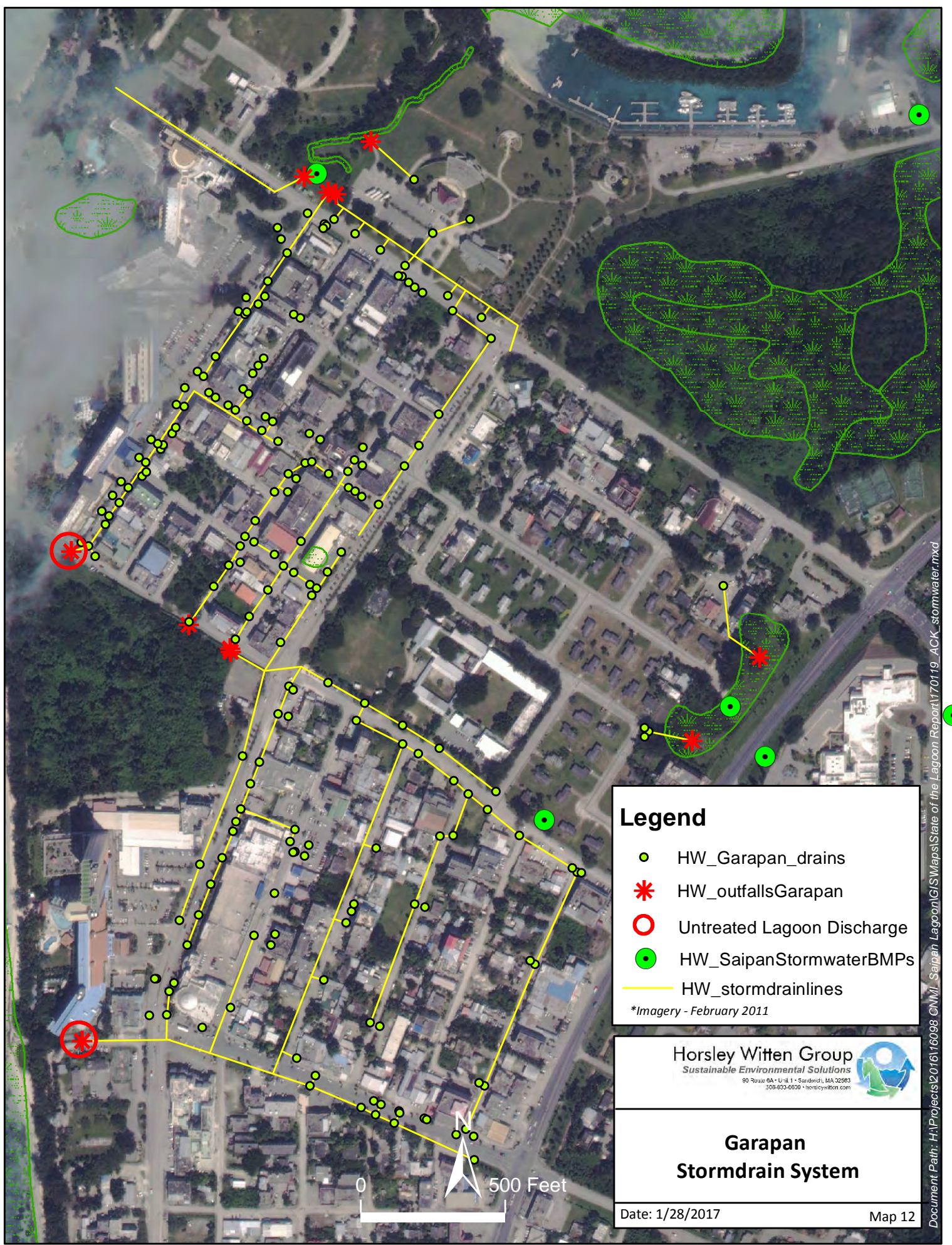
**Imagery - February 2011*

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**Water System
CUC**

Date: 2/3/2017 Map 11

Document Path: H:\Projects\2016\16098 CMM\Saipan Lagoon\GIS\Maps\State of the Lagoon_Report\170119_ACK_drinkingwater.mxd



Legend

- HW_Garapan_drains
- * HW_outfallsGarapan
- Untreated Lagoon Discharge
- HW_SaipanStormwaterBMPs
- HW_stormdrainlines

**Imagery - February 2011*

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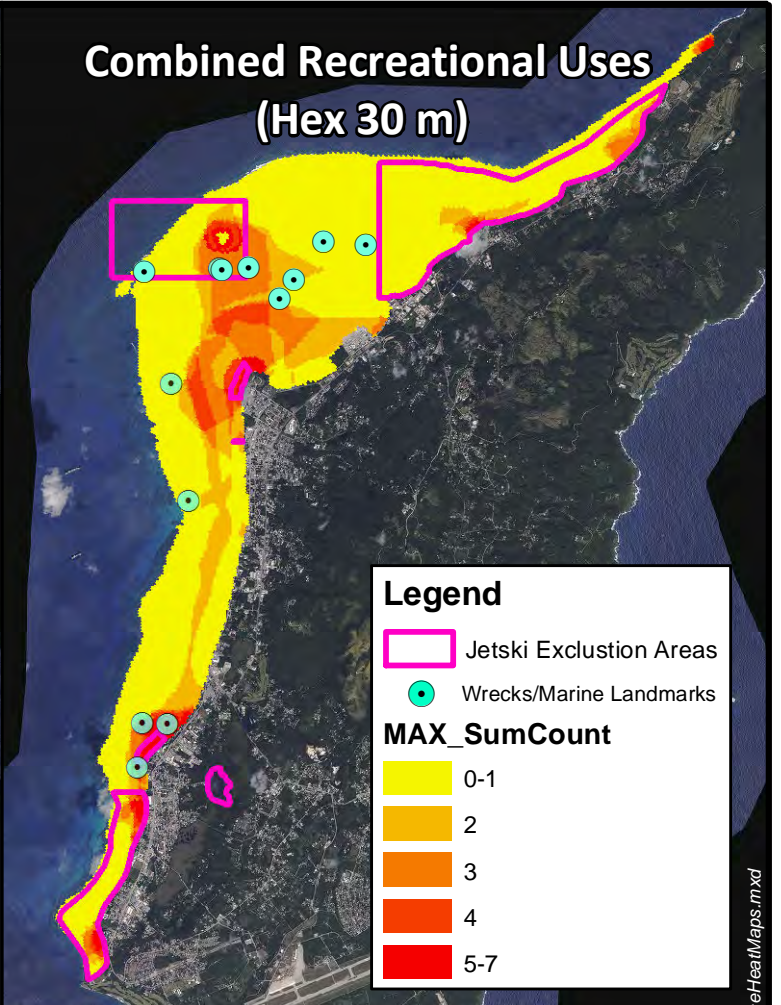
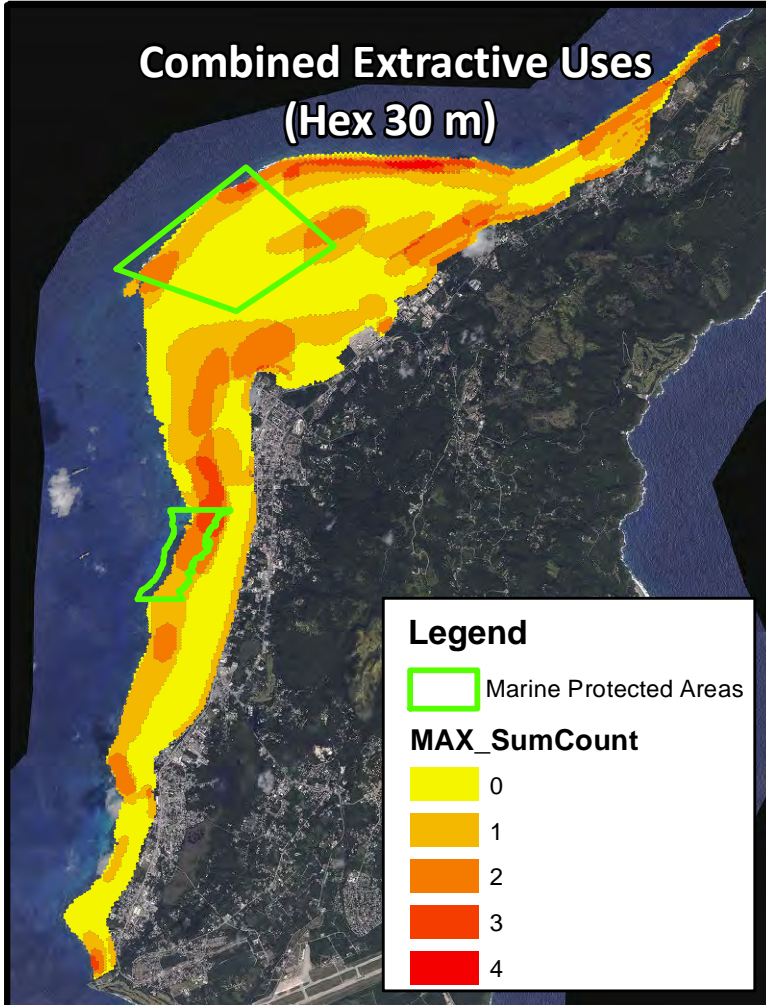
**Garapan
 Stormdrain System**

Date: 1/28/2017 Map 12

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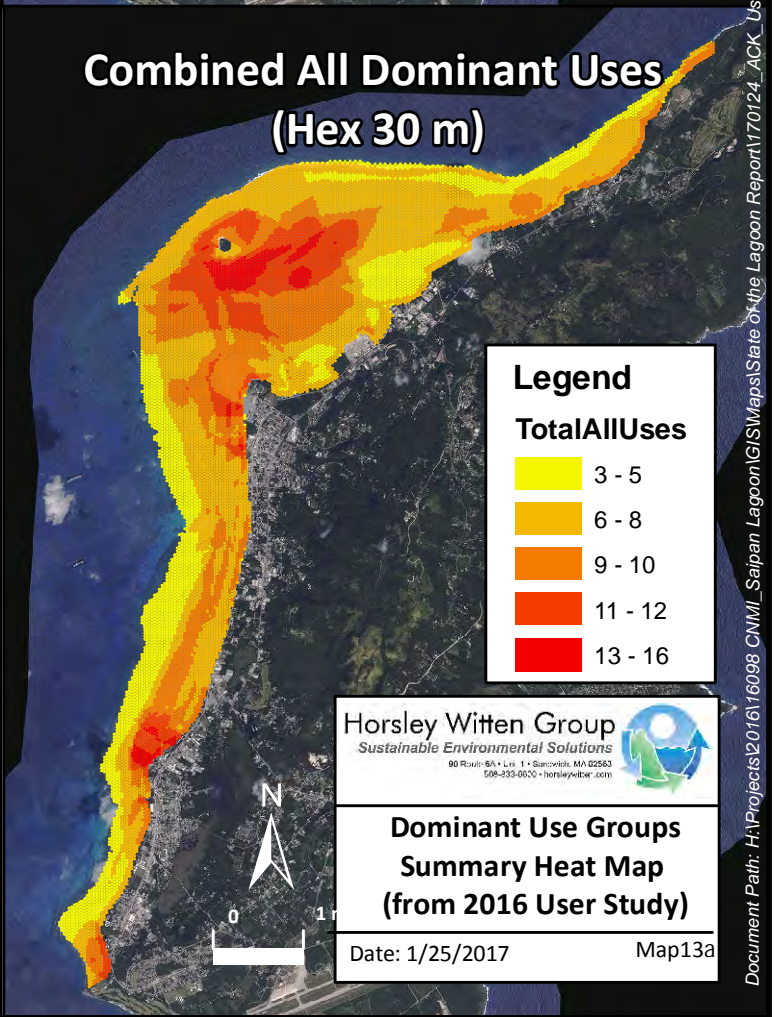
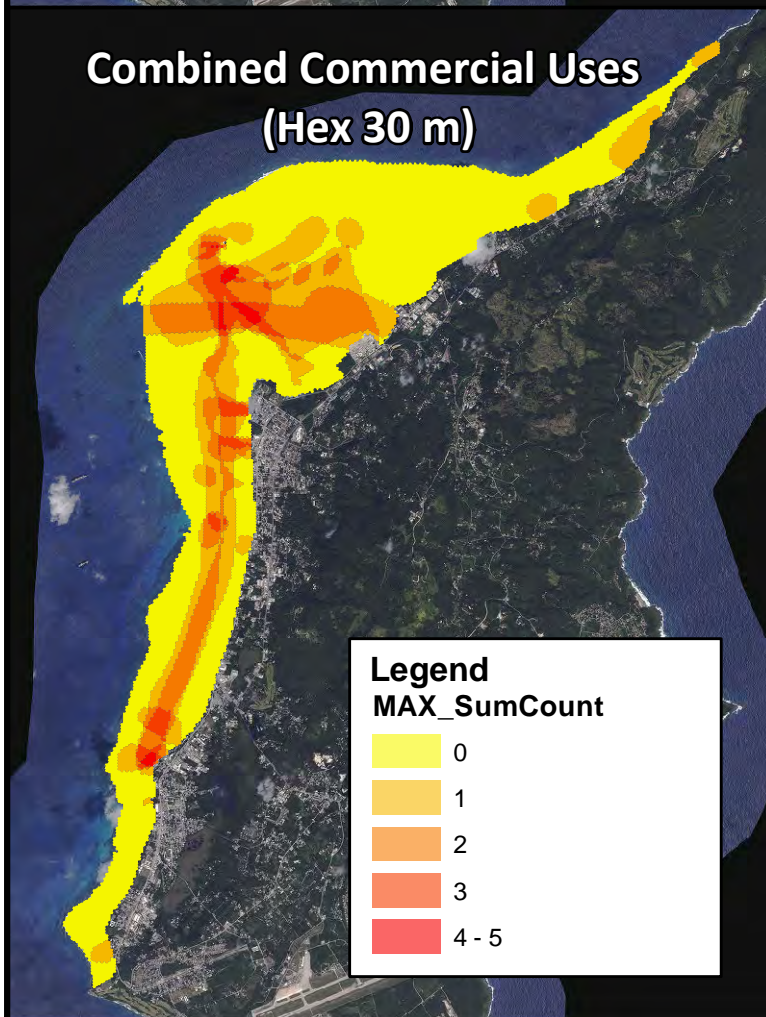
Combined Extractive Uses (Hex 30 m)

Combined Recreational Uses (Hex 30 m)

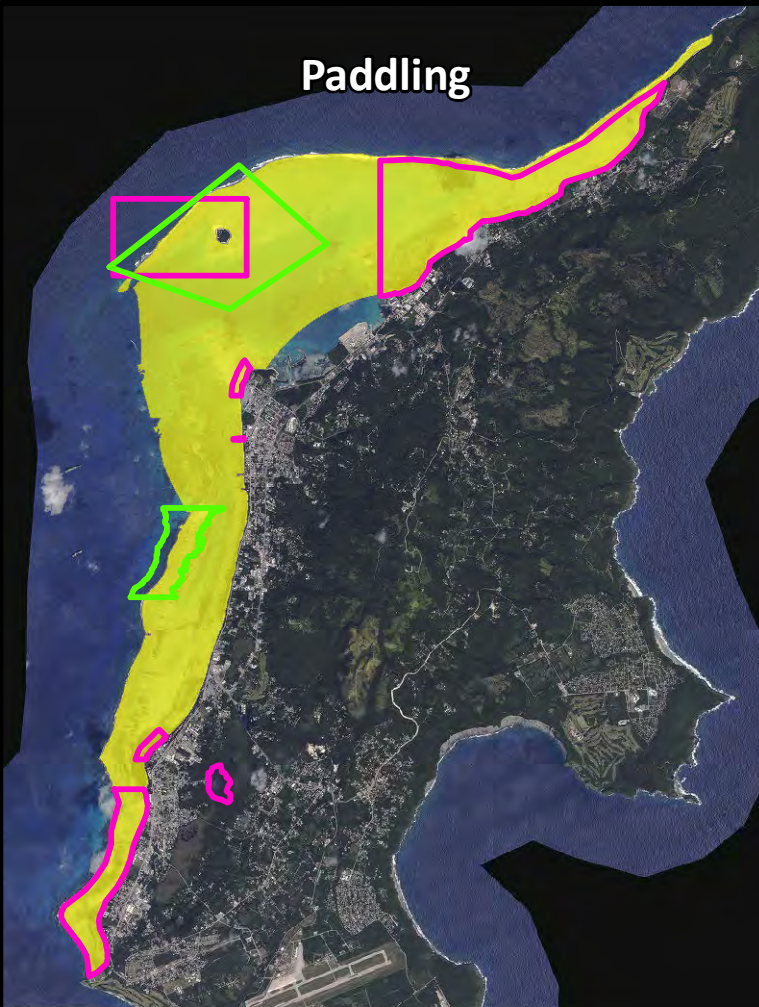


Combined Commercial Uses (Hex 30 m)

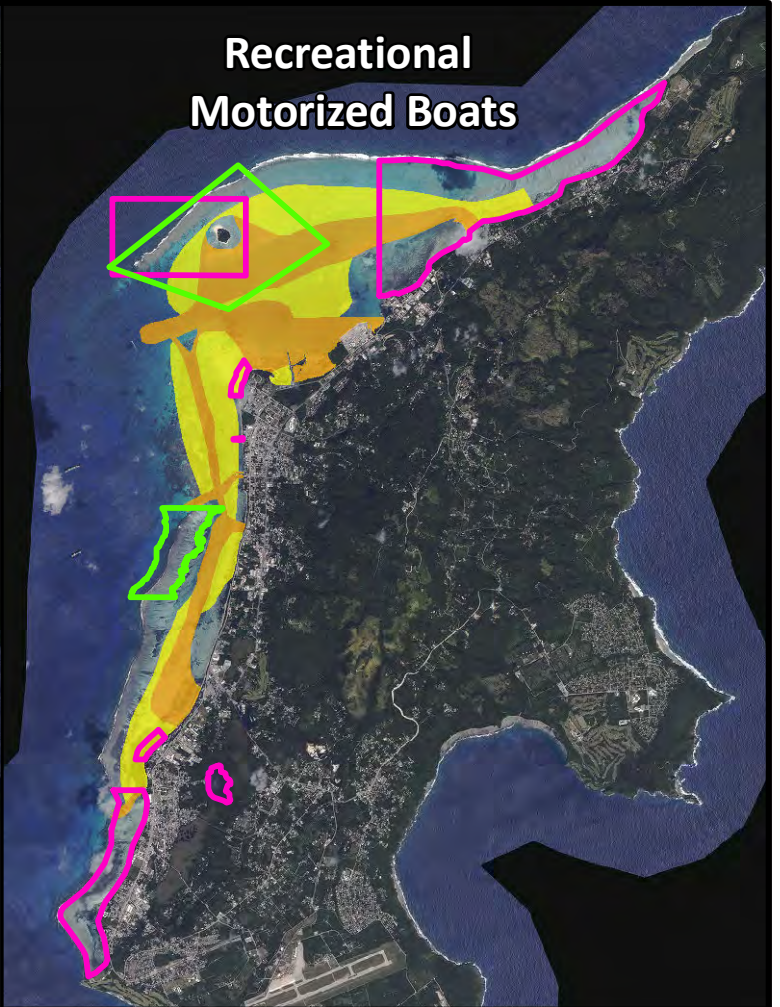
Combined All Dominant Uses (Hex 30 m)



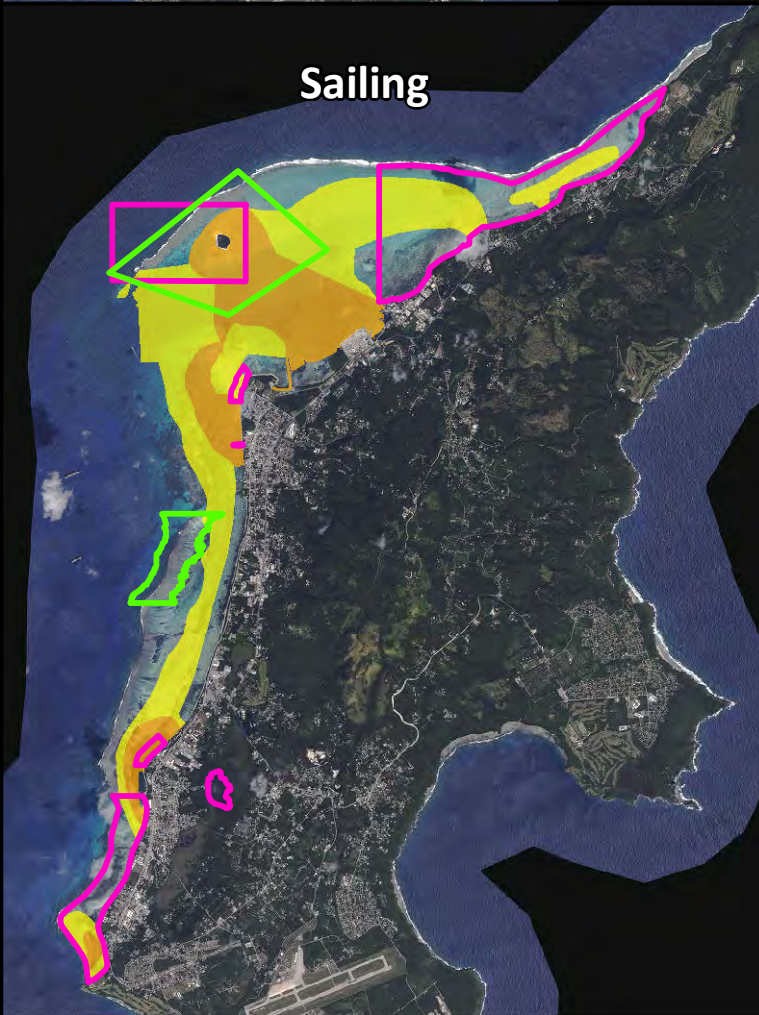
Paddling



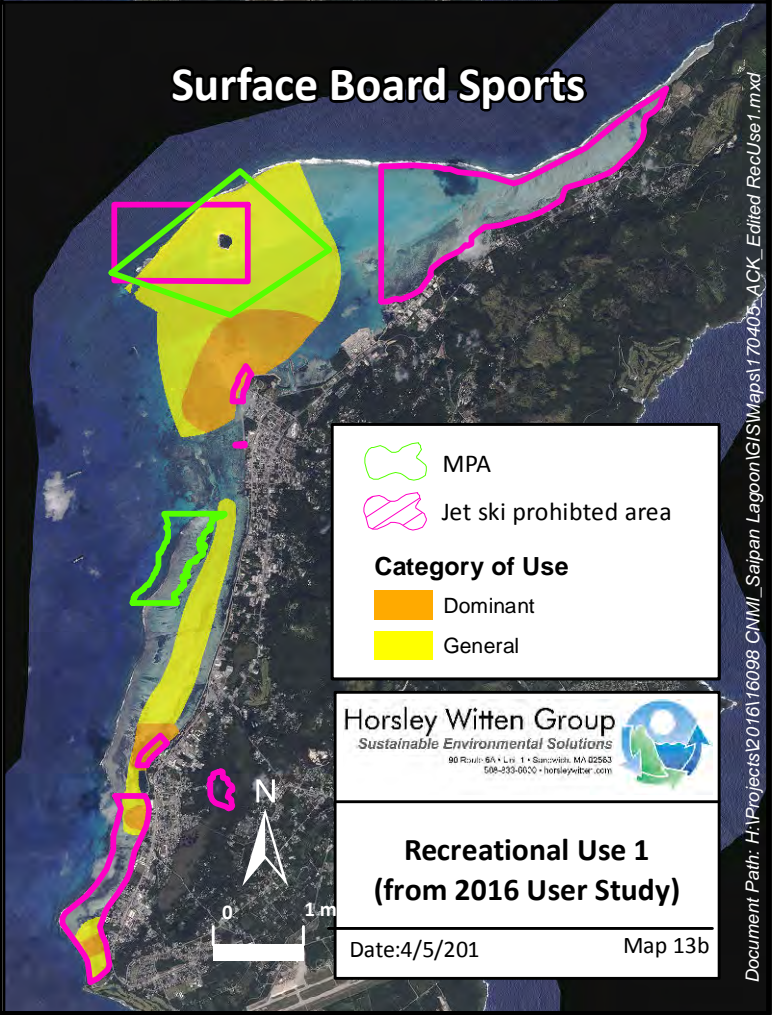
Recreational Motorized Boats





Sailing




Surface Board Sports




 MPA

 Jet ski prohibited area

Category of Use

 Dominant


 General

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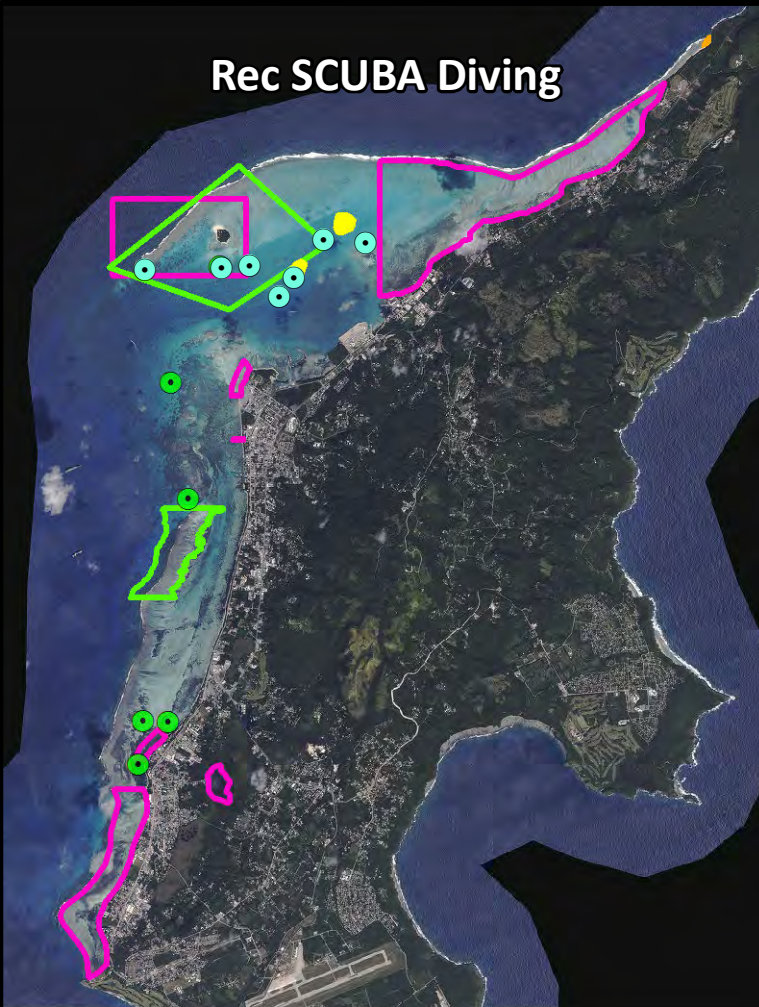


Recreational Use 1
(from 2016 User Study)

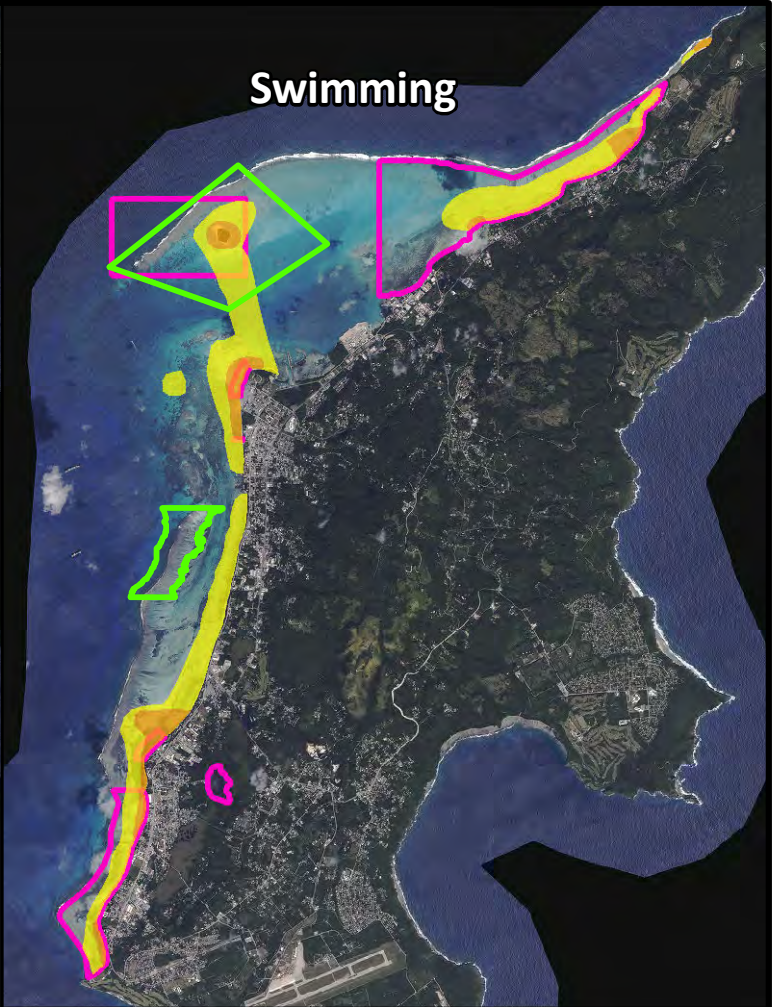
Date: 4/5/2011 Map 13b



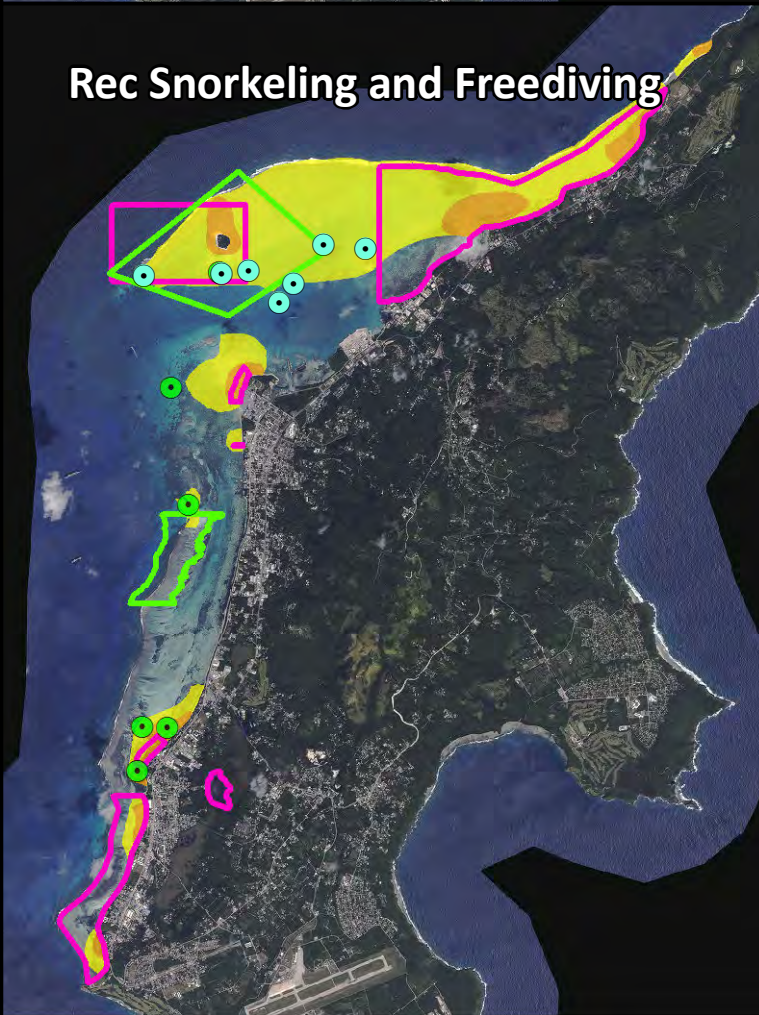
Rec SCUBA Diving



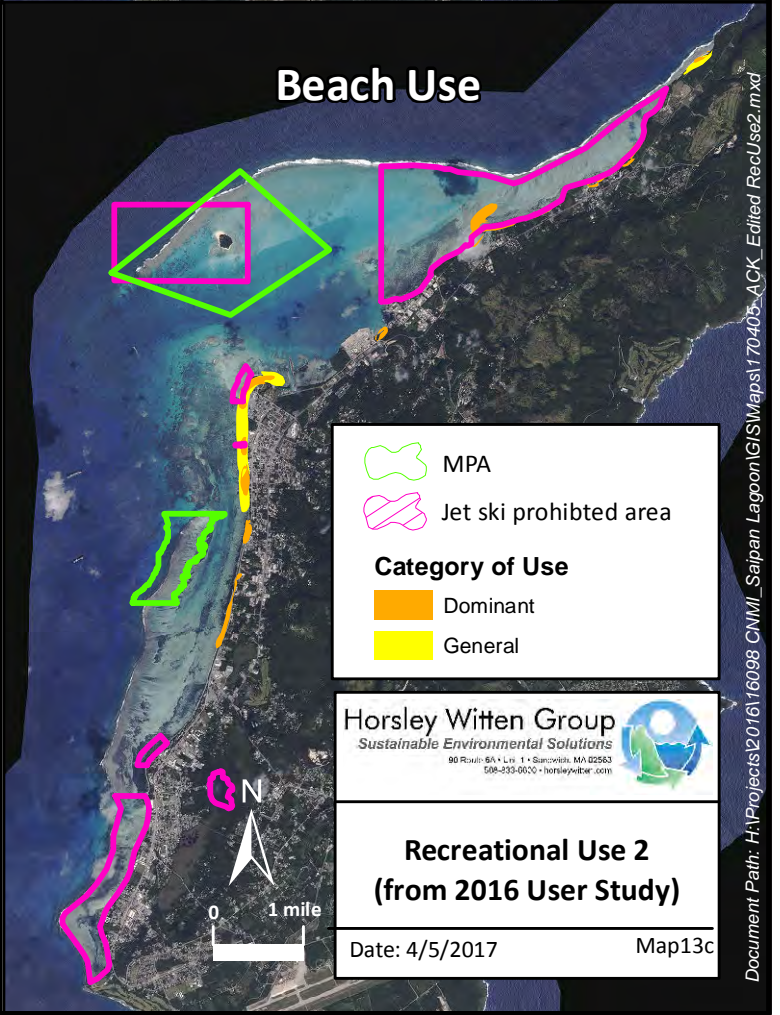
Swimming





Rec Snorkeling and Freediving




Beach Use




 MPA

 Jet ski prohibited area

Category of Use

 Dominant

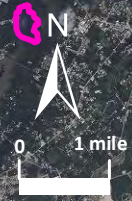
 General

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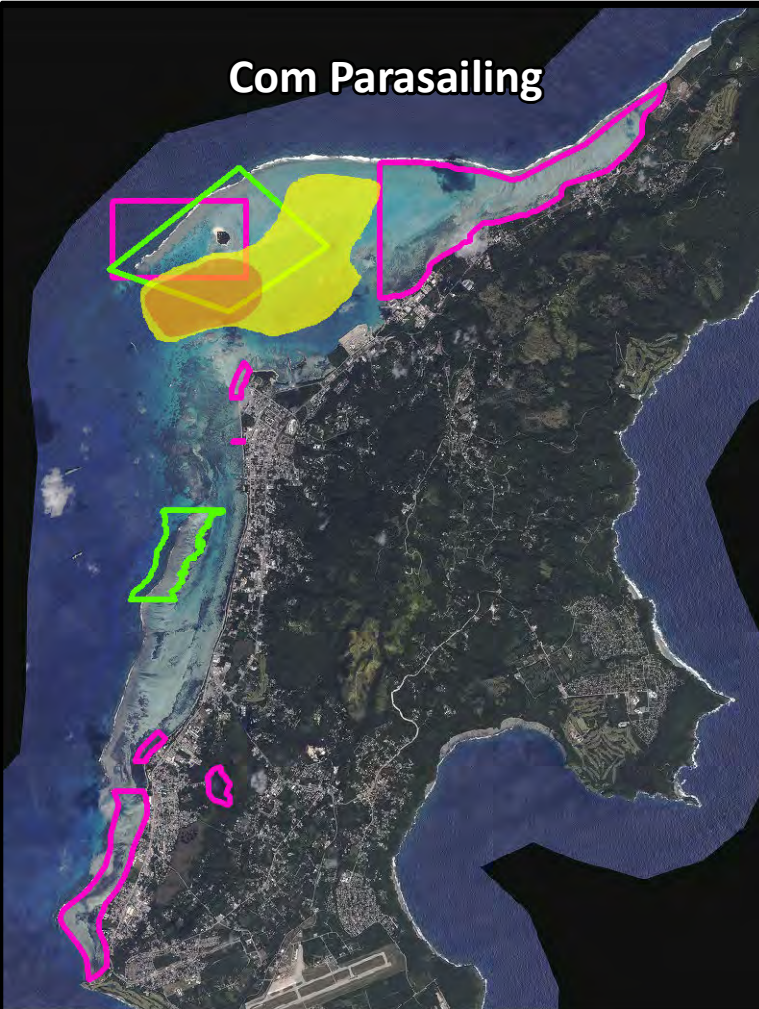


Recreational Use 2
(from 2016 User Study)

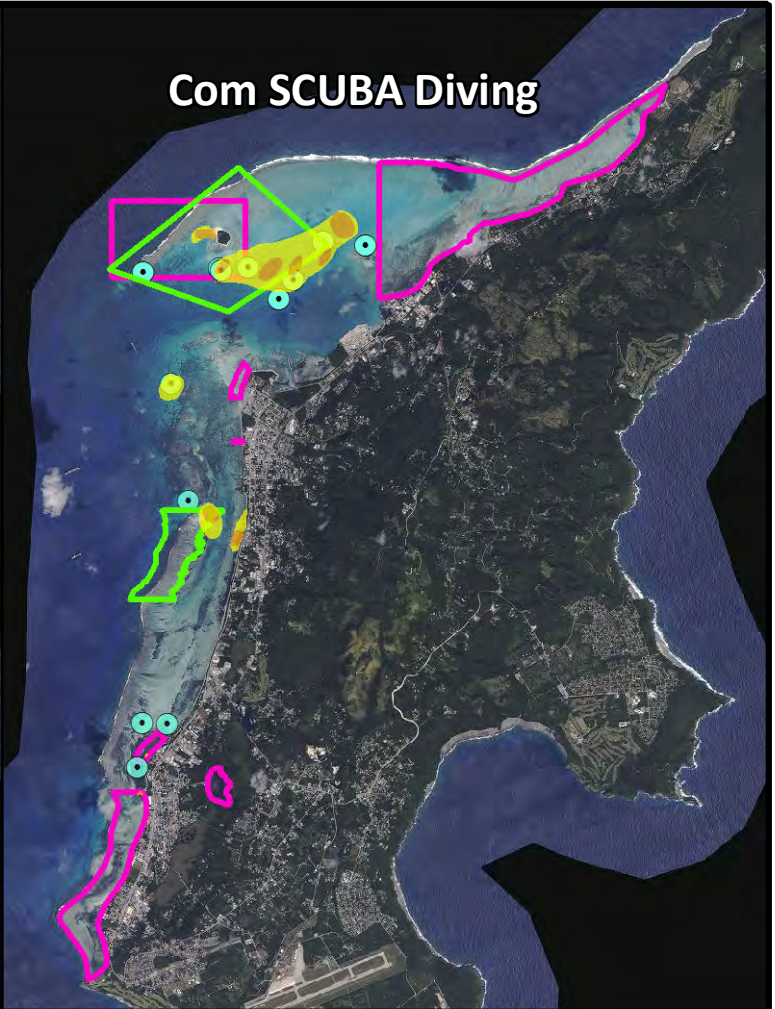
Date: 4/5/2017 Map13c



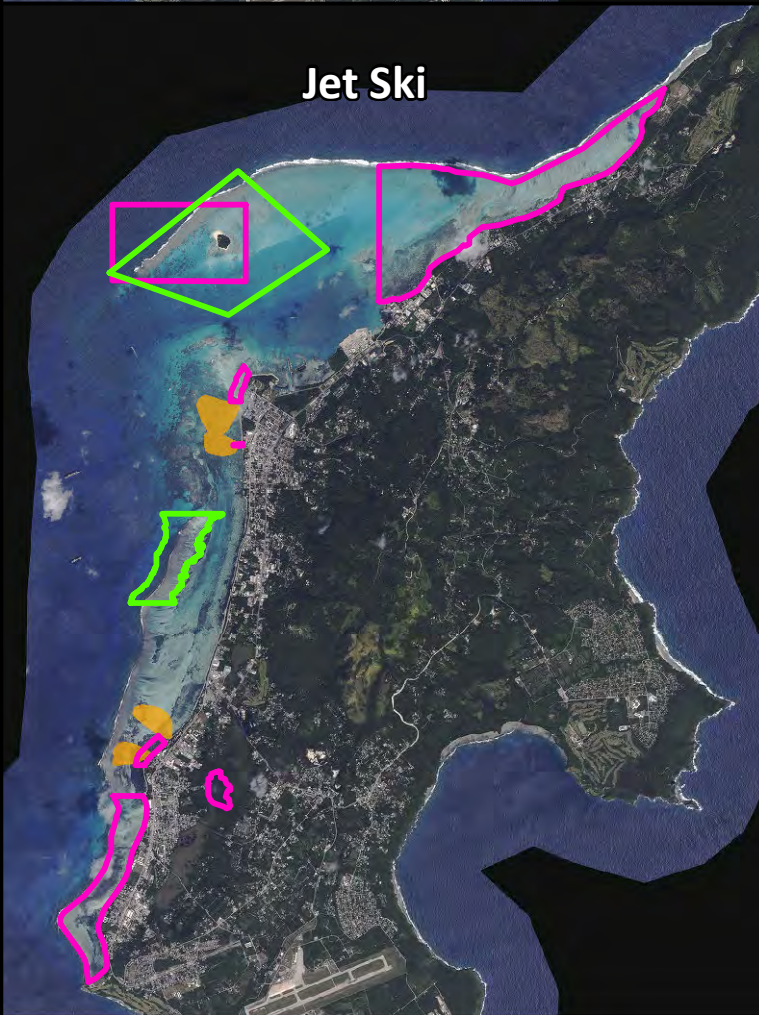
Com Parasailing



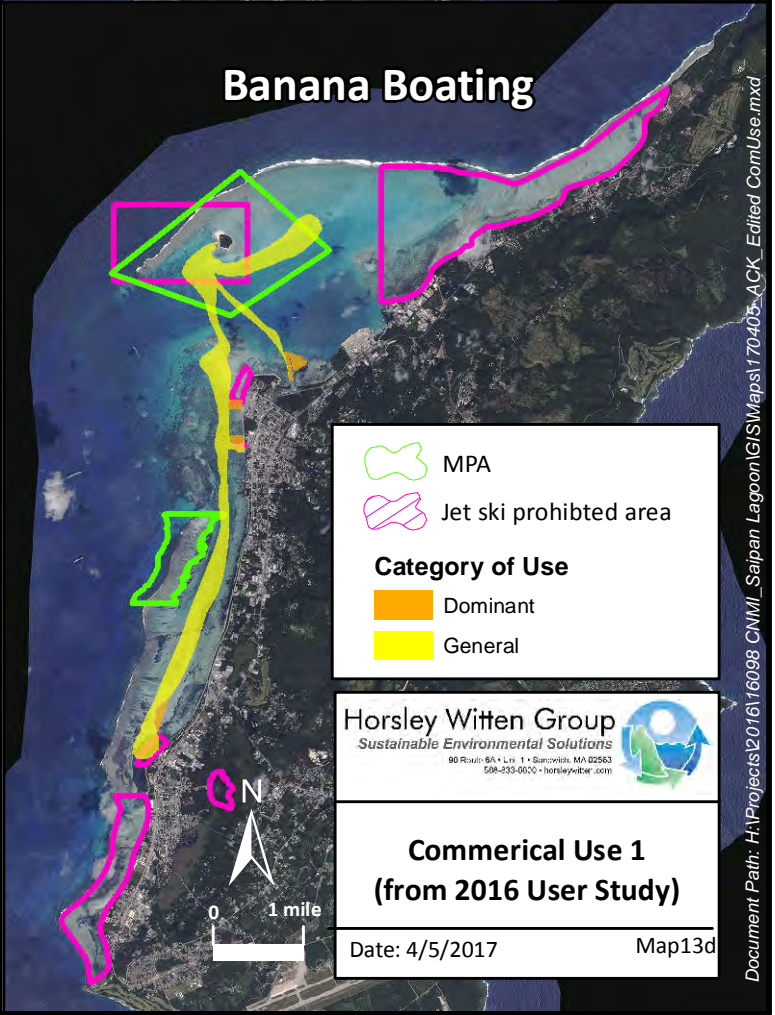
Com SCUBA Diving





Jet Ski




Banana Boating




 MPA

 Jet ski prohibited area

Category of Use

 Dominant


 General

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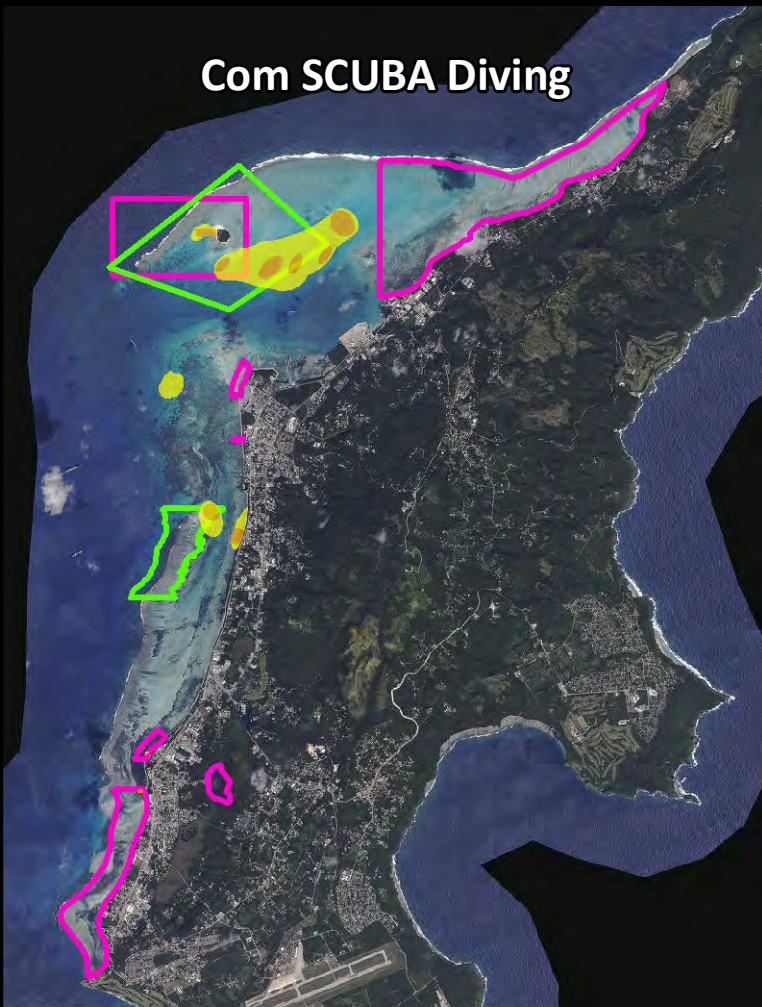


Commerical Use 1
(from 2016 User Study)

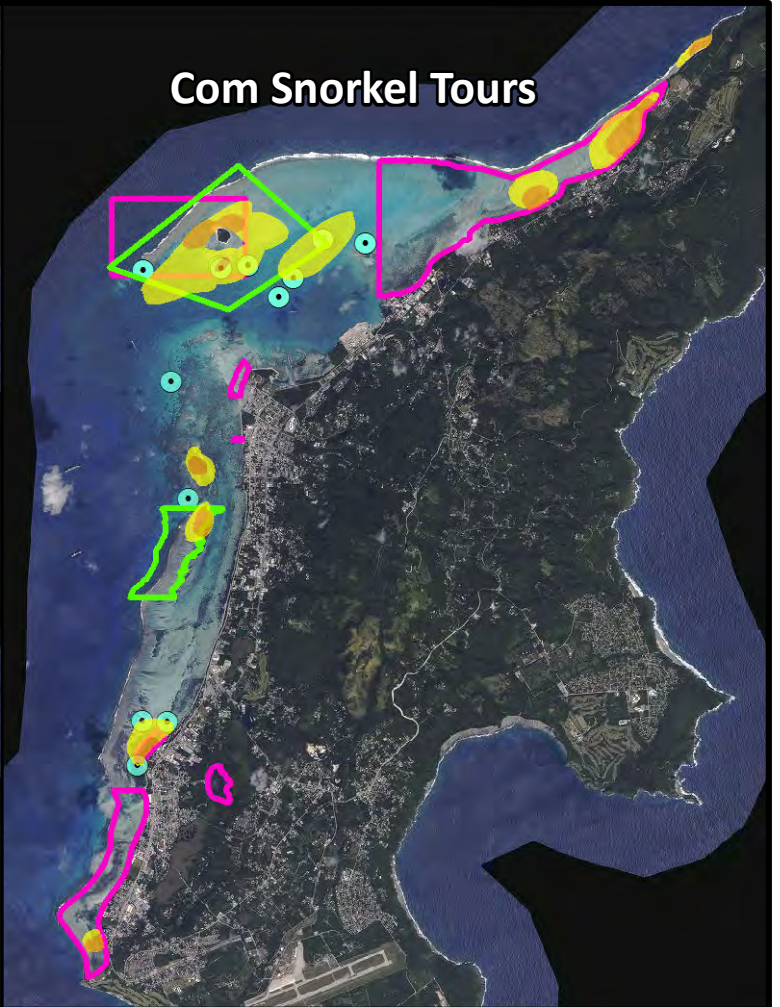
Date: 4/5/2017 Map13d



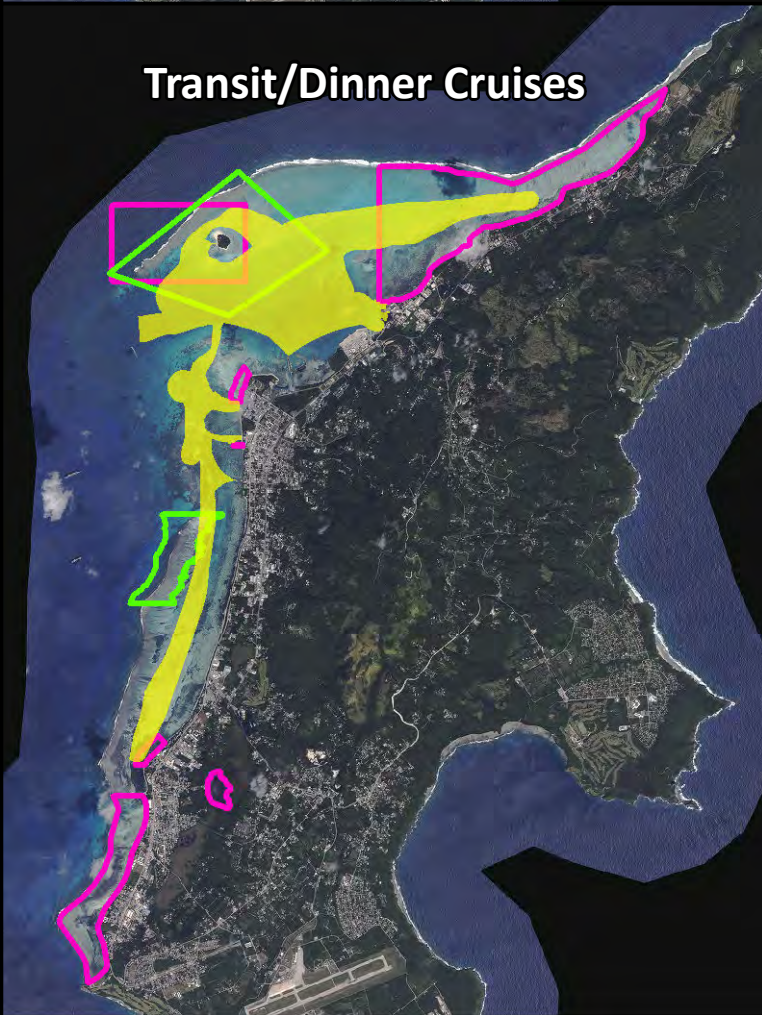
Com SCUBA Diving



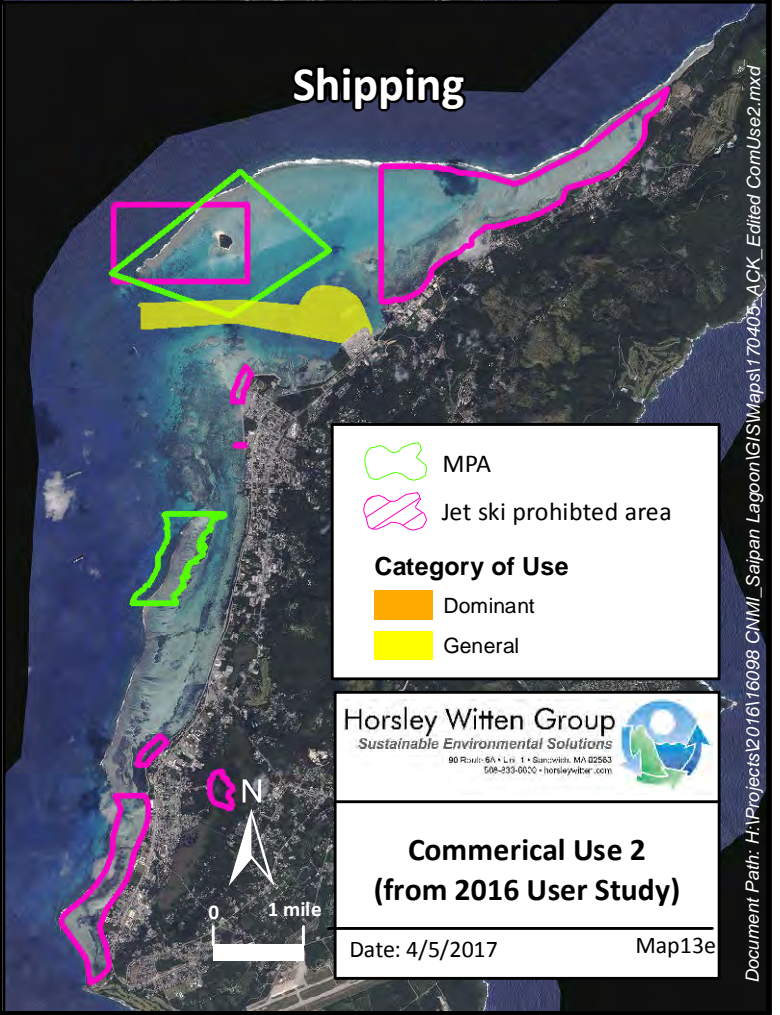
Com Snorkel Tours





Transit/Dinner Cruises





Shipping



-  MPA
-  Jet ski prohibited area

Category of Use

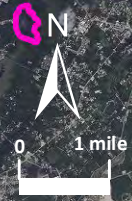
-  Dominant
-  General

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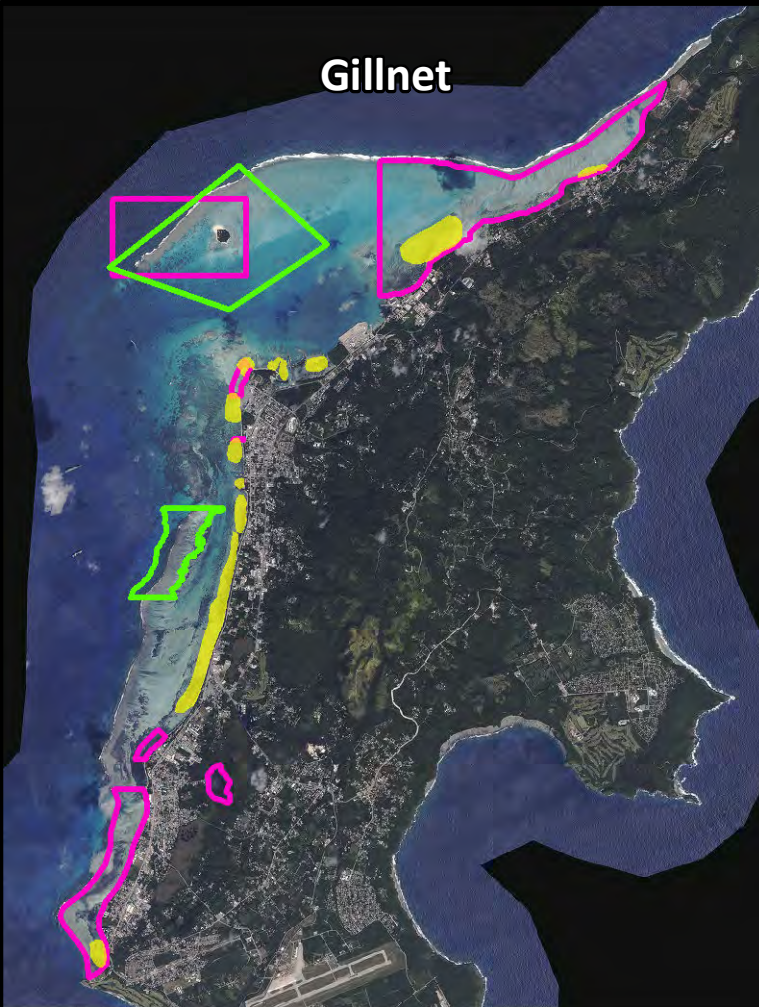


Commerical Use 2
(from 2016 User Study)

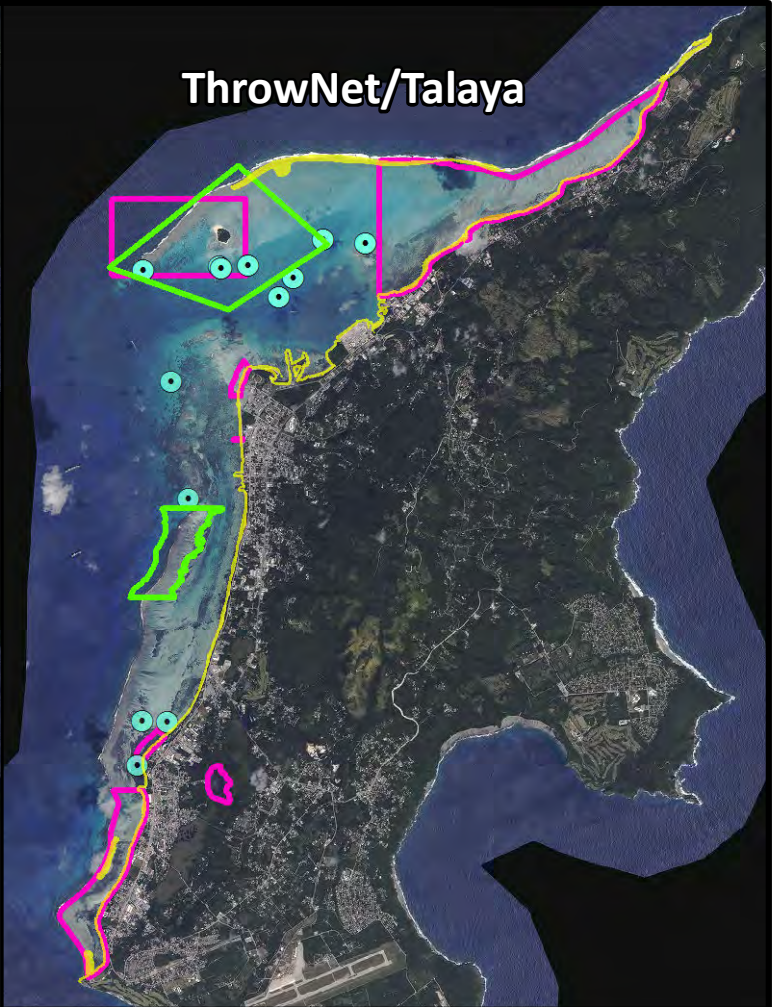
Date: 4/5/2017 Map13e



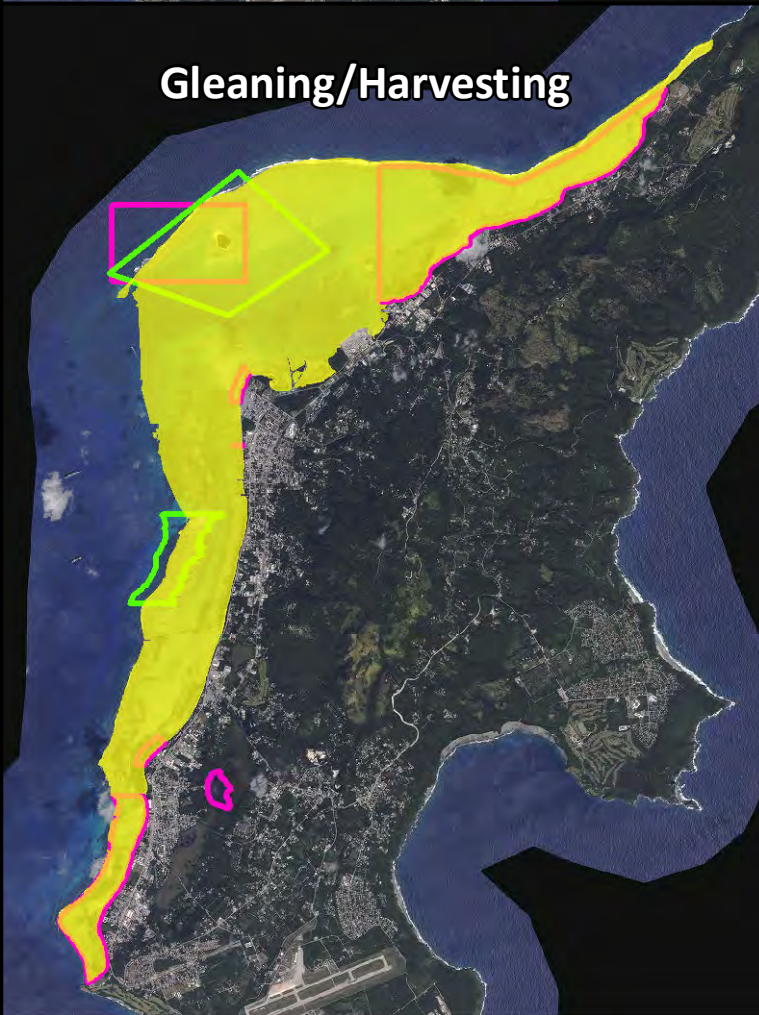
Gillnet



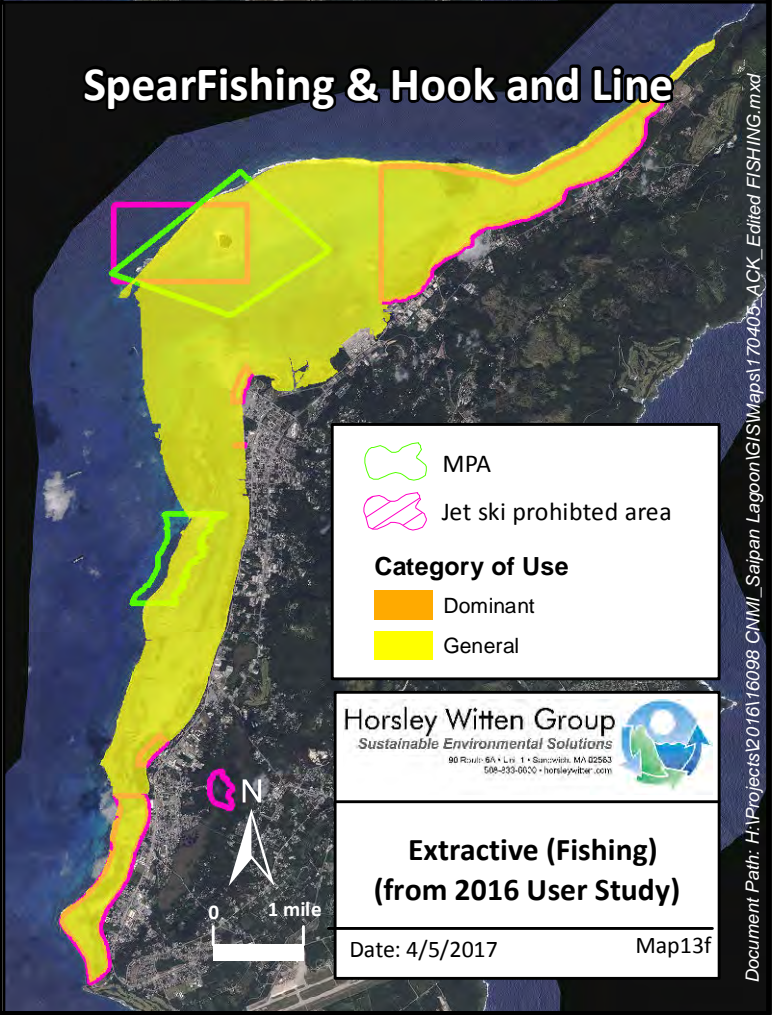
ThrowNet/Talaya





Gleaning/Harvesting





SpearFishing & Hook and Line



-  MPA
-  Jet ski prohibited area

Category of Use

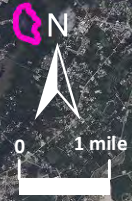
-  Dominant
-  General

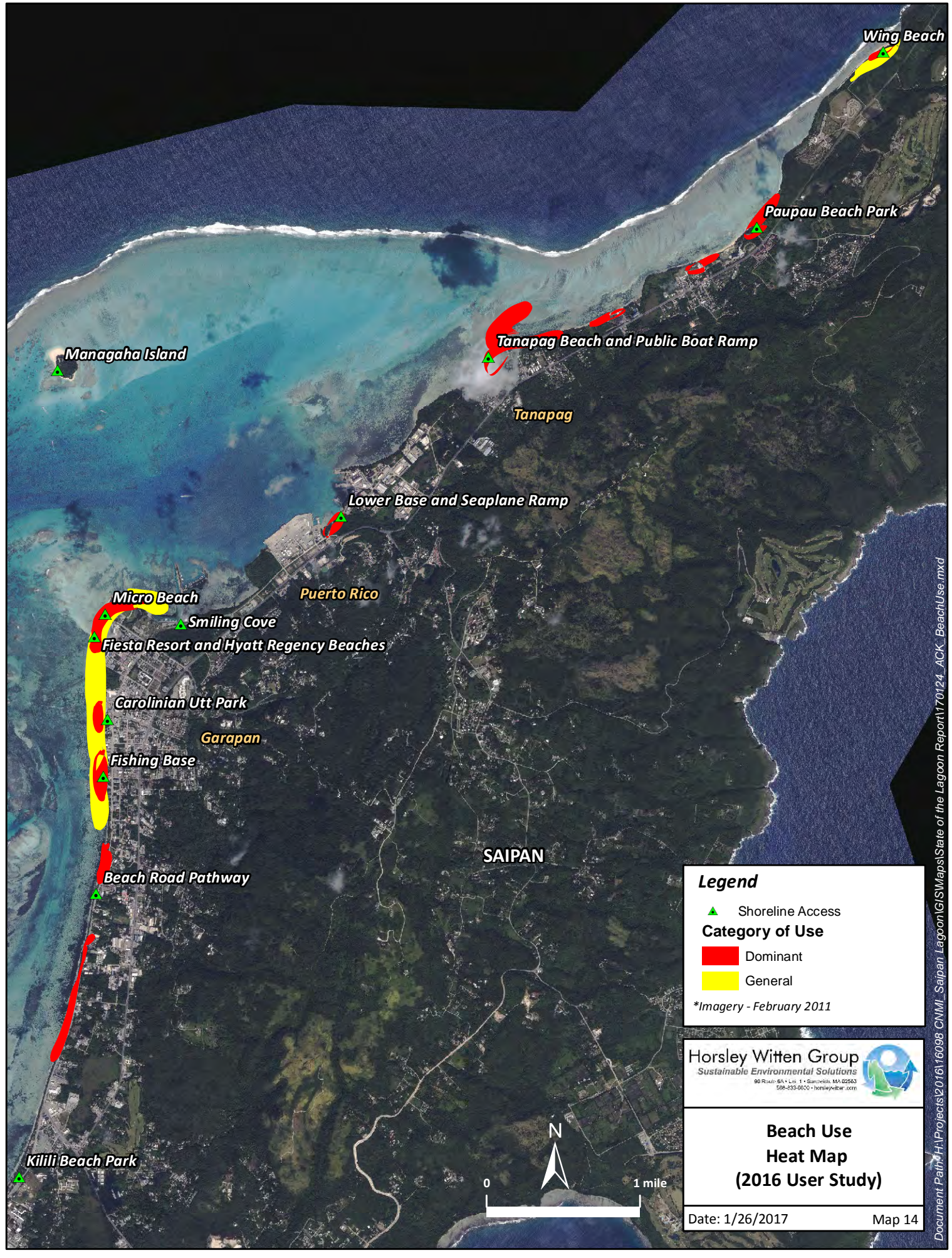
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Extractive (Fishing)
(from 2016 User Study)

Date: 4/5/2017 Map13f





Legend

- ▲ Shoreline Access

Category of Use

- Dominant
- General

**Imagery - February 2011*

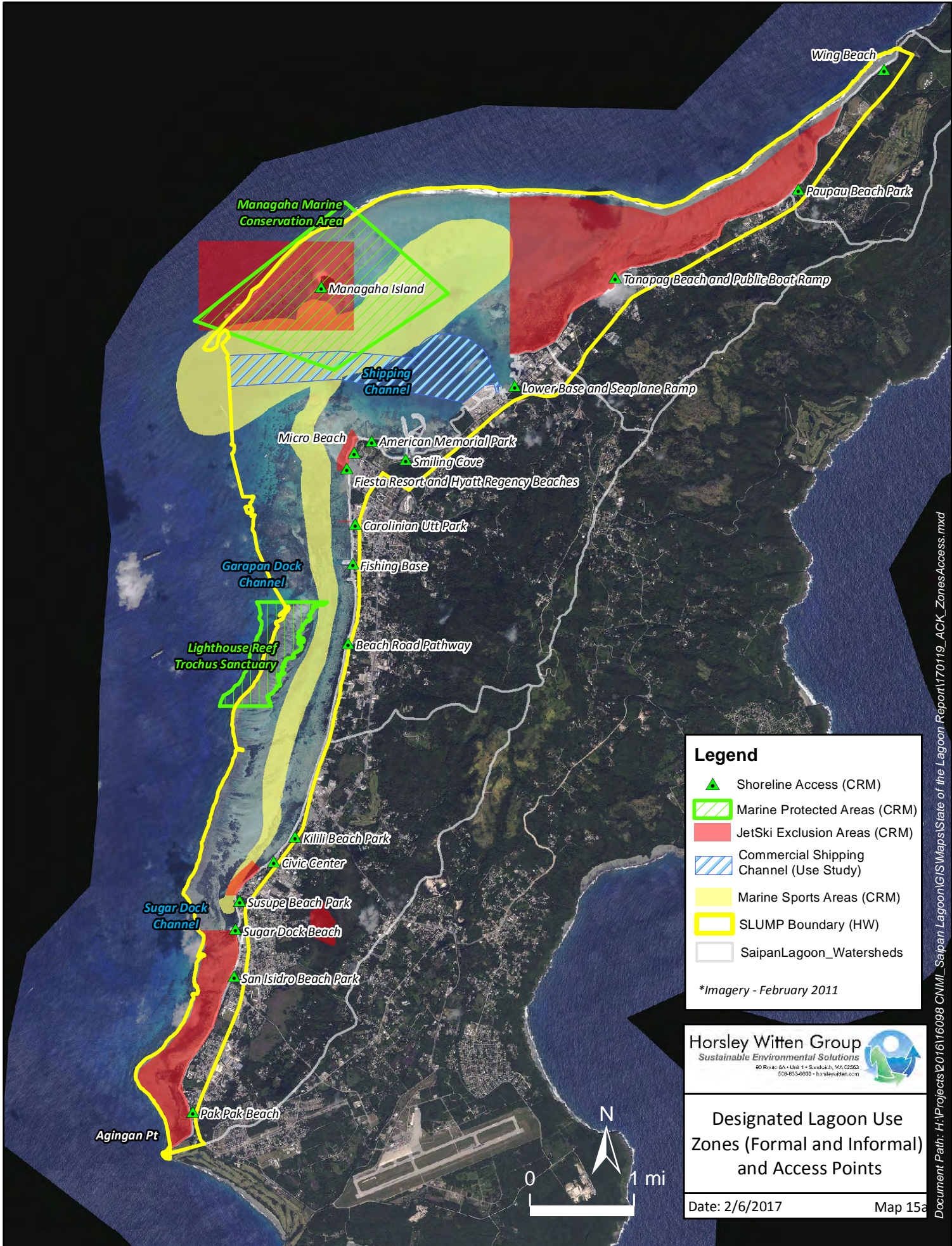
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**Beach Use
 Heat Map
 (2016 User Study)**

Date: 1/26/2017 Map 14



Document Path: H:\Projects\2016\16098 CNM - Saipan Lagoon\GIS\Maps\State of the Lagoon Report\70124 - ACK - BeachUse.mxd



Legend

- Shoreline Access (CRM)
- Marine Protected Areas (CRM)
- JetSki Exclusion Areas (CRM)
- Commercial Shipping Channel (Use Study)
- Marine Sports Areas (CRM)
- SLUMP Boundary (HW)
- SaipanLagoon_Watersheds

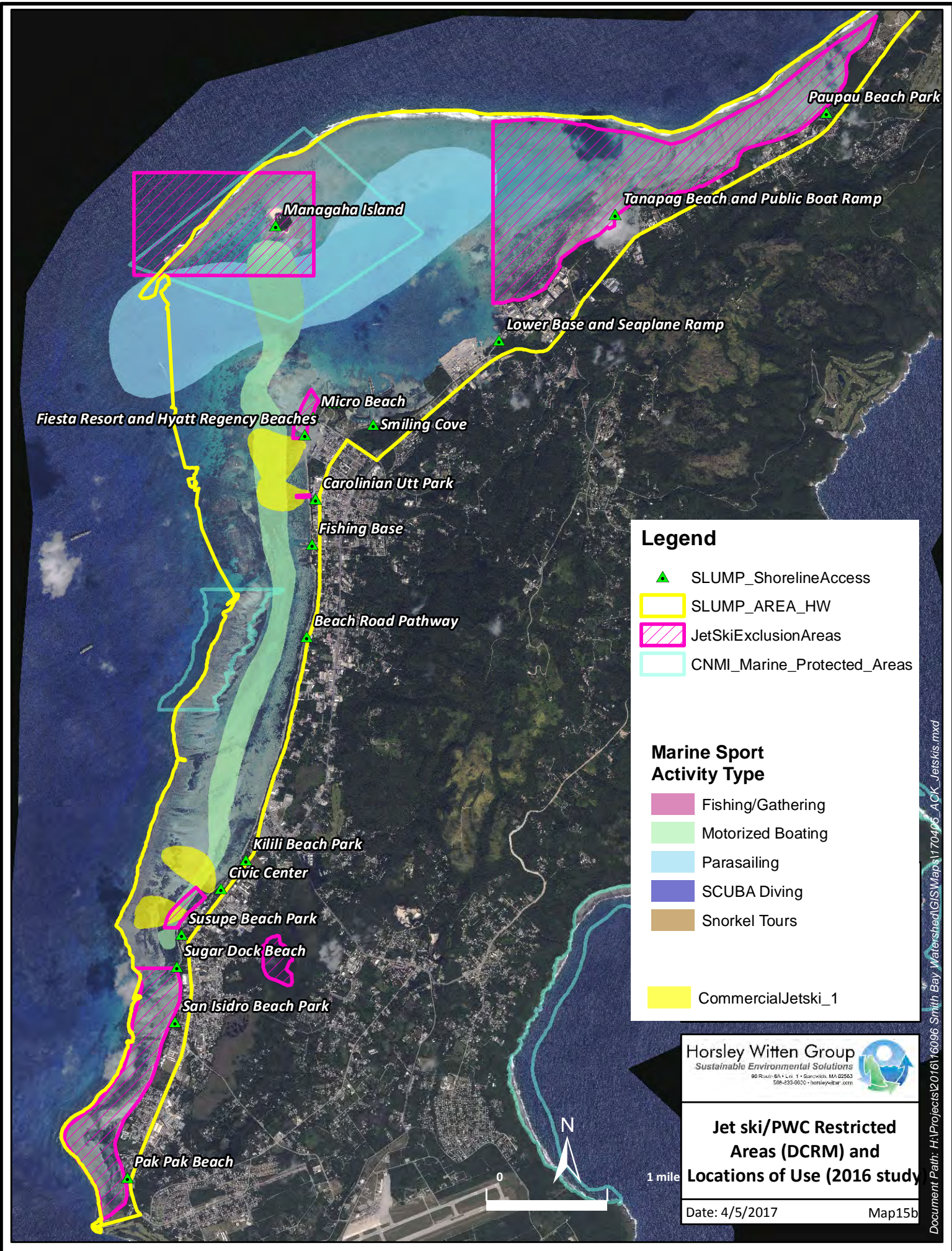
**Imagery - February 2011*

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Designated Lagoon Use Zones (Formal and Informal) and Access Points

Date: 2/6/2017 Map 15a



Legend

- SLUMP_ShorelineAccess
- SLUMP_AREA_HW
- JetSkiExclusionAreas
- CNMI_Marine_Protected_Areas

Marine Sport Activity Type

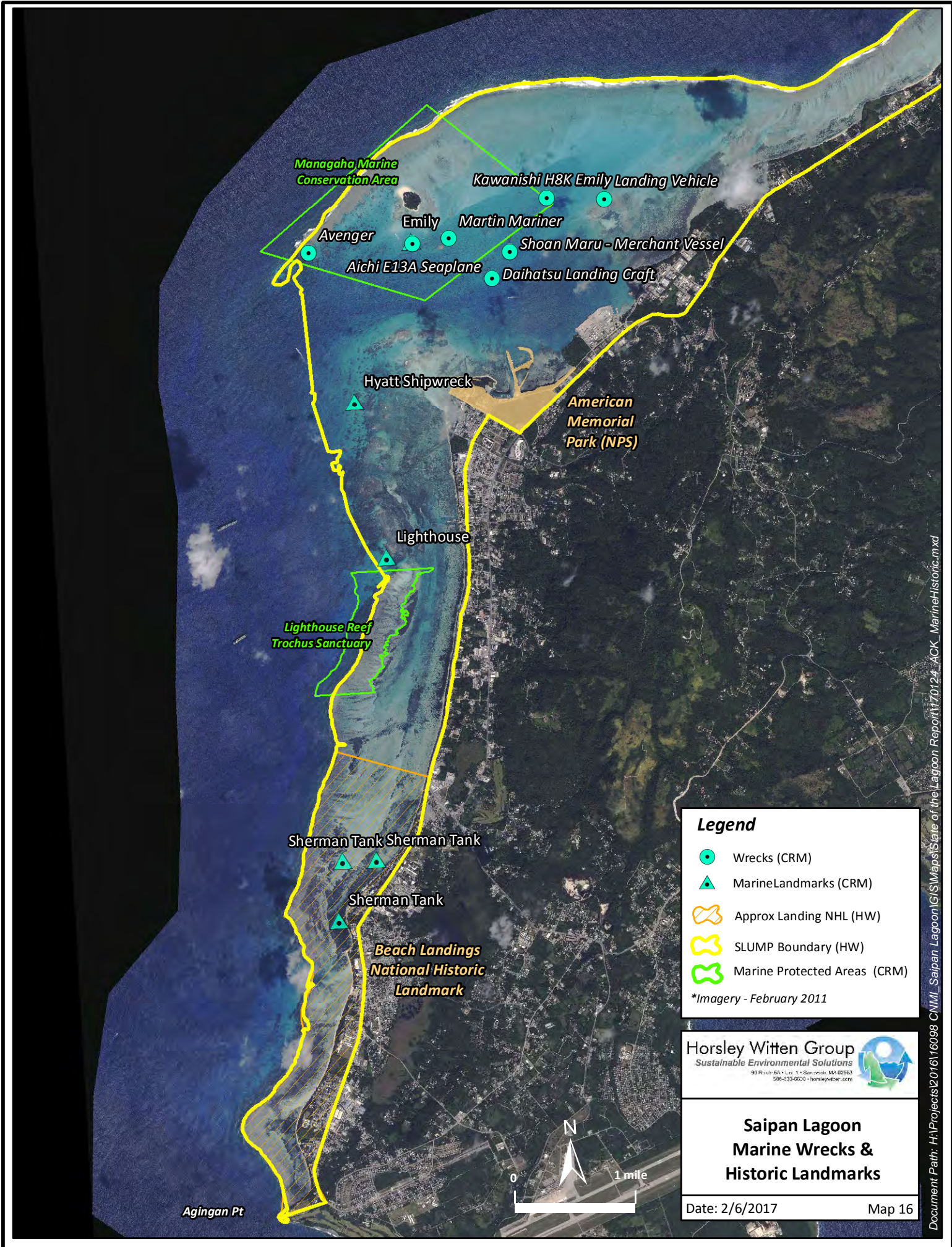
- Fishing/Gathering
- Motorized Boating
- Parasailing
- SCUBA Diving
- Snorkel Tours
- CommercialJetski_1

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Jet ski/PWC Restricted Areas (DCRM) and Locations of Use (2016 study)

Date: 4/5/2017 Map15b

Document Path: H:\Projects\2016\16096 Smith Bay Watershed\GIS\Maps\1704\6_AOK_JetSki.mxd



Managaha Marine Conservation Area

Kawanishi H8K Emily Landing Vehicle

Emily

Martin Mariner

Avenger

Shoan Maru - Merchant Vessel

Aichi E13A Seaplane

Daihatsu Landing Craft

Hyatt Shipwreck

American Memorial Park (NPS)

Lighthouse

Lighthouse Reef Trochus Sanctuary

Sherman Tank Sherman Tank

Sherman Tank

Beach Landings National Historic Landmark

Agingan Pt

Legend

- Wrecks (CRM)
- Marine Landmarks (CRM)
- Approx Landing NHL (HW)
- SLUMP Boundary (HW)
- Marine Protected Areas (CRM)

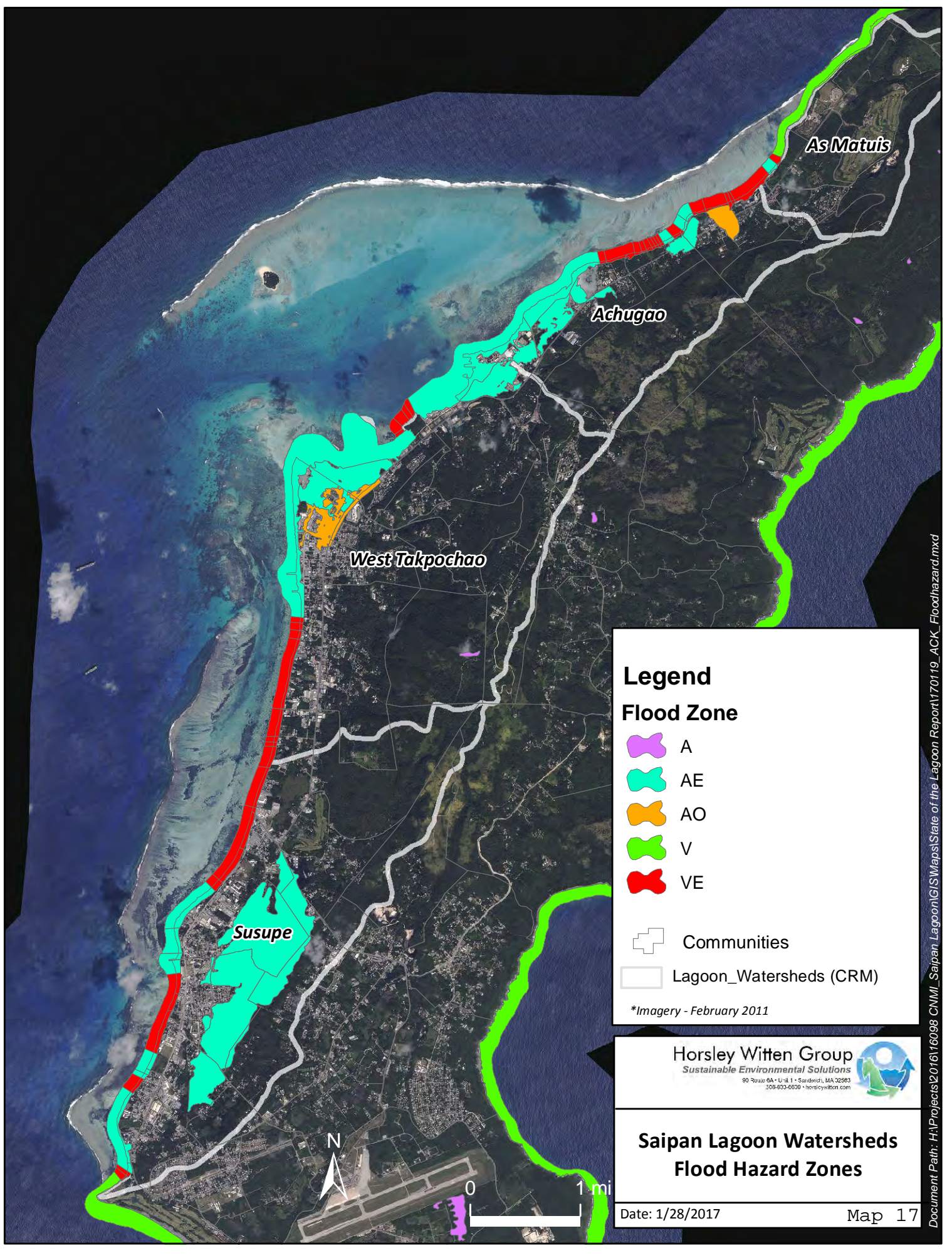
**Imagery - February 2011*

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Saipan Lagoon Marine Wrecks & Historic Landmarks






Date: 2/6/2017 Map 16



Document Path: H:\Projects\2016\16098 CNM - Saipan Lagoon\GIS\Maps\State of the Lagoon Report\720124 - ACK - MarineHistoric.mxd



Legend

Flood Zone

-  A
-  AE
-  AO
-  V
-  VE

-  Communities
-  Lagoon_Watersheds (CRM)

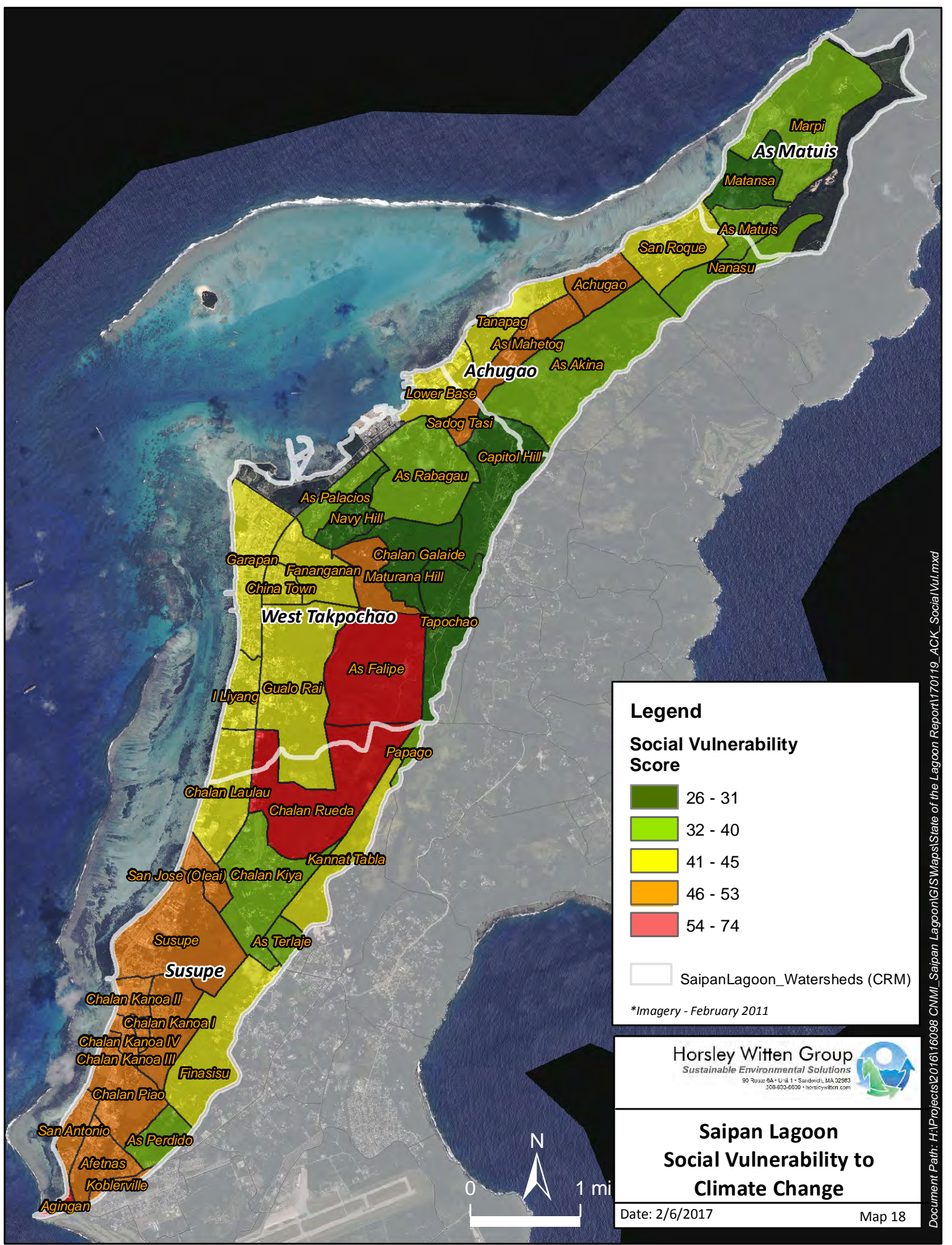
**Imagery - February 2011*

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**Saipan Lagoon Watersheds
 Flood Hazard Zones**

Document Path: H:\Projects\2016\16098_CNM1_Saipan_Lagoon\GIS\Waps\State of the Lagoon Report\170119_ACK_FloodHazard.mxd



Legend

Social Vulnerability Score

- 26 - 31
- 32 - 40
- 41 - 45
- 46 - 53
- 54 - 74

SaipanLagoon_Watersheds (CRM)

*Imagery - February 2011

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**Saipan Lagoon
Social Vulnerability to
Climate Change**

Date: 2/6/2017

Map 18



Appendix B

New, Pending, or Proposed Development

Appendix B: Recent, Pending, and Potential Development within SLUMP and Contributing Watersheds (HEC)

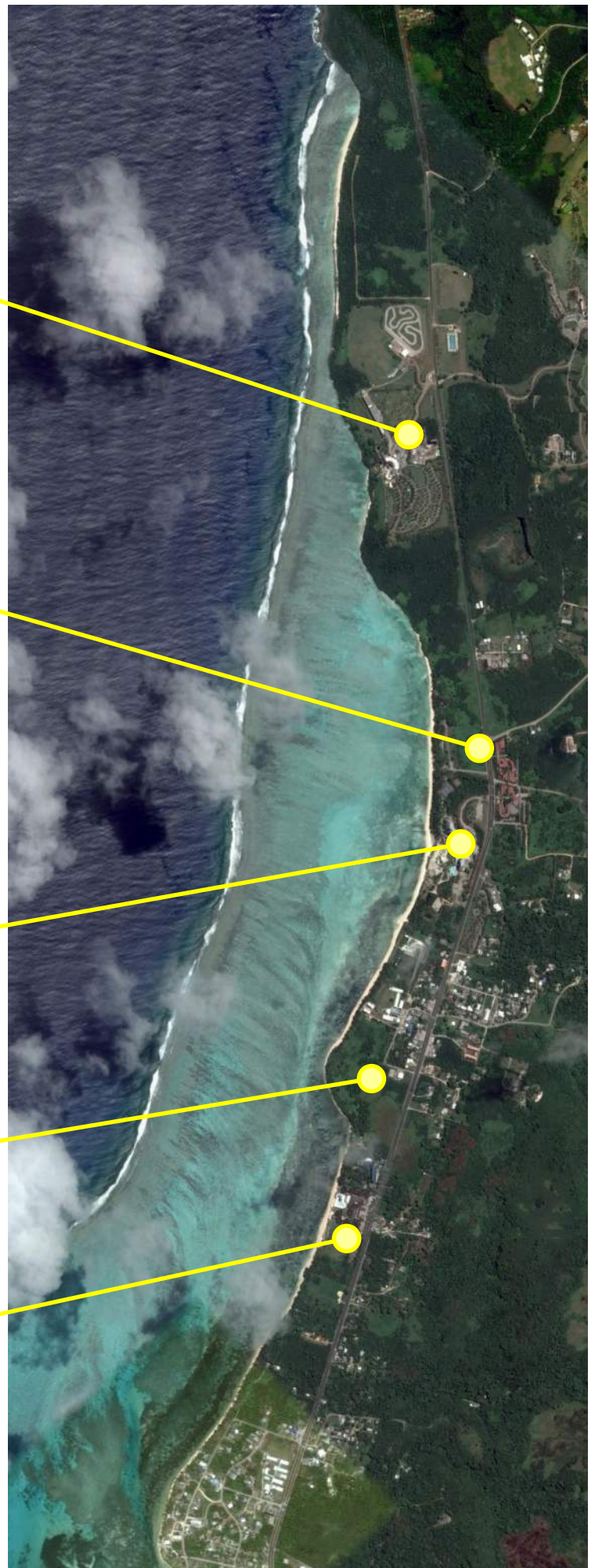
Mariana Resort and Spa: resort renovations expected as BSI assumes ownership.

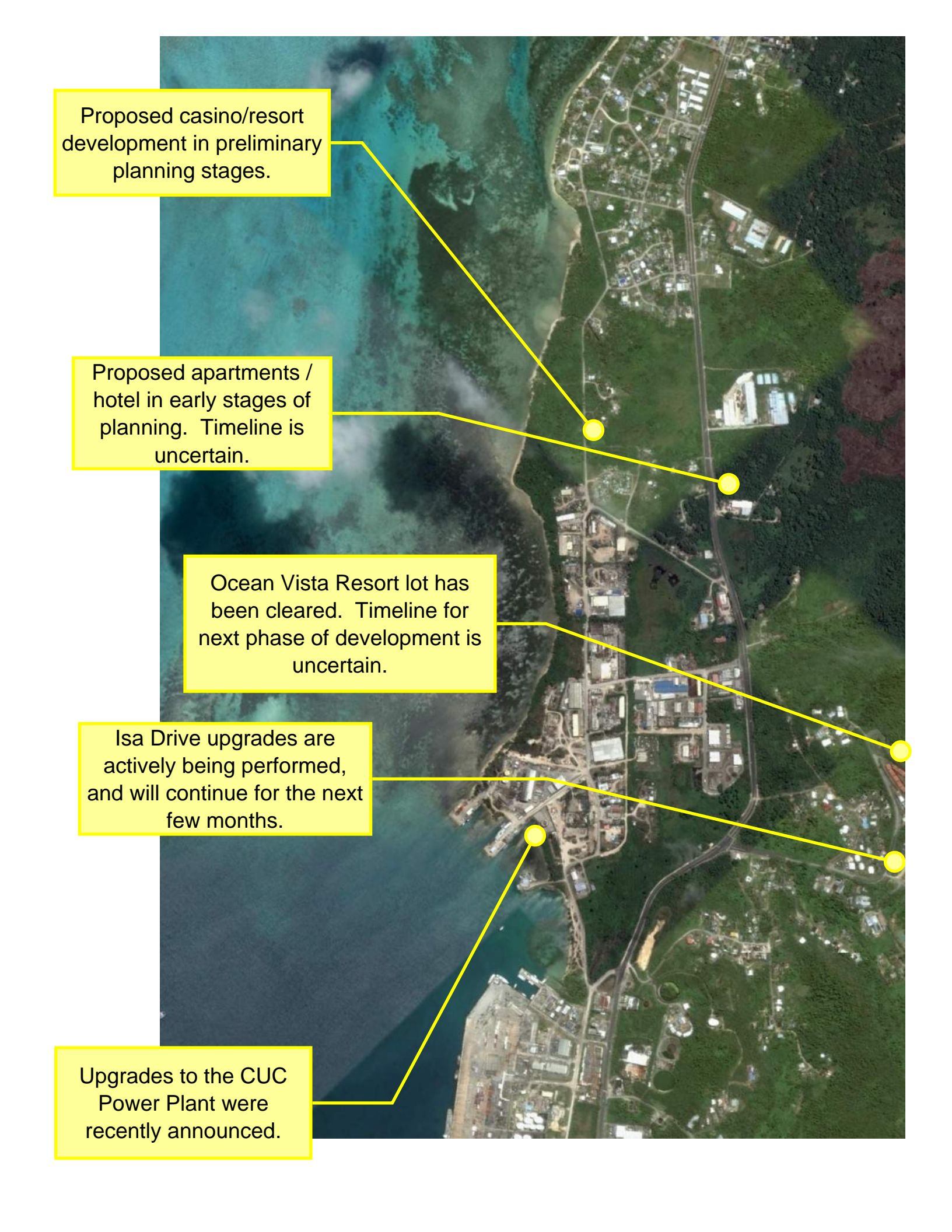
Property uphill of Paupau Beach (adjacent to roadway) recently cleared. New development may be on the way.

Former Hotel Nikko recently reopened as Kensington Hotel.

Globe International proposed casino/resort has already requested a permit from the CNMI Zoning Board.

There is a permitted Condo development south of Aqua Resort, though the status of construction is not known.





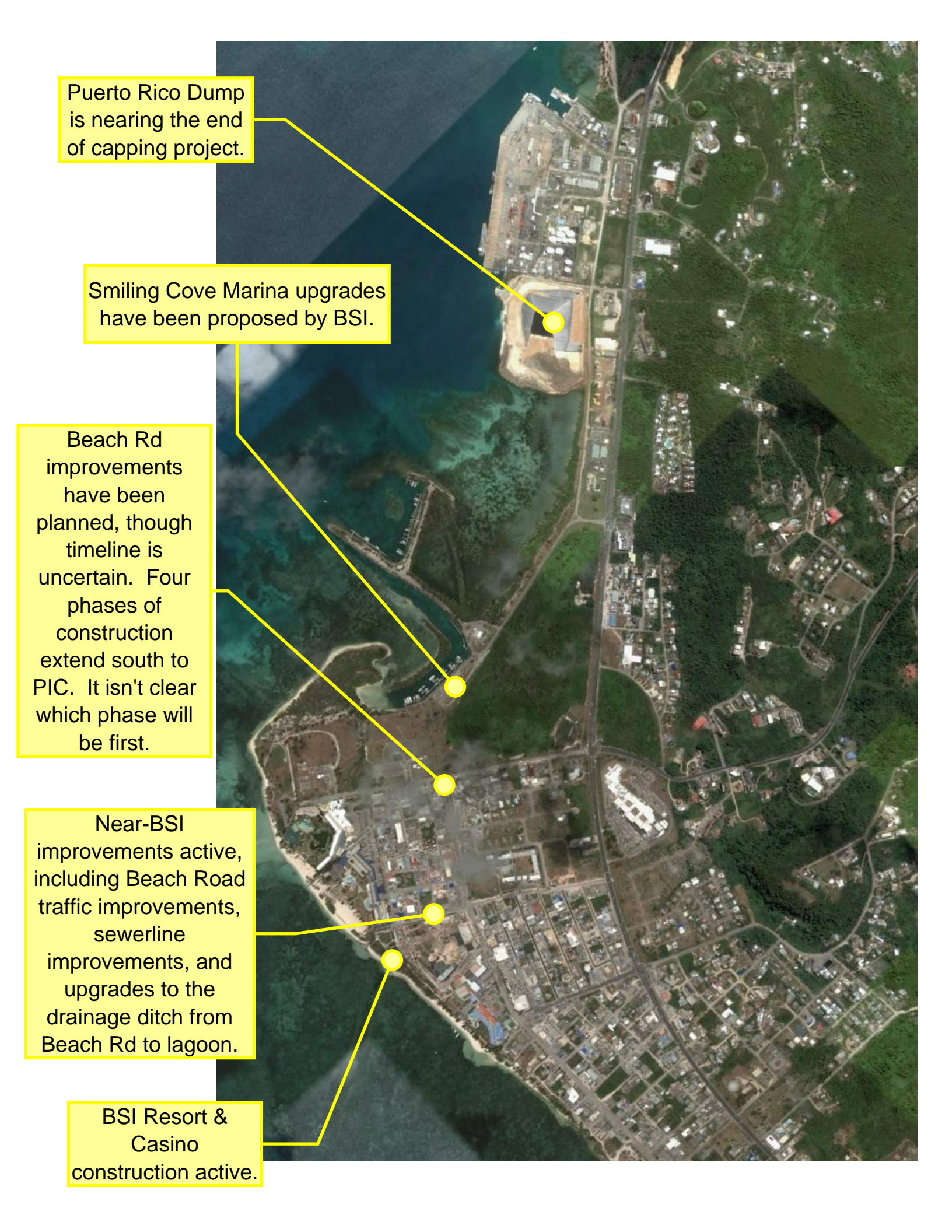
Proposed casino/resort development in preliminary planning stages.

Proposed apartments / hotel in early stages of planning. Timeline is uncertain.

Ocean Vista Resort lot has been cleared. Timeline for next phase of development is uncertain.

Isa Drive upgrades are actively being performed, and will continue for the next few months.

Upgrades to the CUC Power Plant were recently announced.



Puerto Rico Dump is nearing the end of capping project.

Smiling Cove Marina upgrades have been proposed by BSI.

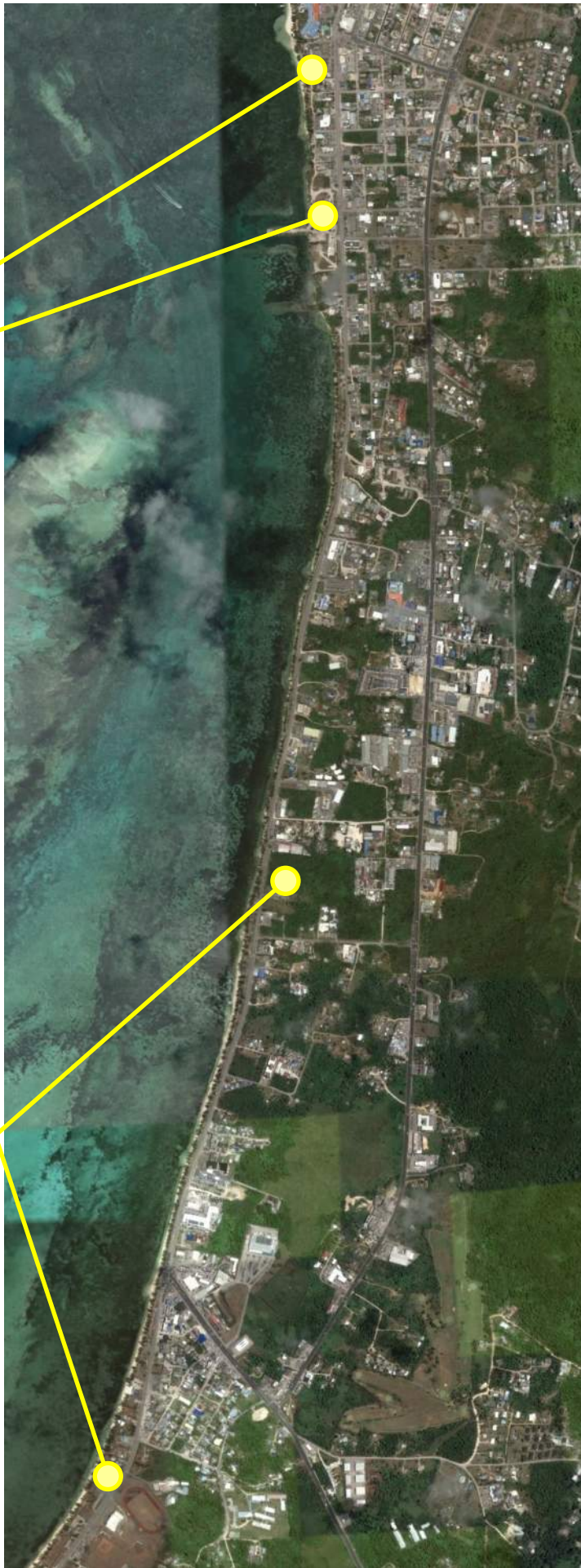
Beach Rd improvements have been planned, though timeline is uncertain. Four phases of construction extend south to PIC. It isn't clear which phase will be first.

Near-BSI improvements active, including Beach Road traffic improvements, sewerline improvements, and upgrades to the drainage ditch from Beach Rd to lagoon.

BSI Resort & Casino construction active.

Increased recreational usage at most public beaches, particularly at the Carolinian Utt, Garapan Fishing Base, and Kilili Beach.

Lot has recently been cleared. New development may be in the works.



Condo / housing development has recently been constructed near Sugar Dock. Along with this, the beachside has been maintained more frequently for use by the condo residents and general public.

Sugar Dock has recently been deemed structurally unsafe and will be repaired some time soon.

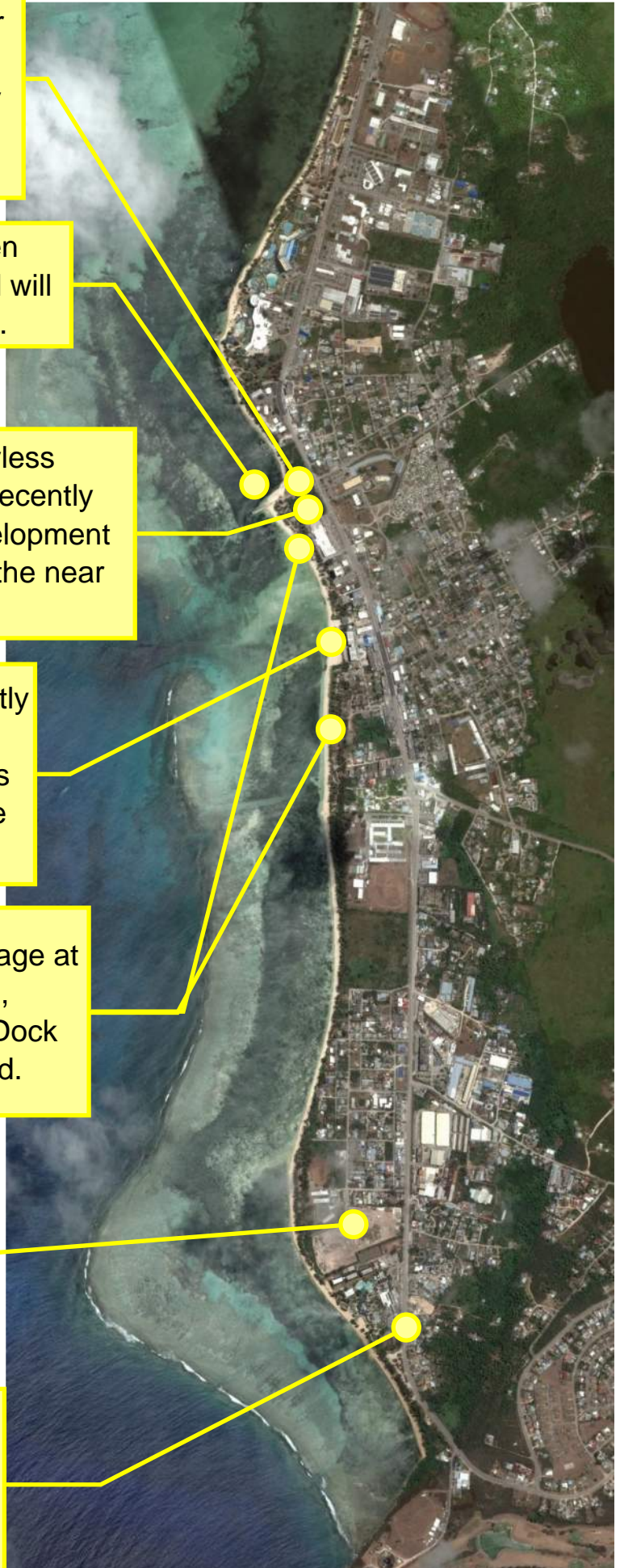
Lot north of Payless Supermarket has recently been cleared. Development may be planned in the near future.

Condo / housing development has recently been constructed in Chalan Piao, right along the beach. The beach undergoes frequent maintenance for the use of the condo residents and general public.

Increased recreational usage at most public beaches, particularly from Sugar Dock and south to Hopwood.

Honest Profit Resort under development. Future phases of the project include obtaining the nearby San Antonio Middle School property to expand the resort, though timeline is not certain.




Beach Rd improvements have been planned, though timeline is uncertain. Four phases of construction extend north to American Memorial Park. It isn't clear which phase will be first.



Appendix C

Management Recommendation Summary Table, Maynard et al., 2015b





APPENDIX C: Maynard et al. (2015b)¹ reef resiliency site descriptions and management recommendations for forereef and lagoon sites within the SLUMP area. Sites are listed roughly from north to south. All text was taken directly from Maynard et al. (2015b), except for italicized text and check marks in parentheses, which are HW's interpretation of management recommendations based upon the site descriptions.




Site Name	Foreereef or Lagoon	Site Description	Management Recommendations Summary	Management Options					
				Warm Water Monitoring	LBSP Reduction	Fishery Regulation and Enforcement	Moorings/ No-Anchoring Areas	Reef Restoration/ Coral Translocation	Conservation
Wing Beach	Forereef 	Wing Beach is located on the northwest side of Saipan and is a Marine Monitoring Team survey site. On calm days, divers often see turtles, sharks and other charismatic megafauna. This site is a great spot to find photogenic anemone fishes. This site has a high score for coral recruitment but a low score for bleaching resistance. Greater than 50% of the benthic community is made up by live coral. Greater than 75% of the total herbivorous fish biomass is comprised of grazers/detritivores.	This site is a target for bleaching monitoring and supporting recovery so should be monitored during upcoming warm seasons. This site is also a target for fishery regulations and enforcement. Examples of actions that can be considered for implementation at this location include increased enforcement, size regulations and bag and catch limits, and mooring and no-anchoring areas.	✓		✓	✓		
Marianas Resort_MMT	Lagoon 	Marianas Resort is named for the adjacent Marianas Resort Hotel & Spa, which opened on Saipan nearly 40 years ago. This site lies near a secluded little beach where guests and residents can snorkel or kayak over to the reef, which is home to stands of staghorn <i>Acropora</i> species. Tawny nurse sharks (<i>Nebrius ferrugineus</i>) can often be seen at this site. Nearly 50% of the benthic community is made up by live coral with most of the remainder split between turfing algae and macroalgae. There are bleaching reports from this site in 2013 so the benthic community is likely to have changed since these surveys were conducted in May/June of 2012. Greater than 75% of the total herbivorous fish biomass is comprised of scrapers/excavators. This site has the highest scores possible for both fishing access and LBSP.	<i>None provided.</i> <i>From review of site description: warm season monitoring, LBSP reduction (road and storm drain improvements); fisheries regulation and enforcement²</i>	(✓) ³	(✓)	(✓)			
Pau Pau	Forereef 	Pau Pau (<i>paopao</i> is a chamorro word meaning sweet or fragrant) Beach is known for its many flowering plants with sweet aromatic smells. This site has a high score for coral recruitment but also received a low score for bleaching resistance, as the majority of the corals found on this reef are highly susceptible to bleaching. This reef was overwhelmingly dominated by bare pavement substrate (>75%). Nearly 75% of the total herbivorous fish biomass was comprised of grazers/detritivores with the remaining ~25% split between browsers and scrapers/excavators.	Pau Pau is highly accessible to fishers so the site is a target for fishery regulations & enforcement actions. Examples of actions that can be considered for implementation at this location include increased enforcement, size regulations and bag and catch limits, and mooring and no-anchoring areas.			✓	✓		




¹ Maynard, J., S. McKagan, L. Raymundo, S. Johnson, G. Ahmadi, L. Johnston, P. Houk, G. Williams, M. Kendall, S. Heron, R. van Hooonk, and E. McLeod. 2015b. Assessing relative resilience potential of coral reefs to inform management in the Commonwealth of the Northern Mariana Islands. Silver Spring, MD: NOAA Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 22. 153pp.





² Italicized text is not taken from directly from Maynard et al. (2015). This text is from HW.




³ Check marks in parentheses indicate that these management recommendations are from HW, based upon a review of the Maynard et al. (2015) site descriptions.

Site Name	Foreereef or Lagoon	Site Description	Management Recommendations Summary	Management Options					
				Warm Water Monitoring	L BSP Reduction	Fishery Regulation and Enforcement	Moorings/ No-Anchoring Areas	Reef Restoration/ Coral Translocation	Conservation
Achugao	Forereef 	Achugao is located on the northeast side of Saipan. Achugao is the name of the village just onshore of this reef. <i>Achugao</i> means “rock with a node in it” in Chamorro. This site is a great spot to find photogenic anemonefishes. This site has high coral recruitment but low bleaching resistance and medium-low temperature variability and herbivore biomass. Greater than 50% of the benthic community is made up by live coral. Roughly 90% of the total herbivorous fish biomass is comprised of grazers/detritivores.	This site is a target for fishery regulations and enforcement and bleaching monitoring and supporting recovery. Examples of actions that can be considered for implementation at this location include: size regulations and bag and catch limits and increased monitoring during warm seasons.	✓		✓			
Achu Dangkulu	Forereef 	Achu Dangkulu translates to “Big Rock”. There is a group of large rocks at this site that the fishers of Tanapag village use as a navigation landmark. This site has medium-low scores for bleaching resistance, temperature variability, and herbivore biomass. This is one of only a few sites where coral cover is >70%. Nearly 75% of the total herbivorous fish biomass is comprised of grazers/detritivores.	This site is a target for fishery regulations and enforcement and bleaching monitoring and supporting recovery. Examples of actions that can be considered for implementation at this location include: size regulations and bag and catch limits and increased monitoring during warm seasons.	✓		✓			
Tanapag Staghorn_MMT	Lagoon 	Tanapag Staghorn is named for a village in the north of Saipan called Tanapag: In the early 19th century, the Refaluwasch people migrated from their home atolls (Satawal and Woleai) after a typhoon devastated their islands. They landed on Guam and received permission from the Spanish governor to settle recently vacated Saipan. The residents of Stawal settled to the north of Saipan, in the village now called Tanapag. Roughly 50% of the benthic community is made up by live coral. Roughly 70% of the total herbivorous fish biomass is comprised of grazers/detritivores with the remainder equally split between scrapers/excavators and browsers. There are bleaching reports from this site in 2013 so the benthic community is likely to have changed since these surveys were conducted in May/June of 2012. This site has high scores for both L BSP and fishing access.	<i>None provided.</i> <i>From review of site description: warm season monitoring, L BSP reduction (road and storm drain improvements); fisheries regulation and enforcement</i>	(✓)	(✓)	(✓)			
Elbow Reef	Forereef 	Elbow Reef is located just inside the Managaha Marine Conservation Area. This part of the barrier reef surrounding the Saipan lagoon has high wave exposure and very strong currents. Elbow reef scored high for the coral recruitment indicator but has medium-low scores for bleaching resistance, temperature variability and herbivore biomass. The benthic community was dominated by turfing algae (64.33%). Greater than 80% of the total herbivorous fish biomass was comprised of grazers/detritivores. This site is a great spot to find photogenic anemonefish and large yellowlip emperors.	Elbow Reef is located just inside the Managaha Marine Conservation Area. This site is a target for bleaching monitoring and supporting recovery so should be monitored during upcoming warm seasons.	✓					

Site Name	Foreereef or Lagoon	Site Description	Management Recommendations Summary	Management Options					
				Warm Water Monitoring	L BSP Reduction	Fishery Regulation and Enforcement	Moorings/ No-Anchoring Areas	Reef Restoration/ Coral Translocation	Conservation
Managaha MPA_MMT	Forereef 	Managaha_MMT is located in the Managaha Marine Conservation Area and is one of the long-term monitoring sites of the Marine Monitoring Team of CNMI BECQ. This site has high scores for temperature variability and herbivore biomass but a low score for coral diversity. The habitat here is primarily dominated by the coral <i>Isopora palifera</i> , which is shown in the photo to the right (this is the source photo for the covers of this and the main report). The benthic community is dominated by live coral (43.33%). Greater than half of the total herbivorous fish biomass is comprised of grazers/detritivores.	Managaha_MMT is located in the Managaha Marine Conservation Area. This site is a target for fishery regulations and enforcement and reef restoration/coral translocation activities. Examples of actions that can be considered for implementation at this location include: increased enforcement, size regulations and bag and catch limits, and mooring and no-anchoring areas.			✓	✓	✓	
Managaha Patch_MMT	Forereef 	Managaha Patch_MMT is located within the Managaha Marine Conservation Area (MMCA). This is one of three sites established by the CNMI Marine Monitoring Team within the MMCA to represent the various habitats. This site has medium-high scores for all resilience indicators excepting bleaching resistance, which has a medium-low score. Greater than 40% of the benthic community is made up by turfing algae. Roughly 75% of the total herbivorous fish biomass is comprised of scrapers/excavators.	Managaha Patch_MMT is located within the Managaha Marine Conservation Area (MMCA). This site is a target for land-based sources of pollution reduction and fishery regulations and enforcement. Examples of actions that can be considered for implementation at this location include road and storm drain improvements and size regulations and bag/catch limits.		✓	✓			
Lanyas_MMT	Forereef 	' <i>Laña</i> ' is a Chamorro word used to express feelings ranging from mild surprise to complete disgust. Local surfers chose this name due to feeling the need to express this feeling after surviving riding waves here. This site is within the Managaha Marine Conservation Area. This reef scored high for the temperature variability indicator and also has high coral diversity and temperature variability. 99% of the benthic community is made up by bare pavement (54%) and live coral (45%). Greater than 80% of the total herbivorous fish biomass was comprised in near equal parts by grazers/detritivores and scrapers/excavators. The Threatened coral species <i>Acropora globiceps</i> was seen at this site during our surveys in May/June of 2012.	This site is within the Managaha Marine Conservation Area. This site may warrant management attention for reasons distinct from the resilience assessment results.						

Site Name	Foreereef or Lagoon	Site Description	Management Recommendations Summary	Management Options					
				Warm Water Monitoring	LBSP Reduction	Fishery Regulation and Enforcement	Moorings/ No-Anchoring Areas	Reef Restoration/ Coral Translocation	Conservation
Fishing Base Staghorn_MMT	Lagoon 	Fishing Base Staghorn is near the Fishing Base Boat Ramp, which is one of four small boat launching areas for accessing the Saipan Lagoon. This site, just a few hundred yards from the pier onshore, contains one of Saipan's largest stands of staghorn <i>Acropora</i> . The reef extends well over 500 meters and is a preferred spot for juvenile Napoleon Wrasse (<i>Cheilinus undulatus</i>). Uniquely, the benthic community at this site consisted of 100% coral cover (all staghorn <i>Acropora</i>) at the time of surveys. This site is highly bleaching susceptible given branching <i>Acropora</i> species are among the most susceptible of all coral types to thermal bleaching. There are bleaching reports from this site in 2013 so the benthic community is likely to have changed since these surveys were conducted in May/June of 2012. Greater than 75% of the total herbivorous fish biomass is comprised of scrapers/excavators. This site has high fishing access (given the adjacent boat ramp) and also has high values for LBSP.	<i>None provided.</i> <i>From review of site description: warm season monitoring, LBSP reduction (road and storm drain improvements); fisheries regulation and enforcement</i>	(✓)	(✓)	(✓)			
Peysonnelia Reef	Forereef 	Peysonnelia Reef is a reef dominated by <i>Peysonnelia</i> , a genus of encrusting fleshy macroalgae. This site is a great spot to find photogenic anemone fishes. This site has high scores for bleaching resistance and temperature variability. The site has high coral cover (>60%). However, this site is also highly accessible to fishers and has high scores for LBSP.	This site is a target for LBSP reduction, fishery regulations & enforcement and reef restoration/coral translocation strategies. Examples of actions that can be considered for implementation at this location include road & storm drain improvements and size regulations & bag/catch limits.		✓	✓		✓	
Quartermaster Staghorn_MMT	Lagoon 	Quartermaster Staghorn is named for Quartermaster Road, which is a short secondary road that connects the two main roads of Saipan, Beach Road and Chalan Pale Arnold. An old American M4 Sherman Tank from World War II is on display where Quartermaster and Beach Road meet. This is a well known landmark on the island and is used to help identify the location of this staghorn <i>Acropora</i> reef. Roughly 60% of the benthic community is made up by live coral. There are bleaching reports from this site in 2013 so the benthic community is likely to have changed since these surveys were conducted in May/June of 2012. Greater than 75% of the total herbivorous fish biomass is comprised of scrapers/excavators. This site has high scores for both LBSP and fishing access.	<i>None provided.</i> <i>From review of site description: warm season monitoring, LBSP reduction (road and storm drain improvements); fisheries regulation and enforcement</i>	(✓)	(✓)	(✓)			

Site Name	Foreereef or Lagoon	Site Description	Management Recommendations Summary	Management Options					
				Warm Water Monitoring	LBSP Reduction	Fishery Regulation and Enforcement	Moorings/ No-Anchoring Areas	Reef Restoration/ Coral Translocation	Conservation
Lighthouse Reef	Forereef 	Lighthouse Reef is located near an old Japanese lighthouse that marks a channel that leads out from the Garapan Fishing Base boat ramp. The Lighthouse Reef is also a preserve area for species of topshell (<i>Trochus</i> sp.). This site has medium-high scores for all resilience indicators excepting temperature variability. This is among the few sites where coral cover was >70%. No macroalgae was observed during our surveys. Greater than half of the total herbivorous fish biomass was made up of grazers/detritivores.	The Lighthouse Reef is also a preserve area for species of topshell (<i>Trochus</i> sp.). This site has high resilience potential and is currently outside established marine protected areas so is a high priority for conservation efforts. This site is also a target for fishery regulations and increased enforcement due to the high resilience potential and that the site is easy for fishers to access. Examples of actions that can be considered for implementation at this location include increased enforcement, size regulations and bag and catch limits, and mooring and no-anchoring areas.			✓	✓		✓
Oleai Staghorn_MMT	Lagoon 	Oleai Staghorn is named for a village established on the southern part of Saipan known as Oleai. Residents of the Micronesian atoll Woleai moved to Saipan and established this village after a typhoon devastated their home. The staghorn <i>Acropora</i> reef that forms this site is just offshore from the village and is a prime fishing ground for parrotfish and wrasses. Roughly 20% of the benthic community is live coral and nearly all of the remainder is bare pavement. There are bleaching reports from this site in 2013 so the benthic community is likely to have changed since these surveys were conducted in May/June of 2012. Roughly 75% of the herbivorous fish community is comprised of scrapers/excavators. This site has high scores for both LBSP and fishing access.	<i>None provided.</i> <i>From review of site description: warm season monitoring, LBSP reduction (road and storm drain improvements); fisheries regulation and enforcement</i>	(✓)	(✓)	(✓)			
Oleai Rocks	Forereef 	Oleai Rocks is located on the western side of Saipan. Dive operators take divers to this area been using as a back-up to more popular sites further south. This site has medium-low scores for bleaching resistance, coral recruitment and temperature variability. Roughly 70% of the benthic community is made up in near equal parts by live coral and bare pavement. Greater than 50% of the total herbivorous fish biomass is comprised of scrapers/ excavators.	This site did not meet any of the criteria we set to identify targets for various types of management action. This site may warrant management attention for reasons distinct from the resilience assessment results.						
Grand Hotel_MMT	Forereef 	Grand Hotel_MMT is adjacent to the Kanoa Resort (formerly known as the Saipan Grand Hotel) and is one of the longterm monitoring sites of the Marine Monitoring Team of CNMI BECQ. This site has a high score for temperature variability and medium high scores for all other indicators excepting herbivore biomass, which is medium-low. The benthic community at this site is dominated by live coral (37%) and pavement (37.67%). The total herbivorous fish biomass was comprised in near equal parts by grazers/detritivores and scrapers/excavators. Grand Hotel_MMT has high fishing access and a medium-high score for LBSP.	This site is a target for land-based sources of pollution reduction and fishery regulations and enforcement activities. Examples of actions that can be considered for implementation at this location include road & storm drain improvements and size regulations & bag/catch limits.		✓	✓			

Site Name	Foreereef or Lagoon	Site Description	Management Recommendations Summary	Management Options					
				Warm Water Monitoring	LBSP Reduction	Fishery Regulation and Enforcement	Moorings/ No-Anchoring Areas	Reef Restoration/ Coral Translocation	Conservation
Pak Pak Beach_MMT	Lagoon 	Pak Pak Beach_MMT is named for Pak Pak Beach, which is the southernmost beach of the Saipan Lagoon. <i>Pak Pak</i> is Chamorro for “popping sound”. One theory as to how the beach received its name is due to the popping noises that would be made as the US military would dump scrap metal and waste off of the cliffs just south of this beach. This site is one of the long-term monitoring sites of the Marine Monitoring Team of CNMI BECQ. Nearly 50% of the benthic community is made up by live coral. There are bleaching reports from this site in 2013 so the benthic community is likely to have changed since these surveys were conducted in May/June of 2012. Greater than 75% of the total herbivorous fish biomass is comprised of razers/detritivores. This site has high scores for both LBSP and fishing access.	<i>None provided.</i> <i>From review of site description: warm season monitoring, LBSP reduction (road and storm drain improvements); fisheries regulation and enforcement</i>	(✓)	(✓)	(✓)			
Point Break Reef	Forereef 	Point Break Reef is one of the southeastern reefs on Saipan. The reef here is adjacent to the island’s most consistent breaking ‘wave’ — the Point Break flowrider mechanical wave at the Pacific Islands Club resort. This site is a great spot to find photogenic anemonefish. This site has a high score for temperature variability and medium-high scores for all other indicators excepting bleaching resistance, which is medium-low. The benthic community is dominated by turfing algae (41.33) and coral cover is 24%. Greater than 80% of the total herbivorous fish biomass was comprised of grazers/detritivores. Point Break Reef is highly accessible to fishers and has a medium-high score for LBSP.	This site is a target for land-based sources of pollution reduction and fishery regulations and enforcement activities. Examples of actions that can be considered for implementation at this location include road and storm drain improvements and size regulations & bag/catch limits.		✓	✓			
Agingan Point	Forereef 	Agingan Point is the southwestern most point on Saipan. An outfall point from a sewage treatment plant is located at this site, roughly 90 feet deep and 100 feet from the coast. A rare yellowedge moray eel was observed at this site. This site has a high score for temperature variability but medium-low scores for bleaching resistance, coral recruitment and herbivore biomass. Roughly 80% of the benthic community was made up in near equal parts by turf algae and live coral. Greater than 75% of the total herbivorous fish biomass was comprised of grazers/detritivores.	This site is a target for LBSP reduction, fishery regulations and enforcement and bleaching monitoring and supporting recovery. This is one of only four sites that met at least three of the criteria set to identify targets for management actions. This site should be monitored during upcoming warm seasons. Examples of actions that can be considered for implementation at this location include road and storm drain improvements and size regulations and bag/catch limits.	✓	✓	✓			

Appendix D

Garapan Watershed Conservation Action Plan Strategic Workplan
Summary Tables (from Mattos, 2015)

Appendix D

Garapan Watershed Conservation Action Plan Strategic Workplan Summary Tables (from Mattos, 2015)

STRATEGY A: BEST MANAGEMENT PRACTICES		
<i>Objectives and Strategic Actions</i>	<i>Partners</i>	<i>Priority</i>
OBJECTIVE 15.A1: By the end of FY2018, water turbidity has been reduced below 2013 ambient levels by 10% on average at all Garapan water quality lagoon monitoring sites		
Continue researching, developing and training farmers on techniques for agricultural areas to decrease reliance on agro-chemicals	NMC-Crees, NRCS, CHCC-BEH	Medium
Conduct FOG campaign to teach residents about proper disposal of waste and contaminants and enforce FOG restrictions	CUC	Medium
Required existing and new building structures proposal to be equipped with centralized with solid waste and effluent containment. i.e., outside centralize trash bin & grease catchment/containment	BECQ, DPW, Zoning	High
Designate accessible waste collection sites for commercial& household waste, i.e. used oil, chemical and other household contaminants	DPW, BECQ, Mayor, SNILD	Medium
Host landowner workshops to encourage proper land-clearing and land stewardship	BECQ, Forestry	Medium
Increase permeable surfaces in the lower watershed using ponding basins, permeable parking lots, rain gardens and permeable pavement	Zoning, BECQ, CIP, DPL (land exchanges)	High
Encourage public and private use of swales and rain gardens to collect and filter stormwater runoff by incorporating stormwater management, green infrastructure, greenspace, and permeable areas (and timelines) into leases (DPL) and permit conditions (other agencies)	BECQ, DPL, Zoning, DFW, DPW, Forestry	High
Create an interagency working group for unpaved roads and prioritize target roads	Mayor's Office, DPW, MVA, Zoning	High
Design and construct the planned stormwater management improvements (retention ponds, wetlands) for drainages leading into the lagoon to help filter water and moderate runoff during storm events (as described in the Garapan Revitalization plan)	Zoning, CIP, DPW	Medium
Implement stormwater retrofits in the Garapan area to decrease and control stormwater and pollutant loading (as described in the 2010 Winzler & Kelly Garapan Tourist District Storm Water Conceptual Study	CIP, DPW, CRM, BECQ	High
Clean and maintain all stormwater drainages including improving, cleaning drainages, clearing open ditch areas, ponds and drainages and cut overgrown vegetation	DPW, Zoning, BECQ	High
Enforce permits and follow-up on BMP installation in order to address maintenance of existing BMPs	BECQ, DPW	Medium
Establish standard practices for maintenance of public infrastructure	DPW, MOS, CUC, BECQ, Parks&Rec, Precinct III	High
Review, reprint and distribute existing resources to encourage "greener" practices (e.g. permeable parking), DEQ -> contractors and engineers, DPW -> material strength and building codes, Distribute GTD plan	BECQ, DPW	Medium
Construct permeable sidewalks and beautify high-use areas with native vegetation as needed	DPW, Zoning, MVA, MOS	Low

Complete stream inventories to identify pollution sources	BECQ	High
Apply for EPA stormwater grants	BECQ, CUC	Medium
Add green infrastructure into Qualifying certificate requirements	CDA	Medium
Consider allowing variances to permit conditions in exchange for green practices (case-by-case)	BECQ, Zoning	Medium
OBJECTIVE 15.A2: By the end of FY2018, annual “red flag” occurrences at Garapan-area beach monitoring sites have been reduced by 10% from 2013 levels		
Initiate illicit discharge detection and elimination program to identify wastewater violations within the Garapan area	BECQ, CUC, DPW	High
Include animal waste detection methods in IDDE protocol	NRCS, Ag, BEH, BECQ	Medium
OBJECTIVE 15.A3: By the end of FY2020, 30% of trash piles and junk cars have been removed or properly managed as required by zoning and environmental laws		
Issue citations and assist residents in removing junk cars and trash piles to reduce feral animal habitat	Mayor’s Office, Zoning, DPL	Medium
Pursue legislation that would allow funds from citations to stay at the agencies and support the enforcement programs	Legislature	High
Grant legal authority to the Mayor’s Office to assist with issuing Zoning citations	Legislature, MOS, Zoning	Medium
OBJECTIVE 15.A4: By the end of FY2023, feral cat and dog populations in the Garapan watershed area are effectively controlled (as indicated by no increase in numbers of annual captures or wild population counts)		
Provide incentives to the public for capturing and turning in strays	DFW, Parks & Rec	Low
Control and monitor stray cats to prevent depredation and attacks on native birds and other wildlife	DFW, Mayor’s Office	Medium
Identify continual support and resources for spay/neuter programs and pet owner education	MOS, DLNR (Parks & Rec)	Medium
OBJECTIVE 15.A5: By the end of FY2015, the quantity of public trash bins in tourist areas has doubled and all public trash bins are secured and maintained (never overfull)		
Maintain existing bins during high volume periods (weekends) and make sure all bins are lidded and secured to protect from feral animals	Mayor’s Office, MINA, DLNR Parks and Grounds	High
Support and continue MVA and Chamber of Commerce “Cash for Trash” programs	Chamber, MVA	Medium
Encourage businesses and organizations to sponsor public trash bins for high-use areas	Chamber, MVA, MINA	Medium
Continue surveillance, surveys, reporting and enforcement of trash/litter laws and regulations within the Garapan business district	BECQ, Zoning	Medium
Promote recycling and pursue a bottle bill	BECQ, Legislature	Medium
OBJECTIVE 15.A6: By the end of FY2018, there is a 20% decrease in weight of trash picked-up per participant at BECQ clean-up brigade sites in Garapan compared to 2010-2013 records		
Maintain existing bins during high volume periods (weekends) and make sure all bins are lidded and secured to protect from feral animals	Mayor’s Office, MINA, DLNR Parks and Grounds	High
Support and continue MVA and Chamber of Commerce “Cash for Trash” programs	Chamber, MVA	Medium
Encourage businesses and organizations to sponsor public trash bins for high-use areas	Chamber, MVA, MINA	Medium
OBJECTIVE 15.A7: By the end of FY2018, all critical habitat areas affected by invasive vines and aquatic plants have been identified and control plans are being implemented		
Identify critical areas where vines are damaging habitat and define higher and	Forestry, DFW,	Medium

lower priorities	NMC-Crees	
Actively remove/reduce presence of invasive plants (scarlet gourd, chain-of-love, devil's gut vine) in critical habitat areas	Forestry, CUC, NMC-Crees	Medium
Remove invasive vines from forest edges and gaps in American Memorial Park mangroves and wetland areas	Nat'l Park Service	High
Replant trees (targeting natives) to increase bird habitat in American Memorial Park where invasive vines have killed trees	Nat'l Park Service	Medium
Create and implement a plan for water hyacinth control and removal in American Memorial Park wetlands	Nat'l Park Service	High

Strategy B: Engineering

<i>Objectives and Strategic Actions</i>	<i>Partners</i>	<i>Priority</i>
OBJECTIVE 15.B1: By FY2028, construction of the Saipan Lagoon Aquatic Ecosystem Restoration Project (SLAERP) ponding basins are complete according to Army Corps of Engineers recommendations and specifications		
Secure funding from partnering agencies and complete planning and construction of basins (as defined in the SLAERP)	DOT, CIP, CRM, DPW, EPA, DEQ	Low
OBJECTIVE 15.B2: By the end of FY2018, water turbidity has been reduced below 2013 ambient levels by 10% on average at all Garapan water quality lagoon monitoring sites		
Install sediment traps, check dams and infiltration basins at the Sugar King Industrial Park and other key locations (as described in the 2005 Winzler & Kelly Conceptual Stormwater Management Plan for the Garapan II Drainage)	BECQ, DPW, EPA, MOS, DPL (land acq.), DOI&CIP (funding)	High
Expand the grassy swale by Sugar King Road, Garapan Street, and other key locations for use in stormwater treatment and infiltration (as described in the 2005 Winzler & Kelly Conceptual Stormwater Management Plan for the Garapan II Drainage)	BECQ, DPW	Medium
Continue to evaluate sewer line repair needs and replace leaking or damaged lines at the earliest possible opportunity	CUC	High
Implement stormwater retrofits in the Garapan area to decrease and control stormwater and pollutant loading (as described in the 2010 Winzler & Kelly Garapan Tourist District Storm Water Conceptual Study)	CIP, DPW, BECQ	High
Incorporate stormwater and climate change considerations into the Beach Road Revitalization Plan and other infrastructure plans near Beach Road	DPW, BECQ	High
OBJECTIVE 15.B3: By the end of FY2018, engineering alternatives or maintenance options have been examined for all unpaved roads within the Garapan watershed		
Create an interagency working group for unpaved roads to address proper maintenance, upgrading and construction of water drainages for unpaved new road projects	DPW, Mayor's Office, Legislature, MVA, Zoning, DPL	High
Discuss collaboration opportunities with Navy pre-positioned ships	DPW, CUC	Low
Complete a Stormwater Management Master Plan using existing plans (GTD 2010, Winzler and Kelley, others)	BECQ, DPW	High

Strategy C: Regulations and Enforcement

<i>Objectives and Strategic Actions</i>	<i>Partners</i>	<i>Priority</i>
OBJECTIVE 15.C1: By the end of FY2018, annual “red flag” occurrences at Garapan-area beach monitoring sites have been reduced by 10% from 2013 levels		
Expend CUC sewer connection funds by identifying and reaching out to eligible property-owners	CUC, BECQ, DPH-BEH	High
Initiate illicit discharge detection and elimination program to identify wastewater violations within the Garapan area	BECQ, CUC	High
Issue notices of violation (NOVs) and citations where appropriate. Ensure proper prosecution and follow-up on all cases	BECQ, CUC, AG’s office	High
OBJECTIVE 15.C2: By the end of FY2020, 30% of trash piles and junk cars have been removed or properly managed as required by zoning and environmental laws		
Issue citations and assist residents in removing junk cars and trash piles to reduce feral animal habitat	Mayor’s Office, Zoning	Medium
Increase enforcement actions in cases of trash burning	DECQ, Fire, USFS	Medium
OBJECTIVE 15.C3: Percent of all environmental infractions recorded by agencies that are resolved in the local court has increased by 20% each year starting in 2018		
Identify funding and fill post of AAG for environmental resource agencies	NOAA, AG	High
Review hearing process for natural resource agencies, identify and fill gaps, monitor change	BECQ, DLNR, NOAA, AG	Medium
Review natural resource enforcement work-plans to identify improvements, updates and needs (training, funding, personnel), specifically regarding turtle poaching, illegal fishing, directed hunting, littering/dumping, trash burning, land clearing, and wastewater elimination	PIMPAC, BECQ, DFW, DLNR, NOAA, DPL, Zoning, DPS	High
Focus agency resources on improving enforcement training, funding and personnel related to turtle poaching, illegal fishing, directed hunting, littering/dumping, trash-burning, land clearing, and wastewater elimination	BECQ, DFW, DLNR, NOAA, DPS	High
OBJECTIVE 15.C5: By the end of FY2016, Forestry consultations are included with DLNR/DFW comments in the one-start permitting process		
Discuss permit requirements and evaluate personnel and capacity to include Forestry consultations in the one-start process with DLNR-DFW	DFW, Forestry, BECQ	Medium
Determine special permitting options for Areas of Particular Concern (APC) related to highly erodible soils	BECQ, Forestry, DFW	Medium
Fill-in capacity and personnel gaps at Forestry to assure smooth integration into the one-start process	Forestry, USFS	Medium
OBJECTIVE 15.C6: By the end of FY2018, there is a 20% decrease in weight of trash picked-up per participant at BECQ clean-up brigade sites in Garapan compared to 2010-2013 records		
Update and introduce new legislation regarding littering fines	BECQ, Zoning, Legislature	High
Continue litter control officer trainings to increase number of officers patrolling and issuing citations in the watershed area	BECQ	Low
Publicize enforcement numbers for the public to report littering (BECQ and Zoning)	BECQ, Zoning	High
OBJECTIVE 15.C7: By the end of FY2015, rigorous environmental and conservation training is incorporated into MVA’s tour guide training program and the program is made mandatory for all tour operators involved in outdoor recreational activities with visitors.		

Create curriculum and develop program logistics	MVA, BECQ, NMC	Medium
Pass law or regulations to require tour guide certification program for all operators in the CNMI	MVA, Legislature	Medium
OBJECTIVE 15.C8: By 2017 Urban greenspace requirements will be incorporated into all DPL leases, as well as all DEQ, CRM, and Zoning permits and regulations, and Qualifying Certificate requirements		
Increase enforcement capacity to prevent and stop spread of invasive species	Quarantine, DLNR Forestry, CPA	Low
Promote green infrastructure within the watershed (rain garden, permeable parking): Voluntary; Mandatory: include some % requirement for green infrastructure in regulations, qualifying certificate requirements; Continue to research available funding	CDA, BECQ, Zoning, DPL, Legislature	Medium
OBJECTIVE 15.C9: By 2017, climate smart adaptation strategies are incorporated into the one-start permitting processes (DEQ, CRM, DFW, HPO)		
Increase enforcement capacity to prevent and stop spread of invasive species	Quarantine, DLNR Forestry, CPA	Low

Strategy D: Education and Outreach

<i>Objectives and Strategic Actions</i>	<i>Partners</i>	<i>Priority</i>
OBJECTIVE 15.D2: Through 2020, continue to conduct targeted environmental awareness campaigns within the Garapan Watershed		
Implement education and outreach through the permitting process to teach property owners about BMPs	DFW, BECQ, HPO, Forestry	Medium
Continue and expand MINA's Plastic Bag Challenge campaign to decrease plastic bag use	MINA, private businesses	High
Create nature trail and interpretive signs at American Memorial Park through wetland and mangrove areas	Nat'l Park Service	Low
Repeat 2003 "Know Your Watershed Campaign" and related activities (tentatively 2014)	BECQ	Medium
Continue "Think Blue" business stewardship campaign to identify BMPs for businesses and help with implementation	BECQ	Medium
OBJECTIVE 15.D5: By the end of FY2018, there are active recycling programs in all public and private schools		
Work with schools, administrators and clubs to initiate programs in all schools using existing models	BECQ	Low
OBJECTIVE 15.D6: By the end of FY2015, rigorous environmental and conservation training is incorporated into MVA's tour guide training program and the program is made mandatory for all tour operators involved in outdoor recreational activities with visitors.		
Create curriculum and develop program logistics	NMC, MVA, MINA	Medium

Strategy E: Stewardship Incentive Programs

Objectives and Strategic Actions	Partners	Priority
OBJECTIVE 15.E1: Beginning in FY 2015, there will be no net loss of urban greenspace each year due to protection of green areas and conversion of urban built-up land into vegetated area		
Target community groups to get involved in land integration and native area stewardship: <i>Neighborhood Watch, Village Revitalization, Saipan Municipal Council, Mayor's Office, Homeowner's Associations</i>	Forestry, BECQ, Mayor's Office	Medium
Conduct tree plantings and offer free trees to private, public, commercial groups	Forestry, Mayor's Office	Medium
Encourage businesses to sponsor large-scale greenscaping projects	Forestry, BECQ, MVA, Chamber of Commerce	Low
OBJECTIVE 15.E2: From 2015-2017, the number of groups participating in MVA's Cash-for-Trash program will increase 10%		
Advertise trash pick-up programs: Cash for Trash, Adopt-a-Beach, BECQ monthly clean-up brigade	MVA, Chamber of Commerce, BECQ	Medium
OBJECTIVE 15.E3: By the end of FY2015, the quantity of public trash bins in tourist areas has doubled and all public trash bins are secured and maintained (never overfull)		
Continue and expand MINA Adopt-a-Bin program	MINA, BECQ	High
OBJECTIVE 15.E4: By the end of FY2018, there is a 20% decrease in weight of trash picked-up per participant at BECQ clean-up brigade sites in Garapan compared to 2010-2013 records		
Design and conduct a watershed- or island-wide anti-litter education and outreach campaign	MVA, MINA, BECQ	High
OBJECTIVE 15.E5: By 2018, 50% of farmers in the Garapan watershed have effectively enrolled in the NRCS EQIP program		
Complete stream inventory and identify EQIP candidates	NRCS, BECQ	
Share NRCS contact information	NRCS, BECQ	
Provide assistance to complete the application process	NRCS, BECQ	

Strategy F: Research and Monitoring

Objectives and Strategic Actions	Partners	Priority
OBJECTIVE 15.F1: By the end of FY2016, all high priority water quality problem areas within the watershed have been identified		
Implement the Surface Water Quality Assurance Monitoring Plan created for BECQ in 2013 by collecting water and sediment samples at designated stream sites to evaluate possible land-based sources of pollution and to isolate affected watershed segments	BECQ	High
Explore relative contributions of agrochemicals, trash burning and other land-based pollution to water quality impairments	NRCS, EPA, BECQ	Medium
Measure volume/velocity of stormwater (explore options with John Riegel/CUC), urgency is high because of climate change predictions of increased rainfall	BECQ, CUC	High
Fill open positions in Water Quality program for data collection and analysis	BECQ	High
Work with CUC (and others) to identify rainfall areas for gauges and monitoring equipment	BECQ, CUC	Medium
Continue ongoing monitoring of forest and wetland birds	DLNR, DFW	Medium

OBJECTIVE 15.F2: By 2017 the data and results of ongoing climate change work are used to inform regulations in multiple regulatory agencies		
Continue to support and participate in the Climate Change Working Group	BECQ, Zoning, EMO, NMC, CUC, DPW, NOAA	High
Integrate NMC into the Climate Change Working Group to contribute to models and datasets and to train communities on climate change concerns/issues	NMC, BECQ, DPW, CUC, Zoning	Medium
Implement climate change-specific components of marine monitoring work	BECQ	High
OBJECTIVE 15.F3: By FY2018, funding is secured and capacity identified to support long-term ecological monitoring within the watershed		
Identify and eliminate gaps in scientific data for fisheries management	DFW, NOAA	Medium
Identify and eliminate gaps in scientific data for marine monitoring	BECQ	Medium
Understand algae preference by herbivorous fish	DFW, BECQ	High
Understand watershed impacts on herbivorous fish	BECQ	Medium
Quantify impacts of various recreational activities on marine resources, including direct contact from boats, snorkelers, divers and swimmers and indirect impacts from beach recreational activities)	DFW, BECQ	Medium
Create monitoring protocols for CRM enforcement related to recreational impacts on marine resources	BECQ	Medium
Understand types and coverage of forest areas	Forestry, USFS, Nat'l Park Service	Medium
Evaluate health of wetlands and mangroves periodically and implement management plans	NPS, BECQ, DLNR	High
Implement rapid assessment methods for wetlands and mangroves	DLNR, BECQ	Medium
Review wetland and mangrove plans to make them climate smart	DLNR, BECQ	Medium
Create plans for groundwater monitoring wells related to wetland areas	Nat'l Park Service	Low
Create biosecurity priorities and protocols and begin Biosecurity monitoring	NOAA, DFW, BECQ	Medium
OBJECTIVE 15.F4: By the end of FY2018, effectiveness of current management strategies for herbivorous fish have been maintained and improved		
Assess recruitment of juvenile herbivorous and other fish species (e.g. habitat preference) and consider management options for preferred habitat	BECQ, DFW	Medium

2017 SLUMP
Appendix B

Personal Watercraft Management Technical Memorandum



MEMORANDUM

TO: Erin Derrington and Emily Northrop, BECQ-CRM

FROM: Anne Kitchell (HW), Kathleen McAllister (HW), and Katherine Chaston Radway

DATE: April 13, 2017

RE: Review of literature on Personal Water Craft (PWC) management from other jurisdictions

This memorandum summarizes our review of management techniques applied in marine protected areas in other jurisdictions, the relevant science on the impacts of personal water craft (PWC) on marine ecosystems and other users, and information on carrying capacity analyses. The purpose of this review is to support BECQ-DCRM as the agency reviews current restrictions on jetski operations in the Saipan Lagoon.

From this review, we found that restricting jetski operations is a common strategy for minimizing impacts on natural resources, improving boater safety, and reducing conflicts with other uses in both freshwater and marine areas across the US and internationally. Much of the justification for management centers on boater safety and minimizing impacts to other users (e.g., noise, erratic operation). There are a number of techniques used to manage PWCs ranging from exclusionary bans, designated jetski areas, and limitations on the number of permits available. Where use prohibitions are in place, the justification is generally related to species or habitat protection, particularly nesting shorebirds and shallow water ecosystems. Interestingly, the Florida Keys is currently in the process of having to justify its PWC bans, primarily due to legal complaints that PWCs are being singled out from other vessels. Because there is enough evidence distinguishing the unique impacts of PWCs from other boats/vessels, particularly their ability to operate in shallow areas close to shore, this argument has previously failed to overturn restrictions in Monterrey, CA and in other local jurisdictions. See Dudiak, 2003¹ for a short primer in the legal precedence for jetski restrictions.

There seems to be little to no scientific consensus or guidance on how to establish thresholds or carrying capacity for PWCs. There are examples of other jurisdictions capping the number of permits and setting maximum number of rental units that can operate at a single time, but it is not clear how the number was agreed upon. From the literature, it appears that managers are

¹ Dudiak, T. A. 2003. The sounds of silence: trends in the regulation of personal watercraft. *Lake and Reserv. Manage.* 19(1):45-54.

moving towards visitor experience-based indicators rather than ecological indicators as the primary factor in setting caps on the number of operators.

For Saipan Lagoon, there is a current moratorium on new commercial PWC operators, little recreational (private) jet ski demand, and designated areas prohibiting jetski use. The information provided here may help current restrictions and, perhaps, generate alternatives for future management considerations as part of the SLUMP Update.

1.0 PWC Management Techniques

The most common management techniques for Personal Water Craft (PWC) are boating safety guidelines for how PWCs should be operated, zones where PWCs are allowed or prohibited, and criteria for who can operate them.

How PWCs are operated

- **Speed restrictions**, such as operating at idle or low speed or with no-wake, in sensitive areas such as residential coastlines, shorelines, edges of flats and locations of bird habitat (Florida Keys National Marine Sanctuary, U.S. national parks where use is permitted, , Hinchinbrook, Great Barrier Reef Marine Park Australia), in Turtle, Dugong, and natural areas (Moreton Bay Marine Park, Queensland, Australia), avoiding birds and marine mammals (Florida Keys National Marine Sanctuary), avoiding adverse impacts to Humpback whales and other protected marine life (State of Hawaii)
- **Free-style riding restrictions** and operating PWC in a way that disturbs birds or marine mammals, endangers life and limb and marine life (State of Hawaii, Florida Keys National Marine Sanctuary, Queensland Marine Parks, Australia)
- **Implementing a code of practice** for PWC (Florida Keys National Marine Sanctuary), or safety guidelines (Queensland an Western Australia Government, Australia)
- **Hours of operation**- permitted only during daylight hours for safety and to reduce conflict with activities that occur at dusk/dawn or evening.

Where PWCs can operate

- **Designating zones** for “free-style” or un-predictable riding (Rock-Islands Southern Lagoon Area Palau, State of Hawaii, Monterey Bay National Marine Sanctuary, Great Barrier Reef Marine Park Australia)
- **Designating commercial PWC Zones** (Maroochy River and Noose River Queensland, Australia, State of Hawaii). Only registered operators can use these areas.
- **Excluding access in sensitive areas (bans)** such as fish spawning and migration sites (Florida Keys National Marine Sanctuary), heritage areas (Victoria, Australia), marine national park

zones (Great Barrier Reef, Hinchinbrook, Great Barrier Reef Marine Park, and Moreton Bay, Australia), national parks (US National Parks), Pago Bay (Guam)

- **Seasonal bans**- prohibiting use during certain times of the year (Maui during whale season)
- **Excluding access to reduce user-conflicts** in certain fishing grounds (Florida Keys National Marine Sanctuary), and requiring PWC to maintain a set distance from fishing boats (Florida Key National Marine Sanctuary)
- **Setting a distance between PWC and marine wildlife**, 300m for whales and dolphins (Queensland Waters including the Great Barrier Reef Marine Park, and Moreton Bay Marine Park, Victoria State waters, Australia)
- **Exceptions** made for sporting and cultural events

Who can operate PWCs

- **Permits for commercial users** (Hinchinbrook, Great Barrier Reef Marine Park, Australia, Rock Islands Southern Lagoon, Palau), limits on number of jet ski operators and maximum number of jet skis to be used for each operation (Great Barrier Reef Marine Park, Australia), limit on number of rental units and safety units operating in an area (State of Hawaii, max 6 rental and 2 safety). Guam has a Recreational Vendor permit requirement.
- **PWC licenses and usage restrictions**, minimum age limit, zero alcohol policy, safety equipment requirements (Rock Islands Southern Lagoon Palau, Florida Keys Marine Sanctuary, Queensland waters, Australia,).
- **PWC certification**, courses for basic PWC use and tow-in surfing operation (Hawaii); certified water safety personnel (Guam for commercial operators)

Table 1 provides a summary of PWC management mechanisms from other jurisdictions that may support current restrictions in the Lagoon, or at minimum, offer ideas for management alternatives.

A summary of the rules and regulations for PWC use in the USA can be found on the Personal Water Craft Association's website: <http://www.pwia.org/rules> or at the US Coast Guard Boating website <http://www.uscgboating.org/regulations/state-boating-laws.php>. The USCG includes information on US territories. Excerpts from the online USCG PWC survey of the coral jurisdictions are provided in Tables 4.6-4.8 (USVI did not have any recorded entries).

Copies of the documents reviewed will be posted on the SLUMP website for download at <http://www.horsleywitten.com/SLUMP/reports.html>.

Table 1. Management Techniques for PWC and Lessons Learned

Place/Reference	Management Technique	Benefit/Lessons Learned/Comments
<p>U.S. National Parks https://www.nps.gov/guis/learn/management/personal-watercraft.htm</p>	<p>Jet skis and all personal water craft banned from all national parks and protected areas, unless individual parks issue a park-specific regulation permitting their use (which requires a NEPA analysis to show no significant impact).</p>	<p>The rule was made to take a precautionary approach to PWC use out of concern for the potential negative impact from PWC use, visitor safety concerns and visitor-use conflicts. PWC is permitted in some national parks.</p>
<p>Hawaii, USA http://dlnr.hawaii.gov/dobor/personal-water-craft/</p>	<p>PWC operators min age is 15, must be certified: offer two PWC courses: basic PWC operation, and tow-in surfing operation. Operation permitted in designated riding areas only (and traversing to them). Permits required for commercial operators, and limit on number of rental units (6) and safety units (2), operating in an area. Operation excluded from marine life conservation districts and natural area reserves. Avoid impacts to humpback whales and other protected marine life. Seasonal use ban during whale season (Maui)</p>	<p>Certification course cover: local ocean safety principles and practices; historical, cultural, and customary practices of Hawaii’s ocean users; and rules regarding protected species and thrill craft operation in Hawaii</p>
<p>Guam Recreational Water Use Management Plan</p>	<p>No person shall operate a Jet Ski or any Motorized Water Recreational Craft within the reef or channel from (Area 4) Mannel Channel to (Area 5) Patti Point, Yigo as shown in Key Map DPR95-1001 A RWUMP 003. All MWRC Crafts shall have access to enter and exit areas outside the reefs from any designated launching area or ramp facility, and only by the most direct route consistent with safety consideration and shall be permitted within this corridor at a speed limit not to exceed Five (5) miles per hour.</p> <p>The DPR shall establish within each RWUMP specifically designated MWRC courses, pursuant to P.L. 20-117. These courses shall be the only areas within the RWUMP where operation of MWRC will be permitted. Within RWUMP area the maximum number of separate and distinct MWRC courses shall be determined after the public hearing. Commercial operators must have a Recreational Vendor permit (annual cost \$1,000), valid business license, liability insurance, and certified water safety personnel. Maximum number of jetskis is regulated by number of designated courses and possibly insurance requirements. There is a lottery system for permits when there are more applicants than permits.</p>	<p>Single, consolidated regulation that covers all recreational/commercial uses. Can’t seem to locate a legible map showing zones</p>

Place/Reference	Management Technique	Benefit/Lessons Learned/Comments
Florida Keys National Marine Sanctuary (1997 EIA) page 182: http://floridakeys.noaa.gov/mgmt/plans/fmp2.pdf page 17 and 108-109: http://floridakeys.noaa.gov/mgmt/plans/fmp1.pdf	Motorized vessel (including PWC) operate at idle speed within 200 yards of sensitive areas, including residential shorelines, edges of flats, and locations used by wading or nesting birds.	Benefit Sanctuary users by reducing adverse impacts on natural resources and wildlife.
Florida Keys National Marine Sanctuary, (Management plan Impact Statement 1997)	<p>Prohibit operating a vessel at a speed greater than idle speed only/no-wake, except in marked channels and other less restrictive marked areas:</p> <ul style="list-style-type: none"> • in areas designated idle speed only/no wake zones; • within 100 feet of the red and white “divers down” flag (or the blue and white “alpha” flag in Federal waters); • within 100 yards of residential shorelines; or • within 100 yards of stationary vessels <p>Additional regulations on the operation of vessels will include: (1) a prohibition on operating a vessel in such a manner as to injure, take or cause disturbance to wading, roosting, or nesting birds, or marine mammals; and (2) operating a vessel in a manner which unreasonably or unnecessarily endangers life, limb, marine resources, or property, including but not limited to, weaving through congested vessel traffic, jumping the wake of another vessel unreasonably or unnecessarily close to such other vessel or when visibility around such other vessel is obstructed, or waiting until the last possible moment to avoid a collision. The final regulations prohibit the operation of PWCs in portions of the Wildlife Refuges.</p>	<p>Environmental benefits: preventing the harassment and disturbance of wildlife in the Sanctuary, especially along mangrove fringed shorelines and in shallow nearshore habitats. Here vessels operated too close to the mangroves cause the flushing of nesting birds, leaving their eggs exposed to extreme temperatures with resultant loss of the clutch of eggs. This unnecessary impact will be lessened by the regulations. NOAA feels this approach to regulating the operation of all vessels will have the least amount of socioeconomic consequences on any one user group with the greatest environmental benefits directed at protecting the wildlife resources of the Florida Keys.</p> <p>PWC industry wants to self regulate and has agreed to work with Sanctuary staff to establish criteria for the management of commercial PWC rental operations. Broad zoning may be introduced if efforts are not successful at significantly reducing or eliminating the nuisance and safety problems.</p>
Florida Keys Marine Sanctuary PWC guidelines (2012 presentation) http://floridakeys.noaa.gov/sac/other/materials/121211guideassoc.pdf http://floridakeys.noaa.gov/sac/other/materials/121211kwanglers.pdf	Restrictions on fish spawning and passage areas, avoid fishing grounds and maintain set distance from fishing boats, designated free style areas, reduce conflict through phone line for fisherman to report PWC incidents. Guidelines codes of conduct includes zero alcohol, set number of guides per passenger group, keeping out of wildlife refuges and military areas, idle thru bridges, requirements for tour guides, proposed zones .	Voluntary guidelines developed by Sanctuary staff, PWC and Fishermen. Environment Studies have proven: -Less bird disturbance than outboards- Set 100’ buffer for all boats around bird colonies- No seagrass impacts when operated in 2’ or greater depth- No manatee deaths from PWC

Place/Reference	Management Technique	Benefit/Lessons Learned/Comments
<p>Monterey Bay National Marine Sanctuary, CA Motorized PWC action plan pg 18 http://montereybay.noaa.gov/resources/resmanissues/mpwc.html http://montereybay.noaa.gov/resources/resmanissues/mpwc.html http://sanctuaries.noaa.gov/jointplan/mb_mpwc.html</p>	<p>Designated zones for Jet skis(year round, and seasonal during big surf). Do not have a limit on the number of MPWC allowed within the specified MPWC riding zones.</p> <p>The zones were created to separate MPWC operations from wildlife concentrations and other ocean recreational activities. They were sited offshore of nearshore kelp forests where marine mammals and birds forage and rest. The 4 year-round zones were sited off the 4 harbors in the sanctuary since the harbors provide launch facilities and the nearby waters are already impacted by constant human activity.</p> <p>GFNMS banned MPWC outright in 2001.</p>	<p>Had 4 zones for 16 years (from 1992), based on location of public launch facilities. Had little use because many riders used 3-plus-person capacity crafts that weren't restricted. Have changed the PWC definition to include larger size PWC, and will evaluate in 3 years. Will exempt public safety agencies, but will develop environment protection protocols for training activities. Other actions include improving demarcation, outreach to PWC operators, & increased enforcement.</p> <p>The Personal Watercraft Industry Association sued NOAA in 1993, claiming the regulation of MPWC was arbitrary and capricious, among other things. See the Appeals Court ruling that upheld NOAA's authority and justifications for restricting these craft.</p>
<p>Queensland Govt. PWC rules on the water (includes Great Barrier Reef Marine Parks) https://www.msg.qld.gov.au/Safety/Personal-watercraft</p>	<p>PWC rules on the water: If you're travelling at more than 10 knots you must keep a distance of 30m from other moving boats, unless you're involved in an approved aquatic event or where doing so would endanger you or another person. Consider the density of waterway traffic in the area to determine a safe speed. You must stay 60m away from, or reduce your speed to 6 knots if within 60m of: people in the water anchored or moored boats, structures, boat ramps, jetties or pontoons, the shore, the boundary of a bathing reserve.</p> <p>Exceptions apply to the 60m from shore rule if: the waterway is less than 120m wide, and: you operate the PWC as close as practical to a straight line to transit the area you stay as close as possible to the centre of the waterway or a marked channel the PWC is being used in waterskiing or towing.</p> <p>In coastal waters, freestyling or wave jumping is restricted to: beyond 200m of the shore if homes are within 100m of the shoreline, and are in the vicinity of the waters where the PWC is operating. Coastal waters do not include dams and inland waters.</p>	<p>PWC not permitted in designated "marine zones"</p>

Place/Reference	Management Technique	Benefit/Lessons Learned/Comments
Moreton Bay Marine Park, Brisbane AU	Go slow areas for turtles and dugongs and natural values. Must not disturb water birds	Examples include: <ul style="list-style-type: none"> • driving a vessel (including personal watercraft) other than in a straight line; for example driving in circles, weaving, and surfing down or jumping over waves, swell or wash towing a person (waterskiing, parasailing or wakeboarding) • personal watercraft not taking the most reasonable direct route between two places
Rock Islands Southern Lagoon World Heritage Site, Palau	4 PWC zones strictly for watercrafts/ water sports use.	Regulations includes minimum age, time, locale, depth, capacity, and dealer and rental restrictions, safety equipment requirements, owner liability, prospective, 2-stroke engine ban, and prohibition of drug/alcohol use
New South Wales coastal areas, Australia (NSW government roads & maritime)	Designated “no-go zones” for PWC, and no irregular driving when within 200m of a river bank or shore (must generally be operated in a straight line)	
Western Australia coastal waters, Australia (Dept. of Transport) http://www.transport.wa.gov.au/imarine/personal-watercraft.asp	PWC operators must have license, age restriction, must carry safety equipment, must stay within distance of shore, restrictions on freestyle driving and wave jumping (for safety), designated prohibited areas, and requirements of 2 crew when skiing, safety guidelines developed.	
Victoria, Australia, Maritime safety http://transportsafety.vic.gov.au/maritime-safety/recreational-vessel-operators/personal-watercraft-pwcs/safe-operation/operating-rules/environmental-and-wildlife-regulations	No watercraft entry into heritage “protected zones” without permit, jetskis not permitted within 300m of a dolphin or whale,	

(Tables 4.6-4.8 are excerpts from <http://www.uscgboating.org/regulations/state-boating-laws.php>)

Personal Watercraft Operation [Table 4.6]

State	Does your state require users to wear a U.S. Coast Guard-approved PFD when operating a PWC?	Does your state require PWC rental operators to provide any instruction or education in PWC operation prior to use?	If you answered "Yes" to the previous question, how much instruction is required?	Does your state prohibit PWC operation at any specific times?	If you answered "Yes" to the previous question, please list the times.
American Samoa	Yes	No		Yes	sunset to sunrise
Florida	Yes	Yes	<p>Liveries must provide instruction to renters on: Operational characteristics of the PWC to be rented. Safe vessel operation and vessel right-of-way rules. Responsibility of the operator, and safe and proper operation of the vessel. Local characteristics of the waterway where the vessel will be used. Operator responsibility (ethics), courtesy and good judgment on the water. Avoiding careless, reckless, and negligent operation of vessels. The effects of alcohol, controlled substances, and stressors. Navigation Rules. Maintaining proper lookout. Safe distance and speed. Operating defensively. Requirements to give way to other vessels. Aids to navigation; buoys and other waterway markers. Awareness of changes in weather or water conditions and proper responses to those changes. Waterskiing and similar activities, if applicable to the personal watercraft rented. Must wear personal flotation devices. Must have observer or wide-angle rearview mirror. May not ski between 30 minutes past sunset and 30 minutes before sunrise. Boating accidents. Causes and prevention of personal watercraft accidents. Legal requirements, Å remaining on scene; rendering assistance; reporting</p>	Yes	Operation of a PWC on the water is prohibited between ~? hour after sunset to ~? hour before sunrise.
Guam	Yes	Yes	No specific amount	Yes	Sun down to Sun up because they have no lights.
Hawaii	Yes	Yes	establish a safety instruction program for customers that includes, but is not limited to, the safe use of a thrill craft, boundaries of operating areas and the use of a personal flotation device.	No	
Puerto Rico	Yes	Yes	For residents a the license for vessel operation is require. For non-residents a brief orientation and an ID is require.	Yes	Before dawn and after sunset.
Northern Mariana Islands	Yes	Yes		Yes	one hour after sunset to one hour before sunrise

Personal Watercrafts and Skiers
[Table 4.7]

State	Does your state allow PWCs to pull water skiers?	If you answered "Yes" to the previous question, are there any restrictions?
American Samoa	No	
Florida	Yes	PWCs must have a person, in addition to the operator, in a position to observe the progress of the skier or have a wide-angle rearview mirror mounted in such a way as to permit the operator to see the progress of the skier.
Guam	Yes	Same as any water ski operations
Hawaii	Yes	same as any vessel towing water skiers
Northern Mariana Islands	No	none
Puerto Rico	No	

Personal Watercraft Restrictions [Table 4.8]

State	Is there a speed limit specific to PWCs other than slow/no wake zones in your state?	If you answered "Yes" to the previous question, please list the speed limit.	Is PWC operation restricted within any area or zone in your state?	If you answered "Yes" to the previous question, please list the restricted area or zone.	Are limitations imposed on wake jumping with PWCs in your state?	If you answered "Yes" to the previous question, please describe the limitations.	Is there a kill switch or safety lanyard requirement for PWCs in your state?
American Samoa	No		Yes	Swimming areas, boat mooring areas	No		Yes
Florida	No		Yes	There are local restrictions. These are not state restrictions.	Yes	Jumping the wake of another vessel unreasonably or unnecessarily close to such other vessel or when visibility around such other vessel is obstructed is prohibited.	Yes
Guam	No		Yes	Within Tumon and Pago bays	No		No
Northern Mariana Islands	Yes	5 mph	Yes	micro beach north to paupau beach and sugar dock area south to San Antonio	No		No

Hawaii	No	Yes	<p> -§13-256-17 Recreational thrill craft operations. (a) Access to and from designated recreational thrill craft operating areas shall be by the most direct route consistent with safety considerations. (b) In non-designated ocean recreation management areas, recreational thrill craft may operate only in state waters between five hundred feet from the shoreline or the outer edge of the fringing reef whichever is greater and two miles off the islands of Kauai, Oahu, Maui and Hawaii. (c) In designated ocean recreation management areas, recreational thrill craft may operate only within locations designated for recreational thrill craft use. (d) No thrill craft shall be operated for profit or gain in a recreational thrill craft operating area. (e) Recreational thrill craft may gain access to state waters only from launching or harbor facilities or from private beach front property. -§13-256-16 Thrill craft operations; general provisions. (b) No person shall operate thrill craft within a marine life conservation district or marine natural area reserve. (c) Thrill craft operations shall be curtailed in certain designated areas as described in subchapters two through eleven as necessary, to: 1) avoid possible adverse impacts on humpback whales or other protected marine life; 2) provide for increased public access; 3) reduce user conflicts; and 4) promote overall public safety. </p>	Yes	per federal regs	No
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Alternatives Analysis from the Florida Keys

The Florida Keys National Marine Sanctuary Final Revised Management Plan 2007 Management Plan (Appendix G) <http://floridakeys.noaa.gov/mgmtplans/appg.pdf> - identifies alternatives examined for use of jet skis. This analysis may provide insight into various alternatives for Saipan Lagoon

1. Status Quo - No action beyond activities implemented in other action plans related to PWC use (e.g. additional WMAs (wildlife management areas), concentrated nearshore enforcement, boater-education initiatives).
2. In addition to the existing idle speed from 100 yards of residential shorelines regulation, establish a 400-yard, point-to-point travel corridor from shorelines where repeated high-speed maneuvers for all vessels would be restricted except in specifically identified rental-riding areas, to be determined in conjunction with rental operators. Beyond 400 yards, vessels should operate in a reasonable and prudent manner. Establish PWC rental-riding areas. Guided tours for renters will be permitted outside of rental-riding zones.
3. In sensitive shallow seagrass areas determined to be detrimentally impacted by vessel operation, establish WMA – No-motor Zones. Increase the number and spatial extent of WMAs to effectively manage natural-resource impacts occurring from all vessels operating in shallow water throughout the Sanctuary. Designation and placement of the areas would coincide with recommended no-motor zones identified in the working group’s scoping process. Placement will also be guided by public input and scientific findings throughout the Keys, beginning with the scoping meetings held by the PWC Working Group in 2000 and 2001.

Numerous shallow-water areas on the Florida Bay side of the Keys have been identified as significant areas to Sanctuary wildlife. Additional flats and nearshore areas on the ocean side have been also identified as important habitats in the Middle to Upper Keys (Marathon to Key Largo). These areas serve as examples of candidate sites for WMAs. An associated activity is to work with rental operators to establish marked areas for operation of rental PWCs throughout the Keys. This activity will include consultation with rental operators and law enforcement.

4. In addition to the 100-yard Idle-Speed-Only Zone from residential shorelines regulation, establish a 400-yard, point-to-point travel corridor from all shorelines where repeated high-speed maneuvers for all vessels would be restricted except in specifically identified rental riding areas, determined in conjunction with rental operators. In areas identified by homeowners as having a need for regulatory markers, establish a process to install 100-yard Idle-Speed-Only markers to address all vessel use, including personal watercraft.

5. Prohibit PWCs throughout the Sanctuary. The Sanctuary Advisory Council has recommended that PWC operation be prohibited within the Sanctuary. This recommendation has raised some questions as the State legislature has passed legislation prohibiting local ordinances from singling out PWCs. Since the state is a co-trustee and partner in the management of the Sanctuary, this recommendation by the Sanctuary Advisory Council raises a difficult issue.

In October 2001, the Sanctuary Advisory Council voted to ban the operation of all vessels in less than two feet of water in the Sanctuary. Although NOAA questions the feasibility of such a regulatory action, considering the diurnal changes in tides and wind driven currents and the enforceability of such a regulation, this option will be added to the list of regulatory alternatives for consideration during the NEPA process, when the public may review and comment on suggested regulatory changes. From Florida keys response to comments

Excerpt from Response to comments from 1997 FEIS - look at L-9-10 and L-17 <http://floridakeys.noaa.gov/mgmtplans/appendixl.pdf>

Response: NOAA recognizes the adverse impact on Sanctuary resources and the user conflicts that can occur from the operation of all vessels. The threat to Sanctuary resources is universal to the operation of all vessels, not just any one type. However, the size, maneuverability, and shallow draft of personal watercraft results in operator behavior that makes them a greater source of user conflict and threatens Sanctuary resources more than any other vessel, particularly in shallow water habitat. Approximately 40 percent of the boating accidents in Monroe County in 1995 resulted from personal watercraft. This statistic indicates that the potential for careless operation of personal watercraft is very high. Most of the negative public comments about personal watercraft were behavior related examples.

The final regulations do not single out personal watercraft. Rather, the regulations apply to operation of all vessels to comprehensively address the potential resource impact, user conflicts and safety problems within the Sanctuary. The final regulations specify that, except in marked channels, vessels are prohibited from operating above idle speed or creating a wake in areas marked idle speed only/no wake, and within 100 yards of residential shorelines, stationary vessels, and marked emergent reefs, and 100 feet from a divers down flag. As regards the 100 foot distance requirement from diver down flags, NOAA modified this from the proposed 100 yard requirement to be consistent with State regulations.

Personal Watercraft Rentals

Comment: Many reviewers commented on the use of rented personal watercraft. Some in support, some in opposition, and some in support with appropriate restrictions. The SAC recommended that NOAA work with the personal watercraft (PWC) industry to begin a process to identify whether there is a need to establish restrictive zones. Comments from the personal watercraft industry representatives indicate interest in self regulation.

Response: NOAA plans to work with the PWC industry, the SAC and the public to determine regulatory and non-regulatory steps to address the issue, including the potential need and location of PWC rental use-zones.

2.0 Literature Review on Impacts of PWC

The following journal articles and resources offer a limited review of some of the scientific literature we were able to find related to measured jetski impacts.

James A. Rodgers J. A. Jr., Schwikert S. T, 2002. Buffer-Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft and Outboard-Powered Boats, Conservation Biology.

Abstract: Outdoor recreation and ecotourism can have negative effects on wildlife species, so it is important to determine buffer zones within which activities near critical wildlife areas are limited. We exposed 23 species of waterbirds (*Pelecaniformes*, *Ciconiiformes*, *Falconiformes*, *Charadriiformes*) to the direct approach of a personal watercraft (PWC) and an outboard-powered boat to determine their flush distances. We used 11 sites with a mixture of low, moderate, and high amounts of human activity along the east and west coasts of Florida during September–November 1998 and April–June 1999. We detected considerable variation in flush distances among individuals within the same species and among species in response to both types of vessels. Average flush distances for the PWC ranged from 19.5 m (Least Tern [*Sterna antillarum*]) to 49.5 m (Osprey [*Pandion haliaetus*]), whereas average flush distances for the outboard-powered boat ranged from 23.4 m (Forster's Tern [*S. forsteri*]) to 57.9 m (Osprey). Larger species generally exhibited greater average flush distances for both types of watercraft. A comparison of the flush distances elicited by each watercraft indicated that only the Great Blue Heron (*Ardea herodias*) exhibited significantly larger flush distances (*t* test, $p < 0.01$) in response to the approach of the PWC than in response to the outboard, whereas four species (Anhinga [*Anhinga anhinga*], Little Blue Heron [*Egretta caerulea*], Willet [*Catoptrophorus semipalmatus*], and Osprey) exhibited significantly larger flush distances (*t* test, $p < 0.05$) in response to the approach of the outboard-powered boat than in response to the PWC. Eleven species (68.8%) showed no significant difference (*t* test, $p > 0.05$) in their flush distances in response to the fast-moving PWC and the outboard-powered boat. Our data suggest that a single buffer-zone distance can be developed for both PWC and outboard-powered vessels. Buffer zones of 180 m for wading birds, 140 m for terns and gulls, 100 m for plovers and sandpipers, and 150 m for ospreys would minimize their disturbance at foraging and loafing sites in Florida.

Miller, L. J. Soangi, M. and Kuczaj, S. A. (2008). Immediate response of Atlantic bottlenose dolphins to high-speed personal watercraft in the Mississippi Sound, Marine Mammals, Volume 88 (6). DOI:<https://doi.org/10.1017/S0025315408000908>

The purpose of the study was to examine the immediate effects of high-speed personal watercraft on Atlantic bottlenose dolphin (*Tursiops truncatus*) behavior. Opportunistic surveys were conducted from a research vessel in the Mississippi Sound from September 2003 through to August 2005. High-speed personal watercraft significantly increased dolphin dive duration, dolphin group cohesion and dolphin breathing synchrony. Additionally, in 47% of the encounters a dolphin group's behavior changed within one minute of the presence of a high-speed personal watercraft. The most notable changes were an increase in dolphin travelling behavior and a decrease in feeding behavior following the boat's presence. The results

demonstrated an immediate, short-term change in dolphin behavior, suggesting that an increase in the frequency of high-speed personal watercraft in this area could produce long-term detrimental effects

Erbea, C. (2013) Underwater noise of small personal watercraft (jet skis). The Journal of the Acoustical Society of America 133, EL326;doi: <http://dx.doi.org/10.1121/1.4795220>

Abstract: Personal watercraft (water scooters, jet skis) were recorded under water in Bramble Bay, Queensland, Australia. Underwater noise emissions consisted of broadband energy between 100 Hz and 10 kHz due to the vibrating bubble cloud generated by the jet stream, overlain with frequency-modulated tonals corresponding to impeller blade rates and harmonics. Broadband monopole source levels were 149, 137, and 122 dB re 1 μ Pa @ 1 m (5th, 50th, and 95th percentiles). Even though these are lower than those of small propeller-driven boats, it is not necessarily the broadband source level that correlates with the bioacoustic impact on marine fauna.

Wall, L.M., Walters, L.J. Grizzle, R.E. and Sacks, P.E. (2005). Recreational boating activity and its impact on the recruitment and survival of the oyster *crasotrea virginica* on intertidal reefs in Mosquito Lagoon, Florida. Journal of Shellfish Research 24(4):965-973. doi:

[http://dx.doi.org/10.2983/0730-8000\(2005\)24\[965:RBAAll\]2.0.CO;2](http://dx.doi.org/10.2983/0730-8000(2005)24[965:RBAAll]2.0.CO;2)

Abstract: Along the east coast of central Florida in the Indian River Lagoon system, intense recreational boating activity occurs year-round, and intertidal reefs of the eastern oyster *Crassostrea virginica* (Gmelin) with dead margins (mounds of disarticulated shells) on their seaward edges are commonly found adjacent to major boating channels. These dead margins are caused, at least in part, by boat wakes and extend significantly higher above the high water line than reefs lacking dead margins (pristine reefs). To determine if these "impacted" oyster reefs alter recruitment and subsequent survival of *C. virginica*, three 8-wk field trials were run between May 2001 and April 2002 in Mosquito Lagoon. During each trial, data were also collected on total sediment loads, silt/clay fractions and relative water motion. Although recruitment did not differ between impacted and pristine reefs, juvenile survival was significantly reduced on impacted reefs. Additionally, larval recruitment and subsequent mortality were greatest during our summer trial. Total sediment loads, percent silt/clay, and relative water motion were significantly higher on impacted reefs. For these three variables, the largest values were consistently found at the bases of exposed (seaward) regions of impacted reefs. By documenting a positive relationship between reduced success of *C. virginica* and dead margins, and knowing that boat wakes contribute to the development of dead margins, we have provided the first cause and effect mechanism between intense recreational boating activity and increased oyster mortality.

Stephanie M. Nowacek, Randall S. Wells, Andrew R. Solow (2001) Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. Marine Mammal Science, Vol 7(4). DOI: 10.1111/j.1748-7692.2001.tb01292.x

Abstract

Coastal cetaceans are subject to potential injury or disturbance from vessels. In Sarasota, Florida, where about 120 resident bottlenose dolphins, *Tursiops truncatus*, share the inshore waters with over 34,000 registered boats, disturbance potential is high. We assessed specific

behavioral responses of individual dolphins to boat traffic. We conducted focal animal behavioral observations during opportunistic and experimental boat approaches involving 33 well-known identifiable individual bottlenose dolphins. Dolphins had longer interbreath intervals (IBI) during boat approaches compared to control periods (no boats within 100 m). Treatment IBI length was inversely correlated with distance to the nearest boat in opportunistic observations. During 58 experimental approaches to 18 individuals, a video system suspended from a tethered airship was used to observe subsurface responses of focal dolphins as boats under our control, operating at specified speeds, were directed near dolphins. Dolphins decreased interanimal distance, changed heading, and increased swimming speed significantly more often in response to an approaching vessel than during control periods. Probability of change for both interanimal distance and heading increased when dolphins were approached while in shallow water. Our findings provide additional support for the need to consider disturbance in management plans for cetacean conservation.

Jennifer L. Miksis-Olds, Percy L. Donaghay, James H. Miller, Peter L. Tyack, John E. Reynolds III (2007). Simulated vessel approaches elicit differential responses from manatees. Marine Mammal Research 23(3). DOI: 10.1111/j.1748-7692.2007.00133.x

Abstract: One of the most pressing concerns associated with conservation of the endangered Florida manatee is mortality and serious injury due to collisions with watercraft. Watercraft collisions are the leading identified cause of manatee mortality, averaging 25% and reaching 31% of deaths each year. The successful establishment and management of protected areas depend upon the acquisition of data assessing how manatees use different habitats, and identification of environmental characteristics influencing manatee behavior and habitat selection. Acoustic playback experiments were conducted to assess the behavioral responses of manatees to watercraft approaches. Playback stimuli made from prerecorded watercraft approaches were constructed to simulate a vessel approach to approximately 10 m in sea grass habitats. Stimulus categories were (1) silent control, (2) approach with outboard at idle speed, (3) vessel approach at planning speed, and (4) fast personal watercraft approach. Analyses of swim speed, changes in behavioral state, and respiration rate indicate that the animals responded differentially to the playback categories. The most pronounced responses, relative to the controls, were elicited by personal watercraft. Quantitative documentation of response during playbacks provides data that may be used as the basis for future models to predict the impact of specific human activities on manatees and other marine mammal populations.

U.S. Department of Interior National Park Service, Fire Island National Seashore 2002. Finding of No Significant Impact (FONSI), Fire Island National Seashore, Personal Watercraft Use, Memorandum to Regional Director, Northeast Region From: Superintendent.

“A typical conventional (i.e., carbureted) two-stroke PWC engine discharges as much as 30% of the unburned fuel mixture into the exhaust (NPS 1999a; California Air Resources Board 1999). At common fuel consumption rates, an average two-hour ride on a personal watercraft may discharge three gallons (11.34 liters) of fuel into the water (NPS 1999a). According to data from the California Air Resources Board, two-stroke PWC engines may consume 5 to 10 gallons of fuel per hour, of which up to 3.3 gallons per hour may be discharged unburned (CARB 1998b). (As described in appendix C, an estimated discharge rate of 3 gallons per hour is used in the water quality impact calculations.) PWIA notes that direct-injection engines have been available

in PWC for four years; and three PWC manufacturers introduced four-stroke engines for the 2002 model year (PWIA, May 28, 2002). EPA assumes that the existing two-stroke engine models would not be completely replaced by newer PWC technology until 2050 (40 CFR 89, 90, 91)". https://www.nps.gov/fiis/learn/management/upload/FONSI_PersonalWatercraftUse_04-19-2005.pdf

Peter A. Gabele and Steven M. Pyle. Emissions from Two Outboard Engines Operating on Reformulated Gasoline Containing MTBE. U.S. Environmental Protection Agency,. Environ. Sci. Technol., 2000, 34 (3), pp 368–372. DOI: 10.1021/es990770e

Air and water pollutant emissions were measured from two 9.9 HP outboard engines: a two-stroke Evinrude and its four-stroke Honda counterpart. In addition to the measurement of regulated air pollutants, speciated organic pollutants and particulate matter emissions were determined. Aqueous samples were analyzed for MTBE (methyl tert-butyl ether) and BTEX (benzene, toluene, ethylbenzene, and xylene) emission rates. Compared to the four-stroke engine, the two-stroke had dramatically higher levels of toxic organic and particulate matter emissions. The organic material emitted from the two-stroke engine resembles the test gasoline due to the predominance of unburned fuel. Emission rates for PM10 (particulate matter with a diameter of 10 µm or less) are equal to those for PM2.5, implying that emitted particles are all in the respirable range. Aqueous emissions from the two-stroke are also higher: the two-stroke's BTEX and MTBE emissions are, on average, 5 and 24 times higher, respectively, and 3–10% of the MTBE fed to the engine is emitted to the water. Aqueous emission rates, expressed in brake-specific units, tend to increase with decreasing engine load, as do the atmospheric emission rates.

Great Barrier Reef impacts of recreational use

<http://www.gbrmpa.gov.au/managing-the-reef/how-the-reefs-managed/Managing-multiple-uses/recreation>. There have been few studies of the impacts of recreational use on the Great Barrier Reef ecosystem. Impacts are expected to be mostly inshore areas close to major regional centers given the distribution of boat ownership. The likely impacts are:

- Localized but frequent anchor damage to corals and seagrass meadows
- Littering
- Boat strikes on marine mammals and turtles
- Fin damage to corals when snorkeling and diving.
- There is some risk of introducing species through fouling on recreational vessels, especially those from overseas.

Vessel Grounding and Prop scars studies in shallow water

<http://floridakeys.noaa.gov/sac/othermaterials/20160419fknmsshallowwater.pdf>

<http://floridakeys.noaa.gov/sac/othermaterials/20160419boatingimpacts.pdf>

<http://floridakeys.noaa.gov/sac/othermaterials/20160816boaterimpacts.pdf>

<http://floridakeys.noaa.gov/sac/othermaterials/20170221boatingimpacts.pdf>

Personal Watercraft Industry Association – Excerpts on Environmental Impacts

<http://www.pwia.org/resources#environmental-impact>

1. Emissions. All PWIA manufacturers ensure their products are meeting or exceeding EPA emission standards, and are leaders in lowering marine emissions. California Riders: All PWC meet with the requirements of the California Air Resources Board (CARB). PWC are among the cleanest and most environmentally friendly vessels on the water.
2. Green Boating. All boaters have many options to reduce fuel consumption, including reducing cruising speed, tuning the engine and taking shorter trips. These are standard practices and are often followed regardless of fuel price. PWC meet the strict national park environmental assessment standards, and provide an environmentally friendly way to explore many of the nation's natural wonders. Boaters and anglers are the original conservationists – they experience and treasure our nation's waterways first hand. They pay fees and taxes that support sportfish restoration and fund government-run environmental protection programs, such as the Sport Fish Restoration and Boating Trust Fund, sometimes called the Wallop-Breaux Trust Fund. As a user-pay, user-benefit system, taxes collected go to state fish and wildlife agencies for fisheries research, habitat improvement, aquatic education and fishing and boating access facilities, such as docks and ramps.
3. Sound. The PWC industry dedicates significant resources to make PWC cleaner, quieter and safer. Today many PWC products are up to 70 percent quieter than models produced only four years ago. Manufacturers are reducing noise through:
 - The use of intake/exhaust system redesign, active noise-canceling devices
 - Improved engine/drivetrain isolation
 - Enhanced hull insulation and other muffling techniques

Improper operation of PWC, such as operating too close to a shoreline, can lead to sound disturbances. The personal watercraft manufacturers and industry associations do their best to educate customers on the safe and courteous use of their boats. Additionally, PWIA and its members endorse the use of shoreline sound measurement laws as contained in the National Marine Manufacturers Association Model Noise Act, and the establishment of slow-speed/no-wake zones near shore for all boats. Manufacturers of personal watercraft are committed to the development of quieter personal watercraft, and are educating operators to be respectful of the noise concerns of shoreline residents.

4. Erosion. Be aware of your surroundings and operate in a manner appropriate to the geography. Follow posted wake and operation restrictions in areas where erosion may be a concern and obey all access restrictions to avoid impacting sensitive areas.
5. Aquatic Invasive Species. Protecting aquatic resources is important for boaters who love to spend time on the water. The spread of harmful plants, animals and other organisms threaten America's water habitats and have lasting economical damage for the boater, local community, and industry. The "clean, drain, dry" educational outreach programs ensure best boating practices and reduce the possibility of invasives making their way into our

waterways. Federal and state agencies support these efforts. Marine manufacturers and the industry are doing their part to examine design controls which help prevent the spread of aquatic invasive species (AIS). In 2014, the American Boat and Yacht Council gathered nearly 100 industry and government representatives to better define the problem and consider ways to simplify prevention efforts required of boaters.

6. *Respecting Nature and Local Residents.*

- It is discourteous to ride too close to shorelines where you might disturb swimmers and homeowners.
- Do not harass wildlife by chasing or interrupting feeding, nesting, or resting. Harassment is defined as any action that may cause an animal to deviate from its normal behavior. It is illegal and can unduly stress wildlife.
- Mammals such as sea otters, sea lions, manatees, and whales can be injured from direct impact by boats traveling at high speeds. Ride at controlled speed so you can see any animals ahead of you. Avoid areas of high animal population. If you hit an animal report it to your local wildlife commission. There may be a chance to save its life.
- When docking or beaching, avoid areas with turtles, birds, alligators, and other animals along shore.
- Avoid docking or beaching where plants such as reeds, grasses, and mangroves are located. These plants are essential to the ecosystem because they control erosion and provide a nursery ground for small animals vital to the food chain, such as crustaceans, mollusks, and small fish

Technology

- No Exposed Propeller
- PWC engine draws water into an impeller, which pressurizes water and pushes it out of a jet at the rear of the vessel
- This advanced system eliminates the hazards of an exposed propeller, creating a clean and safe system that PWC riders can count on
- Steering Enhancement
- New PWC technology allows for steering assistance even during deceleration
- Speed-Limiting Systems
- New engine management technology allows users to limit engine speed, creating a safe and fuel-efficient experience for riders of all ages and abilities
- Additional Features
- PWC are more user friendly than ever, with GPS systems, side mirrors, reverse throttles and more (members should highlight which of these features their PWC's boast)
- All PWIA PWC include an engine cutoff lanyard, which immediately cuts the engine should the rider fall off the PWC. This feature ensures rider safety

3.0 Carrying Capacity Research

Based on a literature review, carrying capacity studies focus primarily on visitor impact management, natural resource protection, and visitor experience. Our findings indicate that there is little to no guidance on the establishment of carrying capacity maximums for PWCs.

The most recent carrying capacity studies examine the relationship between visitor use and natural resource protection to demonstrate a balance between acceptable environmental impact and the quality of the visitor experience; rather than setting a maximum number of visitors. These studies augment empirical data (e.g., correlation between visitor use and monitoring natural resource impacts) with qualitative information or survey data. Earlier carrying capacity studies that tried to establish maximum visitor numbers through solely empirical data analysis were not successful (e.g., The Florida Keys Study – Clark, 2002). In an examination of carrying capacity methods used to support visitor management on the Boston Harbor Islands, the authors claim that "by defining indicators and standards of quality, carrying capacity can be determined and managed through an associate program of monitoring and management" (Manning et al., 2005). Although this study was focused on land, it may offer an approach. The Saipan user surveys and habitat mapping could augment other monitoring data to better understand the carrying capacity of jetskis or other PWCs in the Saipan Lagoon.

While the literature review did not elicit recommendations for carrying capacity methodologies as they *specifically* relate to jetskis or PWCs, the information and lessons learned from these studies could be useful in the development of management strategies. See below for a complete reference list.

Literature Review – Carrying Capacity Studies Reference List

Clarke, Alice L. March 2002. Assessing the carrying capacity of the Florida Keys. *Population and Environment*; 23, 4; Research Library. pg. 405

Gray, D.L., Canessa, R., Rollins, R. et al. Incorporating Recreational Users into Marine Protected Area Planning: A Study of Recreational Boating in British Columbia, Canada. *Environmental Management*; 46: 167. doi:10.1007/s00267-010-9479-1

Haas, Glenn E. July 2001. A reframing of visitor capacity. *Parks & Recreation*; Jul 2001; 36, 7; Research Library. pg. 68

Haas, Glenn E. 2008. "The Federal Interagency Task Force on Visitor Capacity on Public Lands and Waters"; Information Presented at the User Capacity Symposium, Yosemite National Park, February 6, 2008.

Manning, Robert; Yu-Fai Leung; Budruk, Megha. 2005. Research to Support Management of Visitor Carrying Capacity of Boston Harbor Islands. *Northeastern Naturalist*; 2005; 12, 3; Research Library, pg. 201

McCool, Stephen F. 1994. Planning For Sustainable Nature Dependent Tourism Development – The Limits of Acceptable Change System. *Tourism Recreation Research*. Vol 19. Issue 2; Pages 51-55.

McCool, Stephen F.; Lime, David W. 2001. *Journal of Sustainable Tourism*. Tourism Carrying Capacity: Tempting Fantasy or Useful Reality? Issue 5.

National Recreation and Parks Association (NRPA). 2001. Visitor Capacity on Public Lands and Waters: Making Better Decisions. Prepared by the Federal Interagency Task Force on Visitor Capacity on Public Lands.

Ríos-Jara, E., Galván-Villa, C.M., Rodríguez-Zaragoza, F.A. et al. 2013. The Tourism Carrying Capacity of Underwater Trails in Isabel Island National Park, Mexico. *Environmental Management*. 52: 335. doi:10.1007/s00267-013-0047-3

Tseng, YP., Kyle, G.T., Shafer, C.S. et al. 2009. Exploring the Crowding–Satisfaction Relationship in Recreational Boating. *Environmental Management*; 43: 496. doi:10.1007/s0026700892495

Viñals, María José. 2016. Recreational Carrying Capacity on Small Mediterranean Islands. *Cuadernos de Turismo*; Murcia 37. (Jan): 437-463.

Wilks, Jeff. 2012. Balancing Tourism and Safety: The Case of Jet Skis. *Travel Law Quarterly*.

Roe, M. and J. Benson. 2001. "Planning for conflict resolution: Jet-ski use on the Northumberland coast." *Coastal Management* 29(1): 19-39.

Abstract: The study takes a much different approach to most recreation conflict research, in its examination of conflicts associated with personal watercraft (PWCs) on the Northumberland coastline. Instead of research focusing on conflict situations at a specific recreation site, this research uses a survey of 150 recreation interest groups and agencies to highlight specific issues with PWCs and comment on appropriate management actions. Management suggestions included legislation, voluntary agreements, zoning, control by clubs, physical barriers, and information and publicity. The results of the survey were used to develop a strategic framework that would act as a mechanism under which conflicts could be identified and resolved. The principles adopted and the study approach and methods illustrate a useful way to provide locally relevant proposals to deal with the dilemmas of managing "new wave" sports such as jet-skiing in ecologically sensitive and aesthetically important coastal landscapes.

2017 SLUMP
Appendix C

Summary of Lagoon User Survey Results

Saipan Lagoon Use Quick Survey



The Saipan Lagoon Use Management Plan is being updated by BECQ-DCRM. As users of the Lagoon, your voice matters. Tell us what you think about current use conflicts and what the management plan should focus on. Please return this survey to Emily Northrop at BECQ-DCRM located at Gualo Rai Center or by mail to Caller Box 10007, Saipan, MP 96950.



1. How do you use the lagoon? Check all that apply.

Recreational Use <i>(I do this activity on my own)</i>	Commercial Use <i>(I pay or get paid for this activity)</i>	Fishing
<input type="checkbox"/> SCUBA Diving	<input type="checkbox"/> SCUBA Diving	<input type="checkbox"/> Hook and Line Fishing
<input type="checkbox"/> Snorkeling and Free Diving	<input type="checkbox"/> Snorkel Tours	<input type="checkbox"/> Spearfishing
<input type="checkbox"/> Swimming	<input type="checkbox"/> Parasailing	<input type="checkbox"/> Throw net/Talaya Fishing
<input type="checkbox"/> Paddling	<input type="checkbox"/> Banana Boating and other boat towing activities	<input type="checkbox"/> Gillnet/Chenculu/Tekken Fishing
<input type="checkbox"/> Surface Board Sports	<input type="checkbox"/> Jetski Rental	<input type="checkbox"/> Harvesting/Gleaning
<input type="checkbox"/> Motorized Boating	<input type="checkbox"/> Transit and Dinner Cruises	
<input type="checkbox"/> Sailing	<input type="checkbox"/> Commercial Shipping	
<input type="checkbox"/> Beach Use		
<input type="checkbox"/> Other use (please specify):		

2. Rate how other users either detract from or enhance your use/experience in the Lagoon.

Use		Significantly Detracts	Somewhat Detracts	No Influence	Somewhat Enhances	Significantly Enhances	No Opinion
Recreational Uses	SCUBA Diving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Snorkeling and Free Diving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Swimming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Paddling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Surface Board Sports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Motorized Boating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Sailing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Beach Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commercial Uses	SCUBA Diving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Snorkel Tours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Parasailing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Banana Boating and other boat towing activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Jetski rental	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Transit and Dinner Cruises	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Commercial Shipping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fishing	Hook and Line Fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Spearfishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Throw net/Talaya Fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Gillnet/Chenculu/Tekken Fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Harvesting/Gleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please explain how other activities affect your use:

3. For each use, do you feel that there are too many users, too few users, or just the right amount of users?

	Use	There are too many users	We have just the right amount	There is a need (and capacity) for more users	I have no opinion
Recreational Uses	SCUBA Diving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Snorkeling and Free Diving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Swimming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Paddling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Surface Board Sports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Motorized Boating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Sailing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Beach Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commercial Uses	SCUBA Diving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Snorkel Tours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Parasailing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Banana Boating and other boat towing activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Jetski rental	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Transit and Dinner Cruises	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Commercial Shipping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fishing	Hook and Line Fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Spearfishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Throw net/Talaya Fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Gillnet/Chenculu/Tekken	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Harvesting/Gleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other use (specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

4. How concerned are you about the water quality (sediment, nutrients, bacteria, or other pollutants) within the Lagoon? Please check the box.

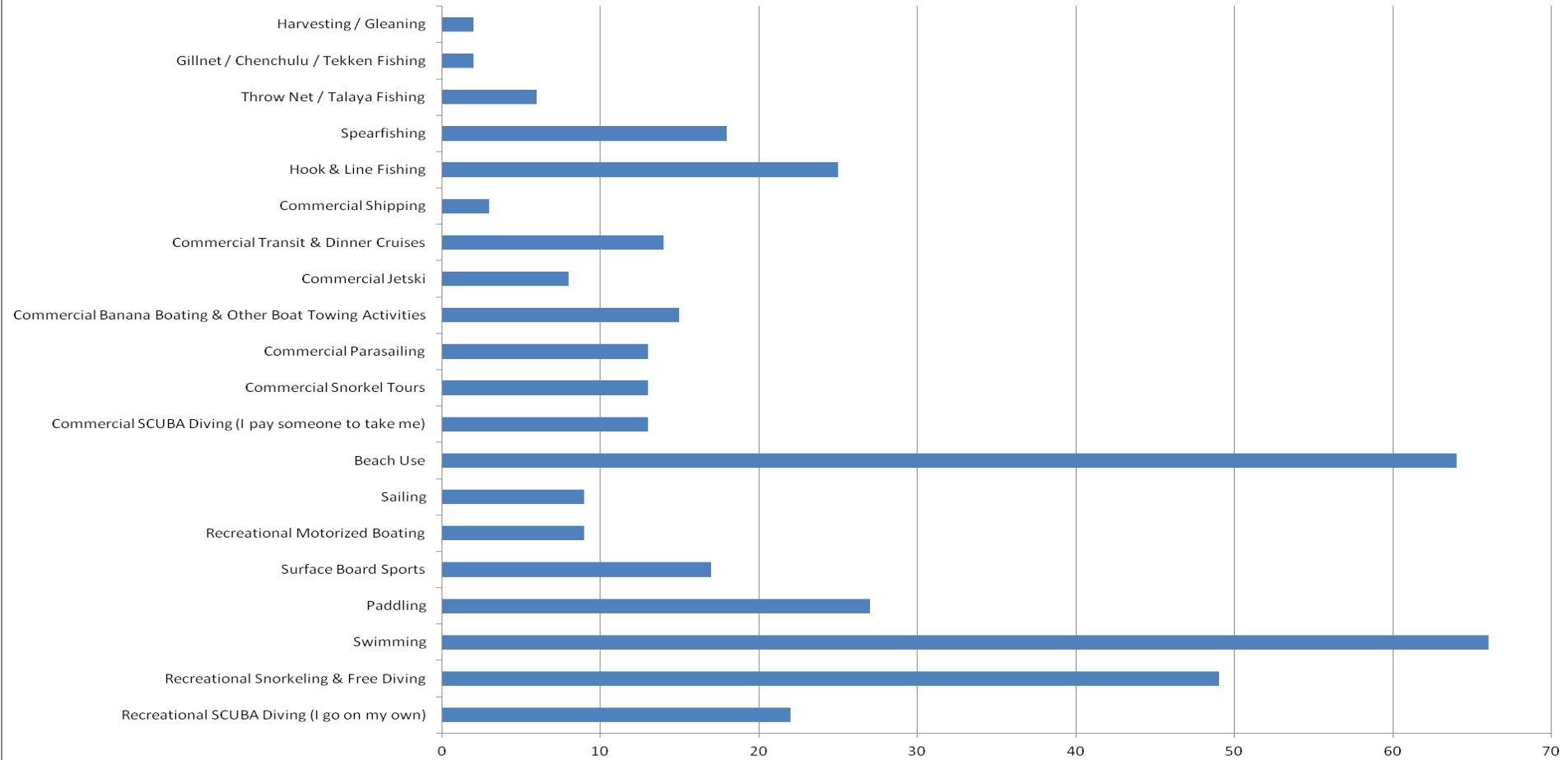
	Not concerned	Somewhat Concerned	Very Concerned
For Human Health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
For Corals/Seagrass/Fish	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Rank each of the following Lagoon management goals from 1 to 5 based on what is most important to you, with 1 being the highest priority and 5 being the lowest priority. Write the rank in each box.

- Reducing conflicts between different recreational, commercial, and fishing users
- Protecting biological communities and habitats (e.g., corals, seagrass beds, wildlife)
- Improving water quality for ecosystem and/or human health
- Revisiting current permitting requirements and user restrictions
- Addressing shoreline erosion and climate change
- Other (please specify and rank): _____

6. What is your vision for Saipan Lagoon over the next 10-20 years?

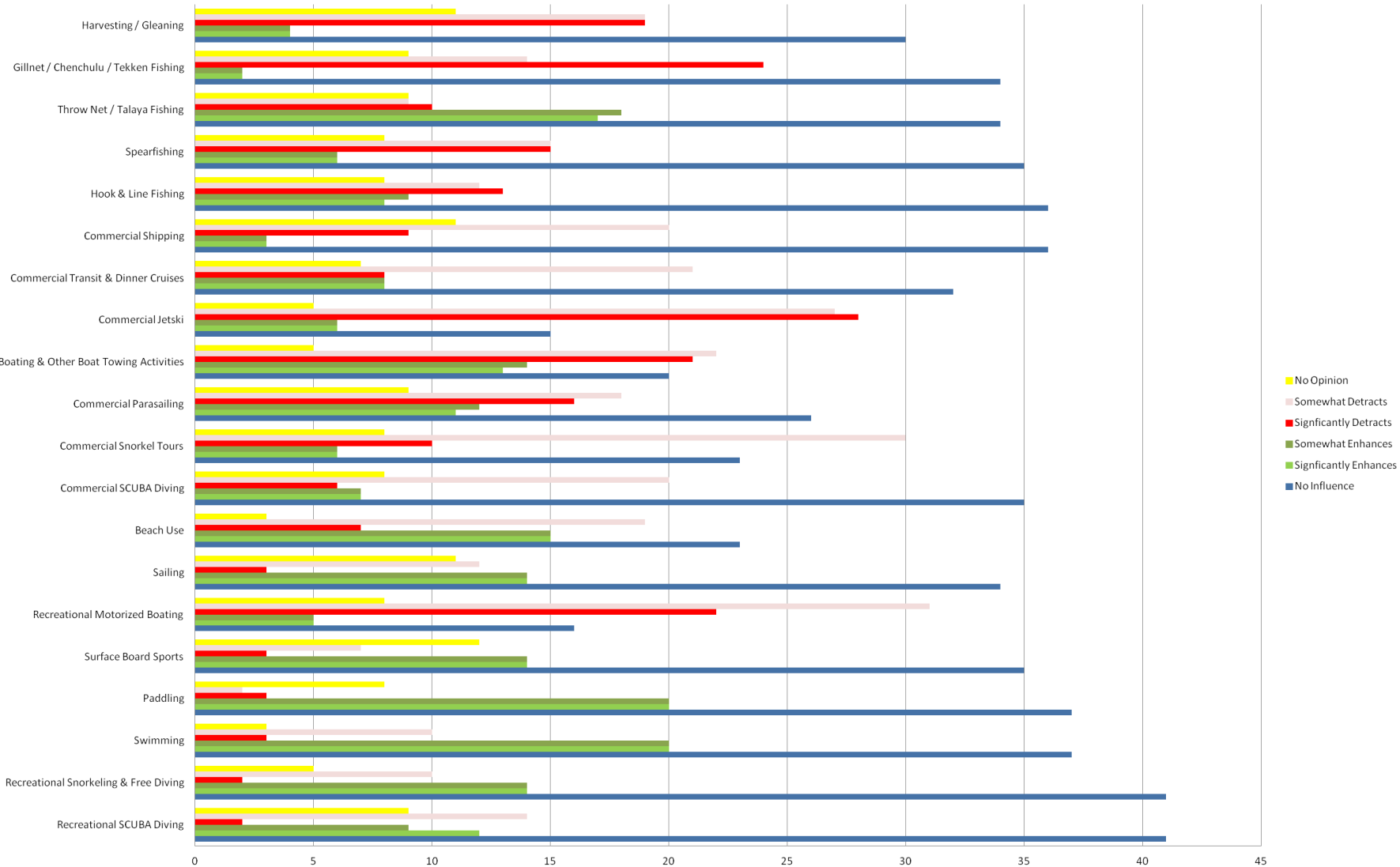
How do you use the Lagoon?



How Do You Use the Lagoon?

Open-ended Responses
Making sandcastles
Outrigger (2 responses)
Yoga
Take Photos
Marine water sampling for CUC

How do other users either Detract from or Enhance your use/experience in the Lagoon?



How do other users either detract from or enhance your use/experience in the Lagoon?

Open-ended Responses

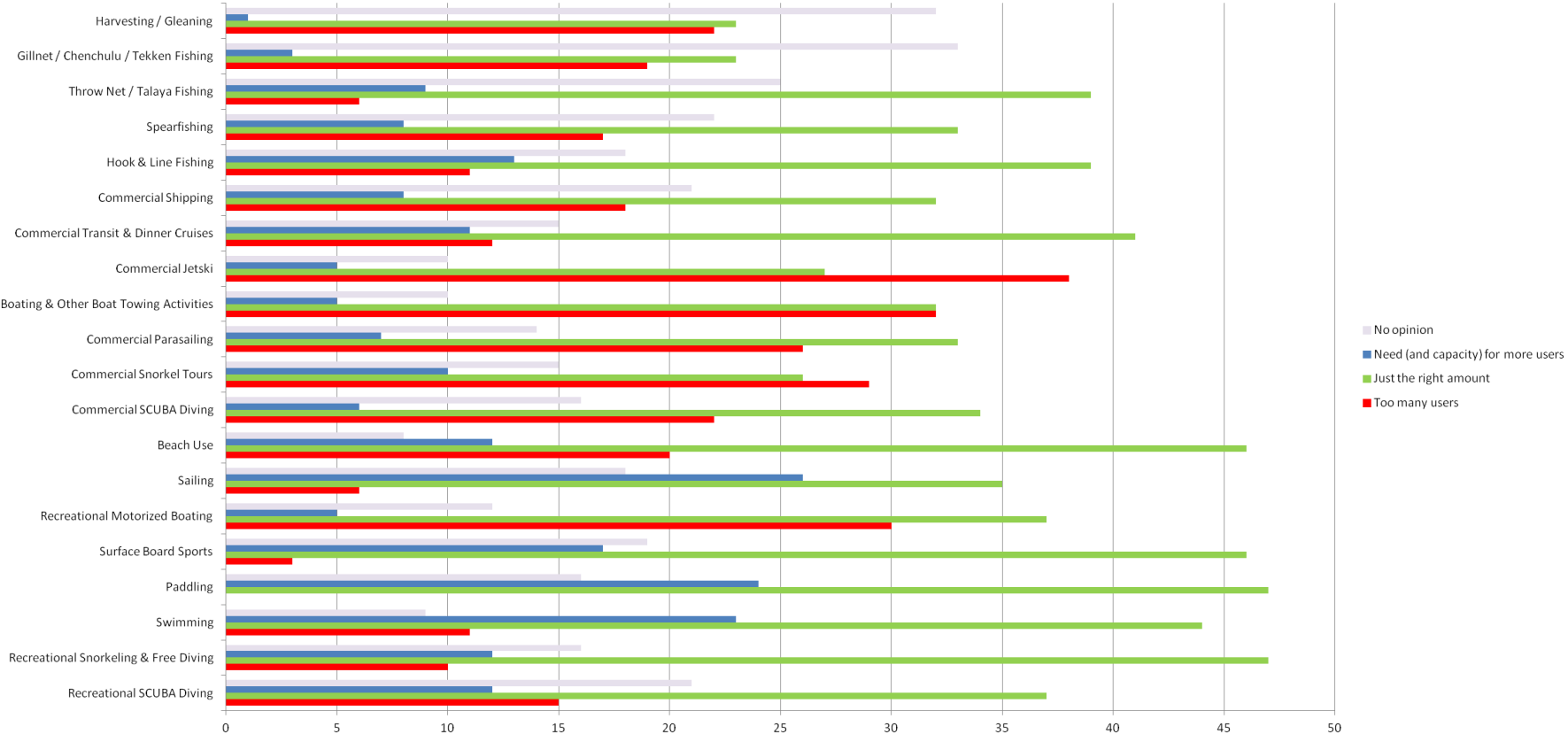
The trash left by people really makes me angry.

Boats (private and commercial) should be required to pass periodic inspections to make sure that they are not polluting. I get very tired of seeing black oil "trails" behind boats (a VERY common thing).

Boats that do not follow "no wake" zones put swimmers in danger.

Hook line fishing creates danger for scuba divers. spear fishing creates danger and takes away fish and octopus that divers and snorkelers want to see

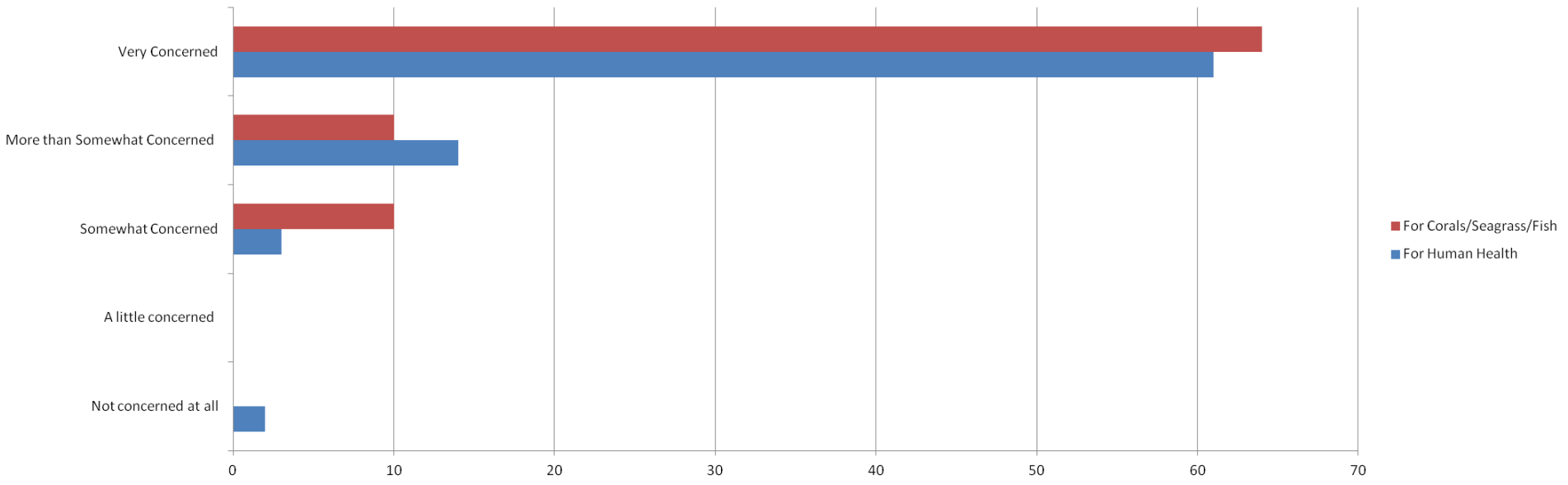
Number of Users



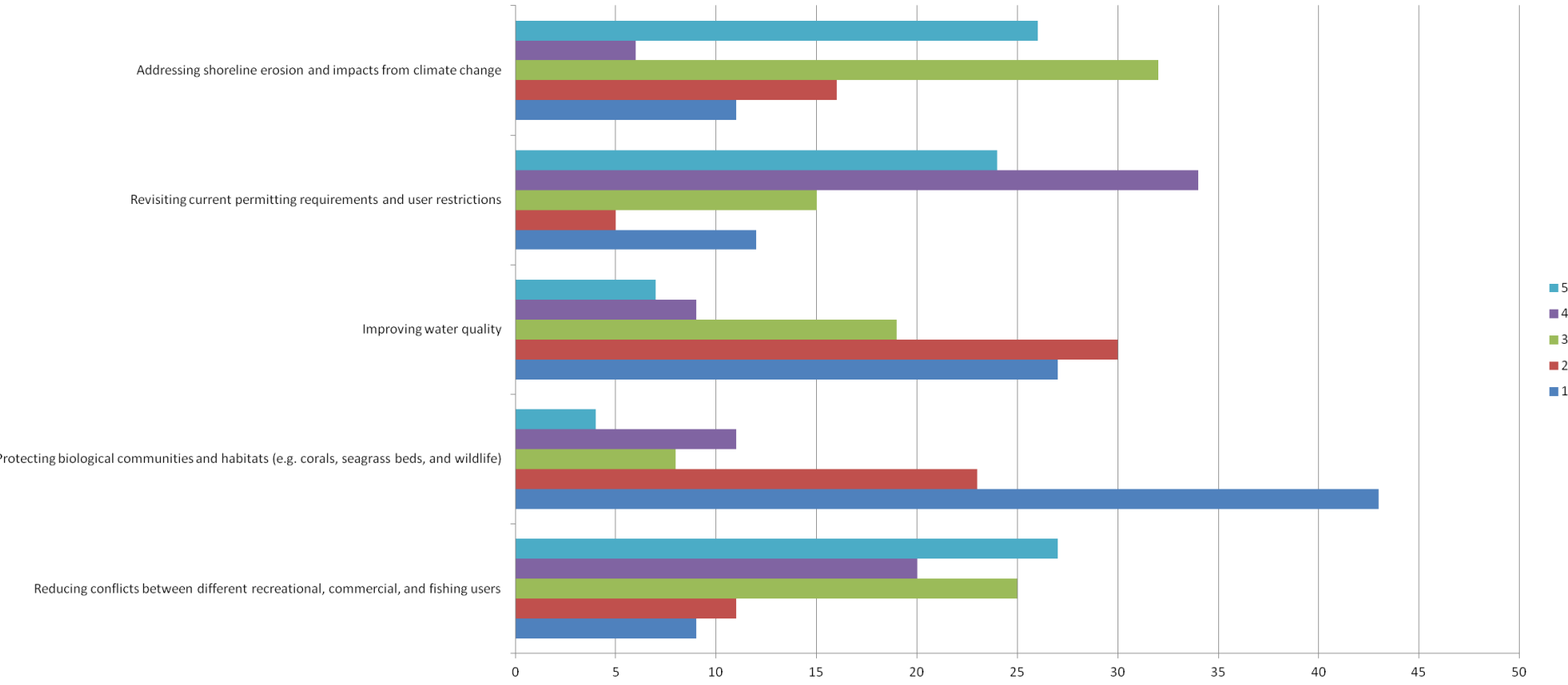
For each use, do you feel that too many users, too few users, or just the right amount of users?

Open-ended Responses
BAN Gillnet/Chenculu/Tekken
Too many users - Large yachts for gambling and prostitution that operate however they please, and cannot be regulated or enforced due to political protections.
No opinion (2 responses)

How concerned are you about the water quality (sediment, nutrients, bacteria, or other pollutants) within the Lagoon?



Rank each of the following Lagoon management goals based on what is most important to you, with 1 being the highest priority



Rank the Lagoon management goals based on what is most important to you.

Open-ended Responses
Erosion study (i.e., Micro Beach)
Be like Palau

What is your vision for Saipan Lagoon over the next 10-20 years?

That the lagoon be in current shape or improved shape for use by future generations. (From Rotary Club on 5/30/17)	I believe local indigenous people deserve use as they desire within ecologically significant guidelines. There are more tourists using and abusing than indigenous.
Improve water quality. Prevent erosion. (From Rotary Club on 5/30/17)	Most of my answers are "No Influence" because there's currently more than enough room for these activities. If anything becomes too frequent, it might start to detract from my experience.
Stable (From Rotary Club on 5/30/17)	I am a fisherman any other users detract from my activity.
To Continue to use for fishing.(From Rotary Club on 5/30/17)	Crystal clear waters and sustainable water sports activities.. no oil spills or pollution....
Restored ecosystem health, people should be able to safely use the lagoon and commercial users should operate in moderation.	Clean and flourishing
I hope that we could continue to work on improving our lagoon so that we can continue to use it as well as for our future generations.	Growth of wildlife and more protection for our lagoon.
Clean water, sustainable commercial operation, stewardship from local users, tourists, and businesses alike. Sustainable development guided by strict permitting conditions and user fees/incentives	With conservation & protection of wildlife & water quality at the utmost importance, I envision continued use of our pride & joy, our waters, for use of SUSTAINABLE fishing & water sports for locals & tourists. We should allow commercial water sports to grow accordingly with the growing number of tourist but with strict regulations & only to an extent that is absolutely necessary.
Beaches kept pristine with recycling and garbage bins on all beaches and signs in all languages warnings not to litter or destroy the ecosystem. monitored to enforce.	Still clean waters, fines for littering on beaches and water, safe parking by beaches, toilets and showers, free drinking water fountains, eco-policeman check points.
Hope for a better beachshore, better water quality.	We should have a mariculture program in place that sees the growth of clams, corals, and other sea life for reintroduction and replacement in the lagoon. Not only will this help replenish the reef and lagoon environment, but it will be a significant educational facility for residents and tourists alike. I envision that the Saipan lagoon will be preserved and protected for the enjoyment of all. A mariculture program, common sense management, and protection-protection, will ensure that in my opinion.
Preservation, Protection, Education, to maintain or improve all lagoon life.	Keep sediment and runoff down so the corals and grasses have a chance to thrive. This should also limit nutrient input and reduce algal blooms.
Open for free swimming.	Lots of traditional canoes and more swimmers, as well as more related events.

What is your vision for Saipan Lagoon over the next 10-20 years?

It will become more clean if we all think about the lagoon more seriously.	Strict usage and profiling so that it doesn't become an environmental cesspool
Cleaner	It'll be dead from overuse, sewage from hotels, and fertilizers from golf courses/farms.
Saipan will be full of Chinese and buildings.	Protect it for residents and tourism even at the cost of less vendors. Lagoon is the main tourism draw for tourists
Saipan lagoon these days looks just fine, but as Saipan's tourism grows Saipan's lagoon may get more dirty because even now, though there are little people using the beaches, there are still a lot of trash.	Sadly it is a bad vision as I believe the development that will occur in Marpi and that has occurred in Garapan is ruining the Lagoon.
Clean beach	Key protector of marine mammals, corals and completely available for swimming and Chamorro and Chamolinian cultural and livelihood practices.
If we keep the Saipan lagoon clean, it will not change anything.	To have a sustainable management plan so we can continue to grow our usage through methods that will not degrade the environment or habitats within the lagoon.
Saipan will grow economically, which means more pollution towards lagoons. We need a "plan" of reducing the harm.	Clean, pristine, and teeming with sea life.
A clean and clear space where lots of users have fun with minimal environmental impact.	If it goes on like this, marine lives may be affected negatively.
Hopefully clean & safe for the future generations	Put more trash box.
Better planning and regulations geared towards sustainable use.	it's going to be more beautiful and clean.
Less marine sports and more traditional canoes in the lagoon.	Everyone can enjoy it in some way without fear for safety or fear for health.
Reduced motorized traffic between Mañagaha and micro beach.	That preservation of its main function would be well managed accordingly, that use of its intended purpose will be enjoyed even the future generation.
That the lagoon will be thriving, healthy from protection efforts implemented by today's SLUMP concerns.	Cleaner Beaches
Excellent	No more red flags.
More non motorized vessels.	I envision the casino messing up the environment. Attracting all the wrong visitors. Hopefully not.
Rejuvenated seagrass and staghorn coral habitats	Full of beautiful corals and fish. Reduced pollution due to responsible residents and tourist. Less boating activities and more non - motored vehicles.

What is your vision for Saipan Lagoon over the next 10-20 years?

More corals and fish	(20 years from now) The CNMI's political powers have realized the economic value of a healthy lagoon ecosystem and healthy water quality, and are taking an active leadership role in pushing/advocating the management solutions from the 2017 SLUMP update. Commercial and shoreline uses are effectively co-managed to save commercial/operators and developers from themselves. Large private yachts have sunk and created vibrant artificial reefs.
Marine life / ecosystems will deteriorate over time if these concerns are not addressed.	Safe and clean lagoon with sustainable resources.
Designated area for commercial Vs Recreational uses.	Controlled marine sports area.
Healthy, abundant sea life.	Effective management of commercial and recreational uses within the lagoon.
A cleaner and healthy environment.	I'd like to see more, like i wish to see more corals and seagrass beds with a healthy fish population. I'd like to see better regulated commercial operators and private owners of motorized vehicles so that all users of the lagoon feel safe and comfortable.
That my children will be able to swim in clean water. I hope that the coral reef is still viable.	Licensing and vetting operators. CNMI needs to be sure to get compensated for the use of its resources in a fair and equitable manner that helps conserve that resource.
Considering the increasing population and the island development, to foresee the high probability of Saipan Lagoon being polluted and exploited in the coming years.	1 Protect PauPau from commercial development such as a hotel. No motorized boats or jet skis should be allowed. It is the only beach on the north side for the residents of Saipan with adequate parking and safe swimming.
Clean and beautiful.	How about the older Chamolinian traditions tied to praying near certain beaches on-island? This needs to be brought back and was stopped due to development.
Consistent green flags & controlled erosion control.	We need to control run off as it significantly damages the coral reef. The past plans to install run-off ponding basins need to be revisited immediately.
Less run-off sedimentation in the lagoon.	To provide guidance and mitigation opportunity to ensure protection of our fragile lagoon.

2017 SLUMP

Appendix D

Lagoon Use Forum Summary and Presentations

Saipan Lagoon Use Management Plan Forum Summary April 25-26, 2017



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MEMORANDUM

TO: Fran Castro, Erin Derrington, and Emily Northrop, BECQ-DCRM
FROM: Kathleen McAllister and Anne Kitchell, HW
DATE: May 12, 2017
RE: Summary – Saipan Lagoon Use Management Plan Forum

Introduction

On April 25 and 26, 2017, a forum was held at the Fiesta Hotel to discuss current and future uses of Saipan Lagoon and strategies for ensuring sustainability of the Lagoon’s resources. The Commonwealth of Northern Mariana Islands (CNMI) Bureau of Environmental and Coastal Quality’s (BECQ) Division of Coastal Resources Management (DCRM) is currently updating the Saipan Lagoon Use Management Plan (SLUMP). Technical information presented and participant recommendations from the two-day forum will inform the development of the SLUMP. This memorandum summarizes Forum presentations and discussions.¹

Forum Agenda

Throughout the Forum’s two days, participants were asked to think critically about uses in the Lagoon. Before discussions began, Fran Castro, Director of DCRM, provided opening remarks and a history of lagoon management in Saipan. She described previous SLUMP efforts and management recommendations, as well as the current moratorium on additional marine sports operating permits, which began in 2000. Technical presentations were delivered by BECQ and NOAA on conditions within the Lagoon and studies including: 2016 high-resolution habitat mapping, a preview of 2017 biological monitoring results, watershed pollution, and findings from the 2016 Lagoon User Survey. In addition, representatives from the local Chamber of Commerce and the Micronesia Islands Nature Alliance (MINA) presented their visions regarding Lagoon management, including partnership opportunities.

Approximately 60 people attended the morning session and about 35 people attended the evening session on April 25th. A smaller group met for the April 26th work session. There was significant representation from the marine sports operator (MSO) community. For a complete list of participants, see Attachment A.

¹ To access the Forum agenda and presentations, visit: <http://horsleywitten.com/SLUMP/events.html>.

The schedule of the Forum allowed participants to provide feedback on lagoon use issues both in morning and evening sessions on April 25th. During the morning session, participants were primarily agency staff from BECQ and DCRM and marine sports operators (MSOs). In the evening session, Manny Borja of Hofschneider Engineering Corporation (HEC)² introduced the purpose of the SLUMP update to the group and then the meeting transitioned into open discussion and solicitation of comments in small groups. Participants were comprised mainly of local high school students, a few interested residents, and MSOs.

At the outset of both sessions, participants were presented with red and blue dot stickers and asked to mark photos of various activities, indicating that they wanted to see more of the pictured use with blue dots and less of the pictured use with red dots. The intent of this exercise was to engage participants in the topic at the beginning of the session. It should be noted that the exercise does not provide representative and equitable data across all Lagoon stakeholder groups. Results from the dot sticker sessions are listed in the tables below.

Dot exercise – Morning Session

	Activity/Use	Blue Dot I want to see more of this use	Red Dot I want to see less of this use
Recreational Uses	Recreational scuba	7	0
	Snorkeling/free diving	15	3
	Swimming	11	0
	Paddling	18	0
	Surface board sports	17	0
	Motorized boating	1	16
	Sailing	19	0
	Beach use	7	0
Commercial Uses	Commercial scuba	5	3
	Commercial snorkel tours	0	15
	Parasailing	1	17
	Banana boating and other boat towing	1	16
	Jetski rentals	2	20
	Transit and dinner cruises	2	1
	Commercial shipping	1	4
Fishing	Hook and line fishing	7	2
	Spear fishing	3	5
	Throw net fishing	5	0
	Gillnet fishing	2	7
	Harvesting	3	8

² HEC, an engineering firm based on Saipan, is part of the HW team for the SLUMP update. In addition to assistance during the Forum, HEC staff provide local data and knowledge to inform the SLUMP.

Dot Exercise – Evening Session

	Activity/Use	Blue Dot I want to see more of this use	Red Dot I want to see less of this use
Recreational Uses	Recreational scuba	12	0
	Snorkeling/free diving	12	0
	Swimming	8	0
	Paddling	12	0
	Surface board sports	8	1
	Motorized boating	0	9
	Sailing	7	0
	Beach use	13	0
Commercial Uses	Commercial scuba	6	0
	Commercial snorkel tours	3	2
	Parasailing	7	5
	Banana boating and other boat towing	2	2
	Jetski rentals	0	9
	Transit and dinner cruises	2	0
	Commercial shipping	1	12
Fishing	Hook and line fishing	0	5
	Spear fishing	1	3
	Throw net fishing	1	10
	Gillnet fishing	0	12
	Harvesting	0	13

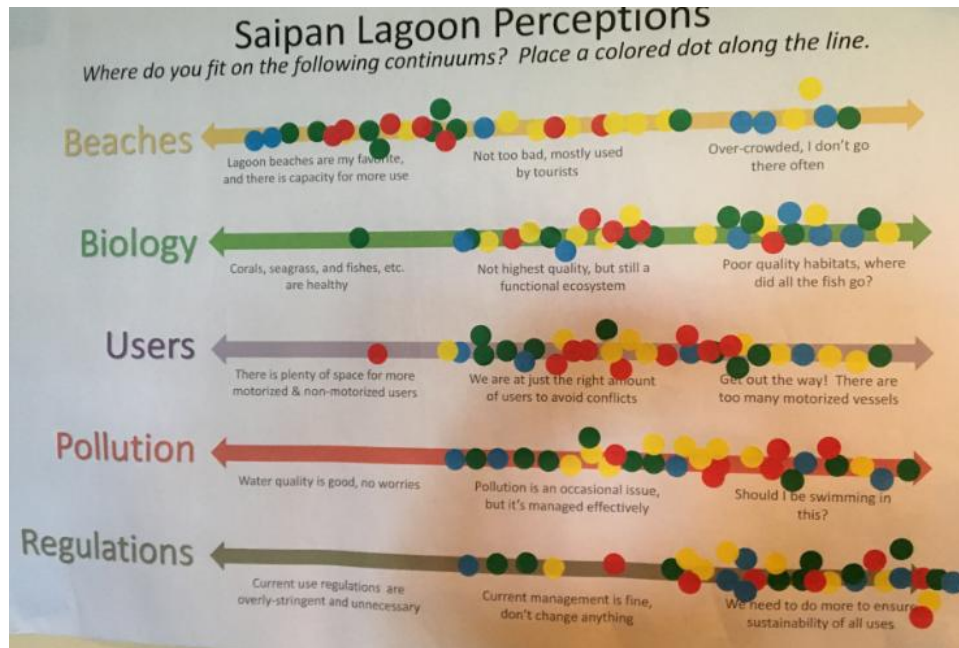
Key Messages from Dot Exercise

During both the morning and evening sessions, participants indicated they would like to see more of non-motorized uses and beach use and less commercial snorkeling operations and jetskis. There were some notable differences between the votes during the morning and evening sessions of the Forum. During the morning session, parasailing received a significant amount of red stickers but far less during the evening session. During the morning session, fishing received many blue stickers but more participants aligned fishing with red stickers during the evening session. Many of the participants who chose red stickers for fishing were local high school students who perceive the fishing activities as harmful to the lagoon ecosystem.

A few themes emerged including:

- The lagoon and shipping channel are crowded for parasailing operations.
- Commercial snorkeling tours can be harmful to the coral.
- Beach use and non-motorized lagoon uses are preferred activities by those in attendance.

Participants were also asked to place dot stickers along a continuum poster to reflect their perceptions of the Saipan Lagoon with respect to beach-going, biology, space for users, pollution, and environmental regulations. Most participants thought that lagoon beaches still have capacity for use, but almost overwhelming indicated that more regulations and actions are needed to ensure sustainability of all uses in the Lagoon.



Participants were also encouraged to complete a brief user survey. Results from this survey will supplement the results from the 2016 User Survey Study and Mapping Project. Those wishing to fill out this survey online can visit: <https://www.surveymonkey.com/r/saipanlagoonuse>.

Presentations

Following the introductory presentation and dot exercise, a series of technical presentations were delivered. Below are brief summaries of remarks by each presenter. Full presentations are available at: <http://horsleywitten.com/SLUMP/events.html>.

Steve McKagan, National Oceanic and Atmospheric Administration (NOAA)

Mr. McKagan presented findings from the recently completed NOAA Habitat Mapping Study of the Saipan Lagoon. This study is based largely on a combination of satellite imagery as well as hundreds of sample sites that were “ground-truthed” by NOAA staff. This mapping effort included 27 square km of lagoon features mapped at a 2 m resolution. Study results illustrate that there have been several notable areas of reef change and seagrass loss since 2003. The study is still in draft form but report writing is underway. All input data and map layers will be available online.

Lyza Johnston, Bureau of Environmental and Coastal Quality (BECQ)

Ms. Johnston provided an overview of current health status of the marine habitats in the Saipan Lagoon based on data from long-term monitoring efforts. She described the negative biological impacts from land-based sources of pollution, coastal development, and daily water activities. In addition, she described impacts from acute disturbances like the 2015 typhoon and ship groundings. Long term monitoring efforts include site-specific data collection and analysis of Lagoon sea grasses and corals.



Through these efforts BECQ has identified areas of particular concern and areas of resilience. During her presentation, Ms. Johnston suggested a few strategies that could be considered for sustainable management of the Saipan Lagoon:

- Protection via regulations (northern lagoon)
- Prioritization of water quality improvement projects (Garapan)
- Additional monitoring and research (Sugar Dock)
- Improvement/implementation of best management practices (BMPs)
- Active restoration
- Inform Lagoon planning efforts (SLUMP)

Robbie Greene, BECQ

Mr. Green provided remarks on BECQ's mapping efforts and in particular focused on impacts to the Lagoon from land cover change, including nonpoint source pollution from runoff due to increased impervious cover surfaces and increased nutrient loading. BECQ's mapping effort can provide data to better inform management decisions.

Emily Northrop, BECQ

Ms. Northrop provided an overview of the recently completed Saipan Lagoon Use Study and Mapping Project.³ APEC, a contracted firm, completed this study in March 2016 to assess and map the recreational and commercial uses of the lagoon, identify potential areas of user conflict, and highlight focus areas for the SLUMP revision. Based on research findings, the study identified management priorities including: management of overcrowding and user conflicts, protection of priority locations and resources, and management of water quality and erosion control with continued stakeholder involvement.

Ron Smith, Chamber of Commerce

Mr. Smith provided an overview of the commercial users of the Lagoon, the challenges faced by commercial users and management suggestions from the commercial user community. Commercial users include MSOs, hotels, restaurants, etc. and the challenges cited include: beach trash, lack of sufficient buoys or moorings, and algae accumulation. Mr. Smith indicated that the commercial user community would like to see a better established mooring system, beach and lagoon maintenance of trash and algae, and the potential formation of a public-private partnership to produce annotated maps of the Lagoon to educate all users.

Roberta Guerrero, Micronesia Islands Nature Alliance (MINA)

Ms. Guerrero provided remarks on MINA's ongoing projects in Saipan related to environmental management and stewardship including marine debris cleanup efforts, trash management, and the "Tasi Watch Ranger" program which employs rangers to assist in program work and provide surveillance and reporting of environmental violations to the appropriate agencies. Ms. Guerrero noted a few of MINA's overarching goals including fostering community and science-based programs, expanding education on ecosystem services and the value of those services, and controlling marine debris. Since 2015, MINA's Adopt-a-Bin program has collected more than 28.2 tons of trash and recyclable items. MINA's programs are integral to protecting the lagoon through management of trash and pollution in coastal and inland areas.

Discussions

Gathering local user feedback was a primary focus of the Forum. Much of the two days was devoted to group discussions during which participants were asked to identify issues or problems related to lagoon use and suggest management actions. On Day 1, breakout groups discussed and reported-out on general lagoon uses and management strategies. Meeting organizers then compiled the reported comments into topic areas and suggested management strategies. Comments from the evening session were added to these strategies and reviewed with participants on April 26th. Below is a compilation of the issues and suggestions that were mentioned (in no particular order):

³ To review the User Study and other related reports, visit: <http://horsleywitten.com/SLUMP/reports.html>

Day 1 Topics and Suggested Management Strategies

1. Conflict between motorized marine sports and non-motorized lagoon users was a primary point of discussion. MSOs have recently organized an industry association, represented at the Forum. There were no specific suggestions or calls to lift the moratorium on new MSO permits; however, issues with concessioner on Mañagaha not being able to offer seawalker (for example) because of permit limitations was mentioned as a repercussion. MSO association representatives indicated that clear operational rules and regulations for each MSO type, primarily related to safety procedures, were needed and could be developed with collaboration between MSOs and BECQ/Boating Safety.
 - Develop a formal zoning plan.
 - Use areas currently defined by Marine Protected Area (MPA) boundaries, jetski courses/jetski exclusion zones and swimming zones, and lagoon depth.
 - Consider a “no fly” zone for parasailing in the shipping channel near Managaha. This is problem in low wind conditions, causing potential safety issues for vessels maneuvering in the shipping channel.
 - Part of the northern Lagoon’s jetski exclusion zone could be re-opened to MSOs, especially jetskis.
 - Include moorings and educational signage in zoning plans. Ensure that signage includes images and/or instructions in multiple languages about the zoned uses in each area.
 - Include transit zone between Micro Beach and Managaha.
 - Consider jetski use area designation, restricted automatically in the rest of the lagoon.
 - Can parasailing happen outside of lagoon?
 - Sugar Dock needs repairs. Participants indicated that the dock is unsafe and the current is strong in this location.
 - MSOs should sign a memorandum of understanding (MOU) to utilize BMPs related to uses in the Lagoon, or permits will be revoked.
 - Discuss how to better manage private jetskis, including Best Sunshine jetskis which operate from Best Sunshine yachts.
 - Develop a lagoon use map/brochure showing areas of use, outlining restrictions, etc. that can be widely distributed to the public and visitors/tourists.
 - Develop a certification program for commercial snorkeling tour operators.
2. Protection of habitat and resilient biota
 - There was concern that this equates to the creation of new MPAs, although there are a number of other management mechanisms including educational signage that designates ecological sanctuaries and education and outreach about the importance of certain Lagoon species and habitat to the overall health and sustainability of the Lagoon.
 - Sanctuaries should be delineated so that commercial and recreational users are aware of their locations.

- Identify high priority areas for biota (e.g., *Acropora* thickets, Puerto Rico wetlands, dense *Enhalus* area, northern area of lagoon with strong currents, overlaps with historical or ecologically significant areas and groundings/wrecks).
- Additional monitoring and research in Sugar Dock area.
- Better managing and preserving mangrove habitats as mangroves serve an important ecological role for juvenile fish habitat as well as shoreline protection
- Where are all the sea cucumbers?

3. Safety for all users

- Better manage recreational MSO use outside of the set commercial jetski areas.
- BECQ can collaborate with Boating Safety on an education and outreach component.
 - Education of operators and tour guides
 - Education for tourists/users
 - Fines for harming coral
- Create video for jetski users and other commercial boating users.
- Develop signage about how not to harm the coral.
- Better enforce fines if jetskis go beyond designated areas.
- Develop a program to provide fishermen with identifying equipment such as flags. Cannot see fishermen, as they don't always use proper safety equipment.
- Better understand and communicate the location of unexploded ordinances. During race course setup, an unexploded ordinance was found in the Lagoon.
- Repair outer cove marina - Safety issues with loading/unloading.
- Drug use at the park is an issue.

4. Nonpoint source pollution (NPS) to the lagoon

- Continue upland BMPs.
- Continue stormwater management and improve drainage across the island.
- Participants suggested that if upgrades to wastewater treatment plants are planned, there may be an opportunity to upgrade/improve treatment processes and/or relocate discharged effluent to outside of the Lagoon.
- Look outside of Garapan for stormwater treatment options. Many of the parcels in Garapan that were identified previously for regional stormwater treatment measures have been developed instead – High cost for retrofitting.
- Look for opportunities during redevelopment and capital improvement projects.
- Possibly higher IC restrictions in sensitive areas.
- Research opportunities for public-private partnerships related to water quality improvements.
- Property owners in Garapan could be required to implement rain gardens to mitigate pollution from stormwater runoff.
- Updated stormwater treatment requires enhanced treatment/retrofitting during redevelopment, infill, and road improvements.

5. Beach erosion/loss of beach land and impacts to users

- Study (currently underway) and implement:
 - Living shorelines
 - Hard-engineering/design solutions
 - Example of eroded beach at American Memorial Park
 - Concerns expressed related to Beach Road.
6. Lack of established/consistent moorings
- Add additional moorings.
 - Add buoys, or markings to delineate the jetski exclusion zones; currently no markings exist.
 - Don't use plastic bottles – establish a common mooring that all MSOs must use.
7. Trash management
- For tourists: Educational video could be shown on airplanes or at the airport in multiple languages.
 - For locals: Educational video could illustrate why proper trash disposal is important to community resources.
 - Trash needs to be picked up. Trash receptacles are not enough.
 - Laly 4, Pau Pau, Sugar Dock, Tanapag are dealing with the most trash issues.
 - Beach users could be required to pay a fee for using popular beaches such as Pau Pau, and the funds from the fees could be used to better manage trash.
8. The need for a dedicated funding source to protect the lagoon
- Collect fee for Best Sunshine Fleet docking/parking.
 - Create “green fee”/departure tax based on Palau example. When visitors leave island via the airport, they are charged a \$50 fee to fund conservation and restoration projects.
 - Consider alternatives for existing or formerly proposed mechanism (e.g. Marine Resource Investment Act, MPA user fee, permit funds, endowment) with board to allocate funds for lagoon implementation projects; agency and non-agency board members.
9. Visitor experience
- Improve concession management, off beach and into hotels.
 - Add bathrooms at the marina.
 - Some beach barbeque areas are reportedly in disrepair. Participants indicated that these areas are also unsafe and reported that illegal drug activity has become a problem. Some suggested increase police presence/law enforcement in these areas in addition to improvement of the facilities.
10. Land protection along the northern shoreline to reduce watershed pollution and protect Pau Pau and Wing beach area habitats, which are some of the healthiest in the Lagoon. The Department of Public Lands will be updating the agency's Strategic Plan for Public Lands on Saipan. It would be good to connect parts of that Strategic Plan with goals from the SLUMP.

11. DLNR is looking for input on the Mañagaha concessioner permit, which is up for renewal.

12. MVA is conducting agency meetings to discuss site specific user fees. They mentioned restricting the number of daily visitors to Mañagaha by increasing the fee.



On Day 2, meeting participants reviewed the top eight lagoon use topics that arose from group discussions on the previous day. Participants broke into small groups to further discuss five topics and present recommendations to the larger group. The five topics were:

1. Shoreline Erosion
2. Funding
3. Water quality issues related to wastewater discharges
4. MSOs, User Conflicts, Zoning, Education, and Safety
5. Habitat protection

Trash management and nonpoint source pollution were not discussed in more detail⁴ at this time, although they are important to include in the SLUMP update. Safety and motorized sports user conflicts were combined. Listed in the table below are implementation recommendations as reported out by the five groups. Implementation challenges and potential partner agencies are also highlighted.

⁴ Trash management and nonpoint source pollution discussions were “tabled.” Meeting participants indicated that other agencies and organizations are involved in stormwater management improvements to protect the lagoon, as well as trash and recycling management on Saipan.

Forum Participant Recommendations

Topic	Recommendation Statement	Implementation Challenge(s)	Potential Partners	Mechanism for implementation	Implementation Justification
Shoreline Erosion	Implement shoreline enhancement and stabilization recommendations from the current shoreline studies including, U.S. Army Corps (2017) report and Access and Shoreline Enhancement Assessment (SASEA).	<p>Identifications of funds.</p> <p>Need legislative and Department of Public Lands (DPL) collaboration.</p> <p>Difficult to identify the main agency in charge.</p> <p>Capital improvement projects are required to integrate shoreline erosion projects.</p>	CIP, legislature, DPW, BECQ	<ol style="list-style-type: none"> 1. Require CIP (and possibly private development/re-development projects) within a certain distance to shoreline to implement pre-designed shoreline stabilization projects 2. Research and prioritize grant funding for projects not covered by capital improvement planning funds. 	We have expended significant funds studying shoreline erosion and developing stabilization plans for priority areas. To maximize our return on investment in the coastal area, we need to implement the priority projects, particularly as we expend other funds on infrastructure improvement adjacent to the shoreline (e.g., Beach Rd.)
Habitat Protection	<p>Establish a regulation which requires educational certification of MSOs - snorkeling and diving tours specifically.</p> <p>Expand DCRM enforcement capacity.</p>	Long term funding.	MVA (current program), DCRM, DFW, MSOs	DCRM can establish a regulation and collaborate with the MVA current program related to education of snorkel tour operators.	To ensure continued sustainable use of the Lagoon and ecosystem services.

Topic	Recommendation Statement	Implementation Challenge(s)	Potential Partners	Mechanism for implementation	Implementation Justification
Funding	Appeal to legislature to establish a special funding source for Lagoon Protection.	Airport departure fee will not work. There may be resistance to new fees.	DFW, DCRM, MVA, DPL, DPS, DCNR Saipan Fishermen Association and NMDOA (diving association) Congressional Representatives (Sablan and Blanco) – House Natural Resources Committee.	Create Lagoon Task Force to manage the funds. User fee – either site specific or blanket fee. MVA – is currently calling all agencies to talk about site specific user fees. Leverage Micronesia Challenge funding.	To implement management strategies and recognize the essential value of the Lagoon.
Water quality issues related to wastewater discharges	1. Research the potential relocation of the Sadog Tasi wastewater treatment plant outfall diffuser to outside of the lagoon. 2. To improve water quality, use long term DEQ water quality monitoring data to assess and target certain sites that experience chronic water quality problems.	Cost is high. Cost is high. Difficult to designate responsible parties.	CUC, BECQ, DPW CUC, BECQ, DPW	Monitor existing outfall plume and use data to determine the need for the outfall relocation.	Discharge degrades lagoon waters. To encourage interagency cooperation and responsibility. The data is available and warrants further research.

Topic	Recommendation Statement	Implementation Challenge(s)	Potential Partners	Mechanism for implementation	Implementation Justification
<p><i>MSOs, User Conflicts, Zoning, Education, and Safety</i></p>	<p>Alleviate user conflicts through regulatory actions and educational methods.</p>	<p>Needed funding for safety equipment to help fishermen who cannot afford all necessary equipment. Suggestion: Equipment loan system.</p> <p>The Fishermen’s Association may be able to operate an equipment loan system – but who will fund it?</p> <p>Users must be more aware and demonstrate common courtesy.</p>	<p>DCRM, Boating Safety, DFW, Coast Guard</p> <p>DFW could be responsible for:</p> <ul style="list-style-type: none"> - Enforcement of zones and required equipment <p>Boating Safety could be responsible for:</p> <ul style="list-style-type: none"> - Enforcement of zones and proper equipment - No wake zones in areas with conflicting uses. - Enforcement of rules of right of way <p>DCRM could be responsible for:</p> <ul style="list-style-type: none"> - Enforcement of zones - Collaboration between agencies related to zoning maps 	<p>Zoning of uses is needed. Specific recommendations for zoning include:</p> <ul style="list-style-type: none"> - “No fly” zones for parasailing in the Managaha Channel. - Establishment of no wake zones. - Establishment of loading and unloading zones for vessels. <p>Implementation of Best Practices:</p> <ul style="list-style-type: none"> - Proper equipment - Common courtesy/pecking order - Vigilance/awareness among users - Safety classes for personal craft operators - Education of users to recognize zones/markings and ecological features 	<p>To ensure safety for all users.</p>

Attachment A – Scanned Sign-In Sheets

Day 1 Night



SIGN-IN
 Saipan Lagoon Use Management Plan - Public Forum
 Tuesday, April 25, 2017
 Fiesta Hotel



First Name	Last Name	Organization/Agency	Signature
Paula	Derrington	NMC	Paula Derrington
ARMY	MR / ARMS	Amigo Aquatic sports	[Signature]
Josie	Pinade	Xtreme Marine Sports	[Signature]
Waka hanyi	Waka hanyi Yuku	NCS	[Signature]
DARIAN	Salas	Mount Carmel School	[Signature]
KEITH MERTZ	MURDOCK	SEAWAASE	[Signature]
Skaolu'i	Che	Tao Tao Manjamas	[Signature]
Jeffrey	Burft	Xtreme Marine Sports	[Signature]
Joagwin	Saldan	Community	[Signature]
Ann	ASTUD	Sells	[Signature]
Theresa Stacy	Zheng	NCS	[Signature]
Miki	Takayama	NCS	[Signature]
Michelle	Palacios	NCS	[Signature]
Aida	Li	NCS	[Signature]
Judy	Stacy	NCS	[Signature]

Dr. Yi Nignt



SIGN-IN
Saipan Lagoon Use Management Plan - Public Forum
Tuesday, April 25, 2017
Fiesta Hotel



First Name	Last Name	Organization/Agency	Signature
Joseph Kyle	Jayng	MCS	[Signature]
Frank	MM,2	n/a	[Signature]
Xinmai + Roberts	Tang Guerrero	Ocean + MINA	[Signature]
gerald	lee	MCS	[Signature]
Yui	Furukashi	MCS	[Signature]
Sonore	TSUKA	MCS	[Signature]
Henry	Yu	MCS	[Signature]
Neil	deLeon	Ocean +	[Signature]
ADONIS	SANTOS	AUTO MAR/MCS	[Signature]
SUNIL	MOLLERICK	BIG DOGS/TECHIBAN	[Signature]
Eun Yong	Song	MCS	[Signature]
Da Young	Han	MCS	[Signature]
Yuta	lee	MCS	[Signature]
ERIC	lee	MCS	[Signature]
ISAAC	Song	MCS	[Signature]

Leadership Lunch



SIGN-IN
 Saipan Lagoon Use Management Plan
 Tuesday, April 25, 2017
 Fiesta Hotel



First Name	Last Name	Organization/Agency	Signature
Vinnie Sobon		CNMT Legislature	
Mariona Fe	Tereyes	ORL	
Sophia Fran	MOR	PLI	
Ray Messyn	Castro	BICE	
Turn Blanco	Messyn	BICE	
Kevin Alden	Alden	House	
David Resendiz		DPS	
TATIANA	BABAUTTA	DPS Banking	
Michael	TERRORS	MVA	
		DFW	



SIGN IN
Saipan Lagoon Use Management Plan Forum
April 25-26, 2017
Fiesta Hotel



First Name	Last Name	Organization/Agency	25-Apr	26-Apr	Signature
MARUKH	PELLICARE	Heard of Gold Divers	X	X	
KAREN	SAMIRANO	BECC	X		Karen Samirano
EMILY	NUTHROP	BECC	X	X	Emily Nuthrop
JOEL	KARPAT	BECC-SDWP	X	X	Joel Karp
FIN DENSK		BECC-DERM	X	X	Fin Denski
JAMES	BENVENUE	" " "	X		James Benvenue
JONATHAN	BERNARD	BECC DER	X		Jonathan Bernard
JANICE	COSTO	BECC-DERM	X		Janice Costo
ADONIS	SANTOS	AUTO MARKING INC	X		Adonis Santos
VLASSIS	ONIRANO	Amigo Agate Spn P	X	X	Vlassis Onirano
XINGLING	LI	Ocean Trust Dive in Saipan	X		Xingling Li
XUE	LI	" " "	X		Xue Li
IAN	TRIARTE	BECC-DERM	X		Ian Triarte
Sohy Saveloy		MERO ENVIROS SERVICES	X	X	Sohy Saveloy
Reina	Camacho	BECC		X	Reina Camacho



SIGN IN
Saipan Lagoon Use Management Plan Forum
April 25-26, 2017
Fiesta Hotel



First Name	Last Name	Organization/Agency	25-Apr	26-Apr	Signature
Rush	Sales	BECA	✓	✓	[Signature]
Clarice	Canarajo	BECA	✓		[Signature]
M D - SAEVA	"	1. M. S			[Signature]
Mick	Murray	MWU		✓	[Signature]
JT	Kintol	MWU			[Signature]
Dei No	Paintalibay	MWU	✓		[Signature]
Antelgyn M. Reyes	Reyes	BECA	✓		[Signature]
Ron	Smith	Saipan Chamber of Commerce	✓		[Signature]
Pat	Mecham	SSCI	✓		[Signature]
Jos	Sanchez	BSEA		✓	[Signature]
Dea	Witt	SA		✓	
Yanney	Yukunomobe	Sponex Inc		✓	[Signature]
Kay	Babauta	PIC Saipan			
Robbie	Stevens	BECA	✓	✓	[Signature]



SIGN IN
Saipan Lagoon Use Management Plan Forum
April 25-26, 2017
Piasta Hotel



First Name	Last Name	Organization/Agency	25-Apr	26-Apr	Signature
James	Fleming	Dept of Public Land	✓	✓	<i>[Signature]</i>
David	Rosario	Hofschneider Eng. Corp	✓	✓	<i>[Signature]</i>
Betty H	Johnson	HEC	✓	✓	<i>[Signature]</i>
Jim	Pratt	CRMA			<i>[Signature]</i>
Robert	Buerrero	MIRA	✗	✗	<i>[Signature]</i>
Ray	Babauta	PIC Saipan	✗	✗	<i>[Signature]</i>
Debris	Thompson	PIC Saipan			<i>[Signature]</i>
Steve	McKean	HCAA	✓		<i>[Signature]</i>
Fran	Castro	BECA	✓		<i>[Signature]</i>
Shaeli	Chae	Tao Tao Maximinas	✓	✓	<i>[Signature]</i>
Dorena	Castro	DCRM	✓		<i>[Signature]</i>
JESLYN		SAKURA			<i>[Signature]</i>
Richard	Brecks	BECA	✓		<i>[Signature]</i>
Julius	REYES	BECA	✓		<i>[Signature]</i>
Attila	Rosario	BECA	✓		<i>[Signature]</i>
Malcolm	Sohnson	BECA	✓		<i>[Signature]</i>



SIGN IN
Saipan Lagoon Use Management Plan Forum
April 25-26, 2017
Fiesta Hotel



First Name	Last Name	Organization/Agency	25-Apr	26-Apr	Signature
Mallory	Maria	BECA - OCEAN	X		Ilene
TRMAS	CAMPARE	" - "	X		Barbara
Dana	Okeano	NOAA	X		Dan De
Kathe	Graciano	BECA	X		Kathy S.
Chris	W. (ST)	BECA / NMC	X		Chris
Rodney	Comacho	BECA	X		RE
David	Bonavent	Bebo	X		David
Mike	Truini	NMFS PISC	X	X	Mike
Lyza	Johnston	BECA	X		Lyza
Bellroy	Carmally	B-SIA	X	X	Bellroy
Yago	Verita	AQUA CONNECTORS	X		Yago
TERANI	KIRBY	BECA	X		TERANI
SIHAN	BINHIE	BECA	X		SIHAN
Minswell	Doronio	BECA Intern / NMC	X		Minswell

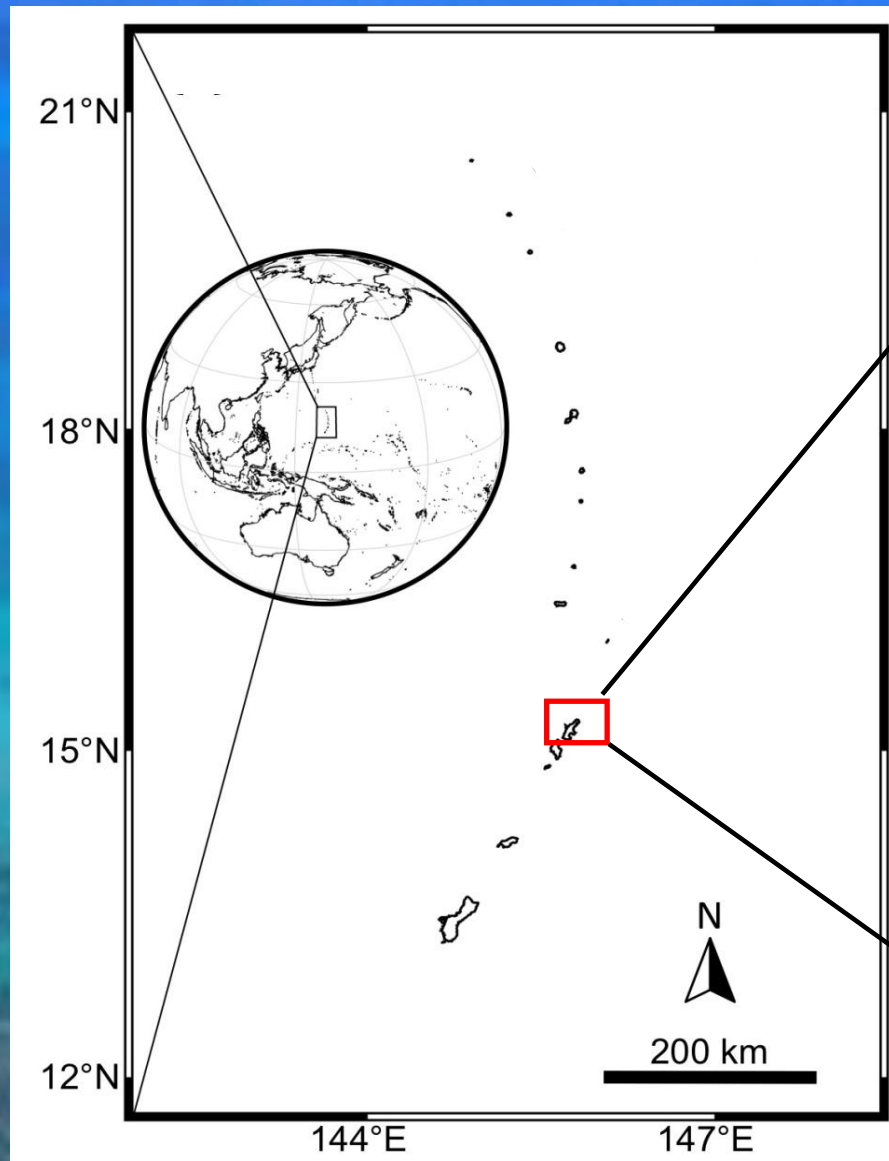
Status of the Marine Habitats in the Saipan Lagoon

Lyza Johnston, David Benavente, Rodney Camacho, John Iguel

CNMI Bureau of Environmental and Coastal Quality

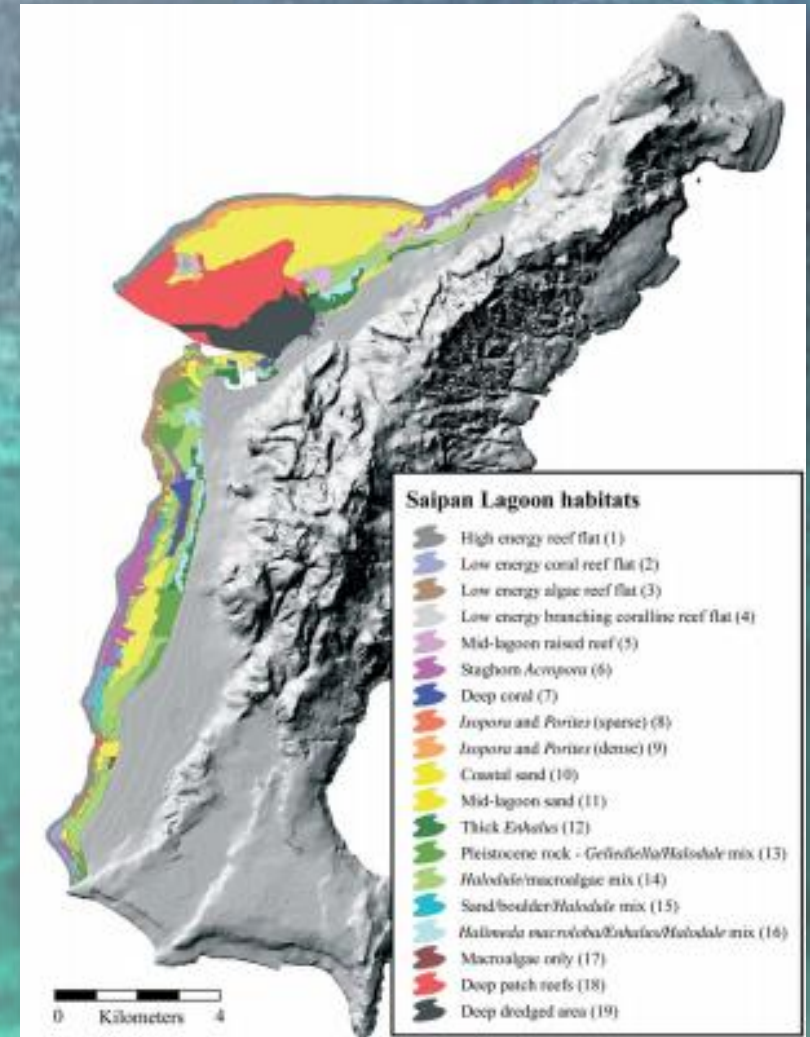


Where is the Saipan Lagoon?



Why do we care about it?

- The Saipan Lagoon is incredibly diverse; Houk and van Woesik (2008) identified 19 distinct habitat types.
- Provides a home/nursery/feeding grounds to many ecologically, economically, and culturally important fishes, invertebrates, and other organisms including ESA listed threatened corals and sea turtles
- Corals and seagrasses buffer wave energy during storm events and stabilize sediments, reducing coastal erosion and flooding
- Heavily used by the tourism industry
- Heavily used by residents for recreation, sustenance, income, and cultural practices



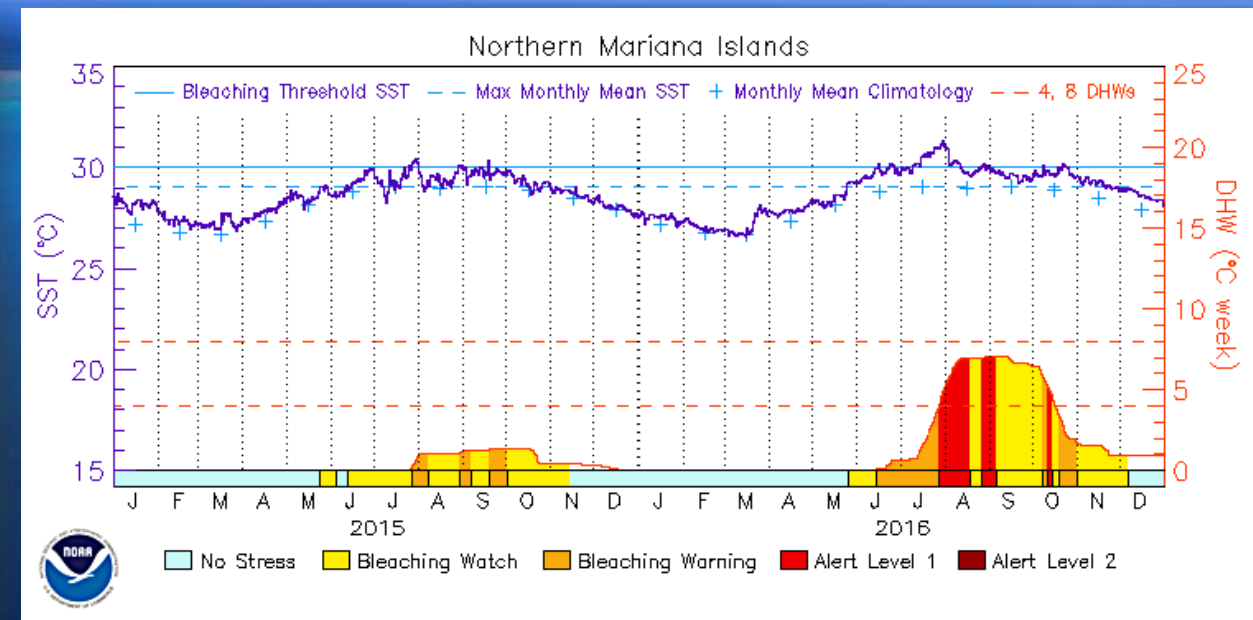
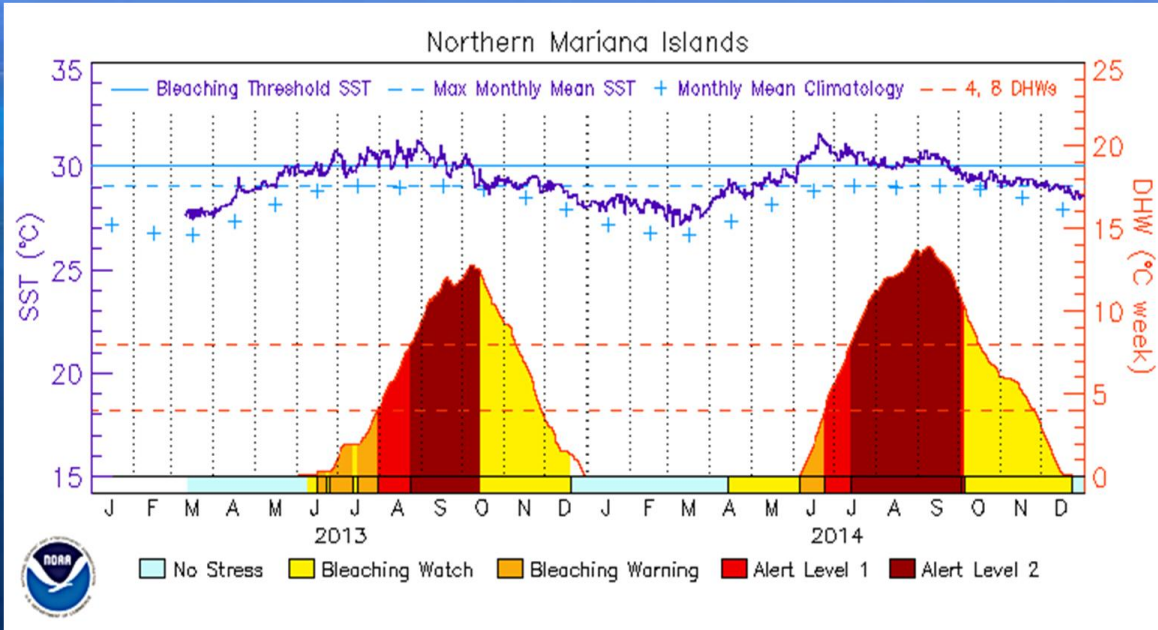
Houk, P., & van Woesik, R. (2008). Dynamics of shallow-water assemblages in the Saipan Lagoon. *Marine Ecology Progress Series*, 356, 39-50.

What are the stressors?



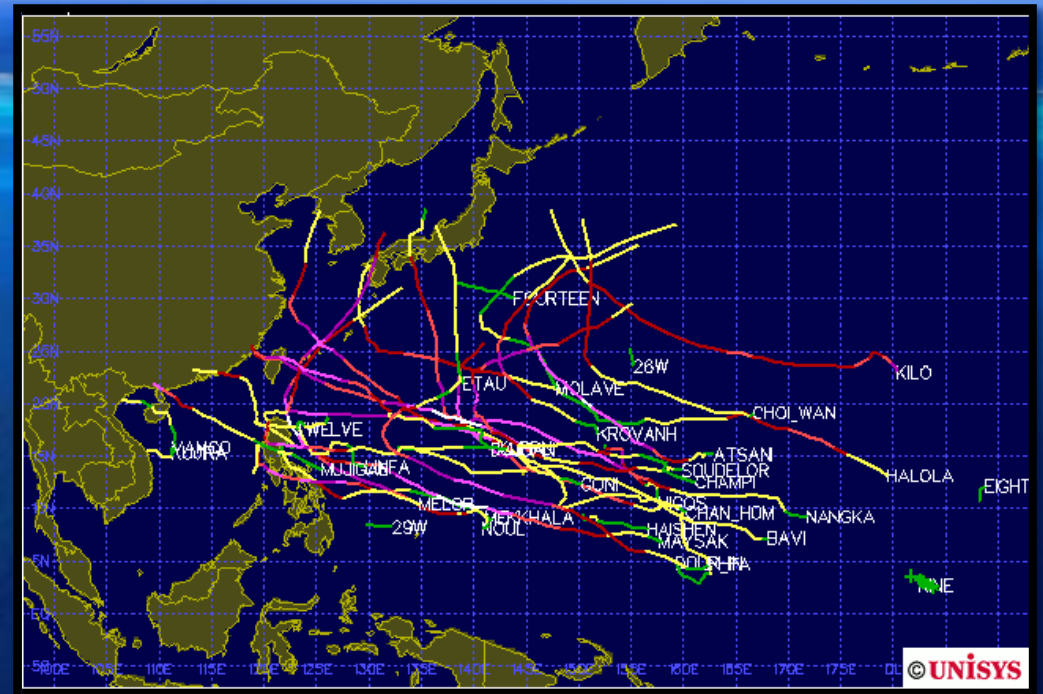
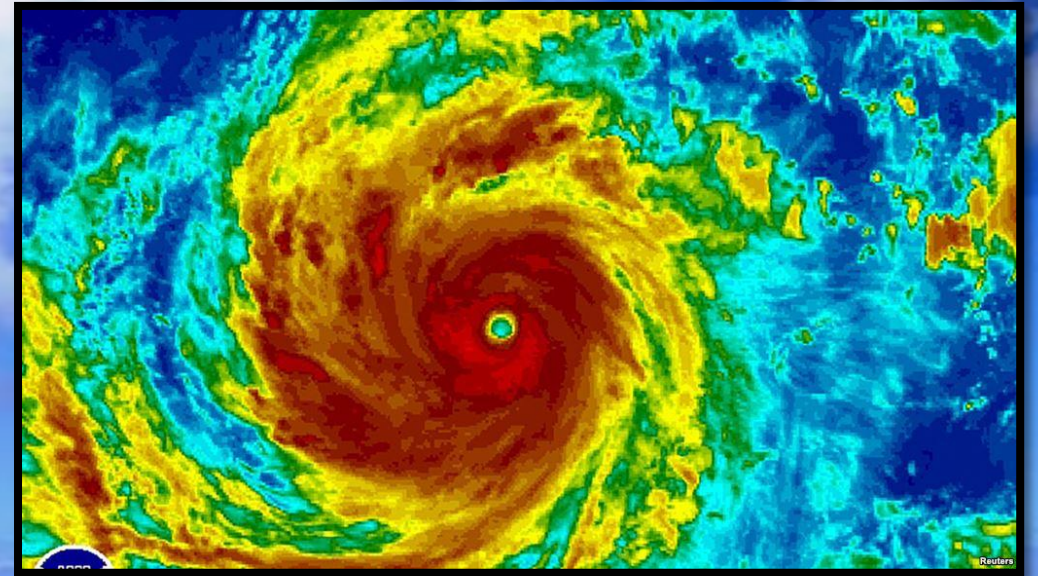
Acute Disturbances

- Thermal stress and bleaching
 - 2013, 2014, 2016



Acute Disturbances

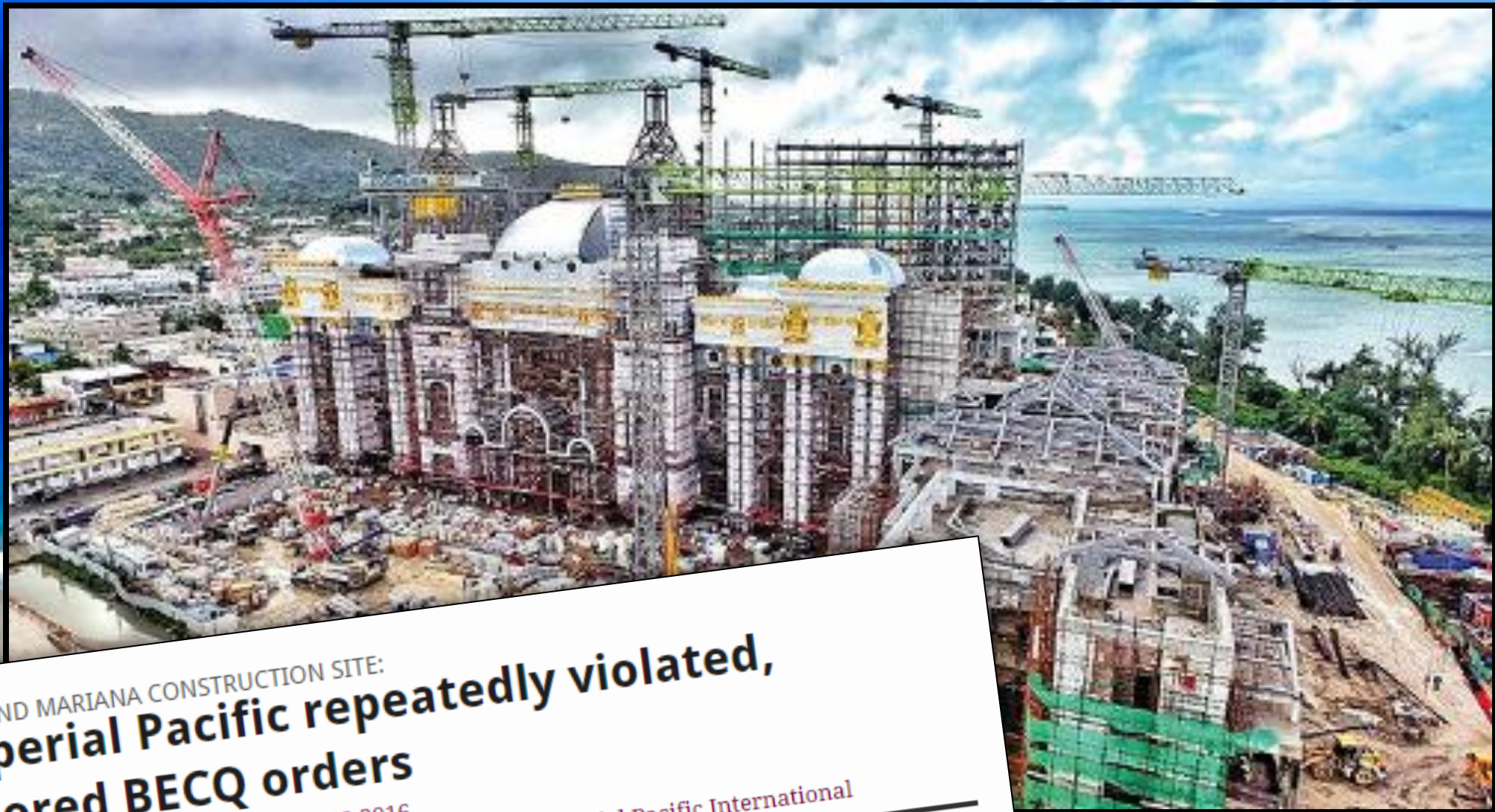
- Typhoons (2015)



Acute Disturbances

- Ship groundings





AT GRAND MARIANA CONSTRUCTION SITE:

Imperial Pacific repeatedly violated, ignored BECQ orders

By Dennis B. Chan

| Posted on Apr 29 2016

Tag: BECQ, Commonwealth Casino Commission, DCRM, Imperial Pacific International

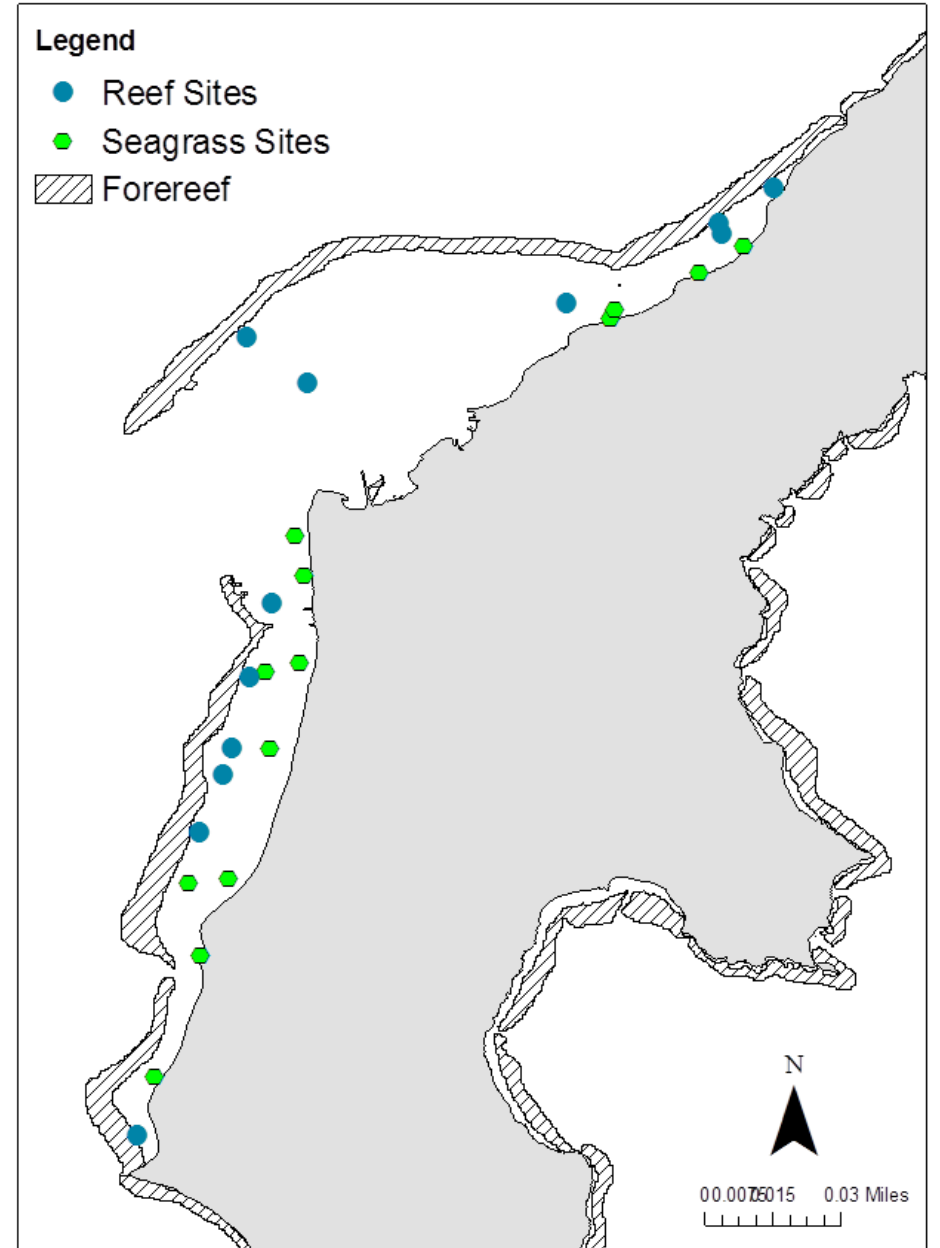
Saipan Tribune

Monitoring Methods

- Long-term monitoring sites
 - Seagrass (n=13)

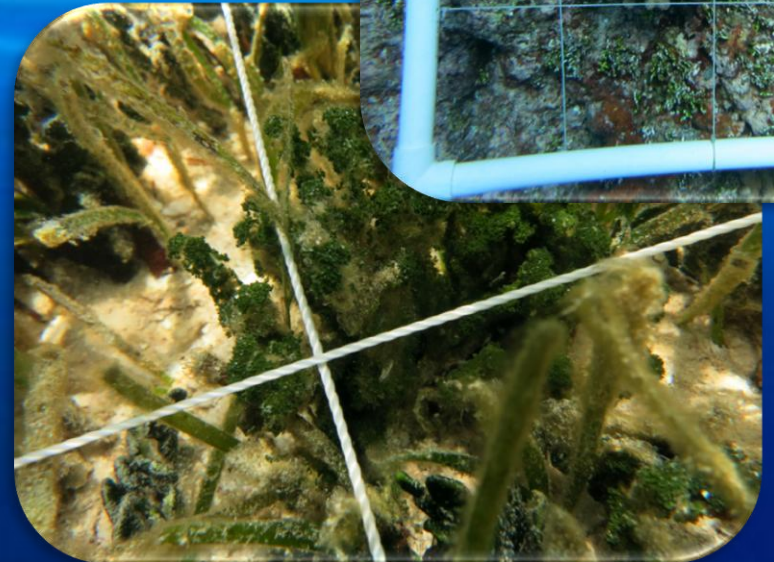
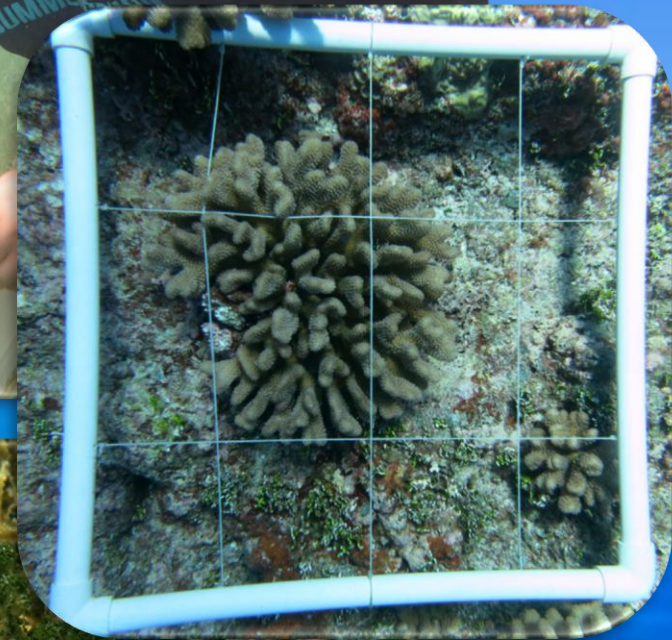


- Coral reef (n=12)



Monitoring Methods

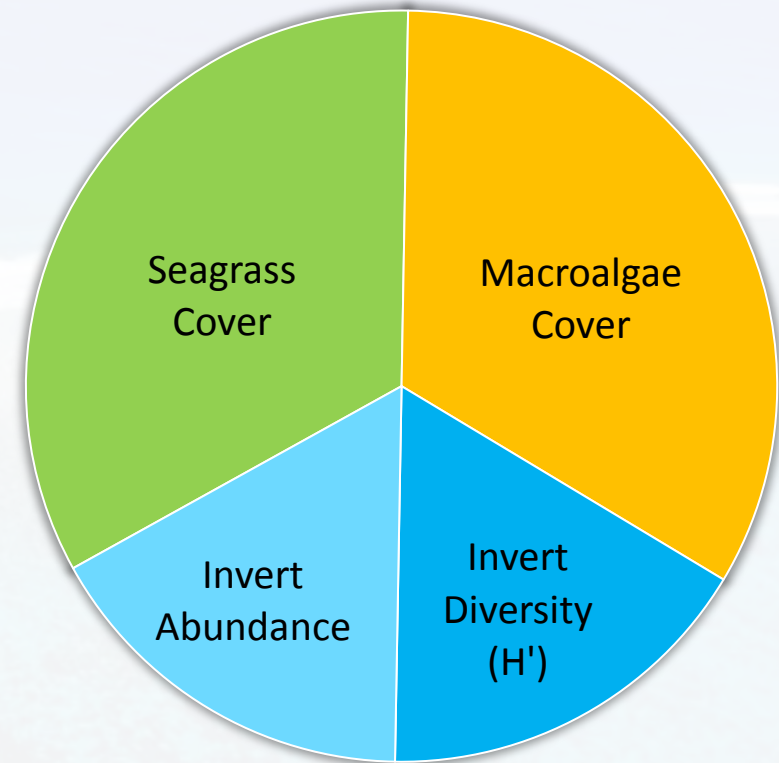
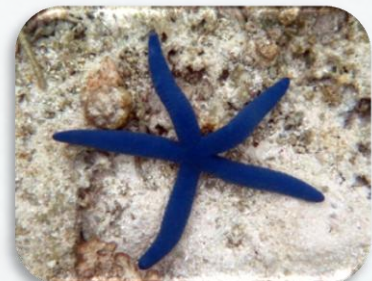
- 5, 50m transect lines
- Benthic cover
 - 0.25m² string quadrat placed every meter (N=250/site)
 - Six intersections per quad recorded *in situ*
- Invertebrate assemblage
 - 2 m x 50 m belt transects; inverts identified and counted
- Overall diversity
 - 10, 1m² quadrats, everything identified to lowest taxonomic level possible



Scoring Process: Seagrass

- Parameters

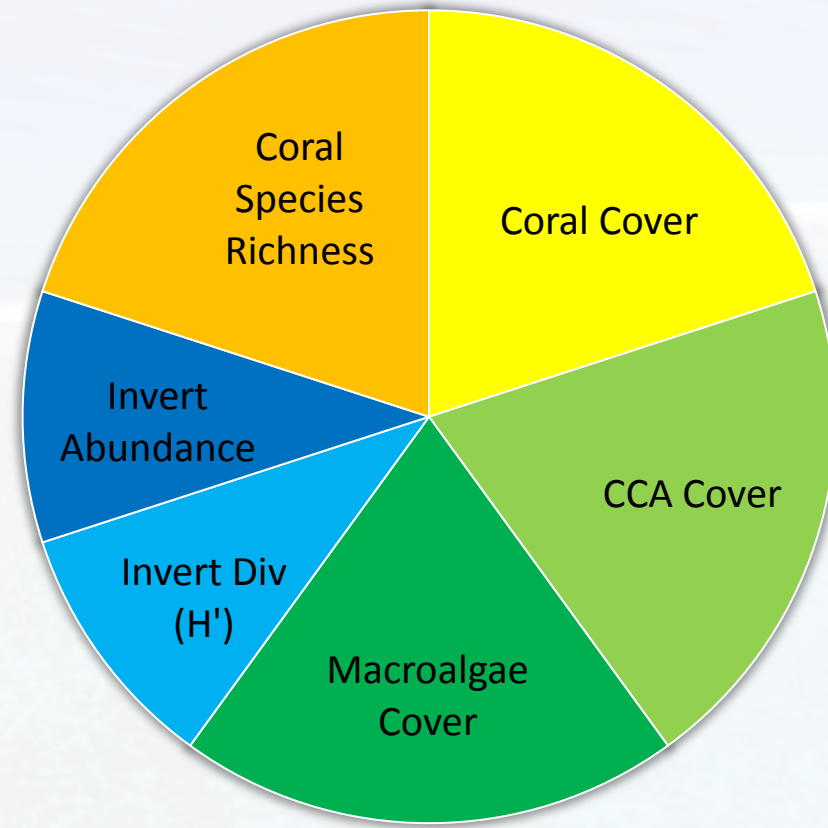
- Seagrass Cover (%)
- Macroalgae Cover (%)
- Invertebrates
 - Diversity (Shannon index, H')
 - Overall abundance ($\#/100\text{m}^2$)



Scoring Process: Reef

- Parameters

- Coral species richness (#/site)
- Coral cover (%)
- CCA cover (%)
- Macroalgae cover (%)
- Invertebrates
 - Diversity (Shannon index, H')
 - Overall abundance (#/100m²)

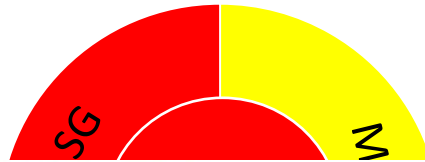


Scoring Process

- Status scores are based on data collected from 2015-2016
- Values for each parameter were normalized by dividing by the maximum value at that site across time ([site score](#)) and the maximum value across all sites in the same habitat measured during the current survey period ([habitat score](#)).
- Scores are on a unidirectional scale from 0-100
 - Macroalgae values were subtracted from 100 prior to normalization
 - All normalized values were then multiplied by 100
- Sites score and habitat score were then averaged to obtain the overall score



Fiesta (FIHA)



b) 2004 IKONOS



c) 2016 WorldView II

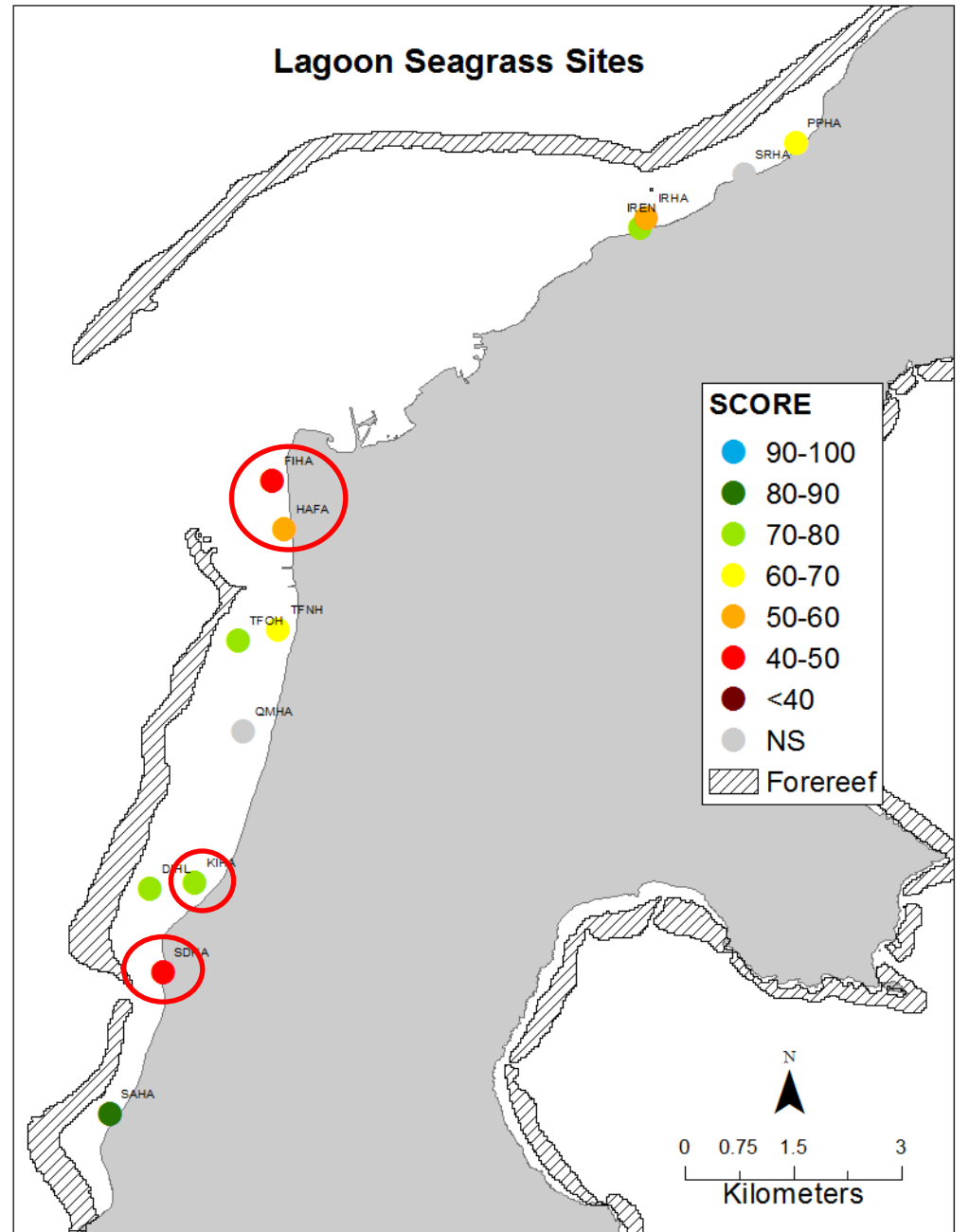


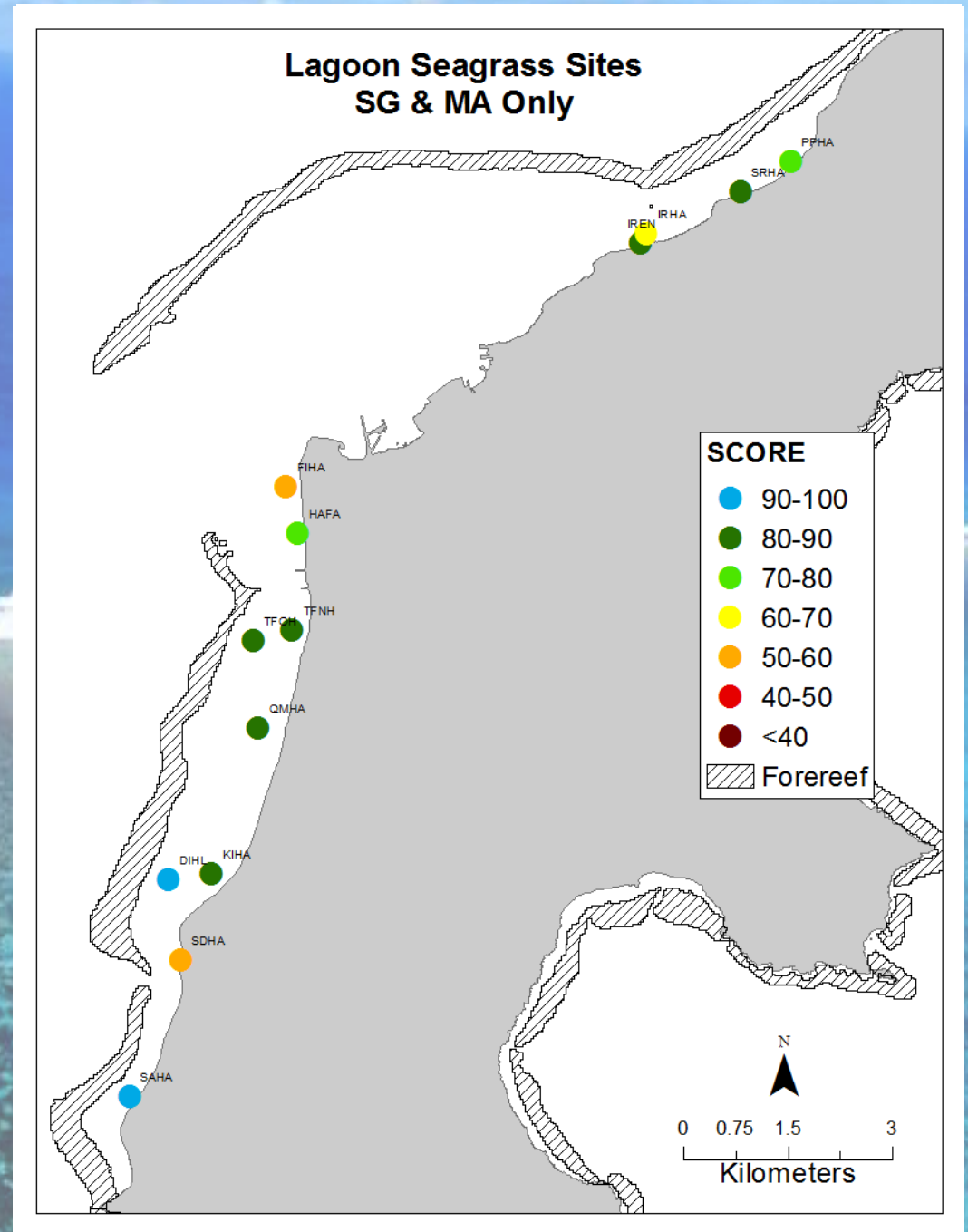
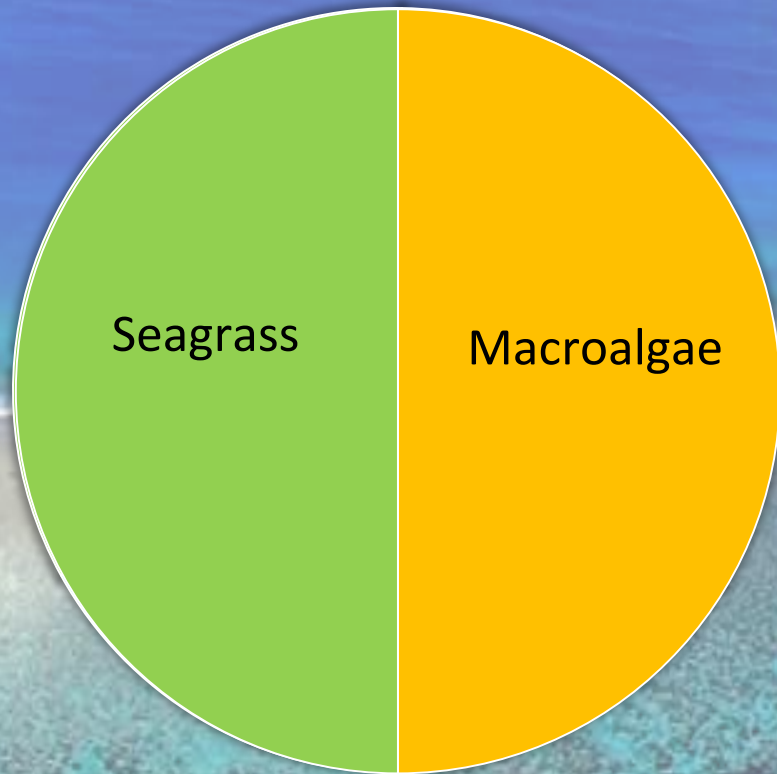
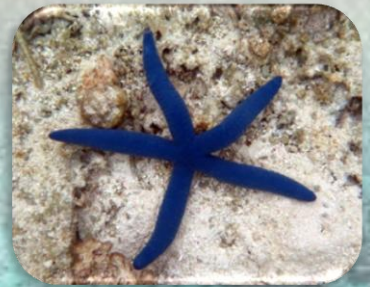
Kendall et al (2017), Benthic habitats of Saipan Lagoon 2001 - 2016. NOAA Technical Memorandum NOS NCCOS 229. Silver Spring, MD. xxxx pp

INVERTS

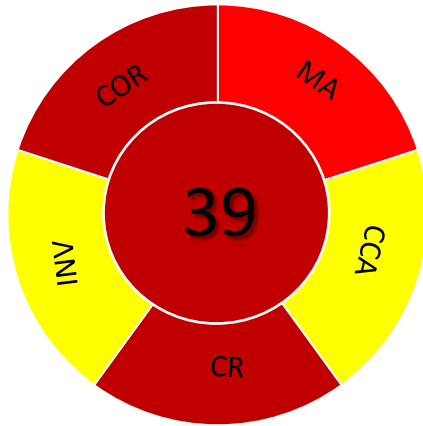
MA_COVER

Lagoon Seagrass Sites

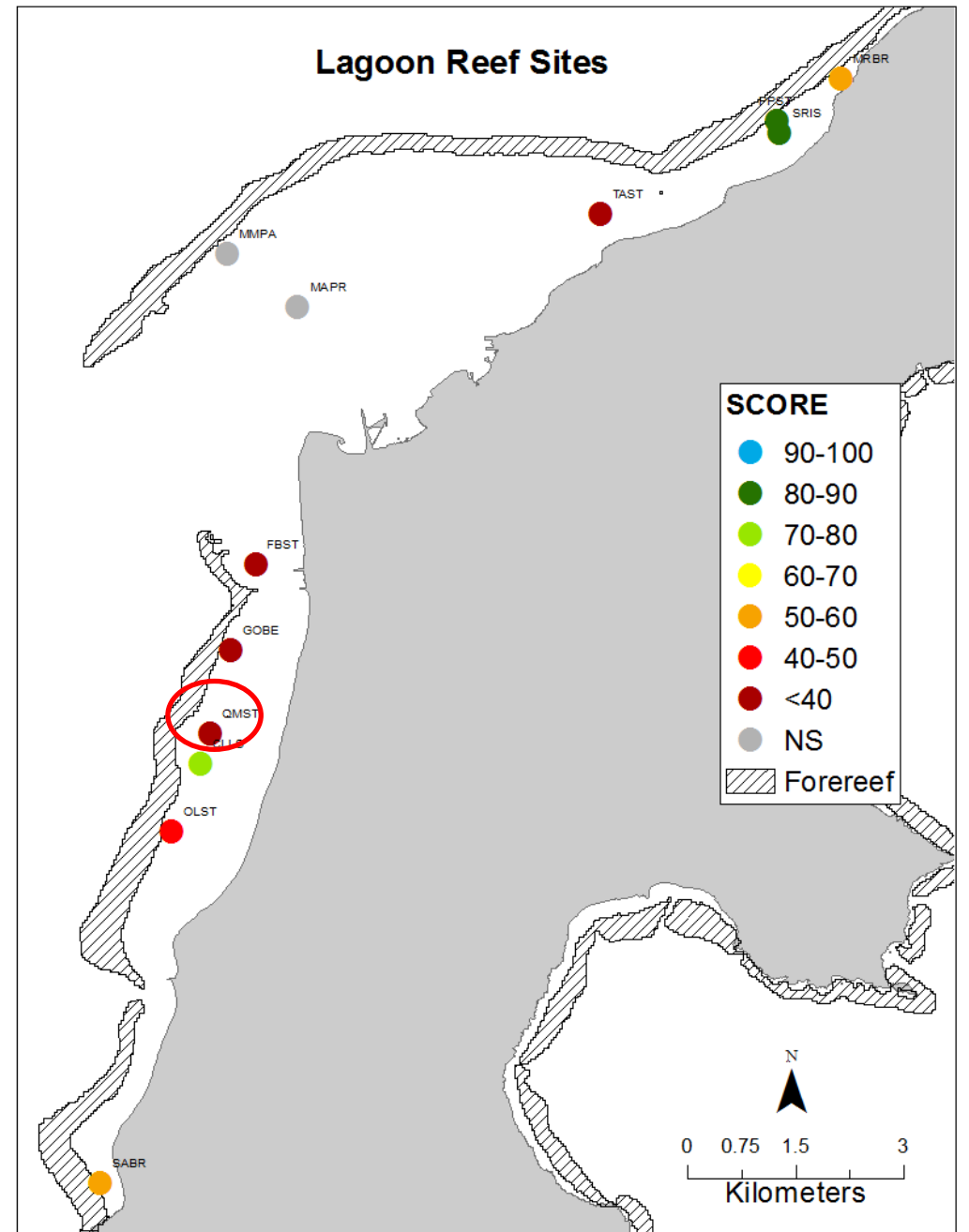
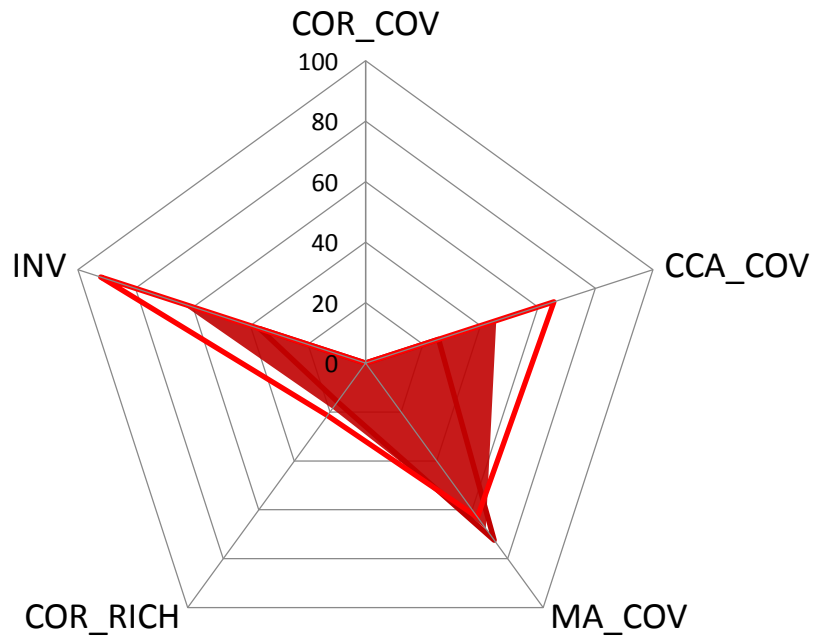




Quartermaster Stag (QMST)



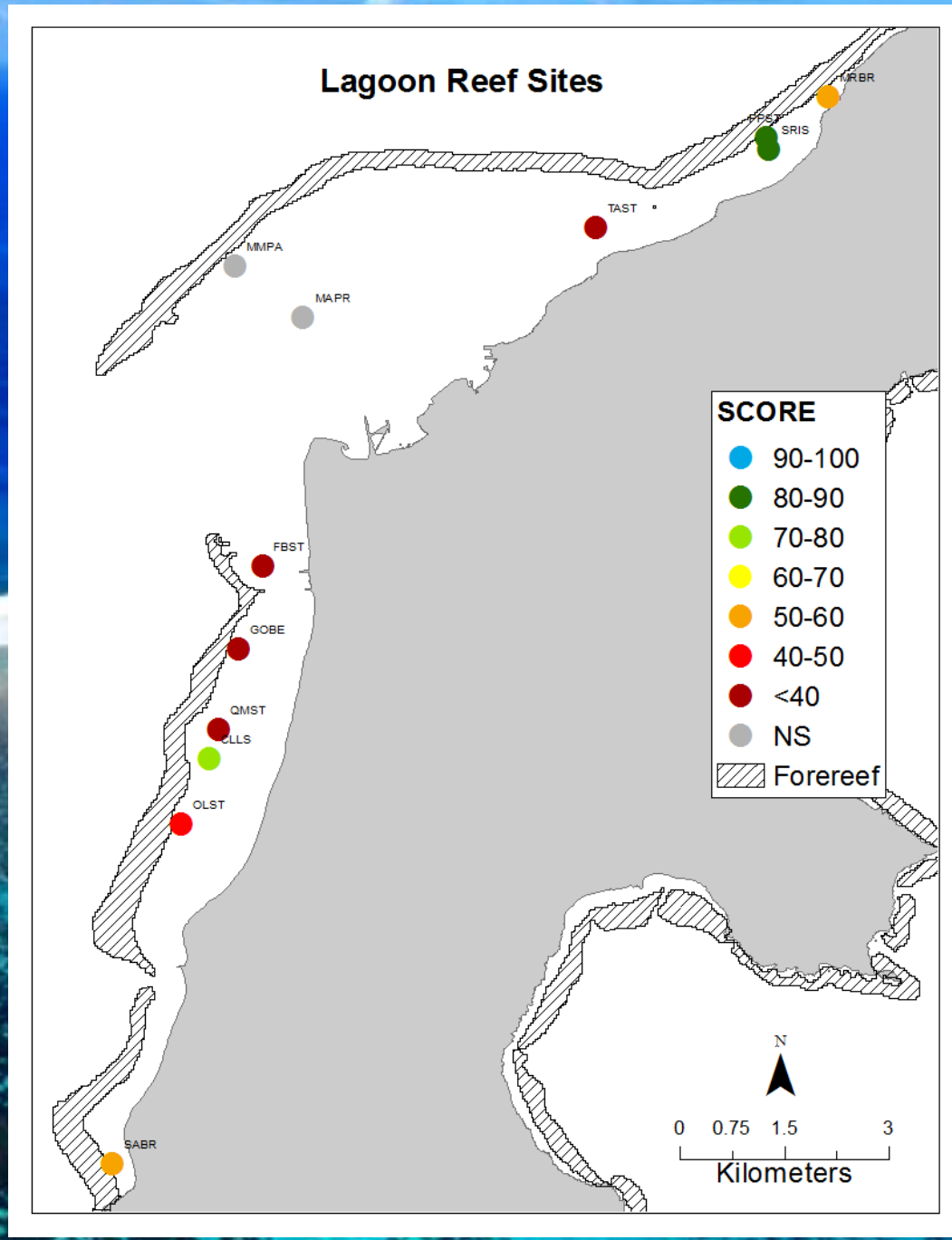
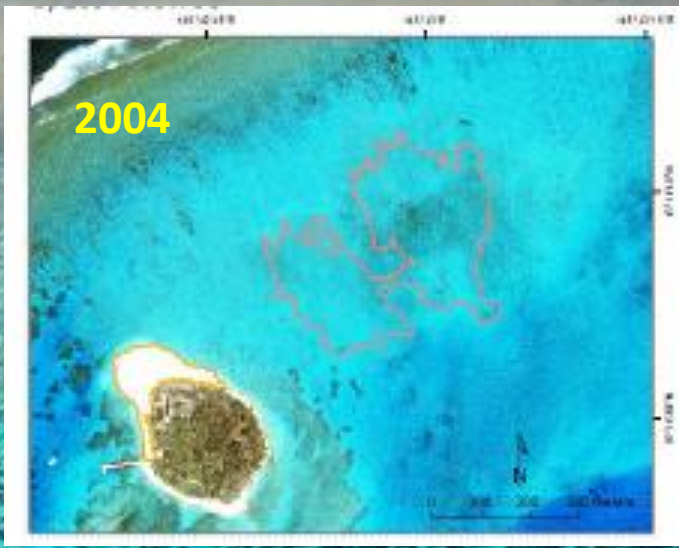
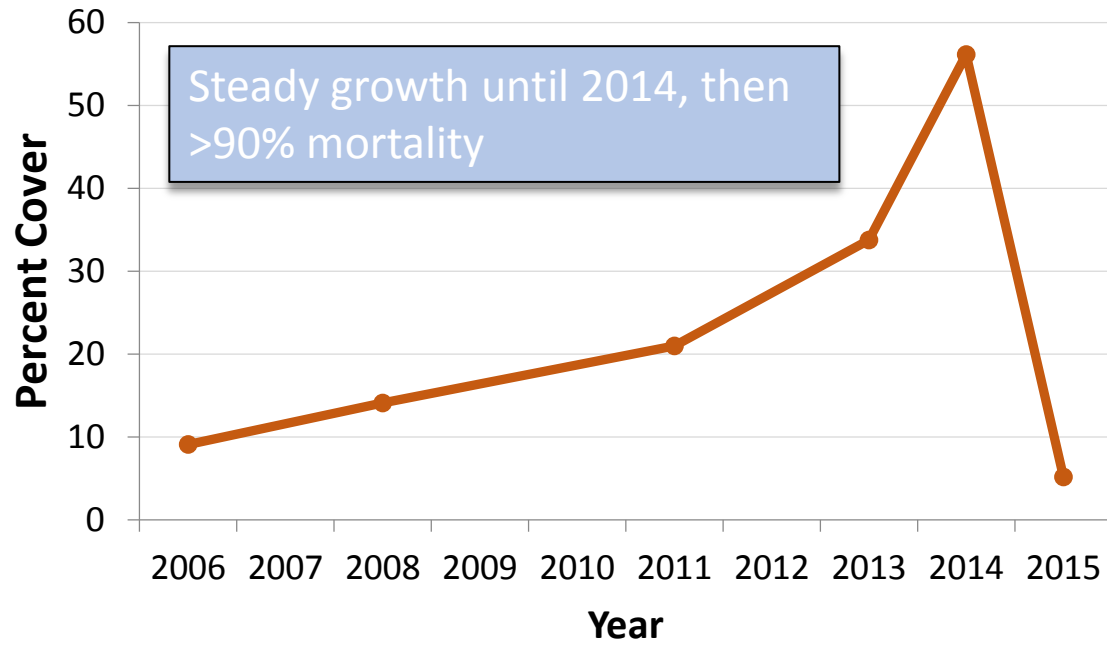
■ Overall score
 Habitat (spatial)
 Site (temporal)



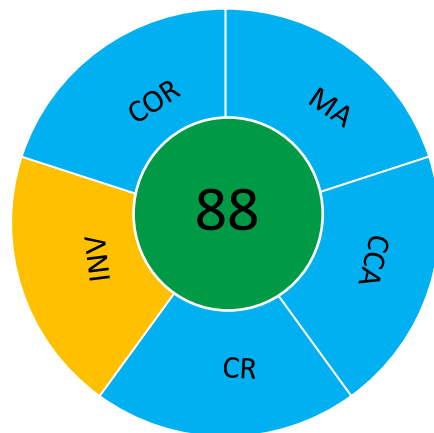
Staghorn Mortality



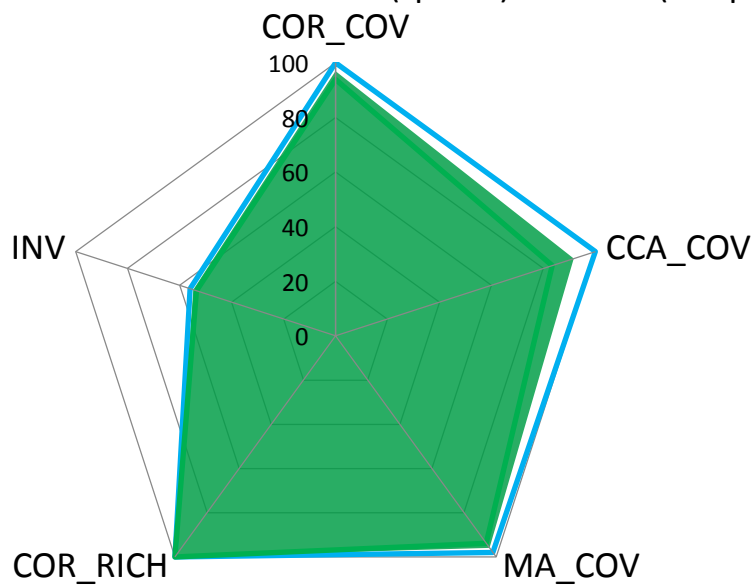
Staghorn Coral Cover



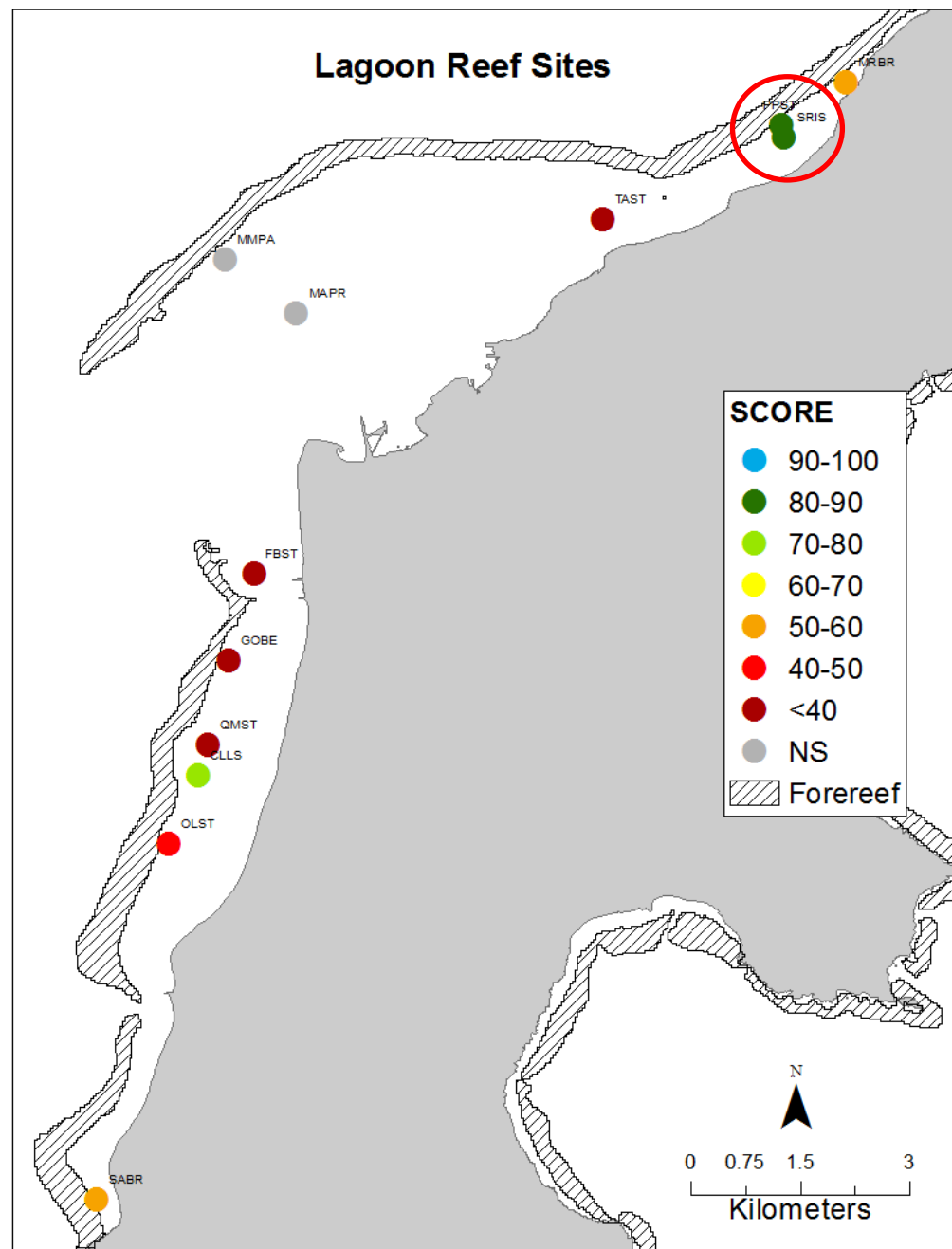
Pau Pau Stag (PPST)



■ Overall score
 ■ Habitat (spatial)
 ■ Site (temporal)



Lagoon Reef Sites



Management Implications

- Monitoring has identified areas of particular concern (some unexpected) and areas of resilience; info which can be used to develop appropriate management strategies.
 - Protection via regulations (northern lagoon)
 - Prioritization of water quality improvement projects (Garapan)
 - Additional monitoring & research (Sugar Dock)
 - Improvement/implementation of BMPs
 - Active restoration
 - Planning (SLUMP)
- Informs the development of management targets used to measure the effectiveness of management actions.
- Provides a mechanism to communicate status of marine resources to stakeholders and funders.

Other Recent and Ongoing Projects

- Updated lagoon habitat map: NOAA Biogeography Branch
 - <https://maps.coastalscience.noaa.gov/biomapper/biomapper.html?id=saipan>
 - Kendall, M., B. Costa, S. McKagan, L. Johnston, and D. Okano. 2017. Benthic habitats of Saipan Lagoon 2001 - 2016. NOAA Technical Memorandum NOS NCCOS 229. Silver Spring, MD. xxxx pp
- Primary productivity and calcification
 - D. I. Perez, S. R. Phinn, C. M. Roelfsema, E. Shaw, L. Johnston, and J. Iguel (Submitted) Primary production and calcification rates of coral reef and seagrass habitats.
- Drivers of macroalgae dynamics in the Saipan Lagoon
 - Rodney Camacho; see his talk!
- Seagrass resilience assessment
 - Johnston et al.; BECQ; ongoing
- Update of Saipan Lagoon Use Management Plan
 - BECQ, Horsley Witten; ongoing
- User impacts in Managaha Conservation Area
 - David Benavente et al.; BECQ & DFW; ongoing



Thank You! Questions?



Saipan Lagoon Use Management Plan Forum



April 24-25, 2017
Fiesta Hotel



www.horsleywitten.com/SLUMP

Summary from Day 1

Dot Voting

- Both forum and public meeting:
 - non-motorized and beach use
 - Commercial snorkeling, jetskis
- Parasailing in forum meeting **red**, public meeting **blue**
- Fishing in forum meeting **blue**, public meeting **red**



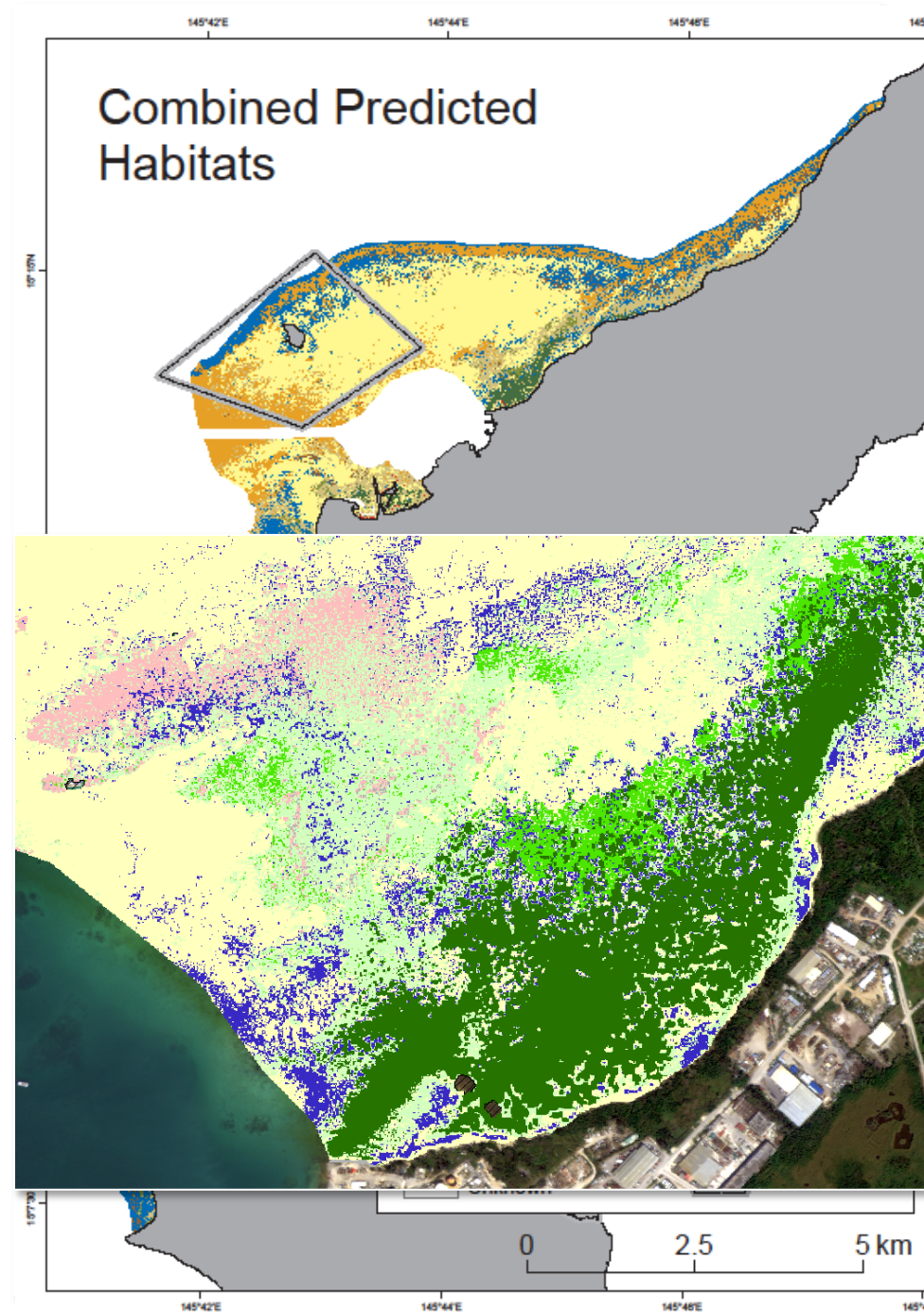
Saipan Lagoon Perceptions

Where do you fit on the following continuums? Place a colored dot along the line.



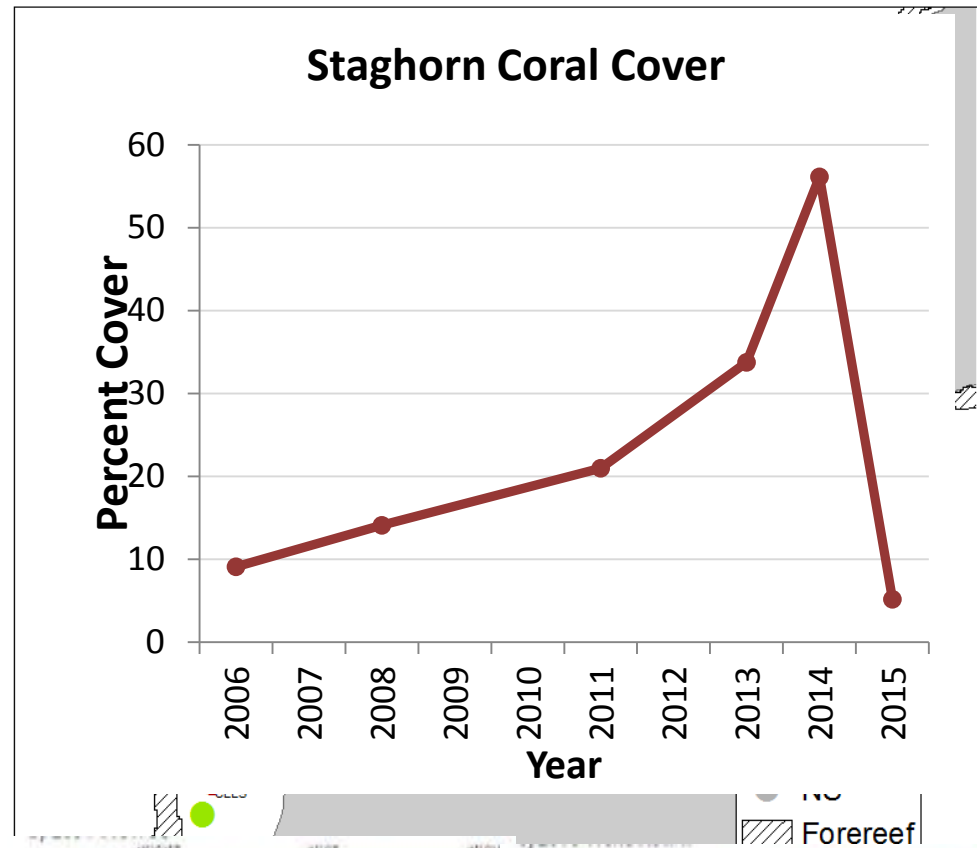
Recent Data

- **NOAA high-resolution habitat mapping**
- Marine biological monitoring
- Water Quality report
- Coastal User Survey and Mapping
- Hydrodynamics study
- Shoreline erosion



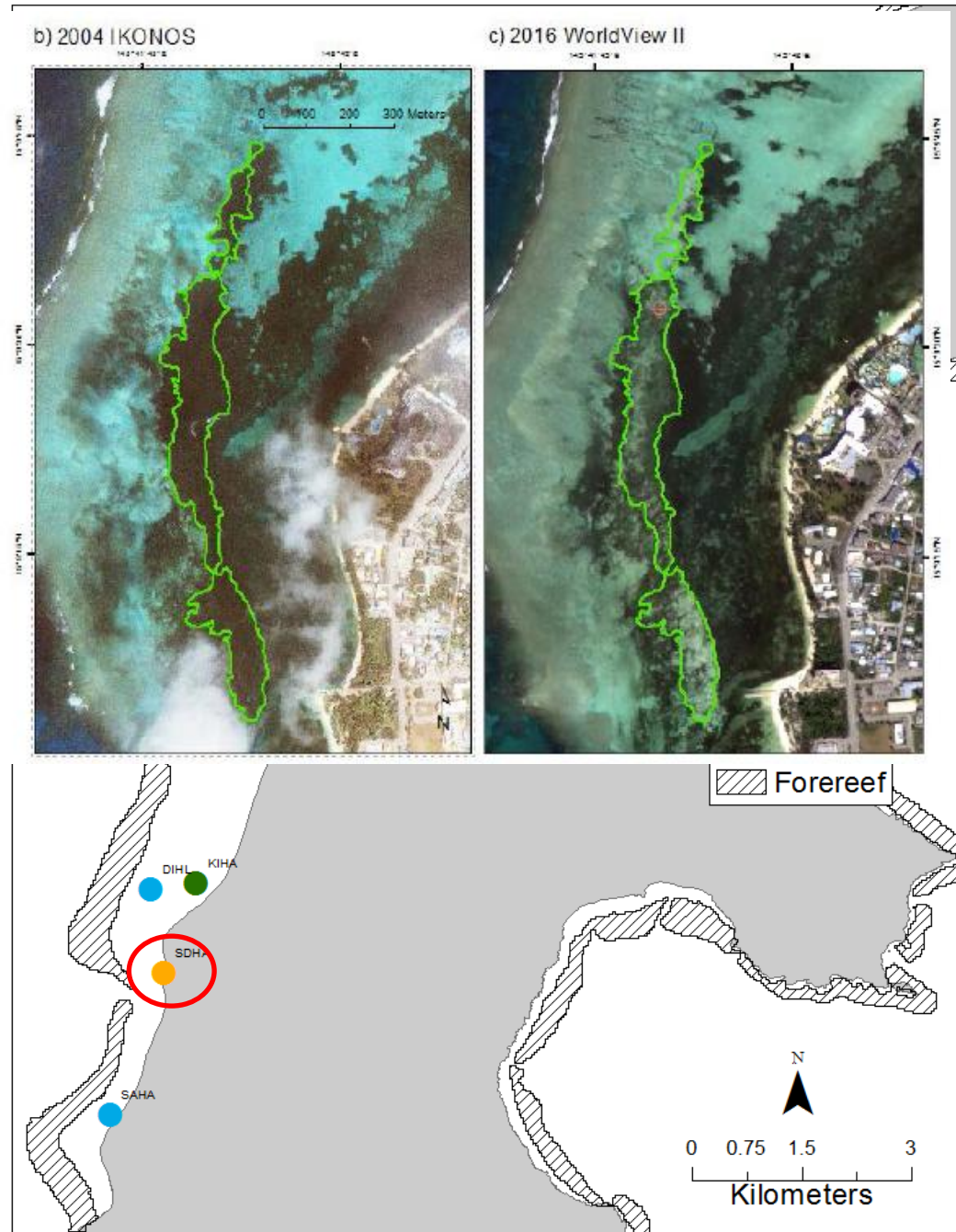
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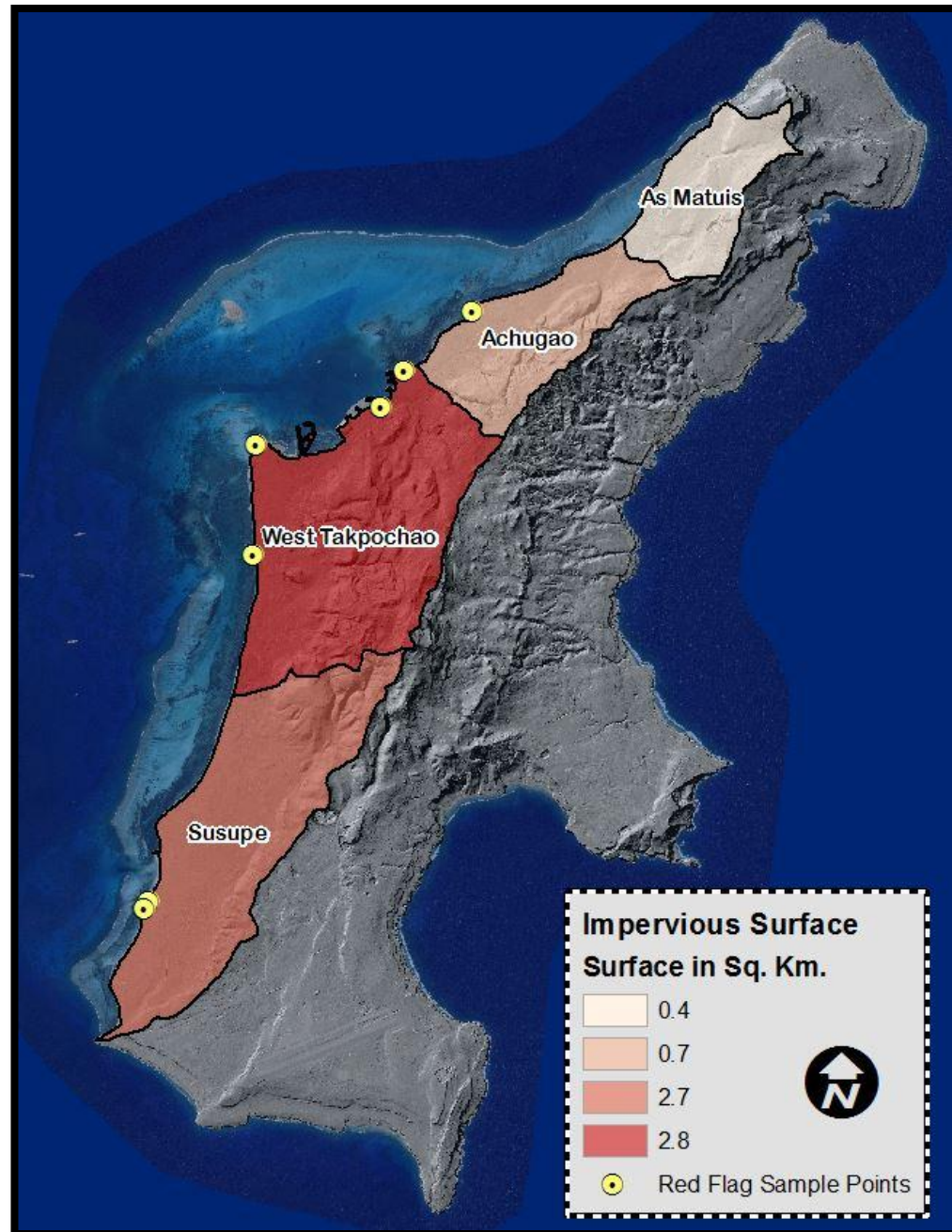
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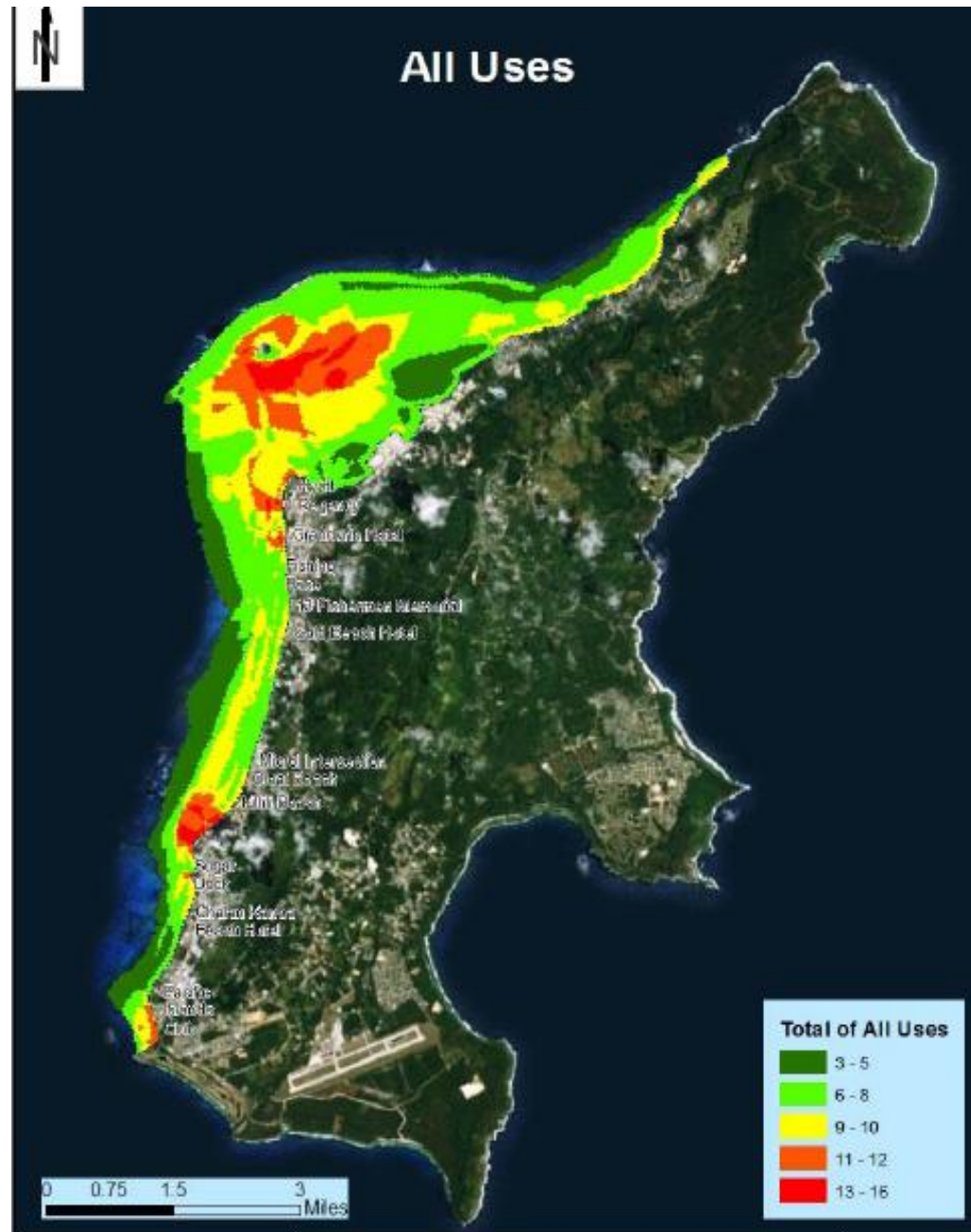
Recent Data

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- Marine biological monitoring
- **Water Quality report**
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- Hydrodynamics study
- Shoreline erosion



Recent Data

- NOAA high-resolution habitat mapping
- Marine biological monitoring
- Water Quality report
- **Coastal User Survey and Mapping**
- Hydrodynamics study
- Shoreline erosion



Economics and the Environment

Chamber of Commerce

- Consistent beach maintenance (algae, trash, etc)
- Better public/private partnerships on water quality issues
- Installation of additional moorings
- Educational Lagoon use maps/brochures for distribution

MINA

- Importance of fostering community and science-based programs
- Goal to expand education on ecosystem services
- Laly 4, pau pau, Sugar dock, tanapag dealing with most trash issues
- Marine debris control
- 28.2 tons of trash and recycles from adopt a bin program

Issues Raised

1. Motorized water sports
2. Safety
3. Water quality
4. Protection of pristine habitat/resilient biota
5. Beach erosion
6. Access- moorings and infrastructure
7. Trash
8. Dedicated funding source for lagoon management
9. Education

Some specific suggestions

- Marine zoning adjustments
 - Safety
 - Environmental conservation
- Access
 - Outer cover marina improvements
 - Mooring buoys
- Funds
 - “Green” tax for tourists
 - Hotel fee

Motorized Water Sports – User Conflicts

- Signage/markings for jetski exclusion zones, sanctuaries, other boundaries.
- Zoning Map for Uses
- Education and outreach
 - Education of operators and tour guides
 - Education for tourists/users
 - Marine sports operators (MSOs) fines for harming coral

Safety

- Develop a zoning plan for lagoon uses
 - Enforcement of fines if jetskis go beyond designated areas
- Video about coral damage for snorkeling tours
- Signage or training for MSOs about how NOT to harm the coral
- Education for MSOs about speed/safety
- Memorandum of Understanding between MSOs
- Consider a no-fly zone (parasailing) around Managaha, particularly in the channel.

Nonpoint source pollution

- Implement upland stormwater BMPs
- Implement stormwater management and improve drainage across the island.

Protection of pristine habitat

- Protect areas with the most resilient biota/organisms.
- Benefits to all recreational and commercial users.

Beach erosion

- Loss of available beach/shoreline
- Potential solutions:
 - Living shorelines
 - Hard-engineering/design solutions

Lack of established/consistent moorings

- Develop mooring plans – where we want them, how many, etc.
- Don't use plastic bottles – establish a common mooring protocol that the MSOs must use.

Trash Impacts to Use

- Educational video at airport – multiple languages or mostly visual images
- Outreach to locals about why this is important
 - MINA collaboration
- Beach signage (images or multiple languages)

Dedicated Funding Source

- Funds directly used for lagoon management
- Transparent
- Fees for lagoon uses in addition to permit fees.
- “Green fee” for island departure (Palau example).

Saipan Lagoon Use Management Plan Forum

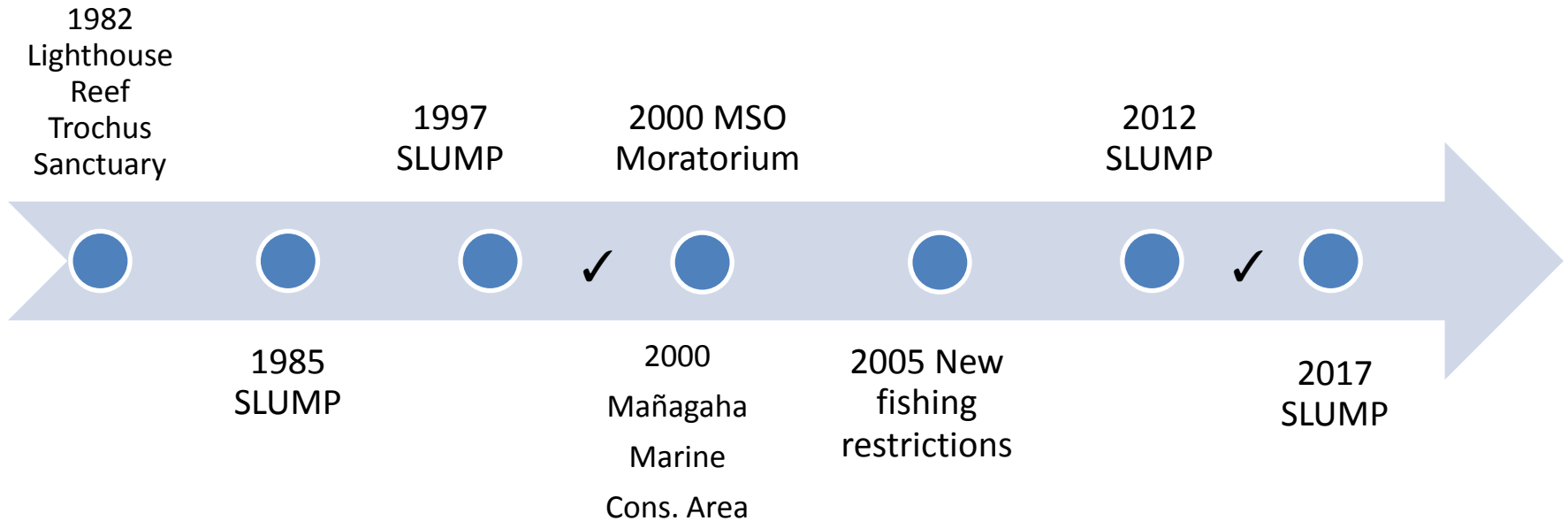


April 24-25, 2017
Fiesta Hotel



www.horsleywitten.com/SLUMP

Where have we been?



CRMO stops issuance of permits for water sports

By | Posted on Mar 15 2000

The Coastal Resources Management Of commercial water sports permits to pro waters off Tinian and Rota.

According to CRMO acting Director Pet capacity to safely and environmentally

CRMO has already given about 70 wate jetski, water ski, wakeboarding, seawall the agency will not be affected.

While the agency has not initiated a sp CRMO has received several letters expressing concern on its effect on the critical situation of the lagoon.

DFW: Strict rules improve fish population in Saipan lagoon

02 Dec 2008

By Emmanuel T. Erediano - Reporter

[Share](#) [Like 0](#) [Tweet](#) [G+ Share](#) [0](#)

THREE and a half years after the implementation of the regulation restricting the use of gill, drag and surround nets in the CNMI, the Division of Fish and Wildlife says the Saipan lagoon has shown an increase in the number of certain fish species.

This positive change came along with the establishment of the Division of Fish and Wildlife's fisheries research facility, which DFW described as a landmark development in the CNMI's marine conservation efforts that aim to scientifically monitor the fish populations surrounding the islands.

1985

- ✓ * Amendments to Saipan's proposed Zones and Land Use Districts, as well as to the rules and regulations to be promulgated thereto.
- ✓ * Regulations governing shoreline setbacks; property coverage ratios; property setback/height limitations; and shoreline fencing.
- * Landscaping guidelines for property development.
- ✓ * Regulations for shoreline landfilling, diking and dredging.
- * Regulations for constructing shoreline structures.
- ✓ * Beach restoration improvements.
- * Water facilities planning for future shoreline uses.

1985

- ✓ * Wastewater facilities planning for future shoreline uses.
- * Design criteria for stormwater drainage facilities.
- ✓ * Planning criteria for evaluating development impacts on infrastructure.
- * Recreation use zones for the Lagoon.
- ✓ * Water safety information program.

1997

The following list of “needs” were registered by those individuals interviewed.

- (1) Water zoning to accommodate all lagoon users, including “traditional” uses, under multiple-use concept.
- ✓ (2) Better communication among GCNMI permitting agencies.
- ✓ (3) Designation of marine preserves/sanctuaries in the lagoon.
- ✓ (4) Mandatory connection of wastewater generators wherever public sewer service is available.
- ★ (5) Interception and retention of stormwater runoff at sites located upstream of lagoon discharge points.
- ★ (6) Stormwater Drainage Master Plan for Garapan and Chalan Kanoa.
- ✓ (7) Clarification of the policy regarding public notice requirements about lagoon water quality.
- ✓ (8) Enforcement of regulations for jet ski, watercraft and diving operations.
- ★ (9) Formal development policy for Managaha.

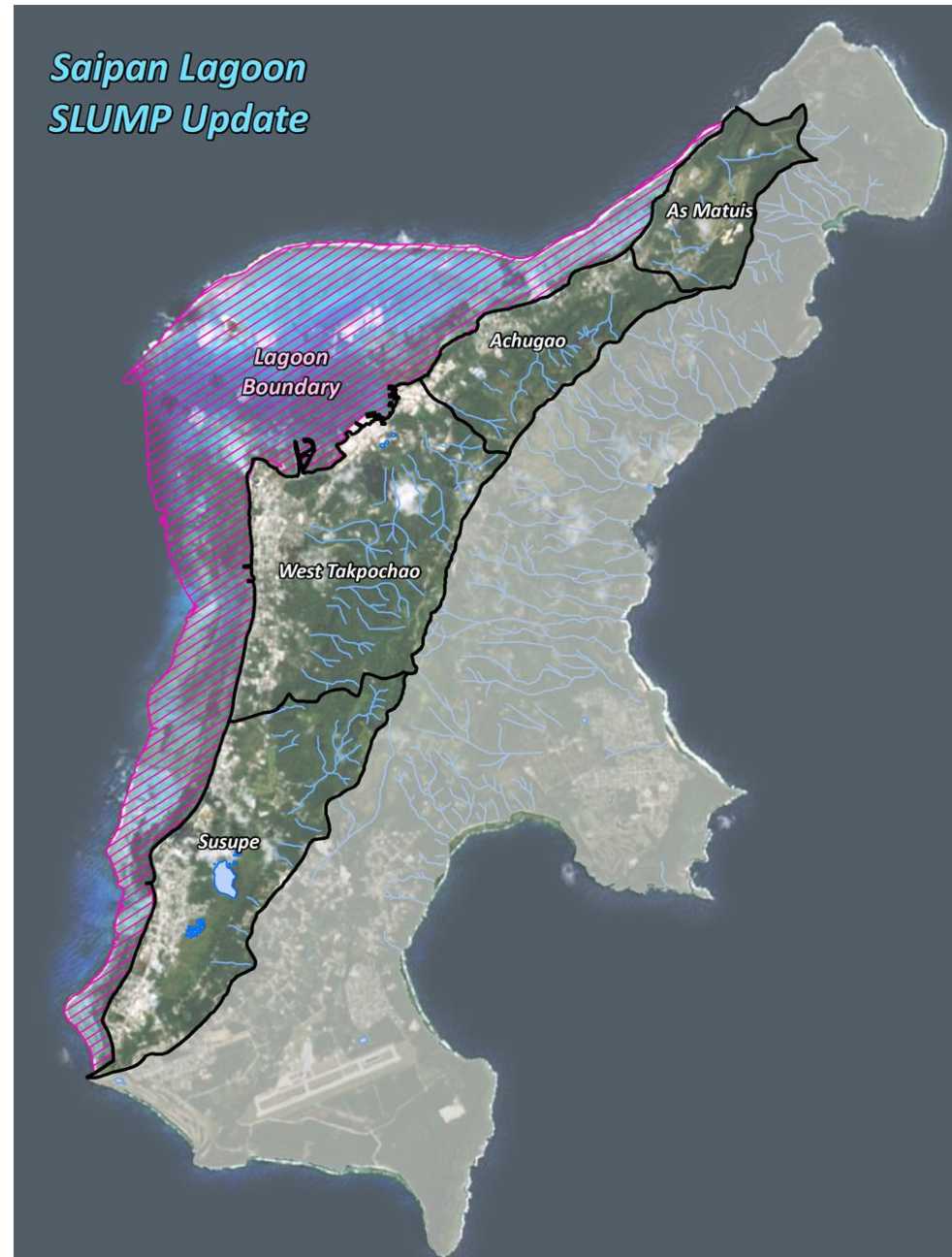
2012

Updating the SLUMP will result in the following:

- ✓ 1. The CRM Office will coordinate all recreational management activities in the area.
- ✓ 2. DLNR will be responsible for fish and wildlife resources.
- ✓ 3. DPS will be responsible for MWRC safety, search and rescue operations, surface and underwater use, and rules governing MWRC use. Officers will have jurisdiction to enforce the rules and regulations of the Plan.
- ✓ 4. The CRM Office will oversee the promulgation of rules to address management needs of the Plan.

Where do we go from here?

- Higher demands on resource
- More user conflicts
- More impacts
- More data to support management actions



Saipan Lagoon Perceptions

Where do you fit on the following continuums? Place a colored dot along the line.

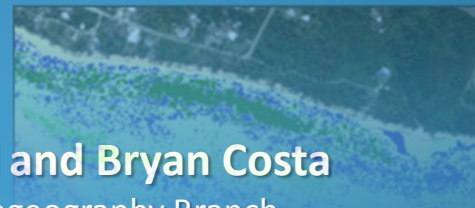
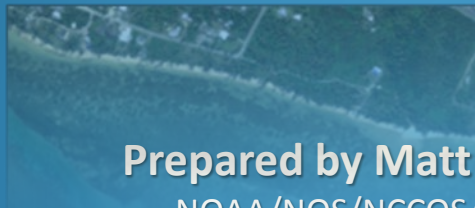
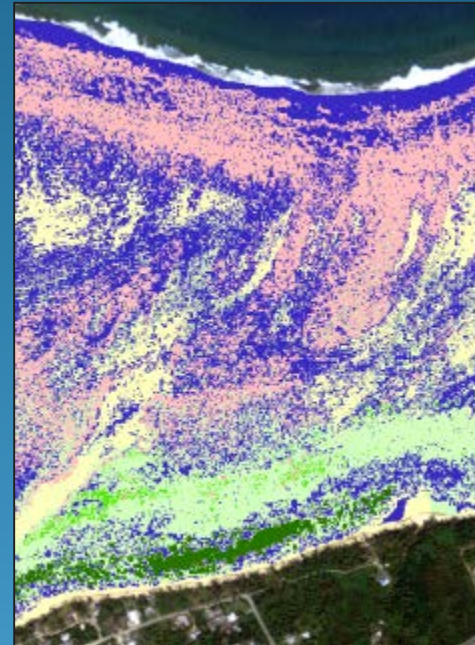


Agenda

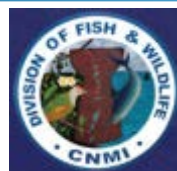
- Introduction
- Lagoon biology, watersheds, and coastal uses (NOAA and BECQ)
- Commercial, Fishing, & Recreational Uses: Opportunities and Issues (MINA & Chamber of Commerce)
- Envisioning Sustainable Management for All Uses
 - Lunch
 - Public Meeting
 - DAY 2

Presented by Steve McKagan
NOAA/PIRO/HCD

Mapping of the Saipan Lagoon



Prepared by Matt Kendall and Bryan Costa
NOAA/NOS/NCCOS/CCMA/Biogeography Branch

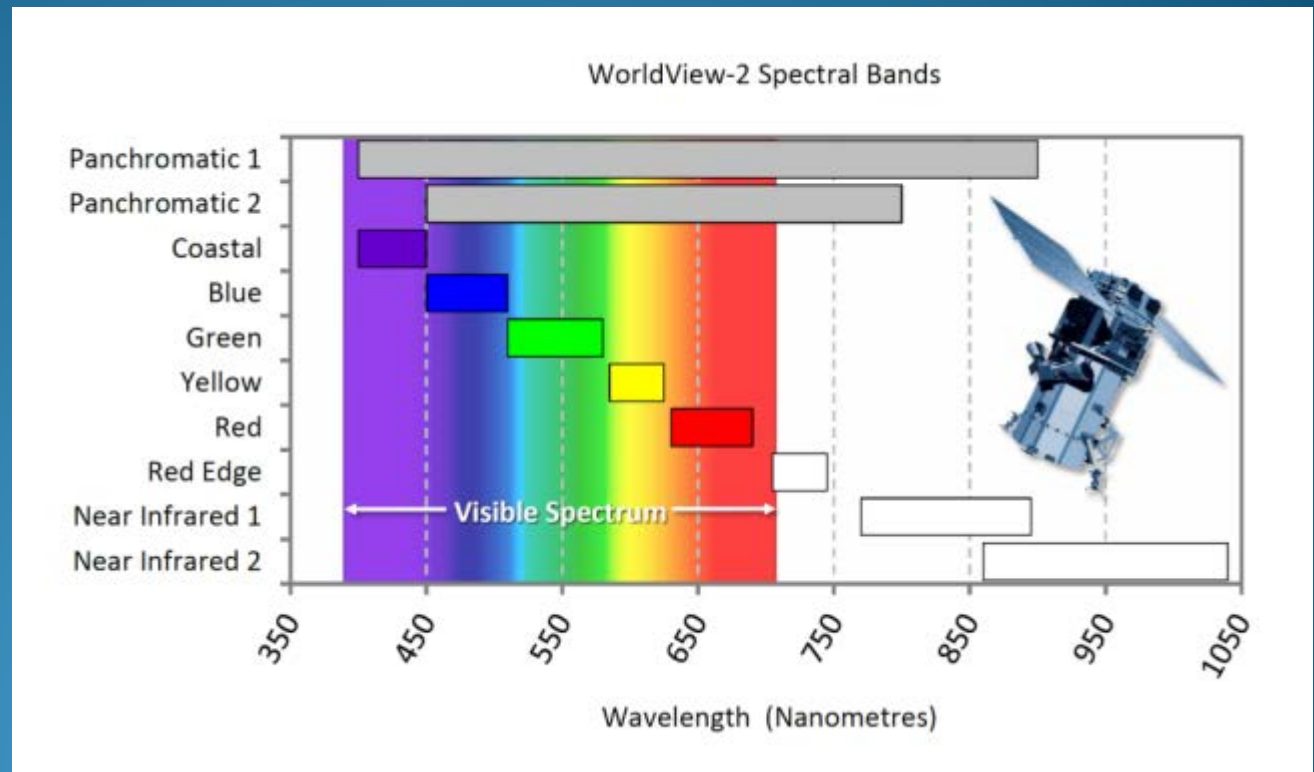


February 2017

Methods

It all starts with a Satellite image

- WorldView2
- Feb 5, 2016 at 10:44 AM
- 8 band
- 0.5 to 2 m resolution
- Clear skies
- Low wind
- Low turbidity



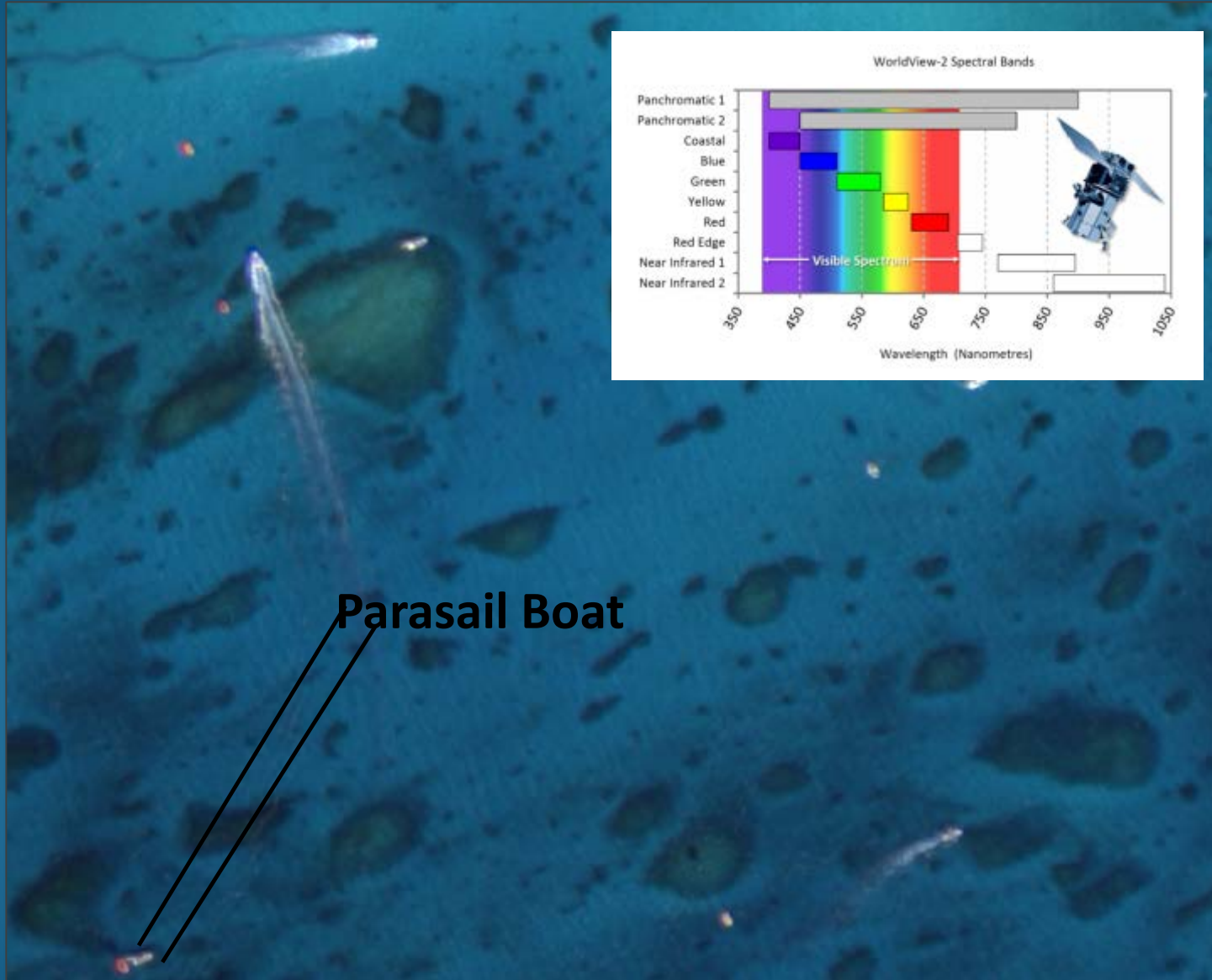
2001 Image



2016 Image



2016 Image (Lagoon Zoom)

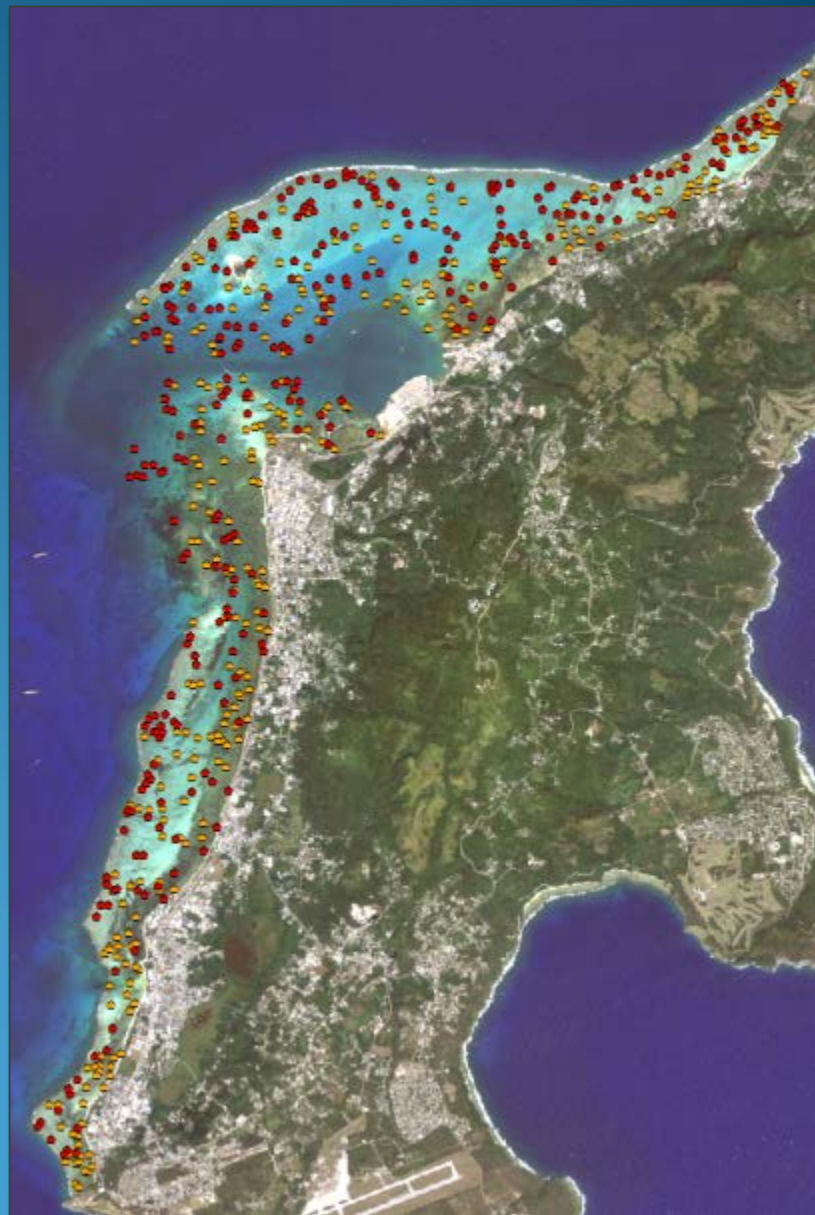


What can the imagery tell us about what is under the water?

A lot – but we need to train the camera to understand what it is seeing

Field work: July-Aug 2016

- **242** Ground Truth sites (selected)
- **+50** GT sites from NOAA interns
- **273** Accuracy Assessment sites (random stratified)



Browser address bar: <https://maps.coastalscience.noaa.gov/biomapper>

Page Title: Saipan Lagoon BIOMapper

Navigation: File Edit View Favorites Tools Help


Logins: abouttabs Suggested Sites CBS Login Web Slice Gallery PIR0 Intranet Junos Pulse Secure Access...

Logo: NCCOS

Page Header: Saipan Lagoon BIOMapper

About

Project Introduction Contact Us



Welcome to the **Saipan Lagoon BIOMapper**, an interactive, online map designed to let users explore benthic habitat maps and associated data in Saipan Lagoon, Commonwealth of the Northern Mariana Islands (CNMI). NOAA's National Centers for Coastal Ocean Science developed updated habitat maps for Saipan Lagoon in partnership with the CNMI's Bureau of Environmental and Coastal Quality and NOAA's Pacific Islands Regional Office. This portal contains the spatial information collected and synthesized during this project, including high-resolution satellite imagery, bathymetry, underwater videos and photographs, and the predicted distributions of various substrate and biological cover types.

These new habitat maps were designed to inform the Saipan Lagoon Use Management Plan, and support the Territorial Government's process to

Close

Data

- Benthic Data
 - Project Area
 - Project Area
 - Unknown
 - Habitat Map
- Additional Data
 - Marine Protected Area Bound
 - Field Data
- Additional Imagery
 - Habitat Predictions
 - Cover
 - Substrate
 - Satellite Derived Depth
 - Satellite Imagery

Project information

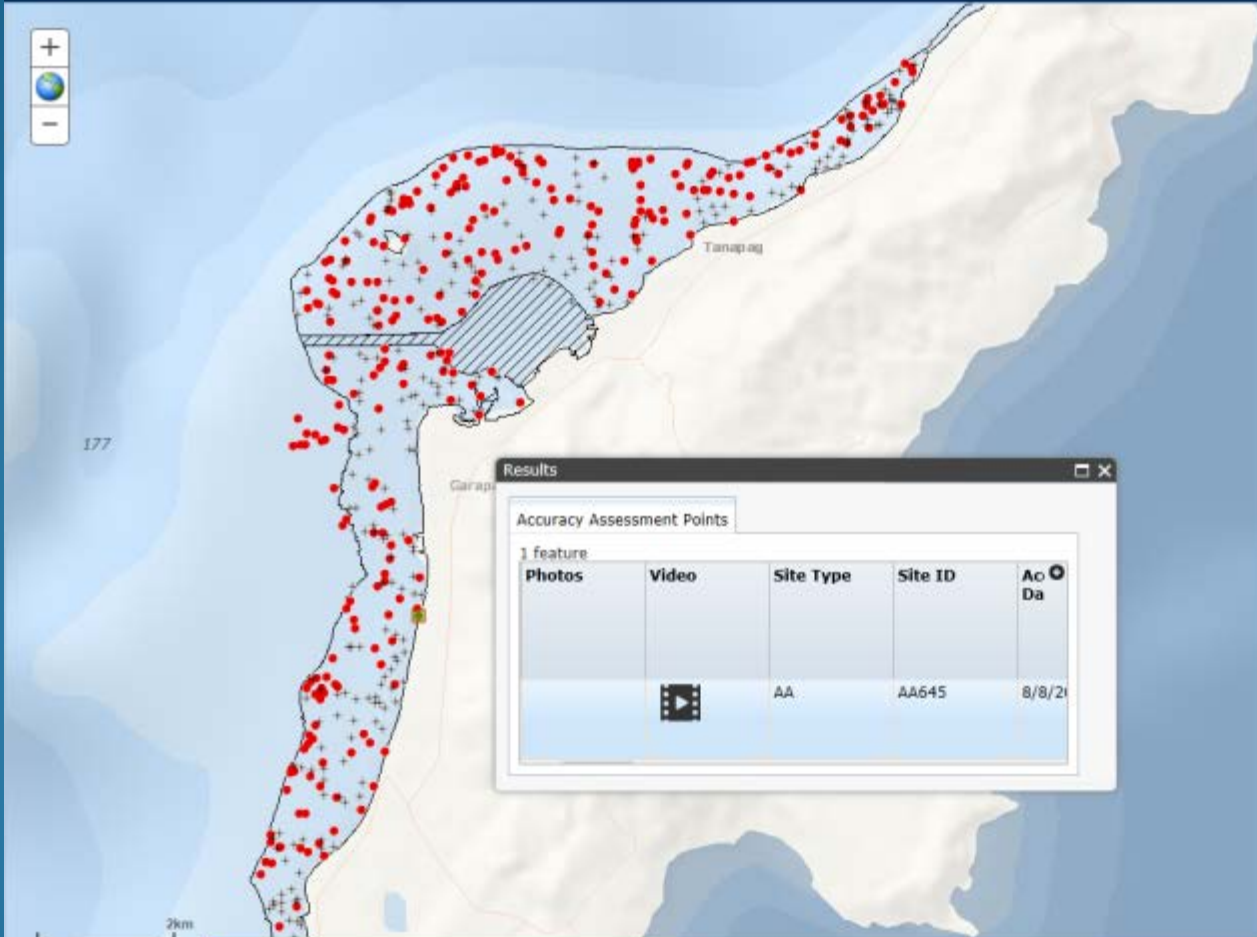
Search

Change Background Map

Department of Commerce | National Oceanic and Atmospheric Administration | National Ocean Service | Website Owner: National Centers for Coastal Ocean Science

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<https://maps.coastalscience.noaa.gov/biomapper/biomapper.html?id=saipan>



Data

- Benthic Data
 - Project Area
 - Project Area
 - Unknown
 - Habitat Map
- Additional Data
 - Marine Protected Area Bound
 - Field Data
 - + Ground Validation Points
 - Accuracy Assessment Po
- Additional Imagery

Project information

Results

Accuracy Assessment Points

1 Feature

Photos	Video	Site Type	Site ID	Ac Da
		AA	AA645	8/8/21



https://maps.coastalscience.noaa.gov/biomaj Saipan Lagoon BIOMapper GTM 9.0 CIV Web Application

File Edit View Favorites Tools Help

abouttabs Suggested Sites CBS Login Web Slice Gallery PIRO Intranet Junos Pulse Secure Access...

NCCOS Saipan Lagoon BIOMapper

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Results

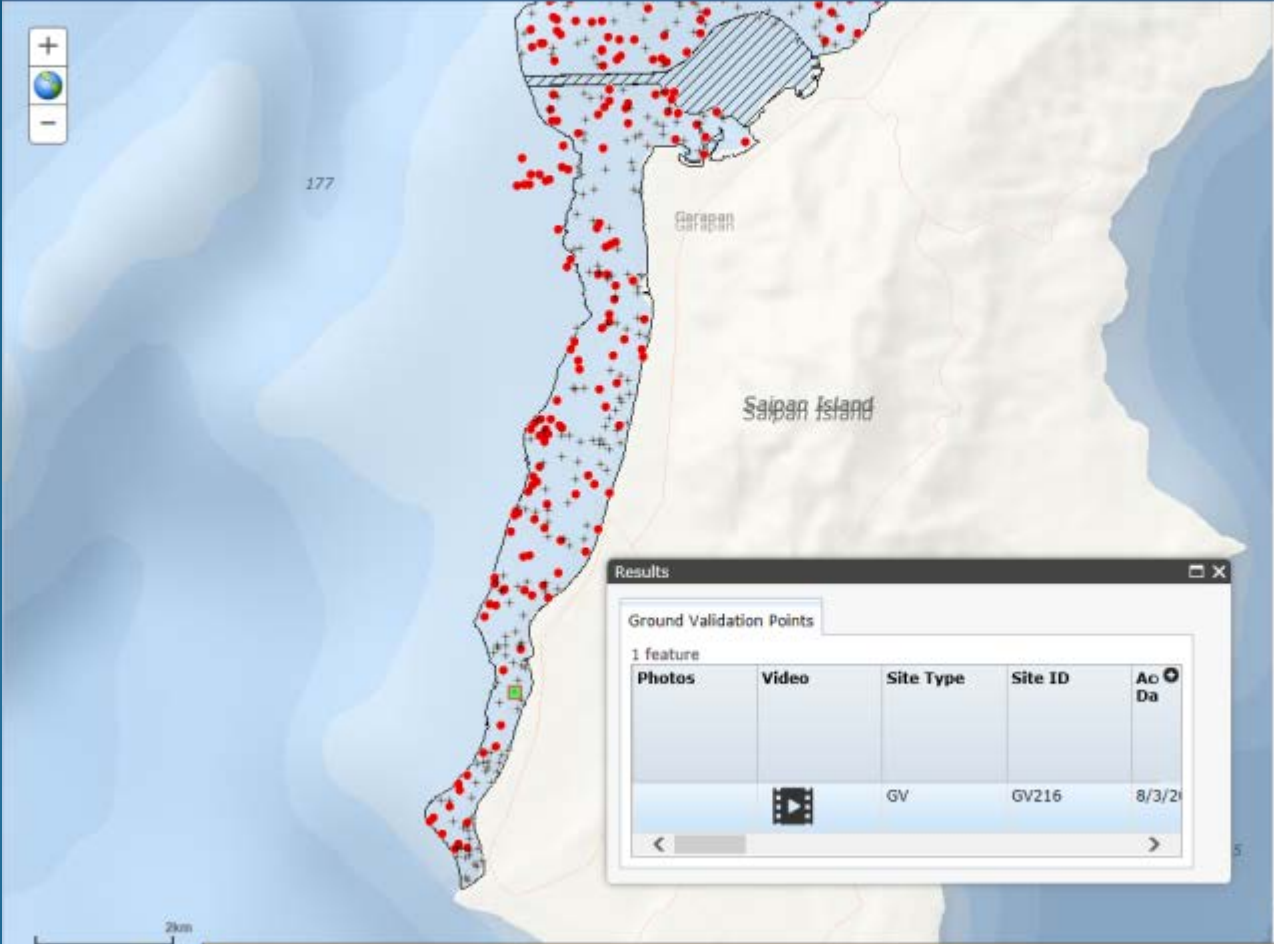
Ground Validation Points

1 feature

Photos	Video	Site Type	Site ID	Ac Da
		GV	GV084	8/9/2

Department of Commerce | Natl 69% of GV084_Video.mp4 downloaded 16 sec remaining Pause Cancel View downloads





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Ground Validation Points

1 feature

Photos	Video	Site Type	Site ID	Ac Da
		GV	GV216	8/3/21



Modeling approach

- Intersected GV data with environmental predictors
- Predictors included:
 - 15 spectral water-column corrected bands
 - 9 seafloor topography metrics
 - 4 geographic metrics

Step 1. Data preparation

In this step, animal and environmental datasets were standardized, and intersected with each other spatially. The result was a combined data table.

Step 2. Model fitting

In this step, we used the combined table from step 1 to find the optimal parameters for creating a model. These parameters minimized the error in predictions about animals and their habitats.

Step 3. Model selection

In this step, we selected the optimal parameters for creating a best model using variety of performance measurements.

Step 4. Prediction across space

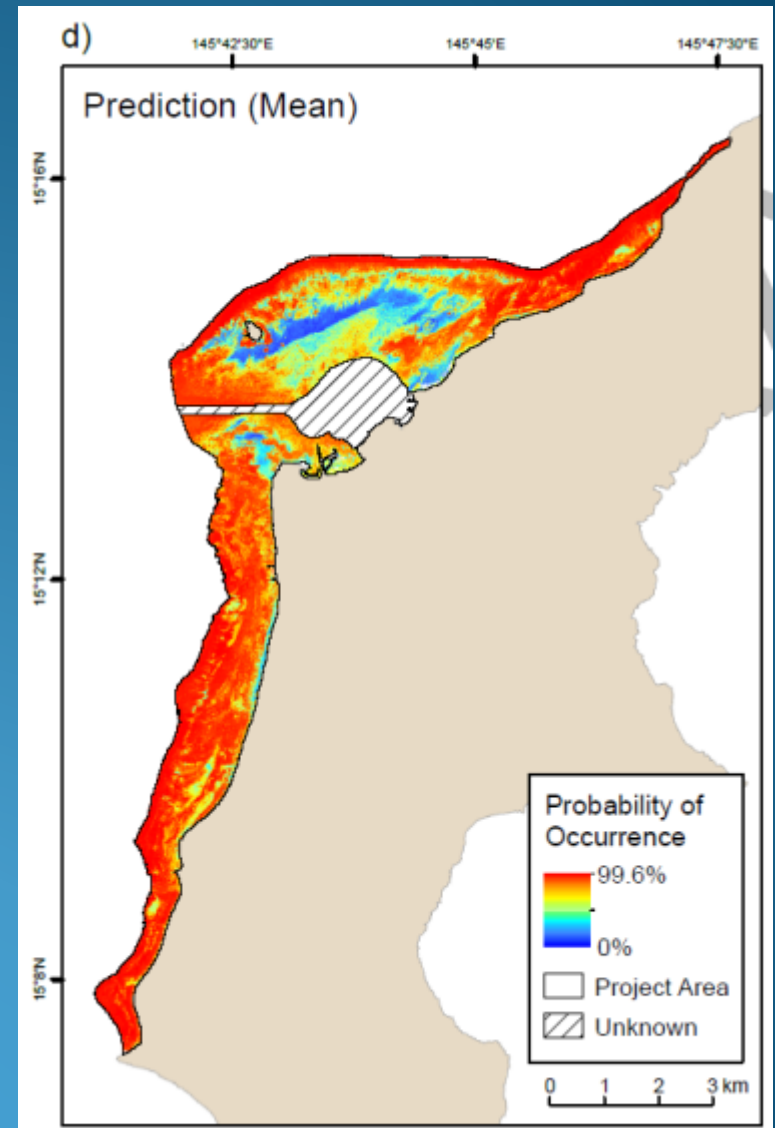
In this step, we applied the best model from step 3 to predict animal distributions in the study area. We repeated this process (using different data subsets from step 1) to understand how predictions varied. The result was a series of maps showing animal habitats, presences and abundances and uncertainties.

Step 5. Model performance

In this final step, we used statistics to evaluate the performance of these spatial predictions.

What kind of output products (maps) do you want?

- Maps showing where we are most likely to find coral?
- Maps of man made structures?
- Maps showing areas dominated by seagrass?
- Locations of dominant coral species like *Isopora palifer*?
- Boundaries of staghorn coral stands?
- Mixed Algae?
- Sand?
- All this and more is available in the report
- *What we really want to know is what are the dominant habitat types and where are they found.*



“Flat Map” Classification Scheme

**Sand,
mixed algae
and seagrass**

Sand >80 % covered with Halodule, Halimeda, other fleshy algae, remainder is mostly rubble covered with turf

**Sand,
seagrass
(*H. uninervis*)**

Sand >90%, covered with Halodule >50%

Sand, bare

Sand >90%, with <10 % cover

**Sand,
seagrass
(*E. acoroides*)**

Sand >90%, covered with Enhalus >90%

**Pavement,
mixed algae**

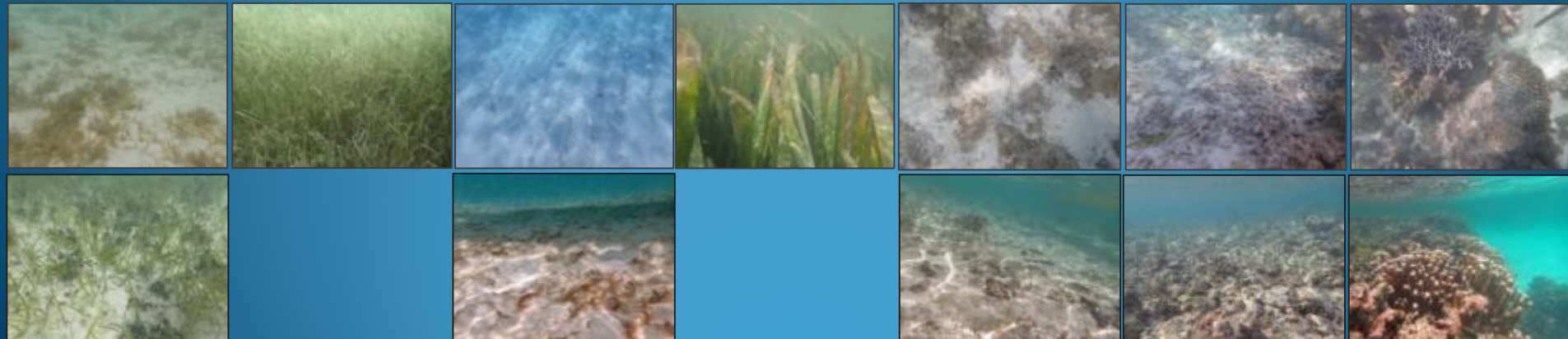
Pavement >50% covered with fleshy and turf algae, remainder is mostly rubble or sand

**Coral rubble,
mixed algae**

Coral rubble >50% covered with turf and fleshy algae, remainder is mostly upright dead, pavement, or sand

**Upright reef,
mixed algae
and live coral**

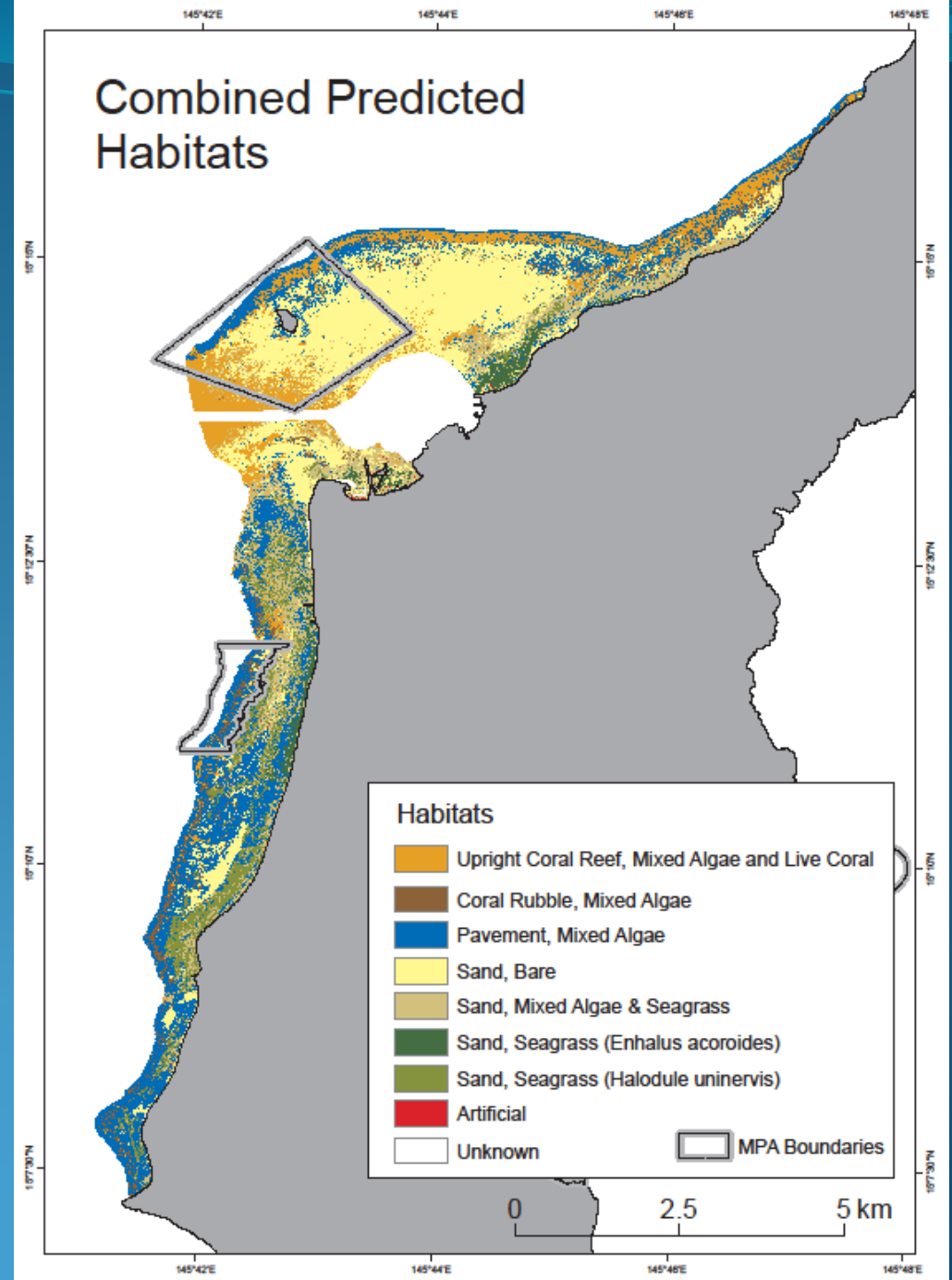
Upright coral >50% can be live or dead and covered with turf and fleshy algae, remainder is mostly rubble covered with mixed algae.

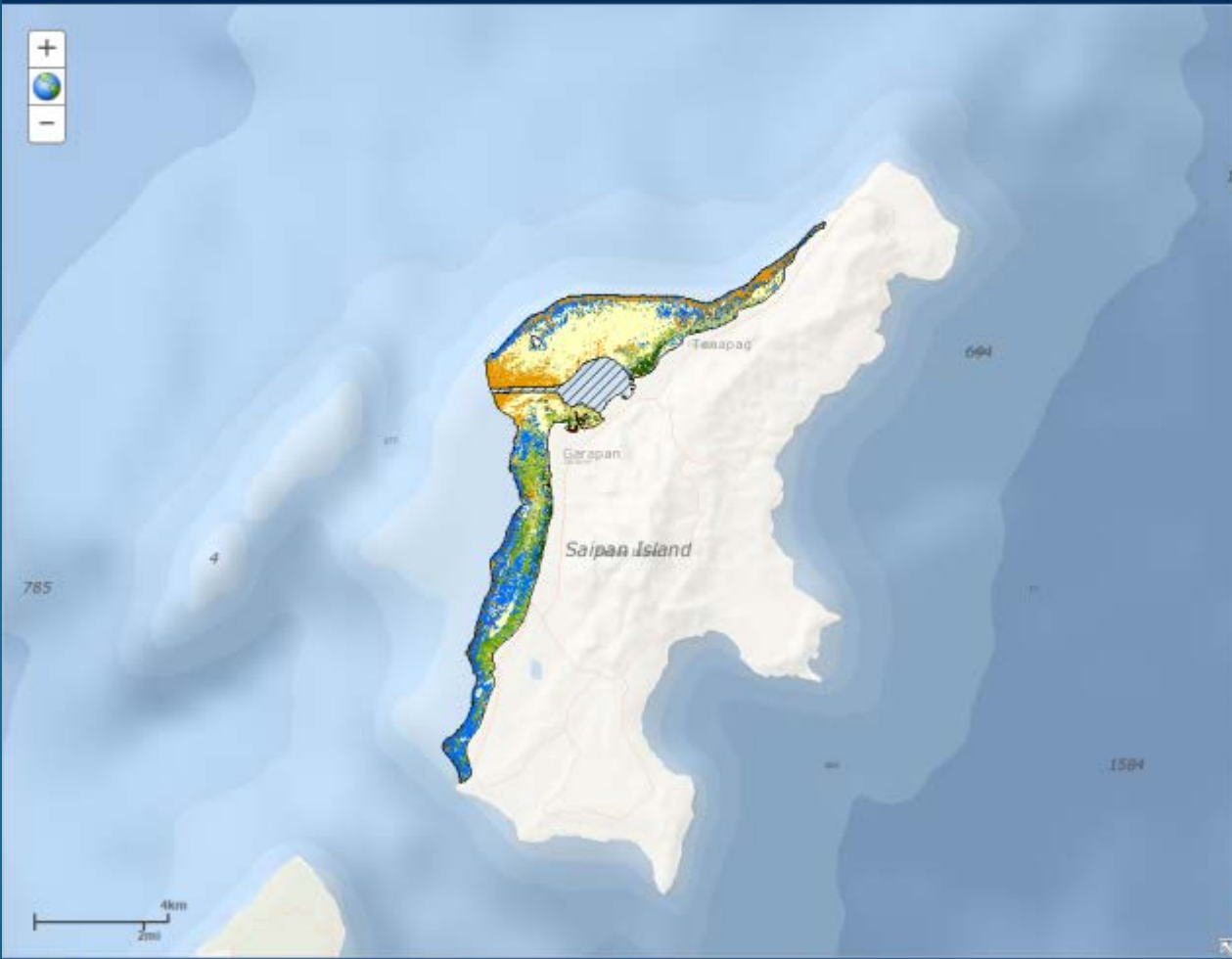


Draft products

- 27.4 km² seafloor characterized
- 1.09 km² (4%) of map edited

Habitats	Inside MPAs (km ²)	Outside MPAs (km ²)	Total (km ²)
Upright Coral Reef, Mixed Algae & Live Coral	1.0	2.8	3.8
Pavement, Mixed Algae	1.1	6.0	7.1
Coral Rubble, Mixed Algae	0.2	1.0	1.1
Sand, Mixed Algae & Seagrass	0.2	3.6	3.8
Sand, Seagrass (<i>Enhalus acoroides</i>)	0.00002	0.7	0.7
Sand, Seagrass (<i>Halodule uninervis</i>)	0.03	1.9	2.0
Sand, Bare	2.6	6.3	8.9
Artificial	0.0014	0.03	0.03
Unknown/Not Mapped	0.00001	2.7	2.7
Total	5.1	25.1	30.1
Total (-Unknown)	5.1	22.3	27.4





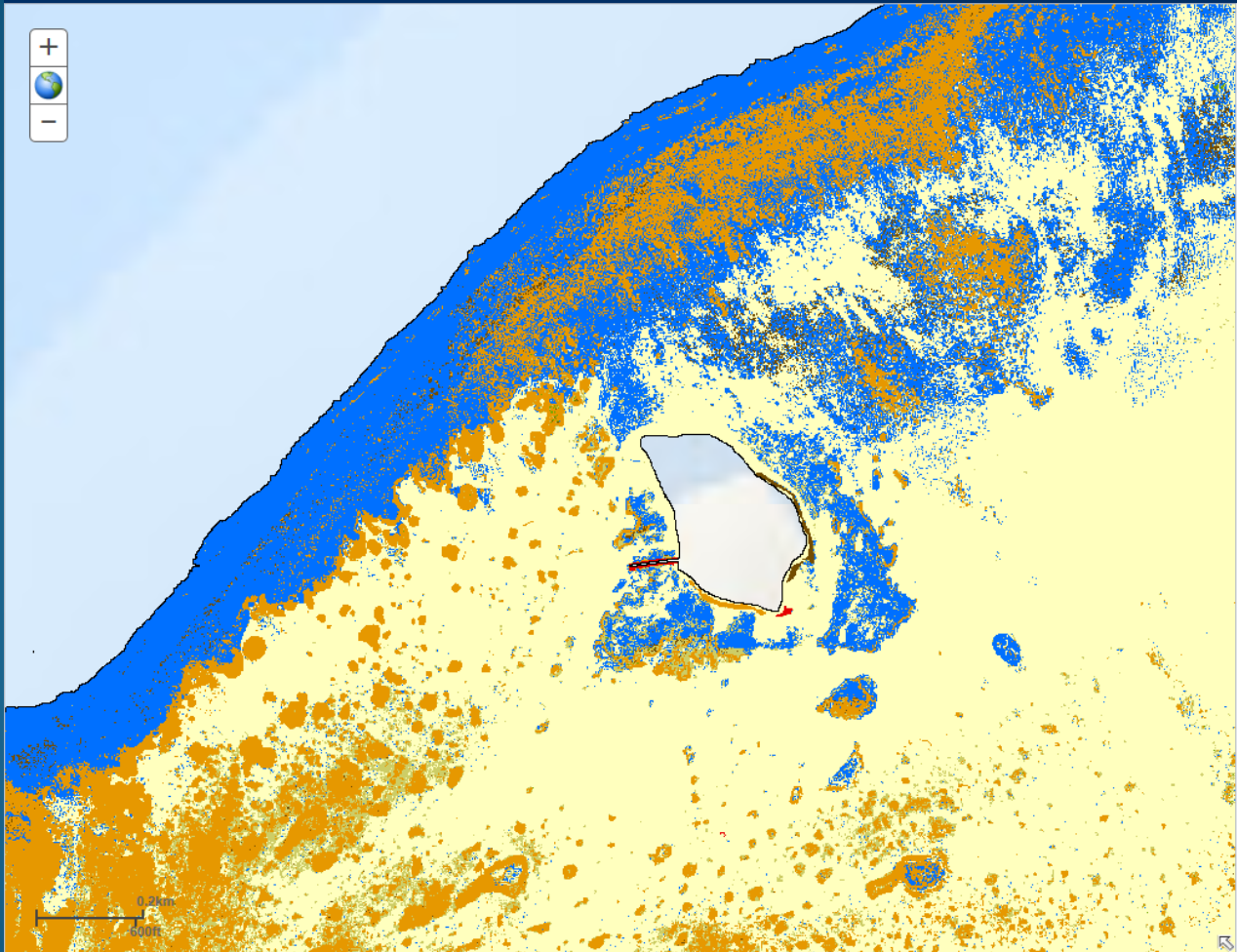
Data

- Benthic Data**
- Project Area**
 - Project Area
 - Unknown
- Habitat Map**
 - Artificial
 - Coral Rubble, Mixed Algae
 - Pavement, Mixed Algae
 - Sand, Bare
 - Sand, Mixed Algae and Seagrass
 - Sand, Seagrass (*Enhalus acoroides*)
 - Sand, Seagrass (*Halodule uninervis*)
 - Unknown
 - Upright Dead and Live Coral Reef, Mx
- Additional Data**
 - Marine Protected Area Bound
 - Field Data
- Additional Imagery**

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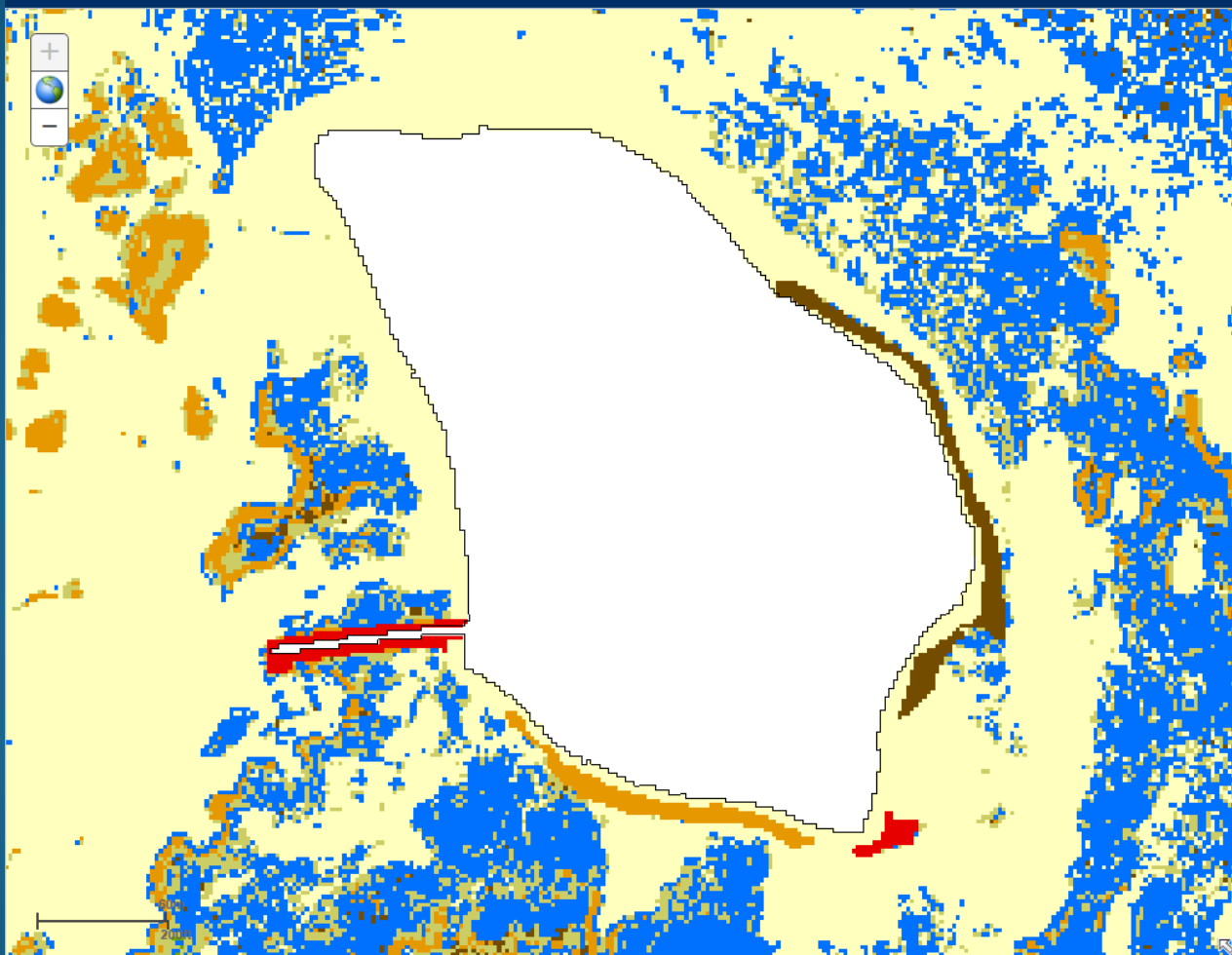
Project information

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Saipan Lagoon BIOMapper



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Project information

Search

Change Background Map

Map Accuracy

- 350 sites positioned via random, stratification
- 273 sites used to create confusion matrix
- Points < 4m (or ~2 map pixels) from the same habitat in the map were considered “correct”

OA = 85.7%

OA prop. = 85.8%

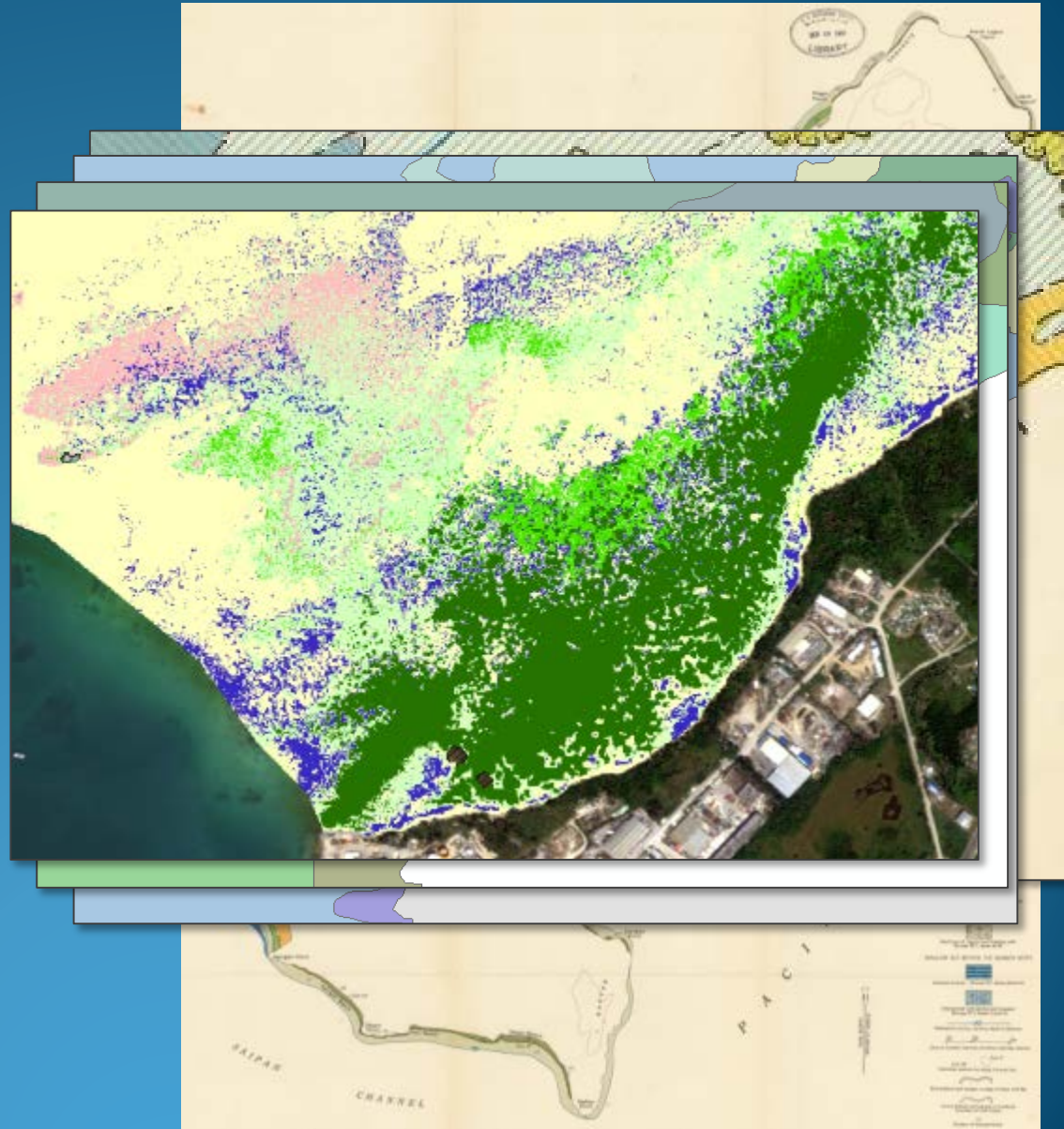
tau = 0.83

		AA (i)						n _j	User's Accuracy (%)	
		Sand, Mixed Algae & Seagrass	Sand, Seagrass (<i>Halodule uninervis</i>)	Sand, Bare	Sand, Seagrass (<i>Enhalus acoroides</i>)	Pavement, Mixed Algae	Coral Rubble, Mixed Algae			Upright Coral Reef, Mixed Algae & Live Coral
map(j)	Sand, Mixed Algae & Seagrass	26				1	2	1	30	87%
	Sand, Seagrass (<i>Halodule uninervis</i>)		11			2			13	85%
	Sand, Bare	2	1	51		4	2	4	64	80%
	Sand, Seagrass (<i>Enhalus acoroides</i>)				5				5	100%
	Pavement, Mixed Algae	2	2	1		75	2	5	87	86%
	Coral Rubble, Mixed Algae					1	11		12	92%
	Upright Coral Reef, Mixed Algae & Live Coral	2		2		1	2	55	62	89%
	n _i	32	14	54	5	84	19	65	273	
	Producer's Accuracy (%)	81%	79%	94%	100%	89%	58%	85%		OA = 85.7%

What can the new map tell us about changes over time?

It turns out that it is relatively difficult to compare the maps based on differences in classification schemes and mapping units but it is relatively easy to compare the satellite imagery

- **Prior maps**
 - Cloud 1959
 - NOAA 2003
 - Houk and van Woesik 2008
- 1940-2003, 20% of lagoon changed from seagrass, staghorn, and other reef habitats to bare sand.

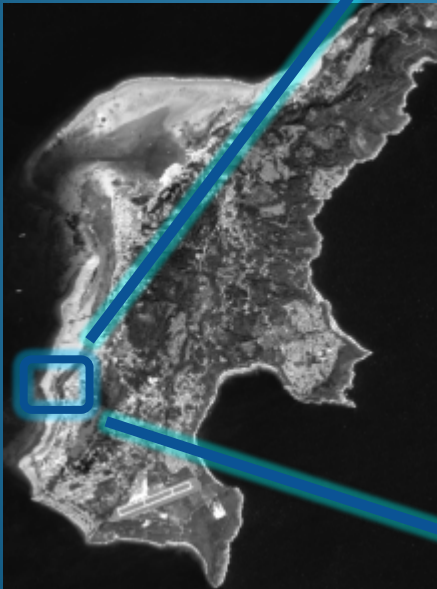


Change analysis

North of Sugar Dock

- *H. uninervis* loss

- Sand movement

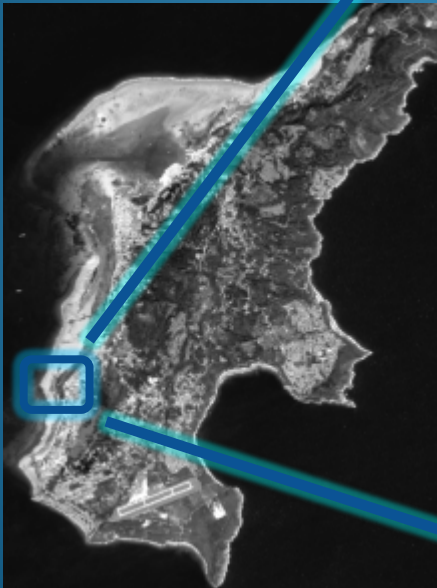


Change analysis

North of Sugar Dock

- *H. uninervis* loss

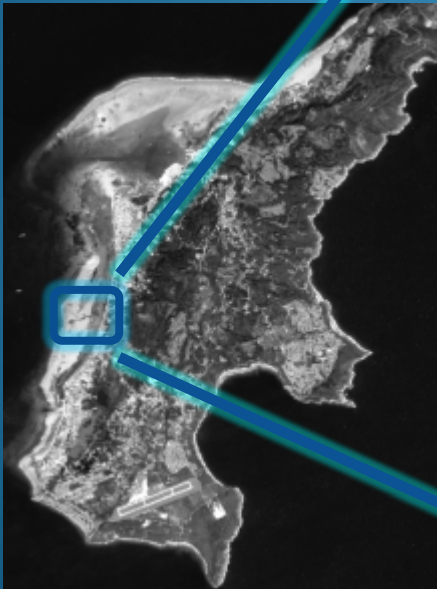
- Sand movement



Change analysis

Red Beach

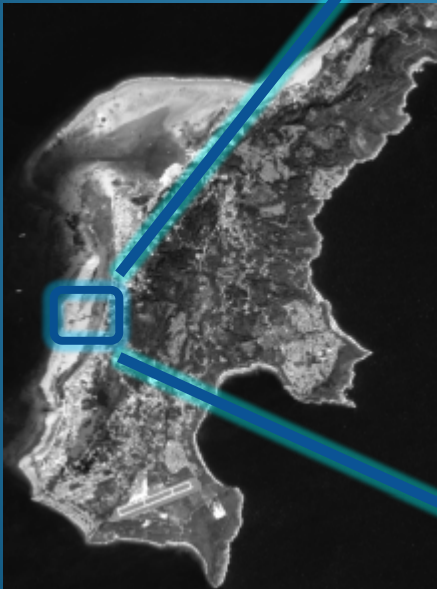
- Gain...but then loss of staghorn corals



Change analysis

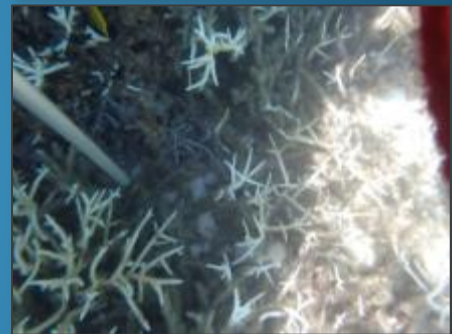
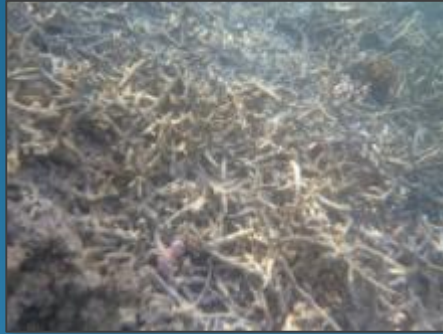
Red Beach

- Gain...but then loss of staghorn corals



Staghorn demise

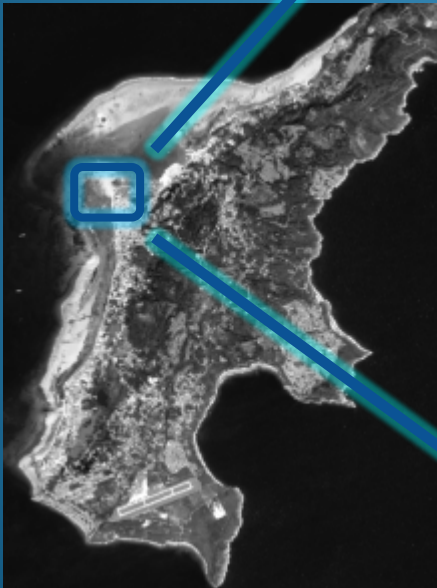
12 sites on staghorn reefs: AA photos



Change analysis

Garapan/Memorial Park

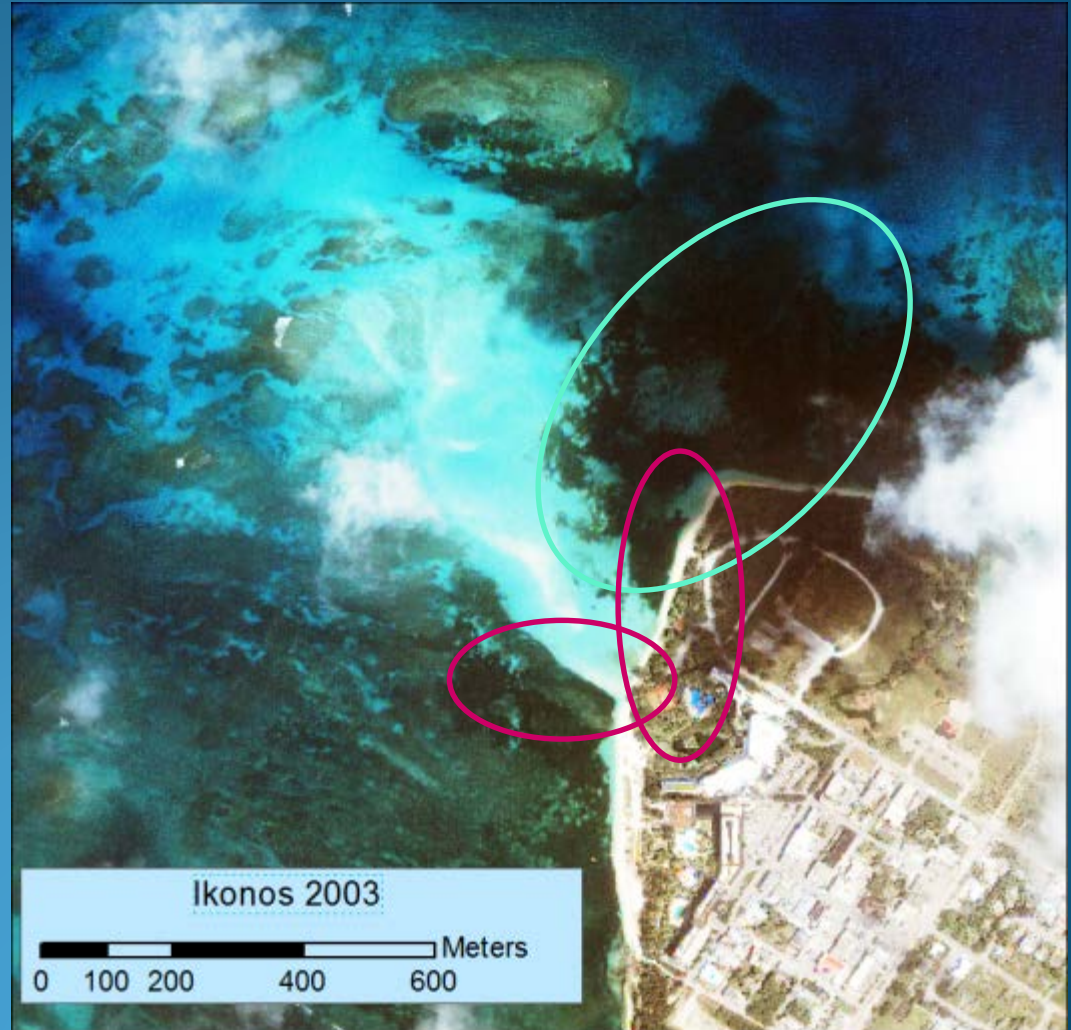
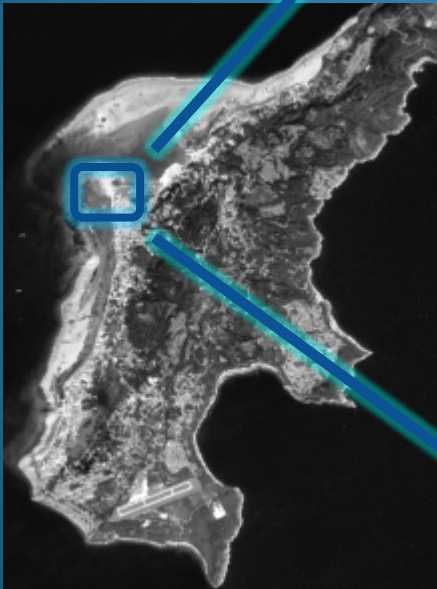
- *H. uninervis* loss
- Beach erosion, accretion, and renourishment



Change analysis

Garapan/Memorial Park

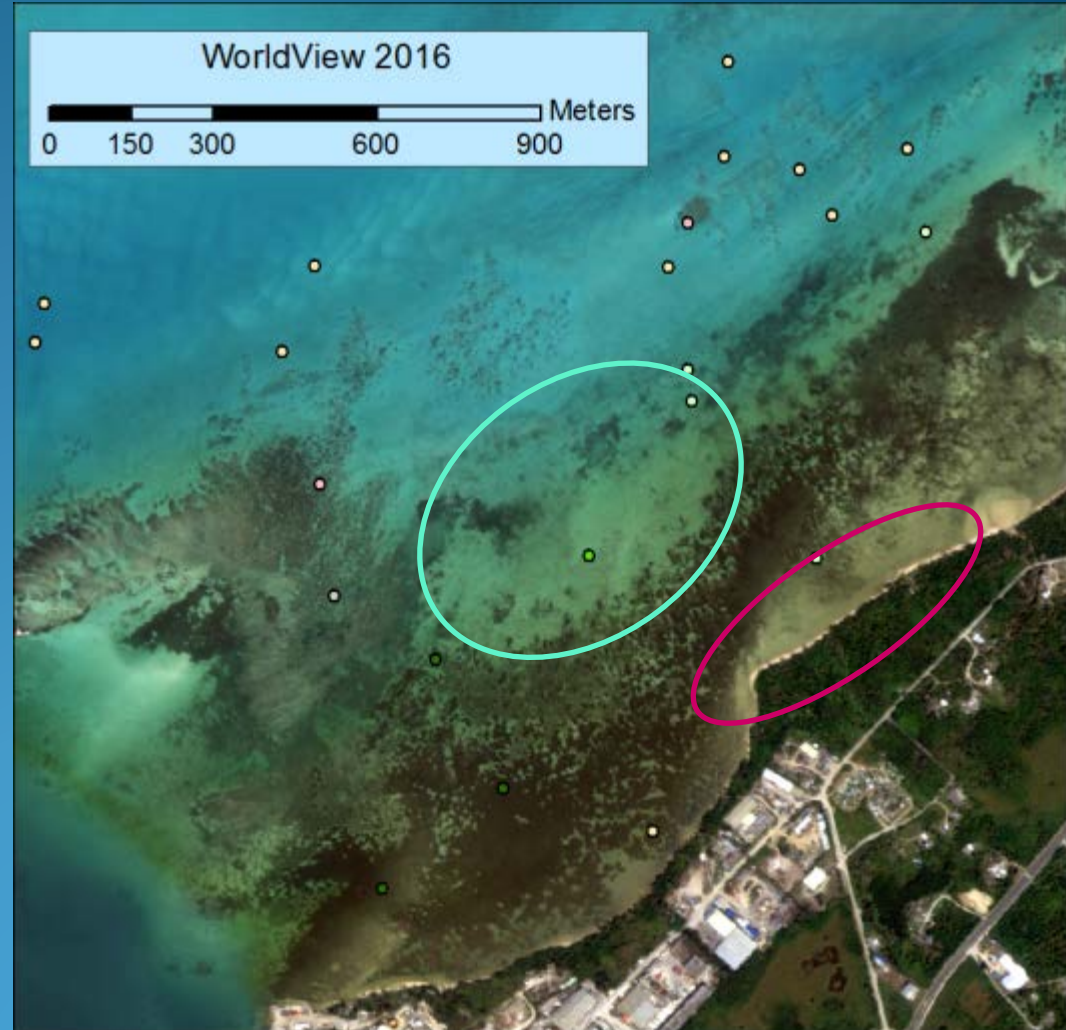
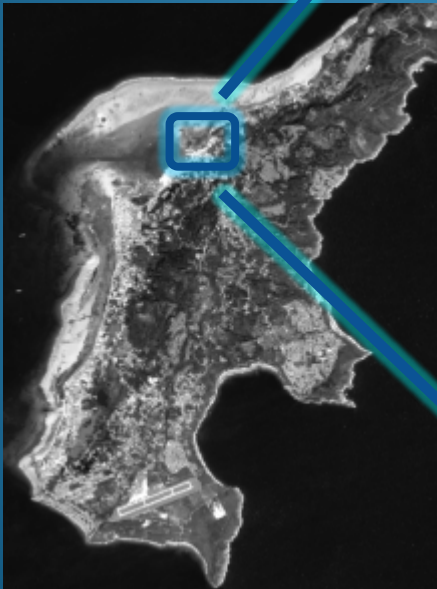
- *H. uninervis* loss
- Beach erosion, accretion, and renourishment



Change analysis

Tanapag

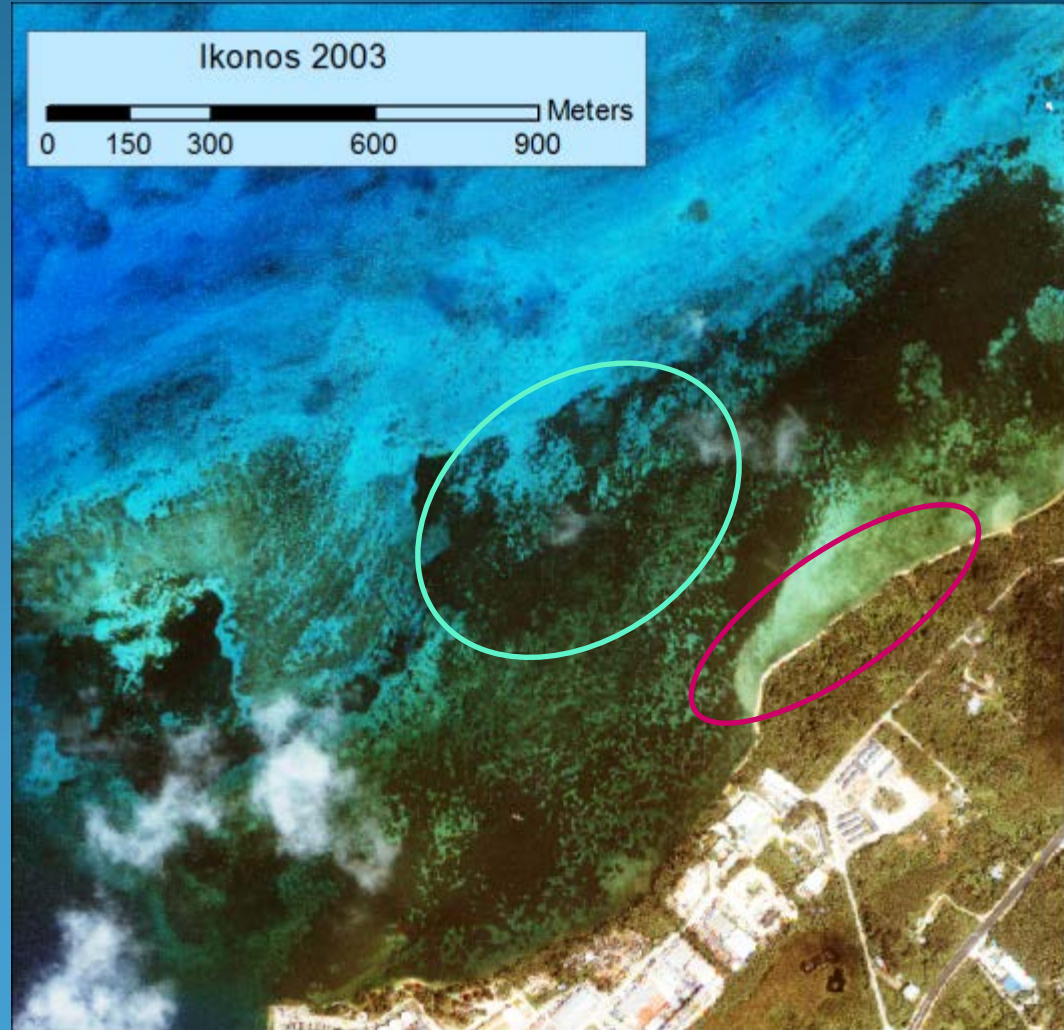
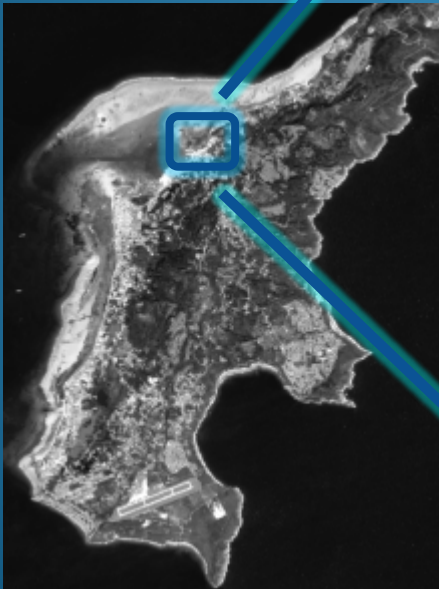
- *H. uninervis* loss
- Nearshore sand redistribution



Change analysis

Tanapag

- *H. uninervis* loss
- Nearshore sand redistribution

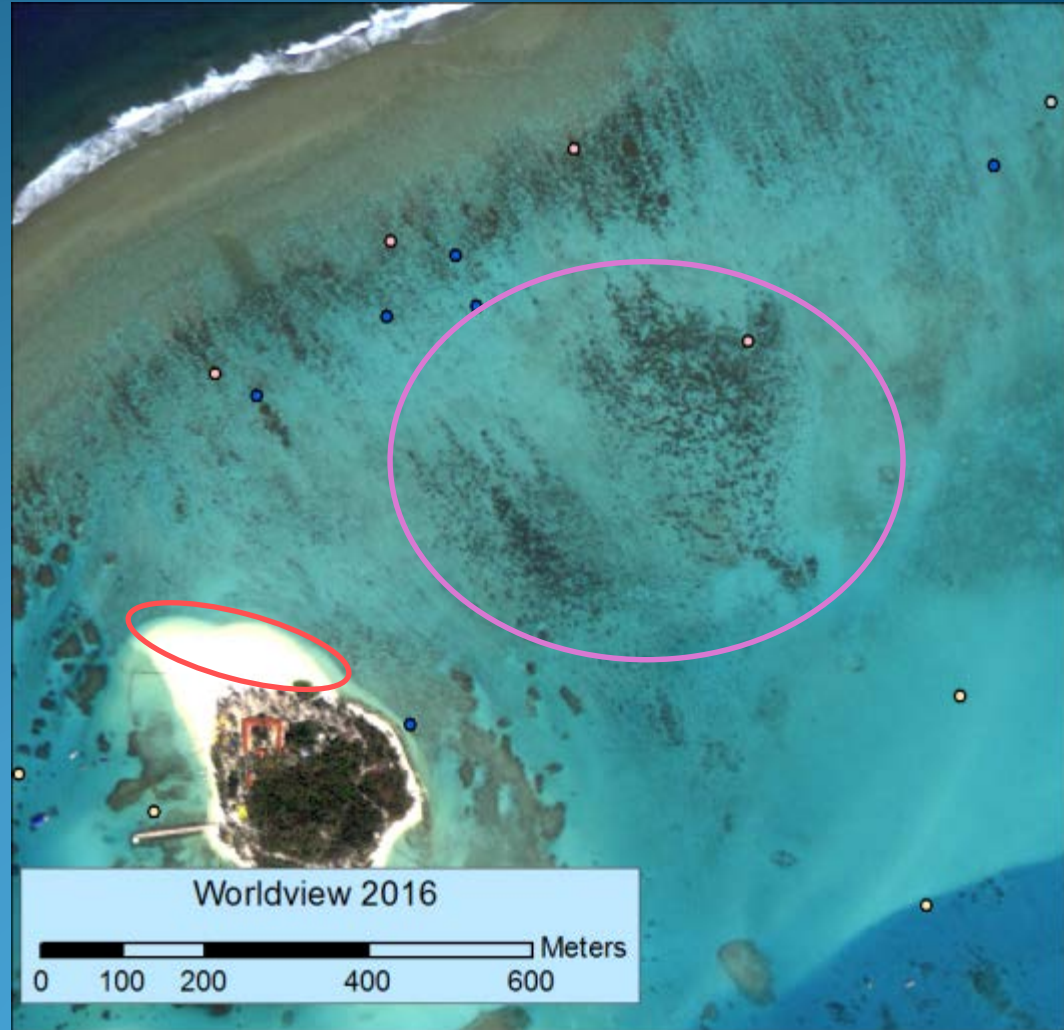
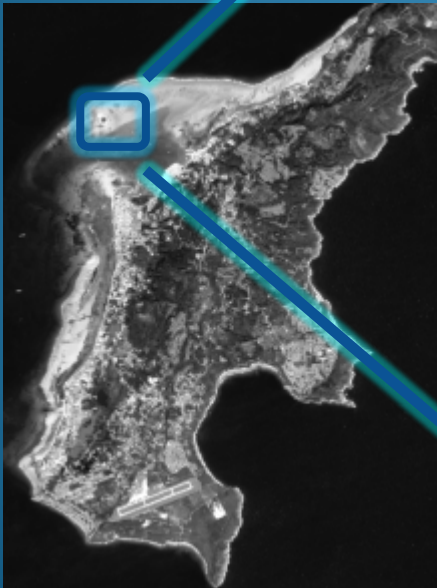


Change analysis

NE of Mañagaha

- *I. palifera* gains

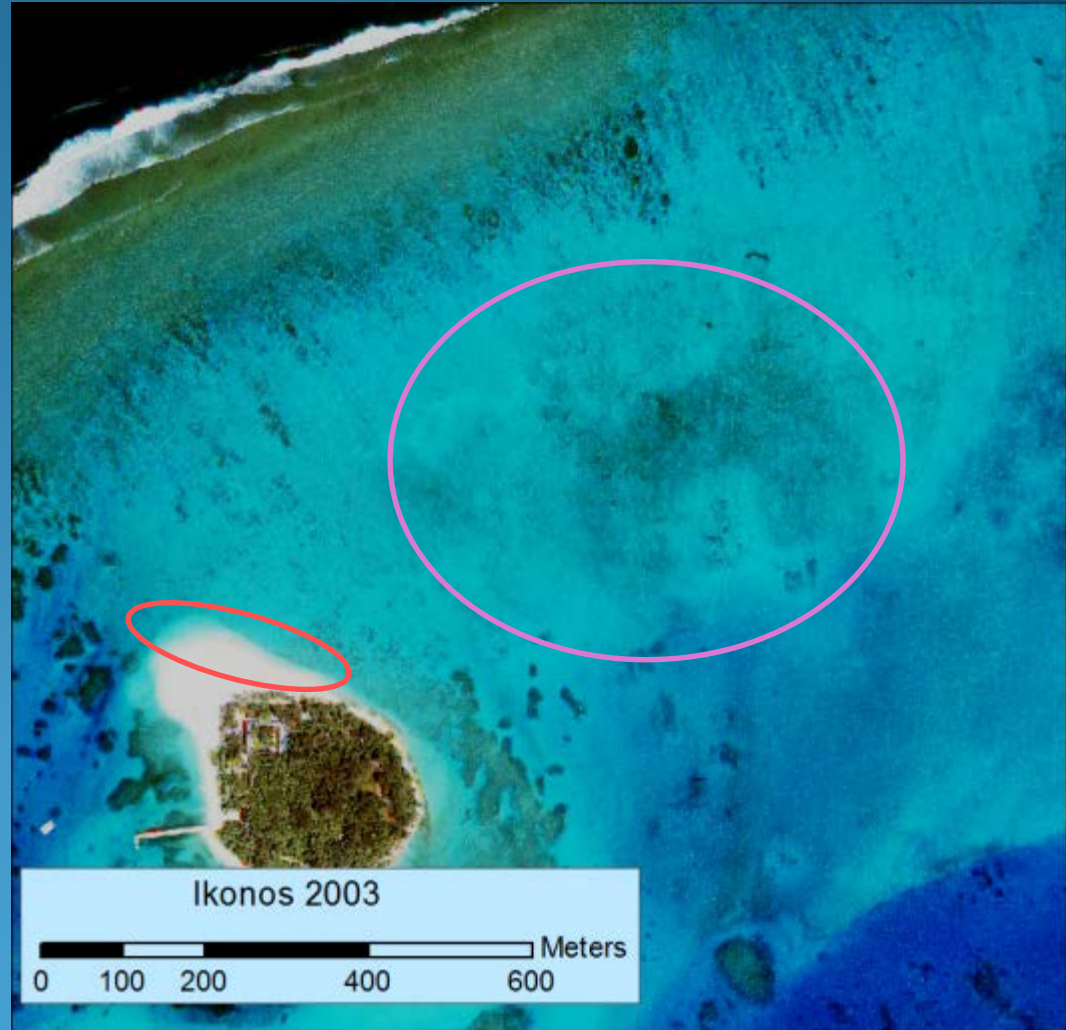
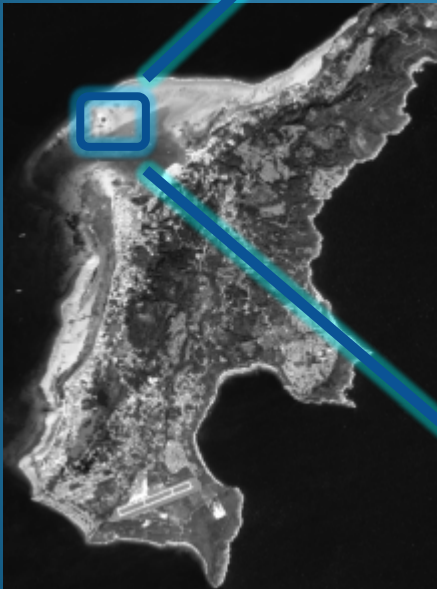
- Beach shape



Change analysis

NE of Mañagaha

- *I. palifera* gains
- Beach shape



Summary

- Maps are based on high resolution satellite image collected during excellent atmospheric and water conditions
- 27 km² of lagoon features were mapped at 2 m resolution
- Flat map was created based on 7 common habitat types
- Overall thematic accuracy: 86% correct
- Several notable areas of reef change and seagrass loss since 2003
- All input data and map layers are available at biomapper

<https://maps.coastalscience.noaa.gov/biomapper/biomapper.html?id=saipan>

Thanks....Questions?



Arielle Baker
Tim Battista
Ken Buja
Rodney Camacho
Fran Castro
B-Sea Charters
Robbie Green
Peter Houk
Rachel Husted

John Iguel
NOAA Interns
Lyza Johnston
Steve McKagan
Todd Miller
Dana Okano
Ryan Okano
Captain Frank Ramon



Rapid Land Cover Change on Saipan

What does it mean for the Lagoon?



Robbie Greene – “GIS Guy”, CNMI Bureau of Environmental & Coastal Quality



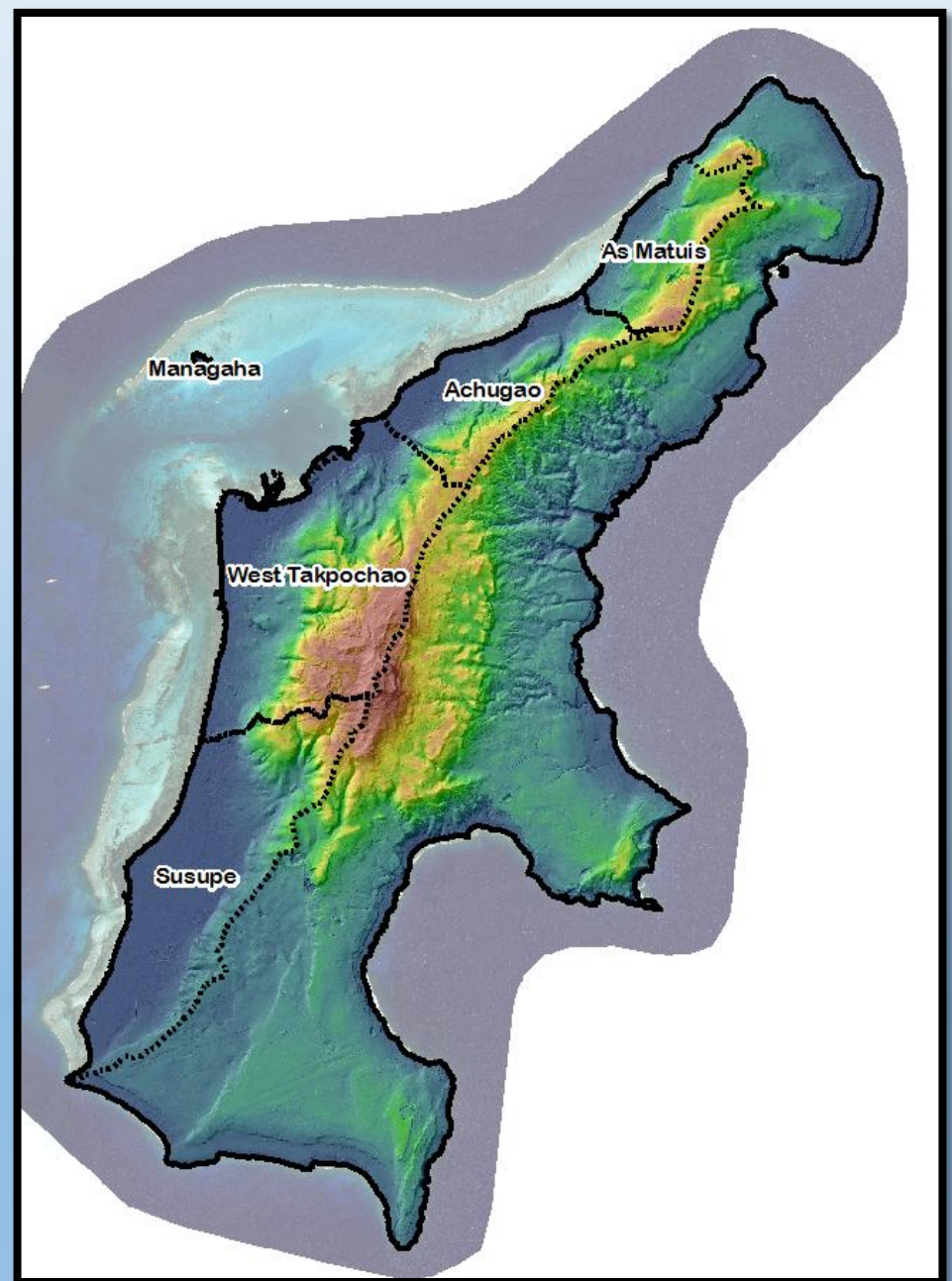
Pay Attention – It goes by quick!

- How do we model watershed-scale influences on the Lagoon?
- Which (sub)watersheds are our worst offenders (according to 2005 data)?
- How has the landscape shifted since then?
- Where do we target our efforts at reducing non-point source runoff?



Priority Watersheds & Density of Development

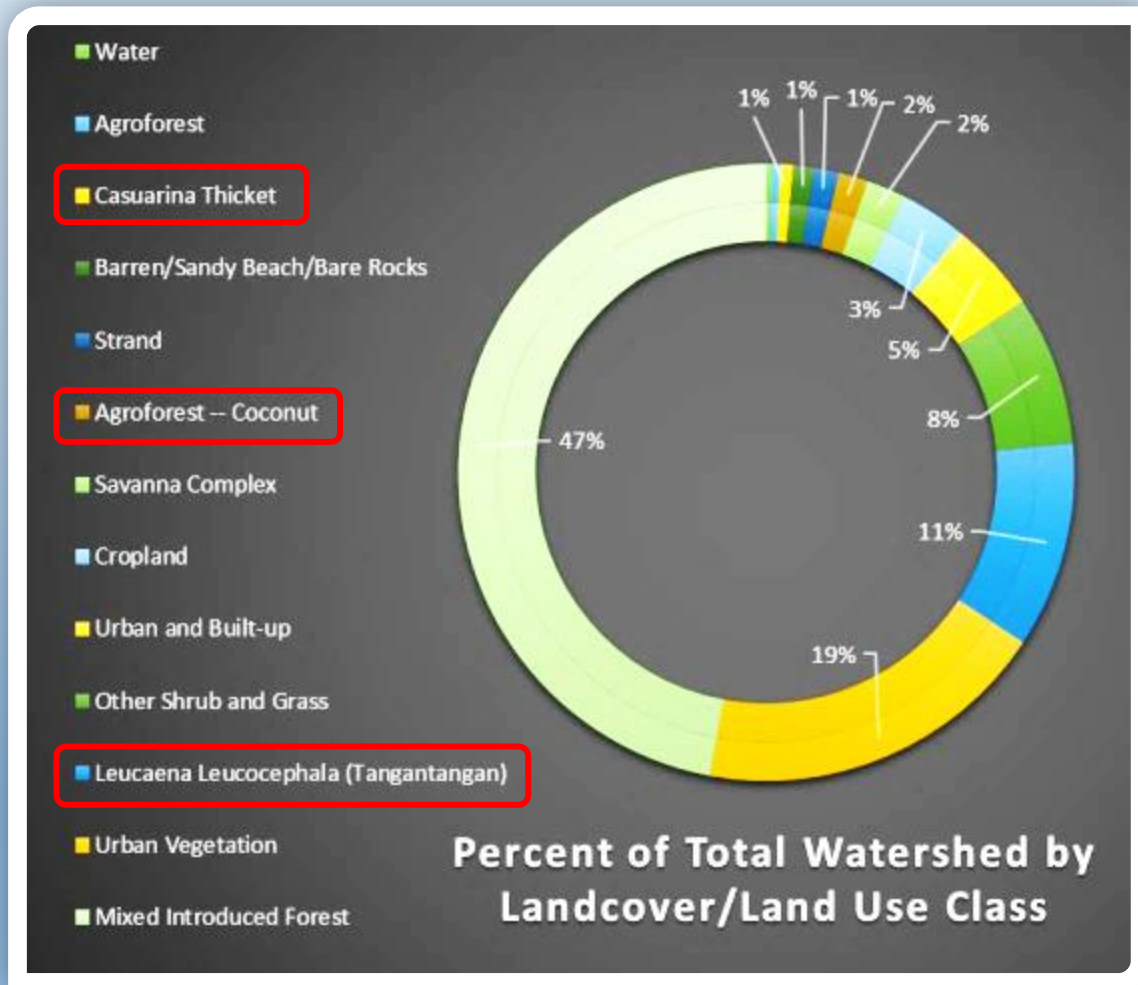
- ~75% of development, dense population centers, and impervious surface on watersheds adjacent to Lagoon.
- Landcover data is our best proxy for large-scale nutrient/pollutant loading
- 2007 U.S. Army Corps Elevation Data enables modelling!



Coefficients for Nutrient Loading in Landcover Data

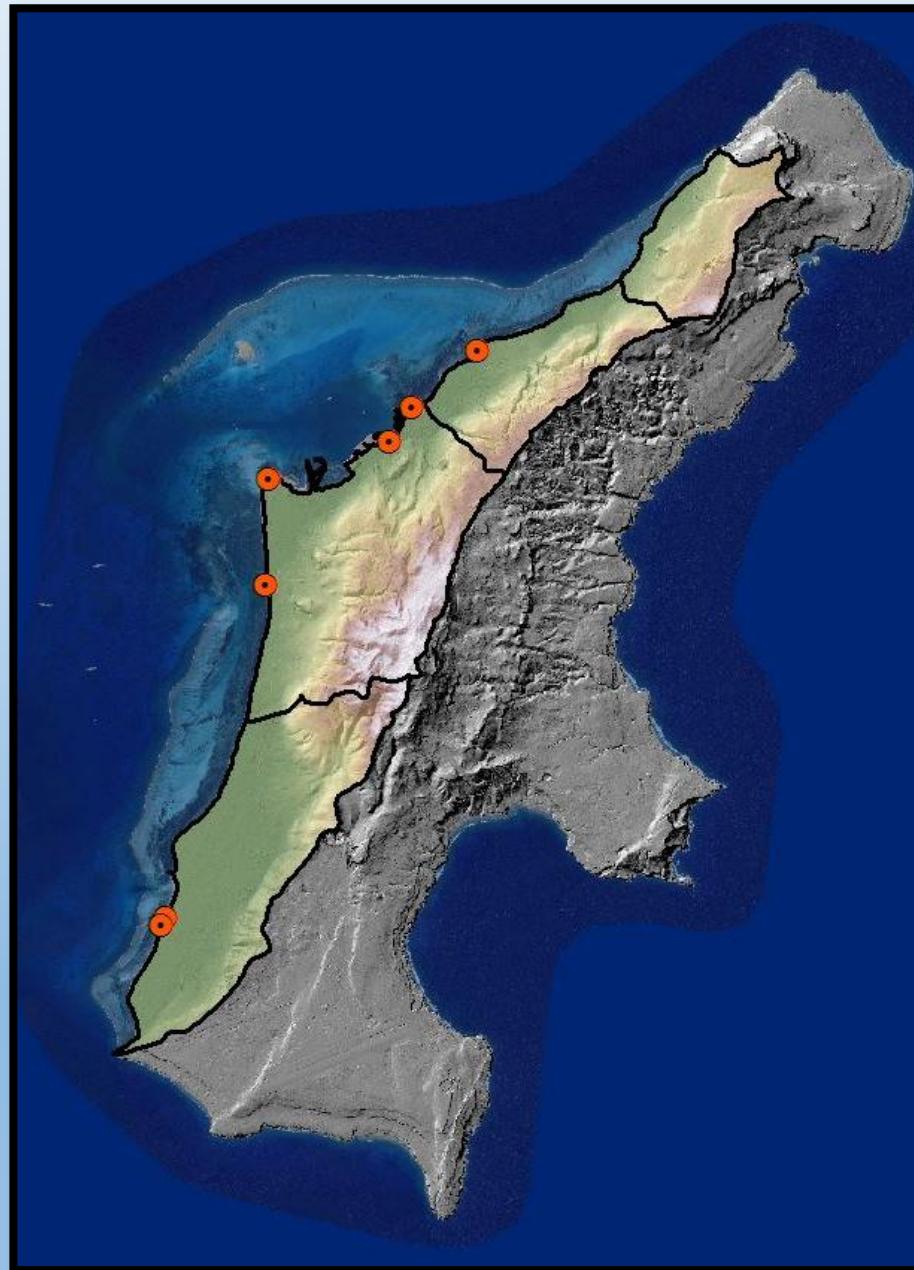
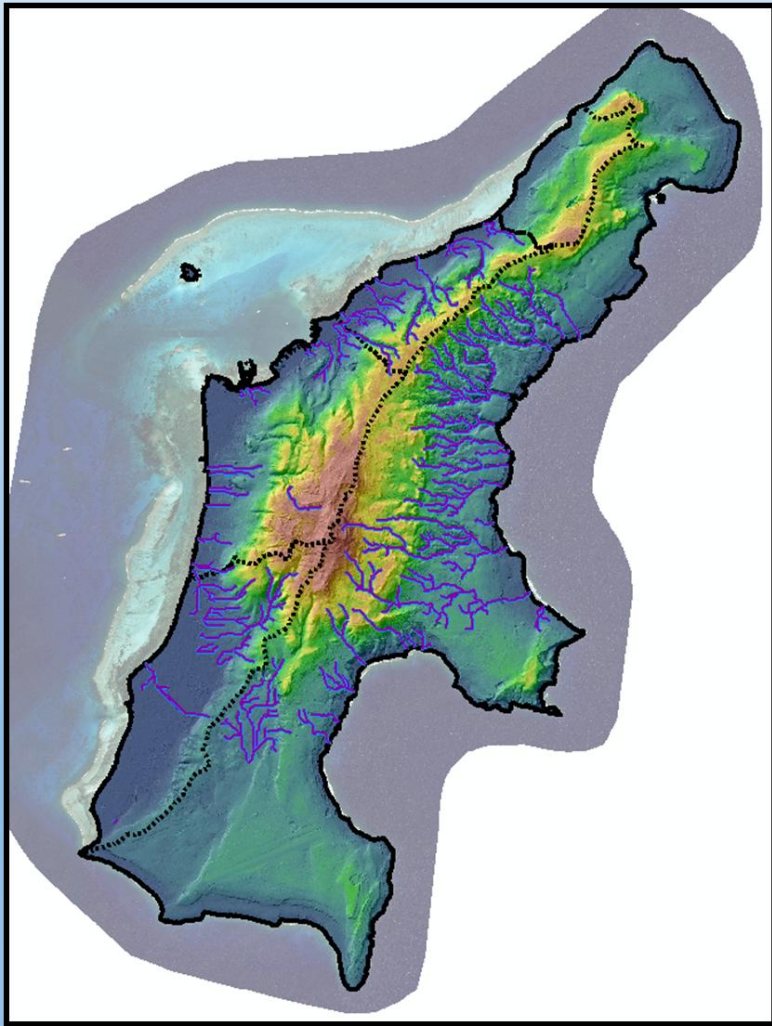
Name	N-C	CN-D	Cover-Factor
Background	000	0.0000	0.000
No Data	000	0.0000	0.000
High Intensity Develop	400	0.9500	0.000
Medium Intensity Dev	000	0.9200	0.010
Low Intensity Develop	300	0.8700	0.030
Developed Open Spa	900	0.8400	0.005
Cultivated Land	500	0.8900	0.240
Pasture/Hay	400	0.8000	0.050
Grassland	100	0.7800	0.120
Deciduous Forest	000	0.7700	0.009
Evergreen Forest	000	0.7700	0.004
Mixed Forest	000	0.7700	0.007
Scrub/Shrub	500	0.7300	0.014
Palustrine Forested W	000	0.0000	0.003
Palustrine Scrub/Shr	000	0.0000	0.003
Palustrine Emergent W	000	0.0000	0.003
Estuarine Forested W	000	0.0000	0.003
Estuarine Scrub/Shr	000	0.0000	0.003

NSPECT Coefficients by C-CAP Class

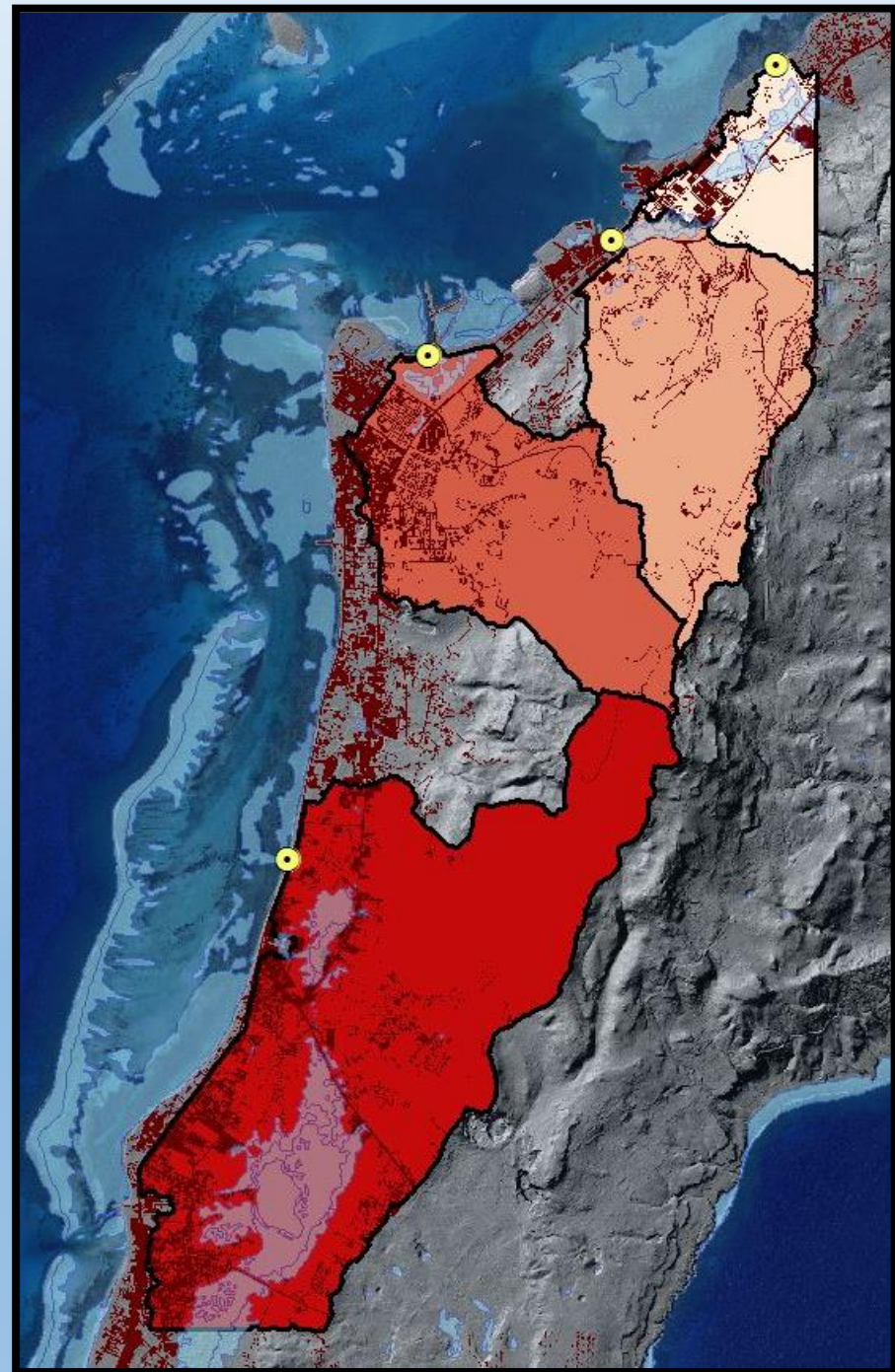
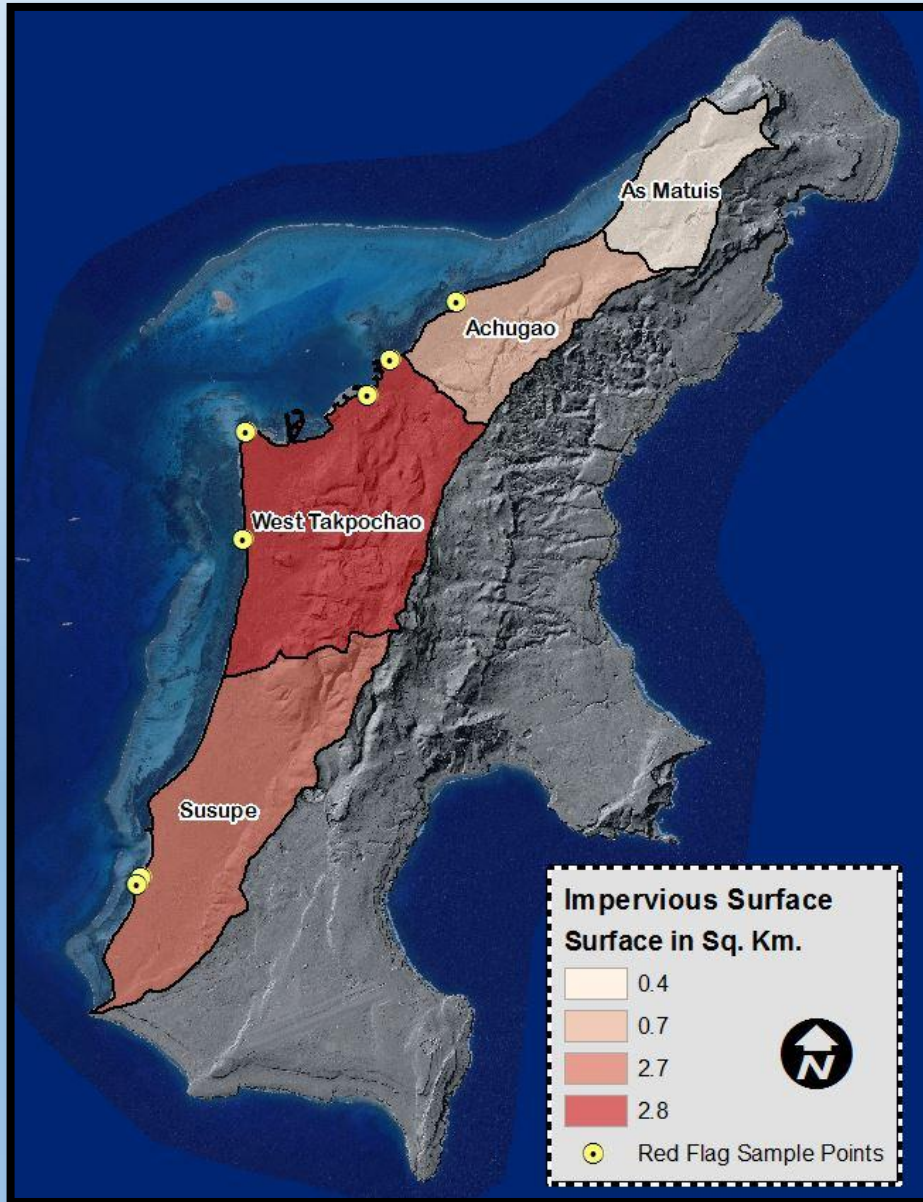


USFS Vegetation Class Distinctions

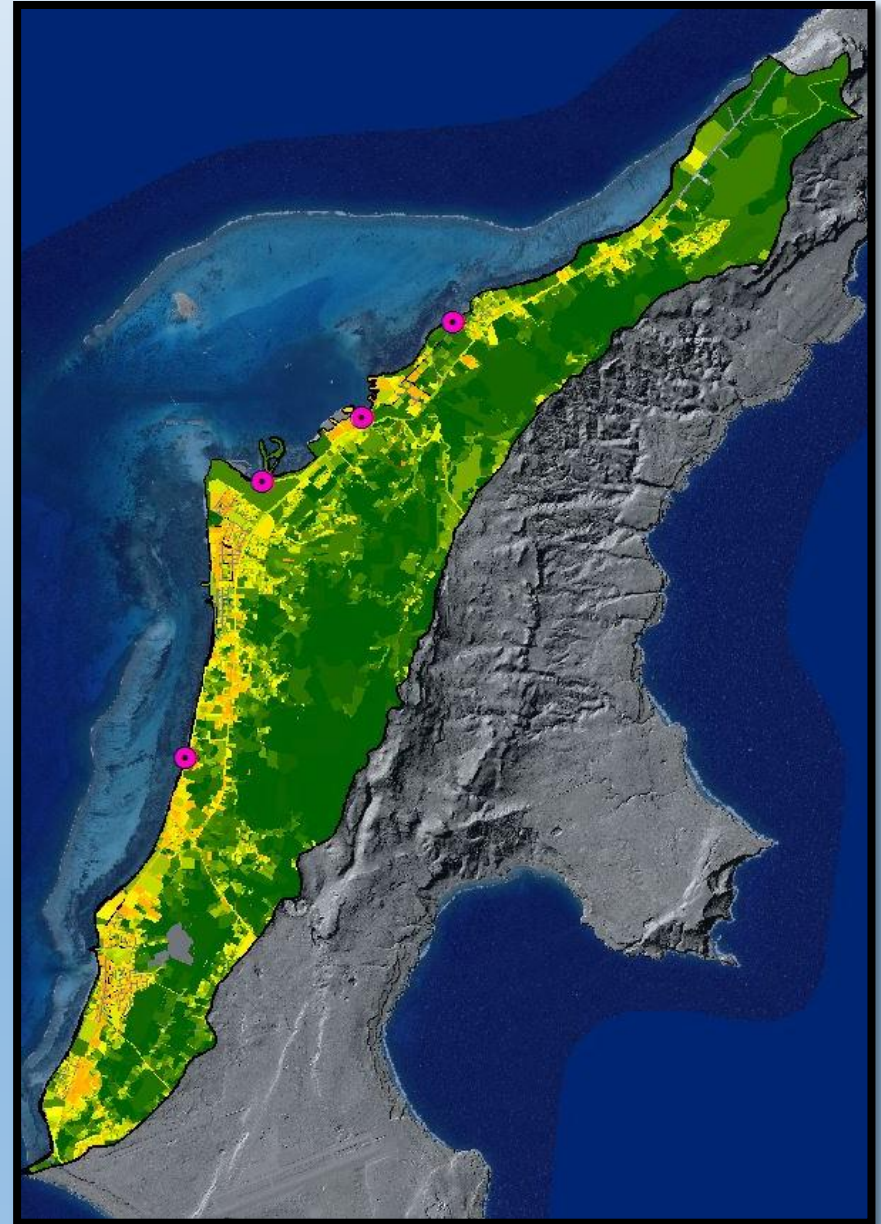
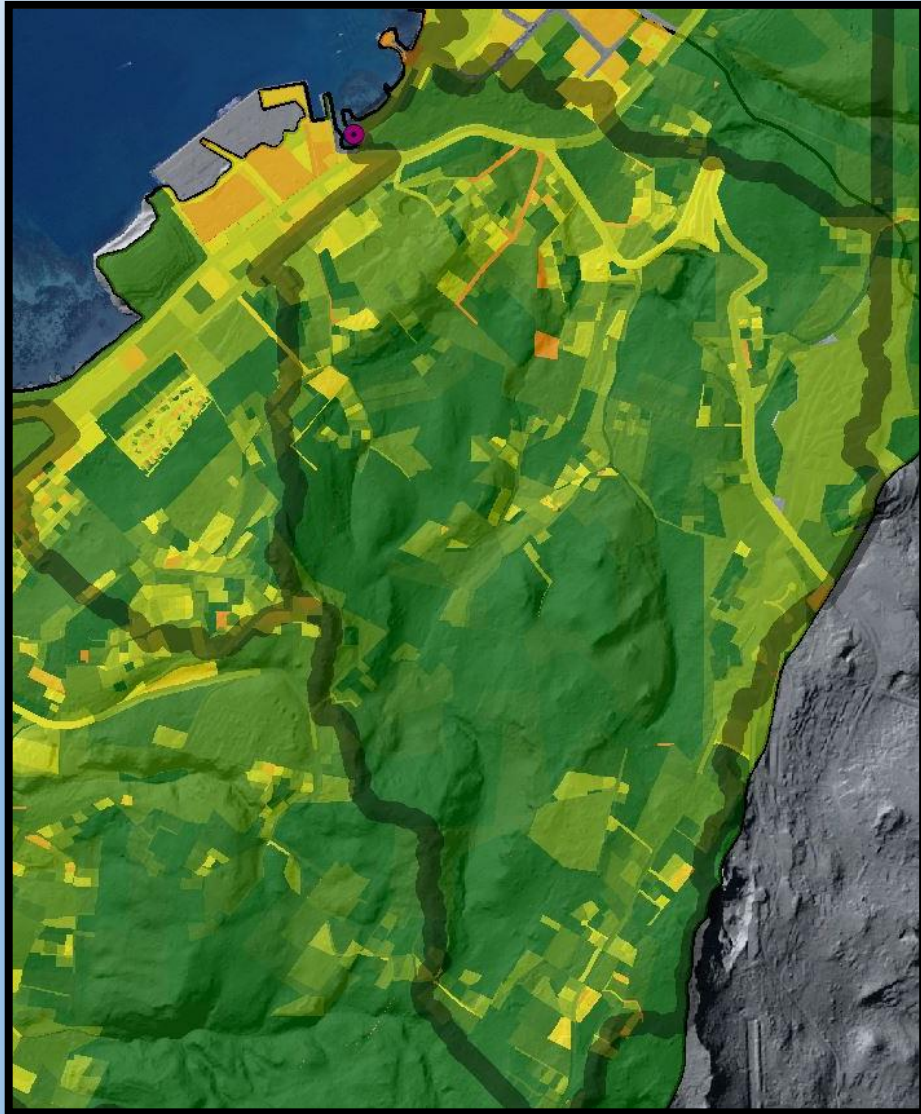
Surface Hydrology & Critical Outflow Points



Impervious Surface Within (sub)water sheds



Targeting Run-Off at The Parcel Scale



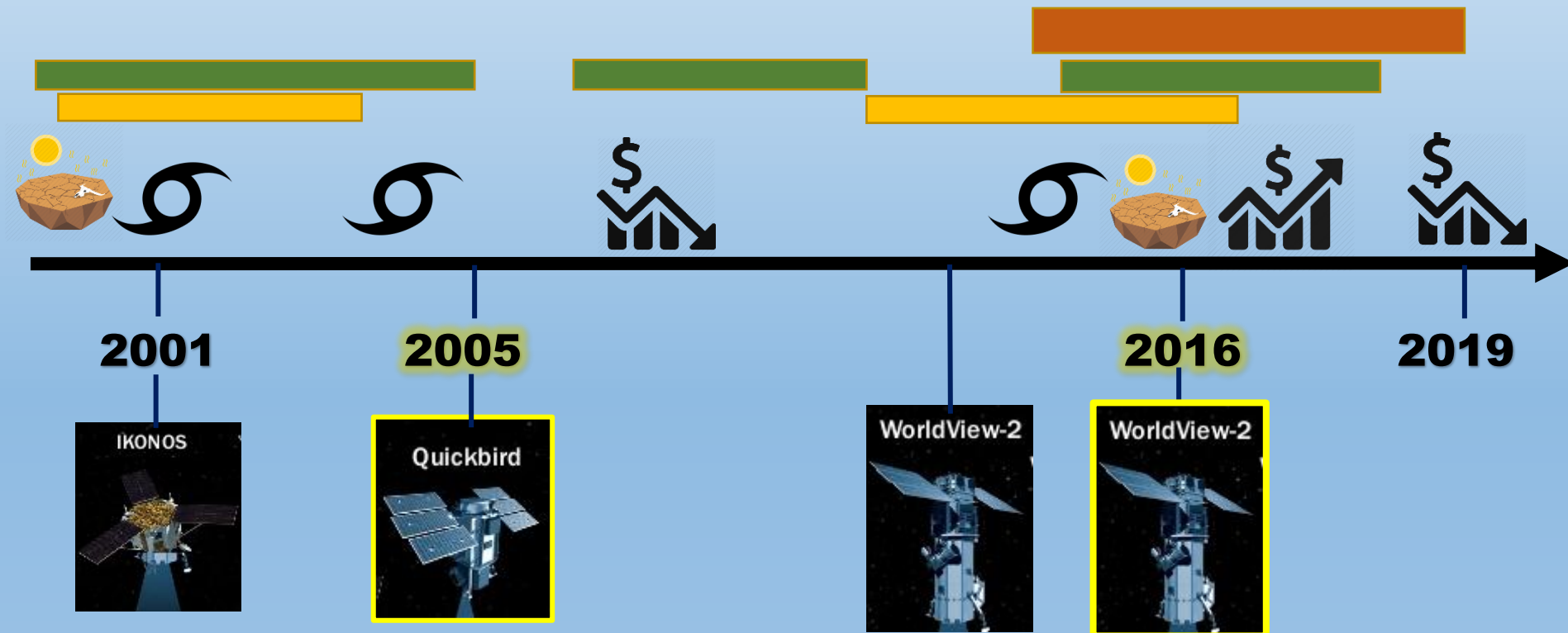
Timeline: C-CAP vs. LC/LU ▲



Type 1: Physical Landform Change

Type 2: Canopy Change & Succession

Type 3: Semi-Permanent LU Change (e.g. Development)



The Casino

Semi-Permanent LU Change



Relevancy of 2016 Update

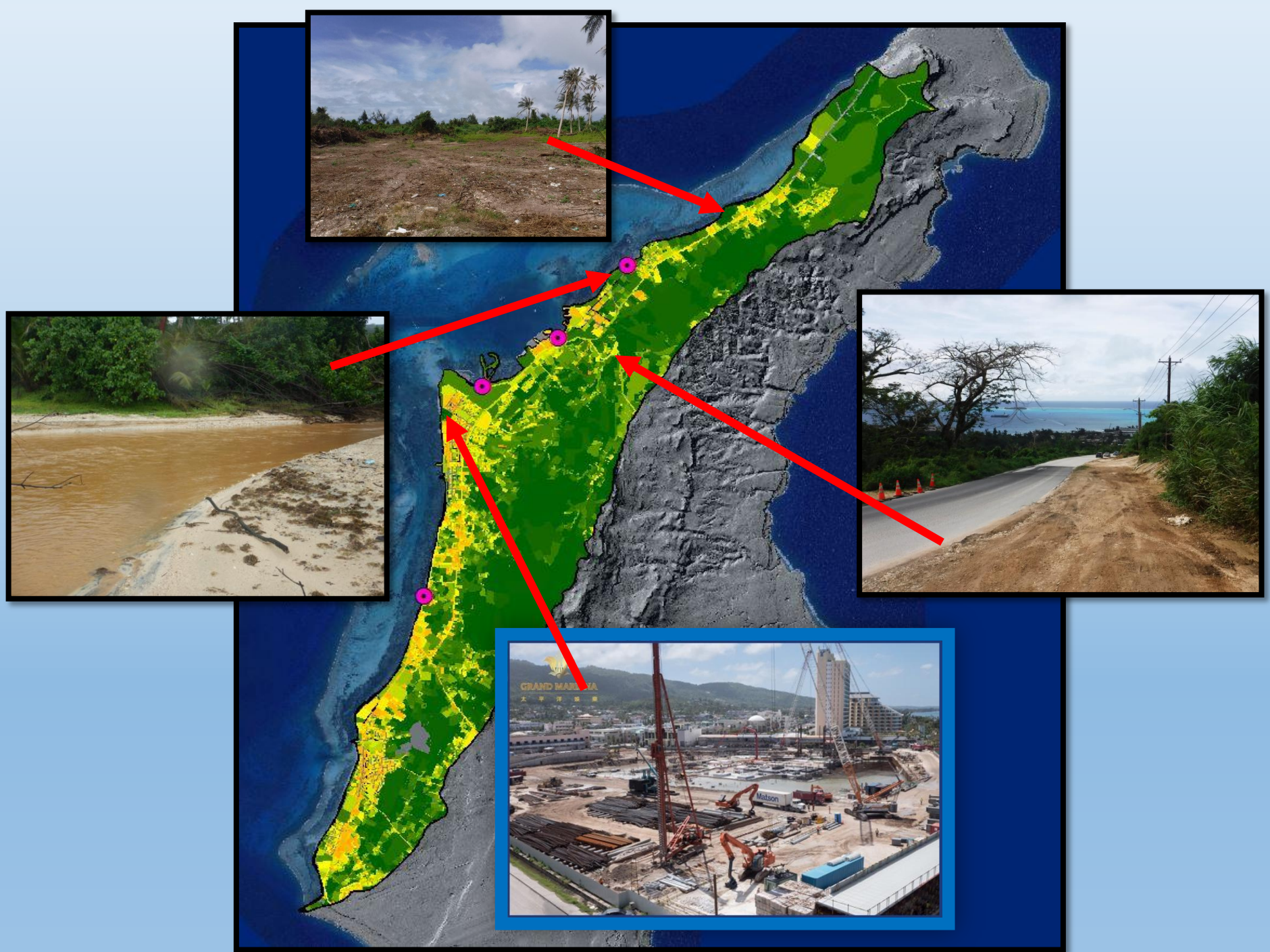
Semi-Permanent LU Change



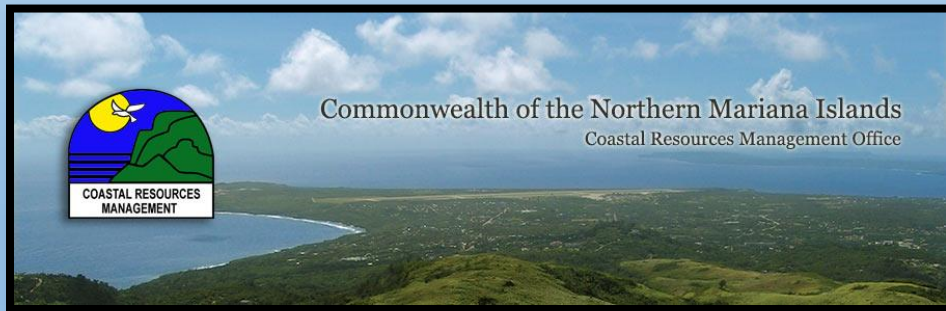
2016 Update

Semi-Permanent LU Change





Questions? Comments? Deep Thoughts?



Robbie Greene – RobbieGreene@becq.gov.mp





MINDA

Micronesia Islands Nature Alliance

A Non-profit 501c3 Conservation Organization

Fostering community and science-based conservation programs to enhance and sustain Micronesia's environments and cultures.

**Saipan Lagoon Use Management Plan Forum
April 25-26, 2017**

Partners in Environmental Conservation

MINA works closely with our partners including BECQ and DLNR to ensure a healthy and vibrant Saipan lagoon for future generations.

Like these agencies, the majority of MINA's funding comes from grants from the Department of Interior, Coral Reef Initiative, NOAA, The Nature Conservancy, Micronesia Conservation Trust, the Saipan and Northern Islands Legislative Delegation, among others.

Ongoing Projects

- *Marine Debris Program initiated in 2015:*
 - 17 cleanups with more than 20 partners
 - 34,383 pounds of trash and recycled materials with the help of more than 740 volunteers.
 - Reached more than 1,500 community members through the outreach efforts

Choose to Reuse Campaign

- ***Choose to Reuse Campaign***
“Taya Plastic Tuesdays”
 - Over half a million plastic bags have been kept out of the lagoon and landfill.
 - Joeten records show that over 46,000 reusable bags have been brought in to their stores since partnership began with MINA in February, 2015.



Adopt a Bin Program

Started in 2010 with a few bins placed at the more popular beaches on Saipan.

Today, MINA manages 20 bins at sites around the island, sponsored by local business and partners.

Since August of 2015, MINA has collected 28.2 tons of trash and recycled materials, and prevents toxic plastic and other trash from washing into the lagoon.

Lead Ranger doing bin maintenance



Tasi-Watch Rangers

- Trained in communication, natural resources, and community enforcement.
- Outreach in their home villages promoting environmental responsibility and lagoon sustainability.
- Maintenance of the bins in MINA's Adopt a Bin program.
- Beach clean up and tree planting.
- Garapan surveillance – routine walk-about in the Garapan watershed area, sighting and reporting environmental violations and reporting to appropriate enforcement agencies.
- Rangers have moved on to higher education or are working in the field with our partner natural resources agencies, law enforcement, and education.



Tasi-Watch Ranger beach cleaning

2016 Beach Cleanup Laly 4

(San Isidro Beach Park, Chalan Kanoa)



Volunteers
removing marine
debris from Marine
Beach





CNMI

REGIONAL NEWS

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Fishermen bring in over 80 pounds of trash

25 Apr 2017



f Share Like 1 Tweet G+ Share 0

(MINA) — The Micronesia Islands Nature Alliance in partnership with the Saipan Fishermen's Association, held its Marine Debris Contest at the Mahi Mahi Fishing Derby on Saturday, April 22, 2017.

MINA challenged fishermen to collect marine debris, which is any man-made trash in the water. Raffle tickets were then given out to participants who brought in debris, for the opportunity to win a \$300 gift certificate to Joeten. Through the contest, 88.35 pounds of trash was collected out of the water, weighed and disposed of properly.



MORE N

- Water inter Rai
- Govt proc
- Guar sent ice tr
- Fish over trash
- Pala mee cour
- Fede laws to NI
- Doct diab mee
- Guar conv com
- CUO

Schools for Environmental Conservation

- Working with Saipan schools to raise awareness about threats to our island environment.
- Students develop school-focused Conservation Action Plans to address conservation issues they see facing their community related to the year's theme:
 - watersheds
 - marine protected areas
 - climate change
 - coral reef conservation

Schools for Environmental Conservation



Students in Schools for
Environmental Conservation
participating in tree planting
campaign at LauLau.



VOLUNTEER BEACH CLEANUP

Marine Beach, Kagman



Socioeconomic Monitoring

The Micronesia Challenge

Established in 2006, Chief Executives of the Commonwealth of the Northern Mariana Islands, Republic of Palau, the Federated States of Micronesia, the Republic of the Marshall Islands, and Guam, united to “effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020.”

MINA is a grant recipient from the Micronesia Conservation Trust and The Nature Conservancy for the purpose of taking the lead for capacity building under this program, and conducts training workshops throughout the region on data collection and its effective uses.

SEM-Pasifika: Socioeconomic Monitoring Guidelines for Coastal Managers in Pacific Island Countries

- ***Data collection***

- Identify threats, problems, solutions and opportunities for lagoon use
- Determine importance, value and cultural significance of lagoon resources and uses
- Assess positive and negative impacts of management measures
- Assess management effectiveness
- Build stakeholder participation and appropriate education awareness programs
- Verify and document assumptions of socioeconomic conditions in the area, community dynamics and stakeholder perceptions
- Establish baseline household and site profiles and relationships of people with lagoon resources

STRATEGIC ACTION PLAN: by 2020, MINA expects to meet the following goals:

- Have the necessary support and capacity to conduct community conservation work.
- An understanding in communities of the status of a healthy and vibrant lagoon; the benefits of coral reef ecosystems and fisheries, and supportive of actions and efforts to address these critical issues.
- Communities understand and use science to inform decisions in support of resilient environments and sustainable economic development.
- An awareness of climate change and actions communities can take to address it.
- Communities and visitors will have knowledge of, and comply with, environmental regulations.

2016-

Micronesia Islands Nature Alliance (MINA) *presents*
An event to raise funds for the protection and conservation
of the CNMI's beautiful natural environment



GREEN GALA

*Celebrating more than **10 years** of working with island communities for conservation*

Friday 9.2.2016 | 6pm | Hibiscus Hall, Fiesta Resort & Spa | Cocktail Attire | \$75

The work of MINA is enhanced by generous support from the business community, as well as sponsorship, particularly for **THE GREEN GALA**, the annual event that raises a significant part of its operational budget.



MIND

Micronesia Islands Nature Alliance



Si Yu'us Ma'ase

Island of Saipan & Saipan Lagoon



Lagoon User Survey & Mapping Report

Completed March 2016

By APEC

Purpose

User Survey:

To assess and map the recreational and commercial uses of the lagoon, identify potential areas of user conflict, and highlight focus areas for the SLUMP revision.

SLUMP:

To identify priority issues and management strategies that DCRM can apply to ensure that economic activity and habitat conservation within the lagoon are balanced for public benefit.

Survey Questions

Recreational Uses

SCUBA Diving

Snorkeling and Free Diving

Swimming

Paddling

Surface Board Sports

Motorized Boating

Sailing

Beach Use

Commercial Uses

SCUBA Diving

Snorkel Tours

Parasailing

Banana Boating and other boat towing activities

Jetski rental

Transit and Dinner Cruises

Commercial Shipping

Fishing

Hook and Line Fishing

Spearfishing

Throw net/Talaya Fishing

Gillnet/Chenculu/Tekken

Harvesting/Gleaning

Why do you use the lagoon rather than other areas of Saipan?

Safety (Sheltered & Shallow)

Proximity to Populated/Commercial Areas

Shoreline Access

Amenities

What are the greatest concerns facing the lagoon?

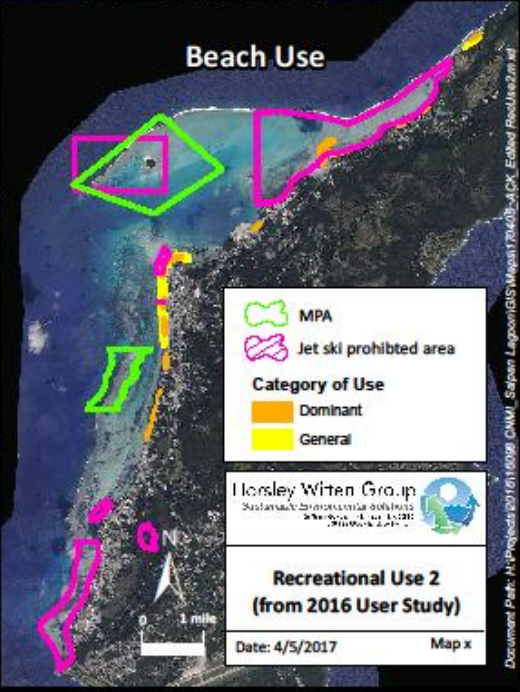
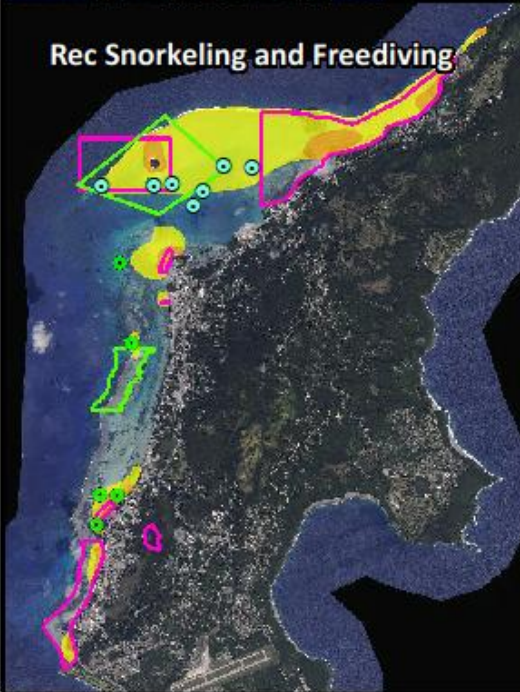
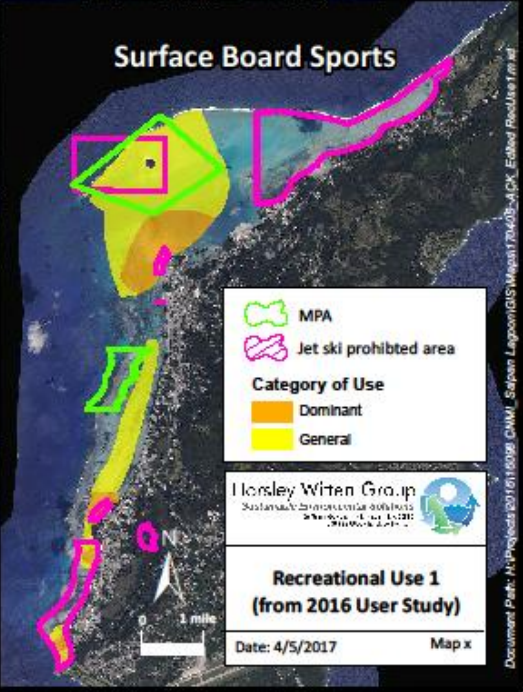
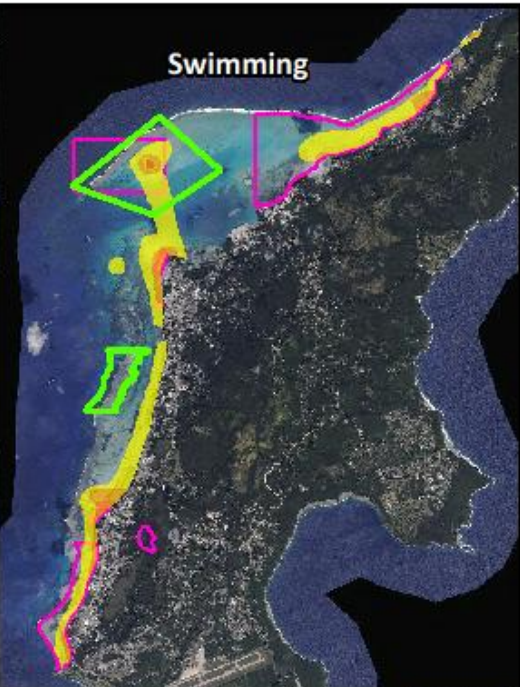
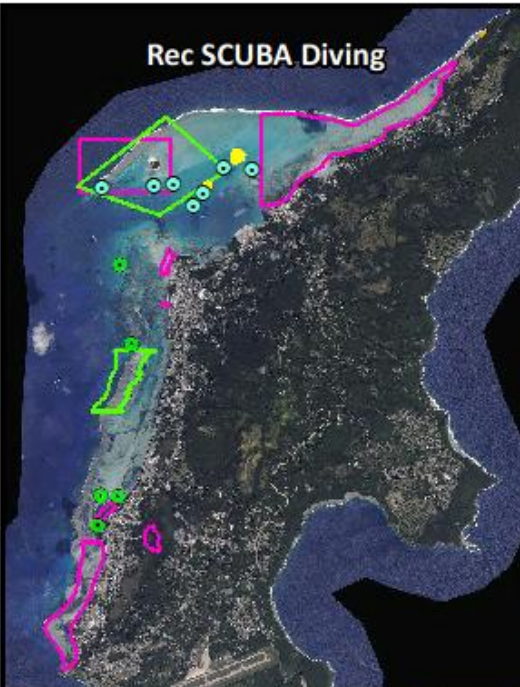
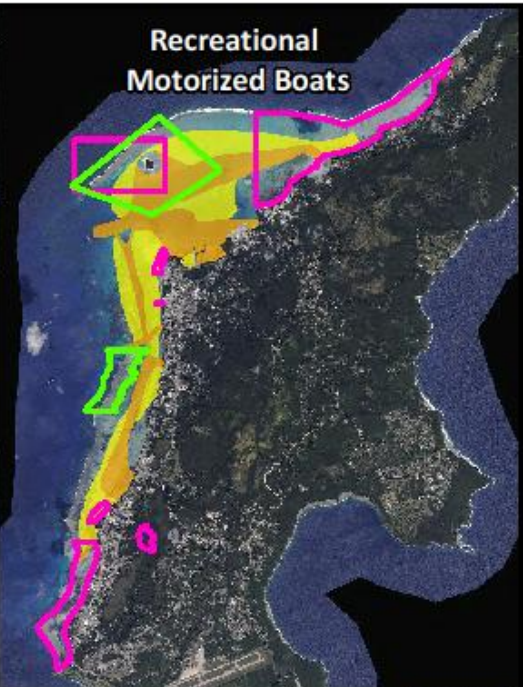
Water Quality

Shoreline Development

Coral Health

Overfishing

Litter



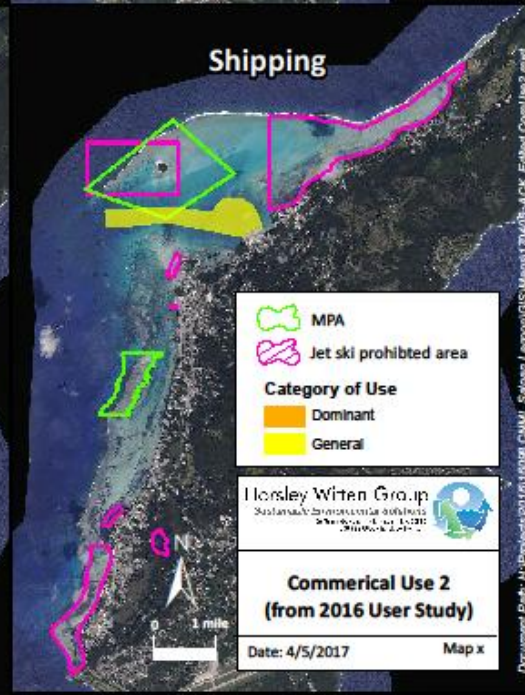
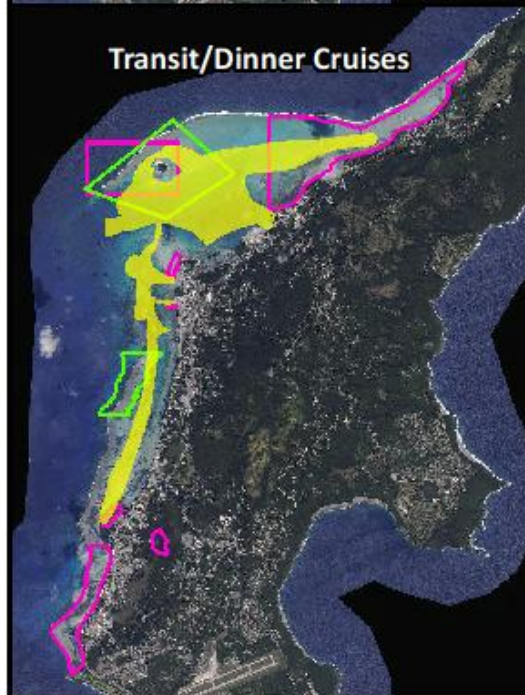
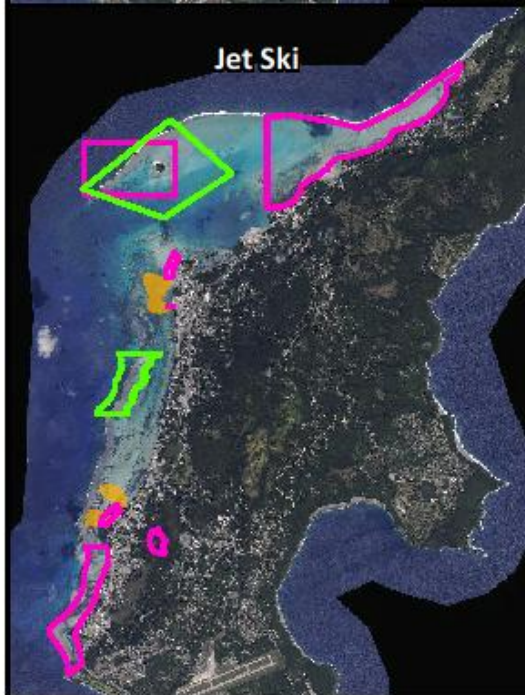
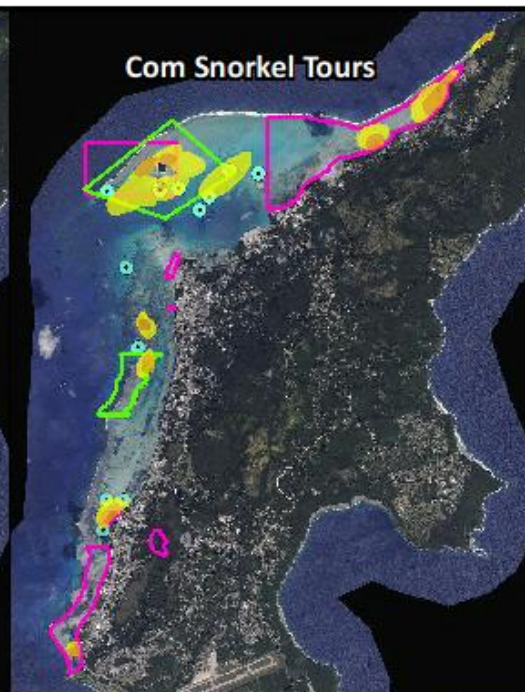
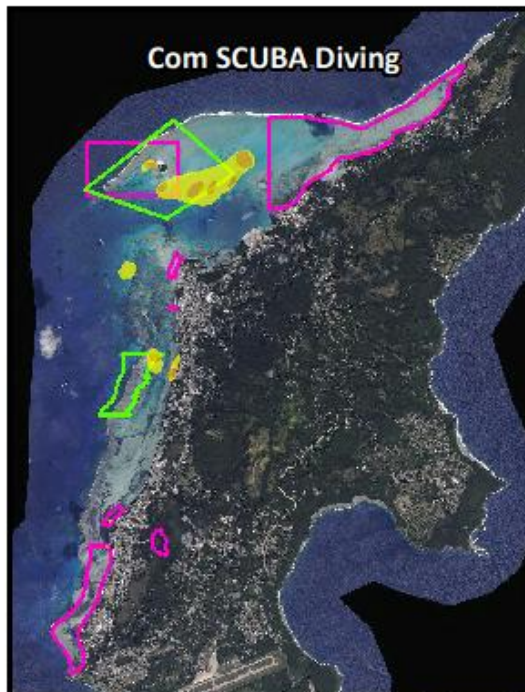
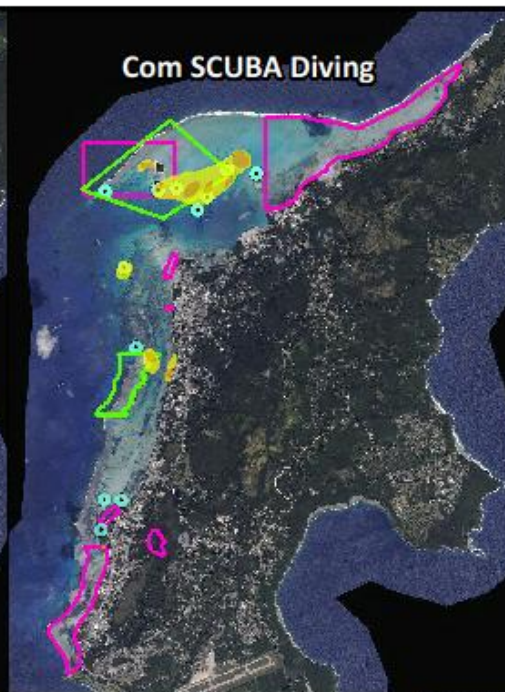
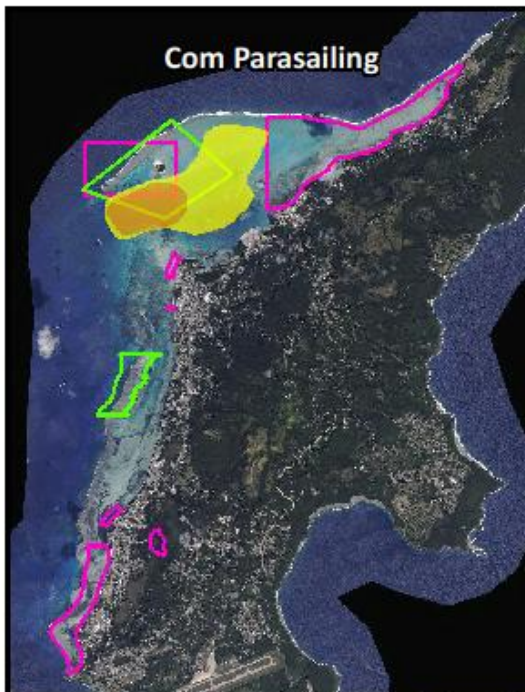
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Findings: Recreational Uses

- SCUBA – Restricted by depth and access
- Snorkeling – Avoid outfalls & boat traffic, prefer beach parks with parking
- Swimming – Exercise between Tanks, Oleai to World Resort & PauPau
- Paddling/Surface Boards – Kilili, Northern beaches & Rental locations

Wing, PauPau, Tanapag, Managaha, Micro, M&M corridor,
Tanks, Sugar Dock, PIC, Pakpak



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Findings: Commercial Uses

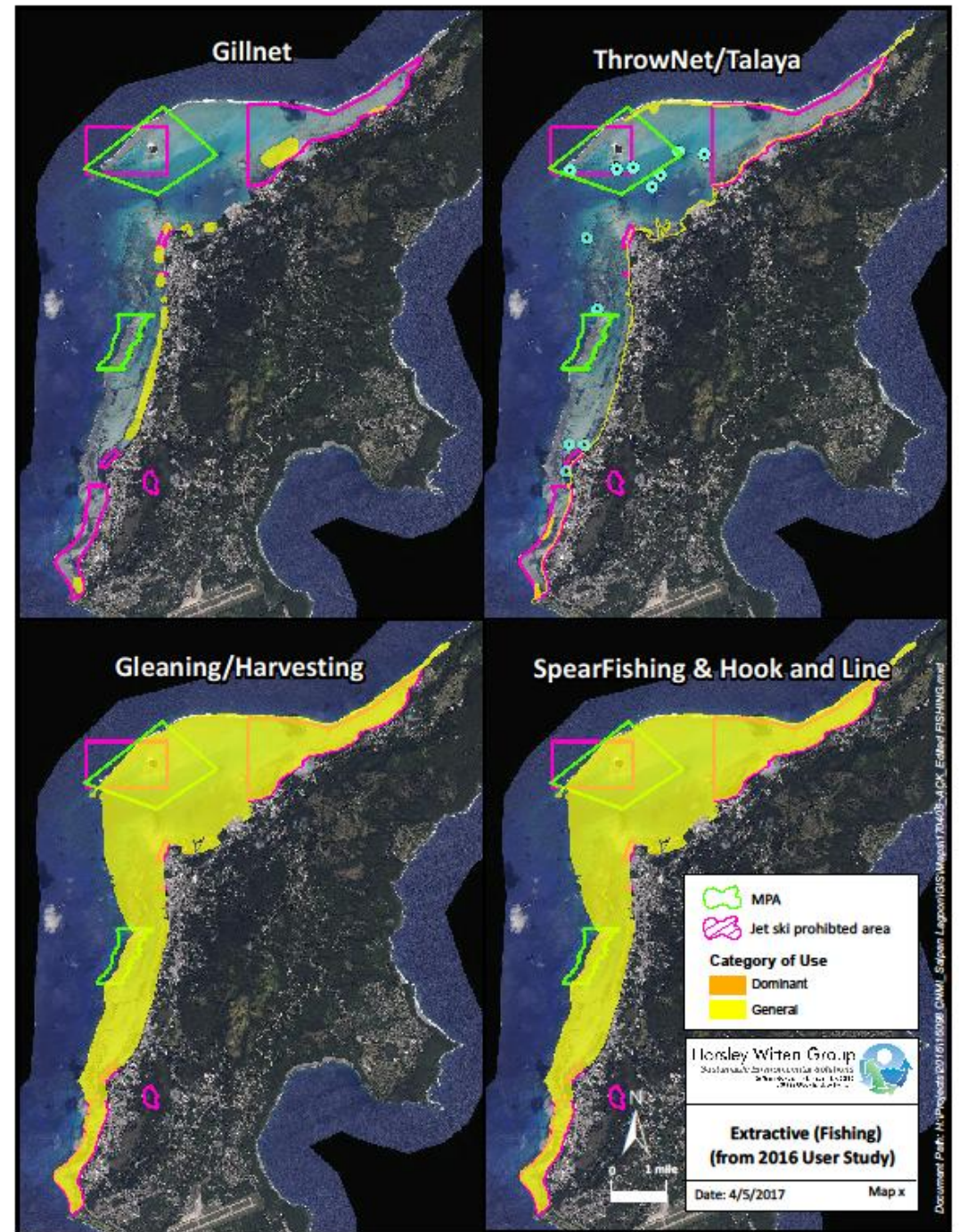
- SCUBA – North central reefs/wrecks & “pool classes”
- Snorkeling – Staghorn reefs near Lighthouse
- Parasailing – Designated deep zones
- Banana Boating – Tracks to Managaha
- Jet Ski – Commercial operating zones & general exclusion areas

Between launch sites and Managaha, Tanapag lagoon,
Hyatt/Fiesta/Grandvrio/World/Kanoa

Findings: Fishing

- Gillnet – Prohibited
- Throw net – Shallow waters
- Hook & Line – Avoid boats and jet skis
- Harvesting – Habitat specific

Pakpak, Beach Rd Pathway,
Micro, Tanapag, PauPau



Management Priorities

- Manage overcrowding & user conflicts
- Protect priority locations & resources
- Maintain water quality & erosion control
with continued stakeholder involvement



The Asahi Shimbun



Salpan Shores

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

SAIPAN LAGOON USE MANAGEMENT PLAN FORUM

SAIPAN CHAMBER OF COMMERCE: THE SAIPAN LAGOON & COMMERCIAL USE

COMMERCIAL USERS OF THE SAIPAN LAGOON:

MARINE SPORTS TOUR OPERATORS (JET SKI, DIVING, BANANA BOAT, FISHING, SNORKELING)



COMMERCIAL USERS OF THE SAIPAN LAGOON:

HOTELS (BEACH ACTIVITIES)



COMMERCIAL USERS OF THE SAIPAN LAGOON:

RESTAURATEURS (BEACH BARS)



COMMERCIAL USERS OF THE SAIPAN LAGOON:

SUBMARINE AND AMPHIBIOUS VEHICLE OPERATORS



COMMERCIAL USERS OF THE SAIPAN LAGOON:

PHOTOGRAPHERS (PUBLICATIONS, PROMOTIONS AND WEDDINGS)



COMMERCIAL USERS OF THE SAIPAN LAGOON:

PUBLIC RECREATION



The background of the slide is a light gray gradient. It is decorated with several realistic water droplets of various sizes, scattered primarily in the top-left and bottom-right corners. The droplets have highlights and shadows, giving them a three-dimensional appearance.

CHALLENGES FACING COMMERCIAL USERS

CHALLENGES FACING COMMERCIAL USERS

ALGAE ACCRETION ON THE BEACH AND NEAR SHORE



CHALLENGES FACING COMMERCIAL USERS

WATER TURBIDITY



CHALLENGES FACING COMMERCIAL USERS

TRASH ON THE BEACH



CHALLENGES FACING COMMERCIAL USERS

LACK OF, OR INSUFFICIENT NUMBER OF PROPER MOORINGS, ESPECIALLY AT SITES OF INTEREST





THINGS COMMERCIAL USERS WOULD LIKE TO SEE

THINGS COMMERCIAL USERS WOULD LIKE TO SEE

CONSISTENT DAILY BEACH MAINTENANCE IN PRIMARY TOURIST AREAS, INCLUDING TRASH COLLECTION, BEACH GROOMING AND ALGAE REMOVAL



THINGS COMMERCIAL USERS WOULD LIKE TO SEE

BETTER PUBLIC-PRIVATE COLLABORATION IN ORDER TO ADDRESS NON-POINT SOURCE POLLUTION THAT LEADS TO WATER TURBIDITY, EUTROPHICATION AND ALGAE BLOOMS.



THINGS COMMERCIAL USERS WOULD LIKE TO SEE


INSTALLATION OF ADDITIONAL MOORINGS THROUGHOUT THE LAGOON WITH PARTICULAR EMPHASIS ON SITES OF INTEREST (WWII ARTIFACTS AND CORAL HEADS).





THINGS COMMERCIAL USERS WOULD LIKE TO SEE

A PUBLIC-PRIVATE PARTNERSHIP SUPPORTING THE CREATION, PUBLICATION AND DISTRIBUTION OF LAGOON MAPS SHOWING POINTS OF INTEREST AND FEATURING LAGOON FACTS TO EDUCATE AND INFORM END USERS OF THE LAGOON, INCLUDING GUESTS. USING DURABLE MATERIALS IN THE PRODUCTION OF THESE MATERIALS WILL REDUCE COSTS AND WASTE.



The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

SAIPAN LAGOON USE MANAGEMENT PLAN FORUM

[HTTP://SAIPANCHAMBER.COM/RESOURCES/FILES/SLUMP_PRESENTATION.ZIP](http://saipanchamber.com/resources/files/slump_presentation.zip)