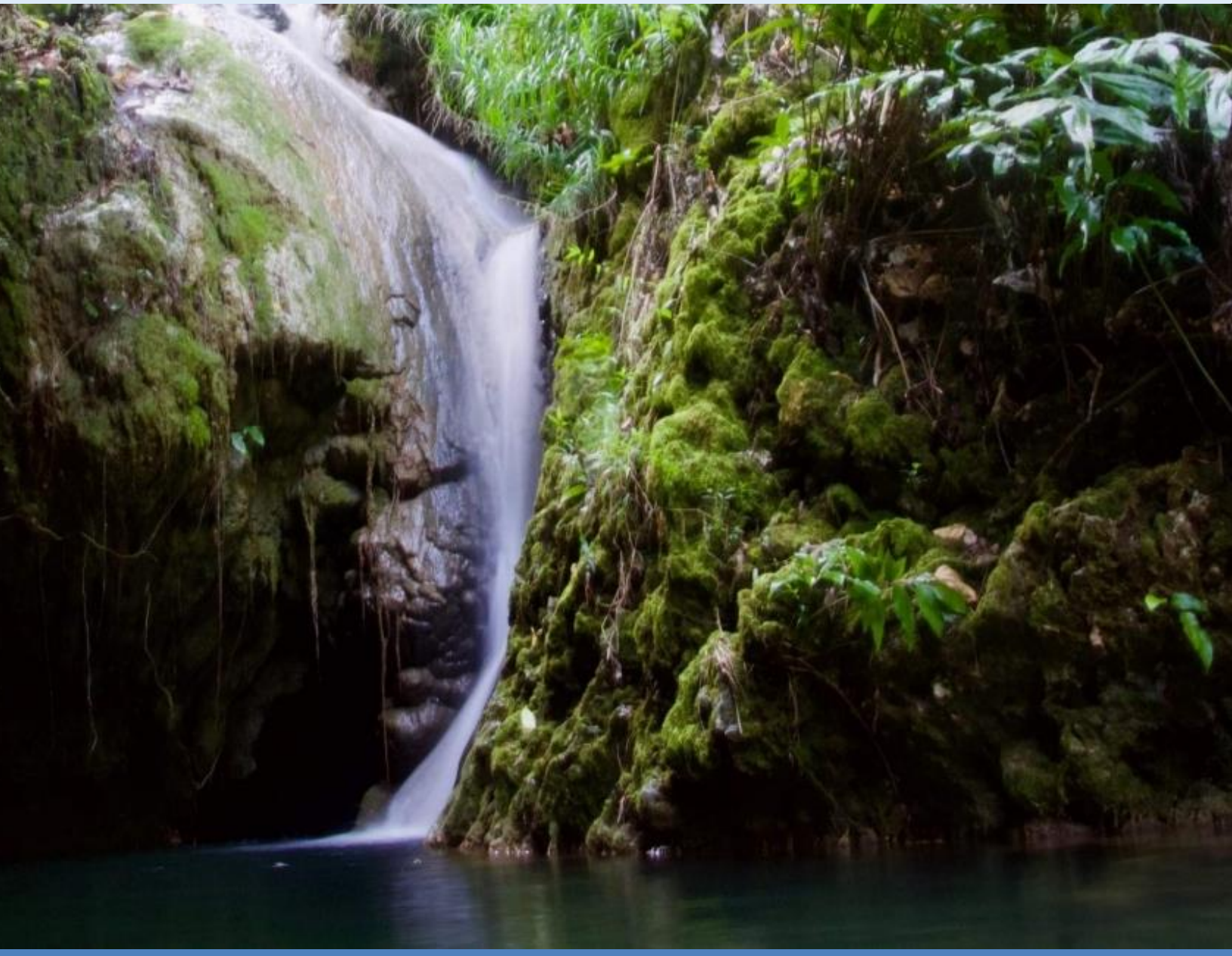
Talakhaya Integrated Watershed Management Plan — 2020

ROTA, CNMI



Prepared for the CNMI Division of Coastal Resources Management under the Bureau of Environmental and Coastal Quality with support from the U.S. Department of Commerce's National Oceanic and Atmospheric Administration and U.S Department of Agriculture's Natural Resources Conservation Service.

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About this Document

This document presents the updated Talakhaya Watershed Management Plan (TWMP) on the island of Rota in the Commonwealth of the Northern Mariana Islands (CNMI). The TWMP and associated planning process was conducted in response to changes in Coral Management Priorities as both the state (CNMI) and federal (NOAA) levels. Additionally, the TWMP aims to address growing community concerns with the future of Talakhaya based on the continued threats of erosion, potential development challenges, the existing political/enforcement concerns, and the ongoing risk of climate change. The following pages detail a characterization of the watershed, an explanation of the TWMP process/objectives, and recommendations for strategic actions to respond to the threats identified in this document following community input.

The planning process was conducted throughout 2018 and 2019, in coordination between multiple agencies and community groups. This plan will serve as the continuation of a process initiated with the first discussion of revegetation of Talakhaya back in 2007. This document offers actions to respond to threats, it is up to the community and local agencies to work together in order to ensure a sustainable future for all inhabitants of Talakhaya, including the farmers, streams, and wildlife.

The TWMP was conducted by the Bureau of Environmental and Coastal Quality (BECQ) Division of Coastal Resource Management (DCRM) in partnership with the collaborating agencies and organizations of the Talakhaya Watershed Stakeholder Group and the residents of Rota. Information for the assessment was derived from a wide range of federal and CNMI government agencies, non-governmental organizations, academic institutions, and community members.

Suggested Citation:

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The TWMP and associated spatial data were originally authored and compiled by the CNMI National Coral Reef Management Fellow, Malcolm Johnson, in cooperation with DCRM. For more information contact: Zachary Williams, DCRM Watershed Coordinator, at zwilliams@dcrm.gov.mp.

Access and Limitations

This is an open-access document, and is available online at https://dcrm.gov.mp/current-projects/talakaya-watershed-restoration/. The document may be distributed freely. Hard copies of the report are available at the DCRM Office on Saipan, and spatial data related to watershed features in Talakhaya can be viewed, queried, and downloaded online at https://becq-dcrm.opendata.arcgis.com/ and https://dcrm.gov.mp/our-programs/water-quality-and-watershed-management/talakhaya/

The TWMP is intended for broad planning and policy purposes, and serves as a scoping document to inform future watershed planning, as well as future research directions for the Talakhaya watershed. This document may also be used for educational endeavors, should any educational institution or pedagogue be adventurous enough to use it for such purposes. The TWMP is not intended for site-specific engineering or parcel-scale design purposes, nor should it be used in relation to litigation. Refer to identified agencies for relevant engineering recommendations.

Acknowledgments

The TWMP would not have been possible without the time, resources, and contributions of many individuals and organizations. The plan was prepared by Malcolm Johnson, National Coral Reef Management Fellow for the CNMI (2017-2019), following the implementation of a multi-year process. Pictures of the watershed were taken by Malcolm, unless otherwise indicated.

The staff of the BECQ Division of Coastal Resources Management and NOAA CNMI Field Office were gracious with their time and generous with their knowledge. Participating agencies provided integral information for the formation for the plan, including DLNR, Rota Forestry, DFW, CUC, DPW, and local community groups.

The participants of the Rota workshops cannot be thanked enough for their knowledge and fascinating stories related to the Talakhaya watershed. One of the main goals of any was to highlight local ecological knowledge and culture, allowing for community input and subsequent ownership. The residents of Rota provided the means of accomplishing this goal, and have guaranteed their voices are reflecting in both the characterization and strategic actions of the plan.

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Acronyms & Abbreviations

Many acronyms and abbreviations are used throughout this Watershed Management Plan. Refer back to this list to help navigate and recall these numerous jargon.

BECQ	Bureau of Environmental & Coastal Quality
BMP	Best Management Practices
CAP	Conservation Action Plan
CELCP	Coastal & Estuarine Land Conservation Plan
CNMI	Commonwealth of the Mariana Islands
CRCP	Coral Reef Conservation Program
CREES	Cooperative Research Extension & Education Services
CRI	Coral Reef Initiative
CUC	Commonwealth Utilities Corporation
DCRM	Division of Coastal Resources Management
DEQ	Division of Environmental Quality
DFEMS	Department of Fire & Emergency Medical Services
DFW	Department of Fish & Wildlife
DLNR	Department of Land & Natural Resources
DPL	Department of Public Lands
DPW	Department of Public Works
EPA	Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
IWM	Integrated Watershed Management
LBSP	Land-Based Sources of Pollution
LLP	Luta Livelihoods Project
LSWCD	Luta Soil & Water Conservation District
MINA	Micronesia Islands Nature Alliance
MMT	Marine Monitoring Team
MVA	Marianas Visitors Authority
NEPA	National Environmental Policy Act
NGO	Non-government Organization
NMC	Northern Marianas College
NOAA	National Oceanic & Atmospheric Association
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PSS	Public Schools System
SLUMP	Sabana Land Use Management Plan
SVAP	Stream Visual Assessment Protocol
SWCA	Sabana Wildlife Conservation Area
TNC	The Nature Conservancy
TWMP	Talakhaya Watershed Management Plan
UOG	University of Guam
USDA	United States Department of Agriculture
WMP	Watershed Management Plan
WWG	Watershed Working Group
4-H	Farm-focused US Youth Organizations Network (“Head, Hearth, Hands, & Health”)

Executive Summary

The 2020 – 2025 Talakhaya Watershed Management Plan (TWMP) serves as the guiding document for watershed managers, agency partners, and community stakeholders to protect, conserve, and monitor the watershed.

More than a decade ago, Talakhaya was identified as a priority watershed and began receiving NOAA Coral Reef Conservation Program (CRCP) funding to implement an extensive revegetation project. An initial Talakhaya/Sabana Conservation Action Plan (CAP) was published in 2012 to guide the strategic actions, encourage inter-agency cooperation, and improve the management of the watershed. In 2015, the entire CAP was reviewed by stakeholders and updated to reflect the current status of management, to update scientific data and stakeholder input, and to revise the list of recommended strategic actions to achieve stated objectives and goals. However, the current and future health of the watershed community remains threatened, a concern that is compounded with the graduation of the watershed from NOAA Coral Reef Conservation Program funding mechanisms.

The document begins by reviewing the history of watershed management of Rota and laying out a values-led management approach that benefits all stakeholders, both human and non-human. It continues with a characterization of the entire watershed, which includes a comprehensive description of the scope of the conservation area and the relevant scientific baselines in the following categories: terrestrial, biological, benthic, riparian, cultural, and socioeconomic. The second section of the plan concludes with a reflection on the current status of the monumental revegetation project and the importance of continued management interventions throughout the watershed. Section 3 provides a review of the integrated watershed management approach and its relevance in the next steps towards conserving the Talakhaya watershed under this Watershed Management Plan (WMP).

Significant progress has been made in addressing identified watershed threats since conception of the original CAP in 2010. Illegally-set fires have decreased through a combination of field agent monitoring and public outreach campaigns. The Luta Livelihoods Project, which provides the volunteers for the summer revegetation activities, is now a well-known and respected community conservation program. Stakeholders during the WMP process expressed optimism in the success of the CAP in managing Talakhaya. However, despite continuous efforts, many issues remain prominent in the watershed, including erosion and sedimentation, the presence of ungulates, and the global threat of climate change and its associated challenges to resiliency. Following a section on the overall mission, developed in the past CAP process, the plan continues by reviewing an updated list of threats to the watershed:

> ***Intentional burning/fires, badlands erosion, streambank erosion, agricultural runoff/practices, high turbidity, road erosion, expanding ungulate populations, invasive species, private land access, political concerns, lack of awareness, and climate change.***

Through the process, stakeholders looked at natural resource targets as well as social and cultural values to determine a set of goals to guide the implementation of the management plan, which can be found in Section 6. In order to address the key threats, seven strategies were developed during the planning process and will be implemented through inter-agency partnership. Each strategy includes SMART (i.e. specific, measurable, assignable, relevant, and time-bound) objectives as well as a list of strategic actions for implementation. The strategies are listed below (with more detailed information found in Section 6.2):

Strategy 1: Improved land management and enforcement in cooperation with local agencies and landowners of both the Sabana Wildlife Conservation Area and Talakhaya Conservation Area.

Strategy 2: Continued support of Forestry revegetation efforts of badlands and expansion towards native reforestation.

Strategy 3: Increased understanding of the geomorphology of the watershed to better inform strategic actions and ensure effective issue response.

Strategy 4: Enhanced stabilization of roads and culverts to reduce sedimentation and improve access of Talakhaya for both landowners and the revegetation project.

Strategy 5: Bolstered collaboration with CUC & DPW to identify, monitor, and evaluate current and future water resources within the Talakhaya/Sabana watershed.

Strategy 6: Raised community awareness and educational outreach for both the planning process and the Talakhaya watershed more generally.

Strategy 7: Improved monitoring of watershed processes through the development of unified monitoring plans and partnerships.

Environmental changes in the Talakhaya watershed has been observed as part of the CNMI long-term marine monitoring program with data collected consistently at several sites since 2000. To support TWMP activities, these surveys will be continued and expanded to ensure management activities have the desired effect on the natural resource targets. Annual work plans will be developed prior to the beginning of each fiscal year to prioritize projects implemented from the plan as well as to guide funding requests.

Additionally, stakeholder meetings to review implementation progress should be held semi-annually and comprehensive updates to the plan should occur every 3 – 4 years to reflect changes within the watershed and the status of strategic actions. Personnel from the Coral Reef Initiative (CRI) program under the Division of Coastal Resources Management (DCRM) at the Bureau of Environmental and Coastal Quality (BECQ) will continue to coordinate meetings with local partners on Rota, however individual agencies and organizations are responsible for implementing their respective actions within this plan, as their directives allow. Partnership and collaboration will be the key towards the vision:

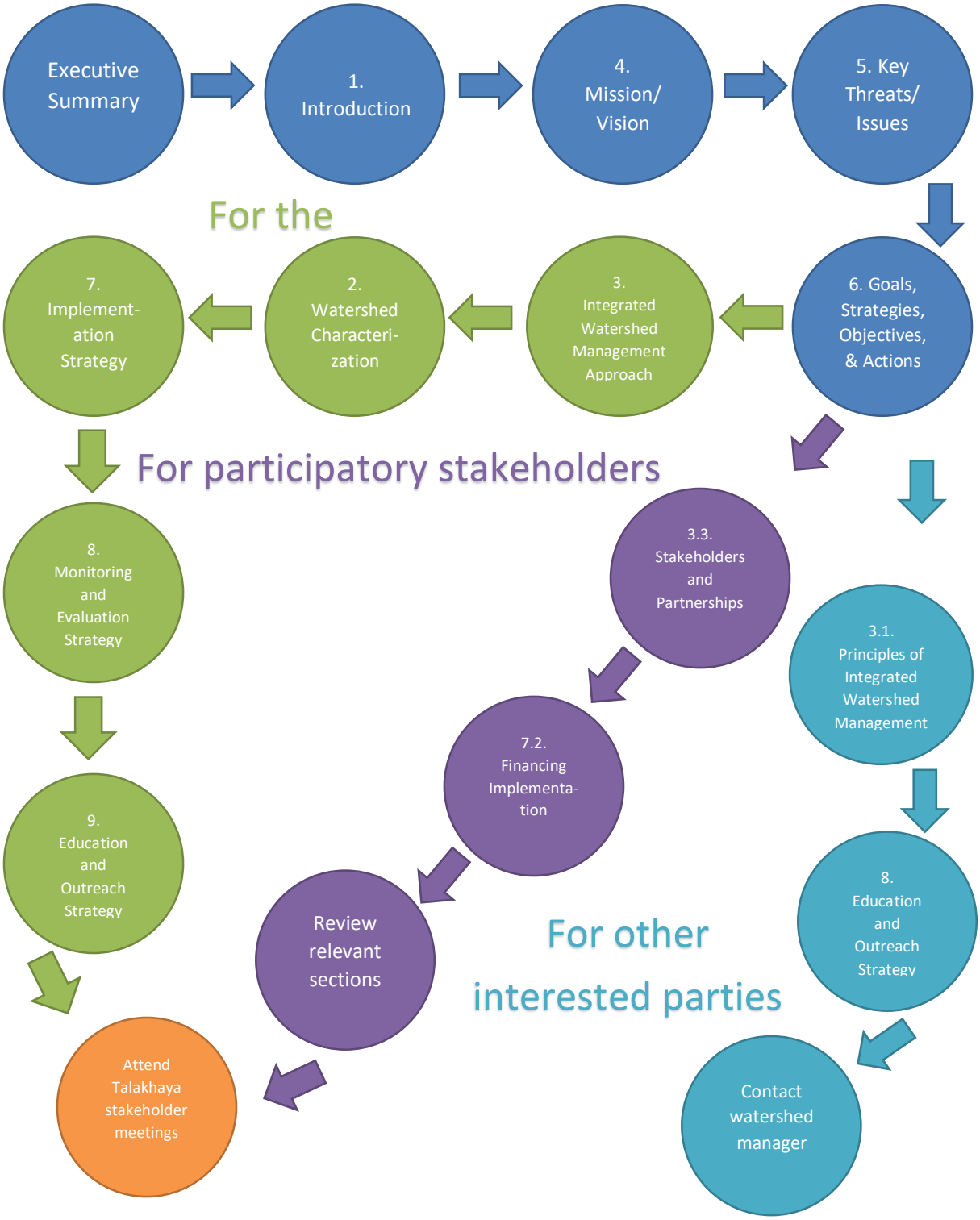
"Pratehi i rikesan i tano yon i tasi" – "Protect the wealth of our land and sea".

Purpose of the TWMP

The purpose of this Talakhaya Watershed Management Plan (TWMP) is to provide guidance for watershed managers, participatory stakeholders, and other interested parties to ensure the continued success of the conservation projects happening in and around Talakhaya. While this document includes a characterization of the watershed, a list of stakeholders and their roles, potential strategic actions to address threats/issues, and plans for implementation, outreach, and monitoring, it does not ensure Talakhaya will remain a priority watershed in the eyes and policies of CNMI. Managers should use this plan to focus efforts and guide cooperation, and be referred to when actions are implemented in Talakhaya. This document is not planned to be static, but rather a dynamic plan that will be updated as threats change and more information becomes available.

How to Use This Plan

Follow this graphic to identify the relevant sections for various stakeholders.



1. Introduction

Watersheds are areas of land where all the water that falls within them ultimately drain into a common water source, whether that be puddles, streams, or the ocean. The dynamic nature of watersheds spanning spatial and temporal boundaries, and ability to cross political and landownership designations, allows them to connect and encompass terrestrial, freshwater, and coastal ecosystems, providing a wide variety of ecosystem services for all members of the watershed community, both human and non-human, from "ridge-to-reef". Postel and Thompson (2005) highlight the importance of incorporating the value of natural services into the use and management of watersheds by highlighting a list of goods provided by healthy watersheds (Table 1). Land-use changes within the boundaries of a watershed – whether that be farmland, savannah fires, revegetation, or urban development – can diminish the ability of a watershed to perform its ecological benefits for the entire community and can result in economic, cultural, and environmental costs that can take decades to recover from (Postel & Thompson 2005). Before effective management can occur in a watershed, it is essential to acknowledge the value of watersheds to their community (as defined by both the human and non-human objects found in and around a watershed), the integration of watershed protection with the provision of safe drinking water (particularly in the context of limited water resources on small islands), and the role stakeholders and managers play in ensuring a resilient and productive watershed for future generations (without sacrificing the needs of the present or undervaluing the impact of today on the future of the watershed).

• Water supplies for agricultural, industrial, and urban-domestic uses
• Water filtration/purification
• Flow regulation
• Flood control
• Erosion and sedimentation control
• Fisheries
• Timber and other forest products
• Recreation/tourism
• Habitat for biodiversity preservation
• Aesthetic enjoyment
• Climate stabilization
• Cultural, religious, inspirational values

Table 1. Ecosystem goods and services provided by healthy watersheds.

This Talakhaya Watershed Management Plan (TWMP) is a cooperative effort between the residents and landowners of Rota, and resource management agencies from both federal to local levels managing resources in the Talakhaya/Sabana watershed, including: Bureau of Environmental and Coastal Quality (BECQ) Division of Environmental Quality (DEQ) and Division of Coastal Resources Management (DCRM), Department of Lands and Natural Resources (DLNR) - Division of Fish and Wildlife (DFW) and Forestry, Luta Soil and Water Conservation District (LSWCD), Department of Public Works (DPW), Commonwealth Utilities Corporation (CUC), Department of Fire and Emergency Medical Services (DFEMS), and the Rota Mayor's Office. Several federal partners have also assisted with the development of this plan, including United States Department of Agriculture (USDA) Forest Service (USFS) and Natural Resource Conservation Service (NRCS), National Oceanic and Atmospheric Administration (NOAA), and Environmental Protection Agency (EPA); as well as NGO partners at The Nature Conservancy (TNC). Additionally, inputs from numerous stakeholder groups have been incorporated into this plan in order to capture the depth and breadth of ecological knowledge, both traditional and scientific, found throughout the island and archipelago. Although not all voices were captured before the writing of this plan, the intention is to offer

an iterative platform to reflect the needs of the entire watershed community beyond the scope of the plan.

Over the past few decades in the CNMI, increased population and urban development has exacerbated threats to both coral reef and watershed ecosystems, including the terrestrial, riparian, and biological resources. The potential impacts of changing agriculture efforts taking place in the Sabana Wildlife Conservation Area (SWCA) may have unforeseen consequences on the freshwater resources of the islands primary aquifer. Land-use changes over the last few decades have had considerable impact on the terrestrial landscapes of the Talakhaya watershed, resulting in increased sedimentation and disruptions of natural systems. Reduced health of the coral reefs and coral-reef associated habitats and biota have been documented, with the exception of certain 'bright spots' (Benavente 2018); additionally, from a long-term perspective, the decline in coral-reef coverage and marine health not only threatens cultural heritage and traditional ways of life but also limits the physical protection from storms and resiliency from climate change. The long-term changes to the watershed have similar impacts on the resiliency and connectivity of the various habitats and biological features, particularly from a ridge-to-reef perspective. However, this decline also immediately impacts tourism, agriculture, and fisheries industries in CNMI, and thus its economy, as described as the ecosystem goods and services of a healthy watershed. As such, the Commonwealth of the Northern Mariana Islands established goals and priorities for protecting and conserving coral reef ecosystems in 2010, which explicitly states the need to reduce land-based sources of pollution in Goal 1 and to implement watershed management planning on Rota via 1.3 (Coral Reef Management Priorities 2010)

1.3 Develop and begin to implement a CAP or comprehensive watershed management plan for a key watershed in Rota to improve water quality and condition of adjacent coral reefs.

The CNMI was approached in 2008 by the TNC Micronesia Program and helped in developing site-specific management plans through the Conservation Action Plan (CAP) format. The CAP process was designed to bring multiple stakeholders to the table and incorporate both scientific and anecdotal information into an overarching set of conservation priorities. The shift of emphasis to site-specific management of threats facing the CNMI's marine environment was further supported by the NOAA Coral Reef Conservation Program (CRCP) as a way of focusing conservation efforts. Through the CRCP priority-setting process and the CNMI Coral Reef Management Priorities document developed from it, the CNMI resource management agencies and their federal partners designated three priority watersheds for conservation action: Laolao Bay and Garapan watersheds on the island of Saipan, and Talakhaya/Sabana watershed on the Island of Rota. Taking place over the course of a year, meetings were held, data was analyzed, and goals were set. A CAP for Laolao Bay was completed in January of 2009, laying out the conservation priorities for the area. It was decided that the Talakhaya area would benefit from a similar process, through which the CAP was developed from 2010 to 2012 and later updated in 2015 with the elimination and addition of priorities.

In many regards, the Talakhaya/Sabana CAP was a huge success for the watershed, providing a successful funding mechanism for the decade-long revegetation project, guidance for researchers and data collection through the watershed, and laid the foundation for effective watershed management on Rota. In 2018, a decade after the initial conversations about CAPs, the CRCP entered discussions to change priorities in order to encourage coral reef jurisdictions to shift from CAPs to WMPs. In order to integrate the socioeconomic and freshwater aspects of watersheds with the slope, soil texture, and vegetative cover

that dominates the CAP approach towards management, as well as incorporating adaptive management techniques, traditional ecological knowledge, and technological advancements, such as remote sensing, GIS, and multi-level social-ecological systems analysis, into watershed management strategies, an WMP approach is essential for the future of the Talakhaya watershed. Following a similar community-based effort, this plan was developed with 'integration' in mind, whether that be of data, knowledge, community, agencies, time, or space. From this grand scope, practical application and action may occur.

1.1. History of Rota

The Chamorros colonized the Marianas at least 4000 years ago) and the population grew to an estimated 50,000-100,000 by the time the first Europeans arrived, with most of Rota being forested prior to the arrival of people (Carano & Sanchez 1964, Craib 1983, Engbring et al. 1986). Rota, Tinian, and Saipan have a long history of human disturbance, with human settlement dating back as far as 4,300 years ago (Athens et al. 2004). The original Chamorros likely altered the terrestrial environment, including cutting and removal of the forest, cultivation of food crops, and hunting of fauna. It was during this time that open savannas began developing on uplands, primarily through the use of fire (Mueller-Dombois 1981).

Ferdinand Magellan landed in the Marianas in 1521 and named them Islas de los Ladrones. In the early 1600s, the name was changed to Islas de las Marianas. Spanish missionaries began the "reduction" of the islands in 1668 shortly after the islands were claimed by Spain (Coomans 1997). During the Spanish period between 1521 to 1899, the Chamorro people were decimated by war and disease and a number of plants and animals were introduced tracing their origins to either the Philippines or Mexico, both regular stopping points for the galleon trade (Enbring 1986). For almost four hundred years, the Marianas remained under Spanish control, during which a considerable number of people immigrated from the Caroline Islands. In 1898, during the Spanish–American war, the United States took possession of Guam and continues to maintain ownership as a Territory. Since that time, Guam has been politically separate from the remainder of the islands in the Mariana Island Archipelago. In 1899, Spain sold the northern Marianas, along with the Caroline Islands (the present Federated States of Micronesia and Palau) to Germany to pay the debt from the Spanish-American War. Germany maintained control of the northern Marianas until World War I when Japan occupied the islands in 1914. In 1920, the League of Nations granted Japan a mandate to administer the northern Marianas and it maintained possession until World War II.

Stone marker for sugar cane company

While land clearing began when the island was first colonized by the Chamorros, it proceeded on a much larger scale during the Japanese administration (1914-1944) with sugar cane farming on flatlands and phosphate mining on the Sabana (Amidon 2000), including the construction of a sugar mill in Songsong Village. A report by Kanehira, (1936) on the forest plants of Rota indicates that large scale clearing of land for sugar cane agriculture began after 1932, resulting in the removal of native forest rapidly accelerating with the development of the sugar cane industry throughout the archipelago and populations swelling with Japanese, Korean, and Okinawan immigrants (Hezel & Berg 1981). During the Japanese administration, an area on Sabana south of the summit was mined for phosphate-rich soil which was transported to the coast using an

aerial tramway that ended at the processing plant at Sagua, east of Songsong Village (Rodgers 1948). During World War II, the United States forcibly took possession of the Saipan and Tinian from Japan in 1945, while Rota was never invaded. The United States took possession of Rota after the Japanese surrender and in 1947 the United Nations created the Trust Territory of the Pacific Islands, under which the United States administered the Northern Mariana Islands, as well as the Marshall Islands and the Caroline Islands. After it was approved in a plebiscite in the Northern Mariana Islands, the United States ratified the *Covenant to Establish the Commonwealth of the Northern Marianas Islands in Political Union with the United State of America* in 1978. This agreement created the Commonwealth of the Northern Mariana Islands (CNMI) and established a unique relationship. The CNMI is self-governing with regard to taxation, immigration, and labor, yet is part of the United States. Several federal agencies, including the US Postal Service, National Park Service, FBI, USGS, and USDA operate in the CNMI.

1.2. Values-led Management

Ecological and socio-cultural changes brought on by global human activities require innovative approaches in how people relate to and draw sustenance from the environment, where changes in mindset or worldview guiding a system can result in substantial effects. Artelle et. al. (2018) argue that models for relating and conceptualizing environments already exist in place-based cultures and that there are numerous examples of values that can influence the management of natural resources. Place-based or indigenous peoples, have a deep connection to their local environments, where their way of life has impacted the place they inhabit and the place has impacted their way of life. Their knowledge of place, referred to as traditional ecological knowledge, is recognized as a holistic and interconnected way of knowing. These environmental values develop over time from the relationships between people and the surrounding environment over generations, linking cultures to places. In the case of Artelle (2018), it is important to highlight the difference between the values that define a worldview versus the valuation of an ecosystem as described above in the form of goods and services that a watershed provides. Exploring the Māori and Coastal Peoples, well-researched place-based cultures, values-led management of their natural resources, the researchers describe three environmental values; relatedness, respect, and reciprocity.

During a stakeholder meeting, a cultural values activity asked a number of questions to determine the source of cultural knowledge, the values associated with Rota, and the ways in which these values could be incorporated. Participants agreed that the Manamko' (elders) hold the longest-term relationship with the landscape in addition to the few residents who regularly spend time working the land. The natural environment is full of native trees, wildlife, cultural history, and freshwater resources that define "place" for stakeholders. In order to protect these resources, participants identified the values of conservation, protection, and stewardship as critical, each of which is reflected in the three sections below.

1.2.1 Relatedness

Relatedness refers to the concept that there is no fundamental distinction between humans and other species, where all living things are related and have a shared history. Relatedness reflects the Chamorro belief in animism, a religious philosophy that supports the concept of the interconnectedness between people and nature. In one legend about Chaife, the god of the underworld, a soul escaped his forge and turned into a rock that was weathered over time by water and wind, eventually becoming a man who proceeded to mix clay, water, and sunlight to create the first people, "children of the earth." Chaife, angry that a soul escaped, found a child on a beach and tried to destroy her, but the child turned into a fish, a

hilitai (monitor lizard), and a bird in order to escape death. Another creation myth about the supernatural siblings of Puntan and Fu'una, who created the earth and turned into a rock which borne the peoples of the earth (Torres 1991). Both of these legends describe not only a connection to place but also the relatedness of people to the animals that define the landscapes. The connection, embeddedness, identity, and other corollaries of a deep inter-relationship with species and places inherently leads to supportive, nurturing, and protective relationships (Bhattacharyya & Slocombe 2017). Following the concept of relatedness, it is important that watershed management on Rota provides equal ontological footing for both the humans and non-humans found within Talakhaya, defined above as "community", ensuring that any proposed activities provide benefits for all species, waters, lands, and people captured within the scope of the project.

1.2.2. Respect

Respect is traditionally recognized by the civil relationships among other people, species, and the broader environment with laws and stories of retribution for disrespectful actions known and understood from an early age. The concept is best highlighted through the Chamorro concept of *inafa'maolek*, which promotes interdependence within the community so as to provide for the well-being of the whole, rather than that of the individual. The literal translation is 'to make' (inafa') 'good' (maolek) where there is the assumption that there was once a state or condition that was somehow altered, perhaps by an act of commission or omission, that must be restored to its original state or condition. Within an environmental context, respect can be seen in the hunters, fisherfolk, and collection of medicinal plants, where people tend not to harvest more than they and their family need. By crafting activities that respect the community, the environment, and the culture, watershed management can highlight concepts of guardianship, stewardship, and sustainability.

1.2.3. Reciprocity

Reciprocity is the right to use a resource, contingent on the responsibility to maintain it, protect it, and honor it. It can be further expanded through the value of *chenchule'* that refers to the intricate system of social reciprocity at the heart of ancient and contemporary Chamorro society. The value is also rooted in the core value of *inafa'maolek* that promotes interdependence within the community so as to provide for the well-being of the whole, rather than that of the individual. Although *chenchule'* tends to be a reciprocity of favors exchanged for future assistance, it is essential that watershed management activities in Talakhaya reflect the generosity the community and where people must not only help one another, but also the wildlife and places.

2. Watershed Characterization

The Talakhaya watershed is unique on Rota compared to the four other watersheds – Songsong, Uyulan Hulo/Teteto, Chaliat/Talo, and Dugi/Gampapa/Chenchon – delineated by a combination of geology and hydrology. Defined by the only perennial streams on the southern side of the island, the watershed is approximately 4,900 acres (20 square miles), comprised of steep terrain with slopes ranging from 5–99% of the watershed. The Talakhaya watershed provides nearly all the fresh water on the island from water caves in the limestone cliffs of the Sabana Plateau. The following sections further characterize the watershed and associated community.

2.1. Location and Geography

The 466-mile long Mariana Island archipelago includes 15 islands, 14 of which are within the U.S. Commonwealth of the Northern Mariana Islands in the Western Pacific. The Mariana Islands are the closest Pacific island chain to Japan, approximately 1,500 miles from Tokyo or slightly less than 3 hours by air. Saipan, Tinian, and Rota are the three developed islands of the CNMI with 90% of the population based on Saipan. All of the watersheds on the islands are considered coastal watersheds due to their small size. On Rota, the Talakhaya watershed (also known as the Talakhaya/Sabana/Palie) is located on the southern portion of the island (Figure 1).

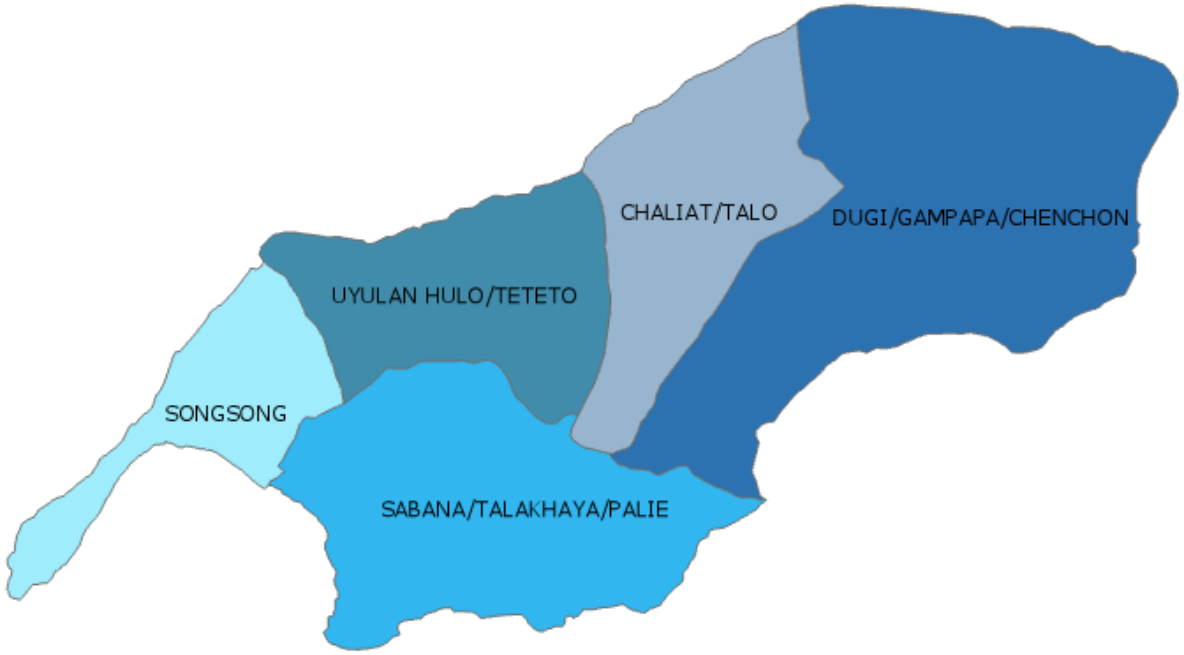


Figure 1. The Watersheds of Rota (historically known as *Zarpana*)

Rota, or *Luta* as it is known in the Chamorro dialect, is the second most southern island in the Mariana archipelago, approximately 3,750 miles southwest of Hawaii. It is the southernmost and third largest island in the CNMI, after Saipan and Tinian. Rota is located at approximately 14° 10' north latitude and 145° 10' east longitude. Rota is located approximately 117 kilometers (73 miles) south of Saipan and 76 kilometers (47 miles) north of the Island of Guam. Sinapalo village is the largest and most populated urban

area followed by Songsong village. In the 2010 United States Census, Rota reported about 2,527 inhabitants.

Rota has a tropical marine climate with average annual temperatures of approximately 80 degrees Fahrenheit, 80 inches of rainfall, and about 80% humidity. Rainfall averages 10.7 inches per month during the wet season (July – November) and 3.8 inches per month during the dry season (January – May). The trade winds are strongest and most constant during the dry season when wind speeds of 15 to 25 miles per hour are common. During the rainy season, there is often a breakdown of the trade winds, and on some days the weather may be dominated by westerly storm systems that bring heavy showers and sometimes torrential rains. (NRCS 2007)

Two distinct climatic seasons occur in the CNMI: wet and dry (Duenas & Associates, 1996). The months of July through November are considered to be the wet season and the months of January through May are considered to be the dry season (Carruth 2003). December and June are considered to be the transitional months. On Saipan, 67% (about 53 inches) of the rain falls during the wet season, and 21% (about 17 inches) of the rain falls during the dry season. The transitional months receive the remaining 12% (about 10 inches) of the annual rainfall, there are comparable rainfall percentages per season on Rota based on rain gauge data gathered during recent studies.

2.1.1. Dimensions of Rota

- Area: 85.38 square kilometers (32.967 square miles)
- 16.9 kilometers (10.5 miles) long
- 4.8 kilometers (3 miles) wide
- Coastline: 61.6 kilometers (38.3 miles)
- Highest point: Mt. Manila, located on the Sabana Plateau - 495 meters (1,625 feet)

2.2. Land Management & Ownership

Three local government agencies partner to manage the project area including: BECQ, which houses DEQ and DCRM, and DLNR, which houses DFW and Forestry. DEQ was created through Public Law 3-23 to protect the right of each person to a clean and healthful environment. The Commonwealth Environmental Protection Act defines the DEQ purpose, jurisdiction, and authorization to issue regulations and implement programs to protect the air, land, and water of the Commonwealth. The Coastal Resources Management (CRM) Office was established with the implementation of Public Law 3-47 within the Office of the Governor. The CRM program was established in order to promote the conservation and wise development of coastal resources; under CNMI law, CRM shares regulatory jurisdiction over all lands of the Commonwealth. CRM – now DCRM – and DEQ were merged in 2013 by governmental order. DLNR was established by Public Law 1-8 and was empowered by that law "To be responsible for the protection and enhancement of the natural resources of the islands ..." DFW was created by Public Law 2-51 which was later revised by Public Law 10-57; DFW is housed within DLNR and its purpose is to conserve fish, game, and wildlife and to protect endangered and threatened species. Through research, monitoring, regulation, enforcement, planning, and management, DFW seeks to ensure long-term survival and sustainability of resources in CNMI.

In order to own land in the CNMI, individuals must prove a certain degree of indigenous lineage. Land leases are available to other corporations or individuals. All lands in the CNMI fall into one of two categories: private lands or public lands. Private lands are all lands that are alienable by the titleholder.

Public lands are those that were transferred into the public domain upon the creation of the Commonwealth. Public lands are freely alienable by the Commonwealth and managed by the Department of Public Lands. Public lands include government acquired lands that have been purchased by the government for public purposes, the use of which is controlled by deed restriction.

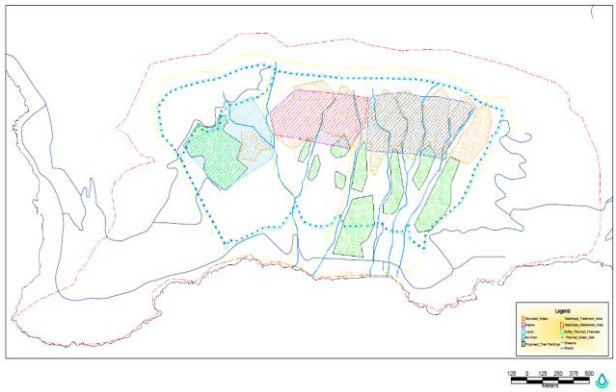
Most private lands on Rota are on flat or low sloping ground (less than 30% slope). These lands comprise approximately 66% of land on Rota, and at least 75% of that land is now or will soon be committed to private land-uses. The 34% of Rota that is less suitable for development primarily consists of cliffs or steep slopes. These are also the areas with the remaining undisturbed native forests. CNMI government programs call for the transfer of portions of public lands from the public to private ownership via agricultural or village homestead programs.

Title to public land in the CNMI is vested in the Department of Public Lands (DPL). DPL, as directed by the Board of Public Lands, has the authority to dispose of public lands, including the issuing of village homestead and agricultural homestead permits on lots and the subsequent transfer of these lands to private ownership. DPL retains authority over the homestead lots until the three-year permit requirements are met whereupon the land is then legally transferred to private ownership through a deed of conveyance, which is an ongoing process (Reconnaissance Survey 2005).

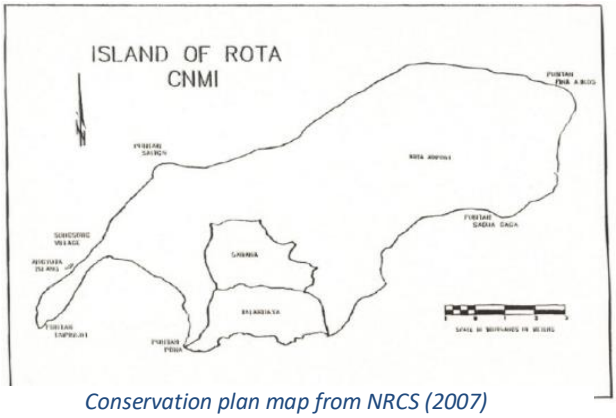
In order to conduct research within the watershed, spoken agreements have been made between landowners and watershed managers. These agreements have existed for a number of years and have been supported through various permitting assistance and inclusion in the planning process. Although these agreements are subject to change, it is expected that effective management of the watershed will continue under the current agreements, provided respect and reciprocity between conservationists and landowners continue as well.

2.3. Project scope

Rota Local Law 15-8 defines the scope of the Talakhaya watershed as the coastline between latitude 14° 6'44.69"N, longitude 145° 10'40.62"E and latitude 14.6'58.62"N, longitude 145°12'19.65"E and all the lands draining into that coastlines' waters extending inland into the Sabana Conservation Area. However, there are a number of non-political alternatives in watershed delineation based on geology, hydrology, and ecology that would expand the scope to include the entire Talakhaya/Sabana/Palie area (the green area in Figure 1) integrating landowners and their land, endangered and endemic species (including the Rota blue damselfly, Mariana crow, Mariana fruit bat, Sambar deer, and other endemic flora/fauna), streams and their associated biota, sub-watersheds that have shown unique dynamics, in addition to the caves, ridges, and cultural landmarks found within the larger watershed. Figure 2 displays various delineations of the watershed:



Full watershed area Map from USDA (1994)



Conservation plan map from NRCS (2007)

Figure 2. Two past alternatives for watershed delineation

Large portions of Rota public lands are currently protected under Rota Local Law 9-1 due to their high resource value; examples include sea bird sanctuaries and conservation areas for forests and wildlife (Figure 3). Additionally, Rota Local Law 9-2 established a marine protected area in Sasanhaya Bay on the southern portion of the island (also shown in Figure 3). DLNR manages these public lands and waters designated as conservation areas. Three of these areas fall within the vicinity of the Talakhaya/Sabana project area:

2.3.1. Sasanhaya Bay Fish Reserve (Coral Gardens Marine Conservation Area)

The reserve, created in 1994 under Rota Local Law 9-2 and regulations promulgated under public law 2-51, was the first established marine protected area in the CNMI. It is located in the Sasanhaya Bay of Rota, between and including Pui'la Point and the Coral Gardens; it sits directly adjacent (to the west) of the marine areas associated with the project area. The reserve, by Rota Law, is a no-take zone and also prohibits “any activities which are exploitive or destructive to the marine life and/or the World War II wrecks...within the reserve" (Rota Local Law 9-2).

Additionally, it should be noted that the United States does not recognize the CNMI as having sovereign waters. The DFW is allowed to manage native marine species which occur within three miles seaward of the low water mark on the CNMI coastlines, this being the current area allowed to the CNMI for enforcement of local laws applicable to fish, wildlife, and coral reef protection by Order Partially Staying Judgment Pursuant to Stipulation of Parties, CNMI v. USA, Civil Action OJ 99-0028, U.S. District Court for the 21st District of the Northern Mariana Islands.

2.3.2. Sabana Wildlife Conservation Area

This high plateau area in the southwestern portion of the Island was established as a protected area in 1994 under Rota Local Law 9-1 to provide watershed protection, wildlife and forest conservation, as well as for community farming and medicinal plant gathering. Within the designated area "all persons are hereby prohibited from taking or in any way harassing or disturbing all varieties of non-game wildlife, including but not limited to fruit bats and Marianas Crow; all plant life, including any fungi, forest vegetation or grasses, with the exception of those plants that possess medicinal properties and/or those that have been used in traditional healing practices and/or those that are being utilized through normal agricultural activities; and any soil, including soil, sand or rock, within or from the area in Rota known and referred to as “Sabana Heights” and “I Chenchon Park" (Rota Local Law 9-1).

In 2018, DLNR created the Sabana Working Group which produced the Sabana Land Use Management Plan (SLUMP) for the Sabana Wildlife Conservation Area, that sought to: protect watershed areas by restricting agricultural activity, enhance terrestrial habitat through reforestation, manage invasive species, develop organic farming areas, prohibit various destructive activities (littering, development, dumping), and establish revenue generating opportunities through sustainable ecotourism (SLUMP 2018). There are direct links between the SLUMP and this plan, with an overlap in goals, activities, and coordinating agencies. Without successful management of the Sabana plateau, future concerns may arise in the lower Talakhaya watershed.

Westward view of the Talakhaya watershed

2.3.3. Talakhaya Watershed Conservation Area

In 2007, the Talakhaya portion of the project area was added to the Sabana Conservation Area under Rota Local Law 15-8 and is given the same status and protection as the initially established area. Through this establishment, the Talakhaya watershed connects the higher plateau of Sabana with the coastal waters, allowing for the well-documented management approach of "ridge-to-reef. The establishment of the Talakhaya Watershed Conservation Area is directly related to the intensive revegetation project incorporated into the previous Conservation Action Plan. It also integrates the freshwater caves and spring systems into a conservation status as well as the five sub-watersheds and riparian areas of the streams found on the south side of the island.

2.4. Terrestrial

The geology of the three most Southern and populated Mariana Islands suggest that they were once submerged below sea-level, allowing a layer of coral reef to form over the volcanic rock. This resultant limestone rock is extremely porous in nature and groundwater discharges unknown amounts of sediment or agricultural pollution that can enter the basal aquifer and marine system. Lack of knowledge about groundwater flow and water quality is a major impediment to improving conditions for many of CNMI nearshore marine systems.

Keel et al. (2005) published a comprehensive study on the geological origins of the island of Rota that utilized the Carbonate Island Karst Model to describe the caves, structure, and history of the island. These Islands are underlain with volcanic rock resulting from eruptions approximately 60 million years ago. The volcanic cores, which were formed below sea level, have slowly uplifted and emerged from the ocean's surface, and a series of limestone plateaus formed as coral reefs. 98% of the area is covered with limestone plateaus of coral reef origin (NRCS 2007). Talakhaya is characterized by a large, relatively steep exposure of weathered volcanoclastic material, with both a discontinuous band of limestone (100 m elevation) and a continuous band (sea-level to about 40 m elevation) (Keel et al. 2005).

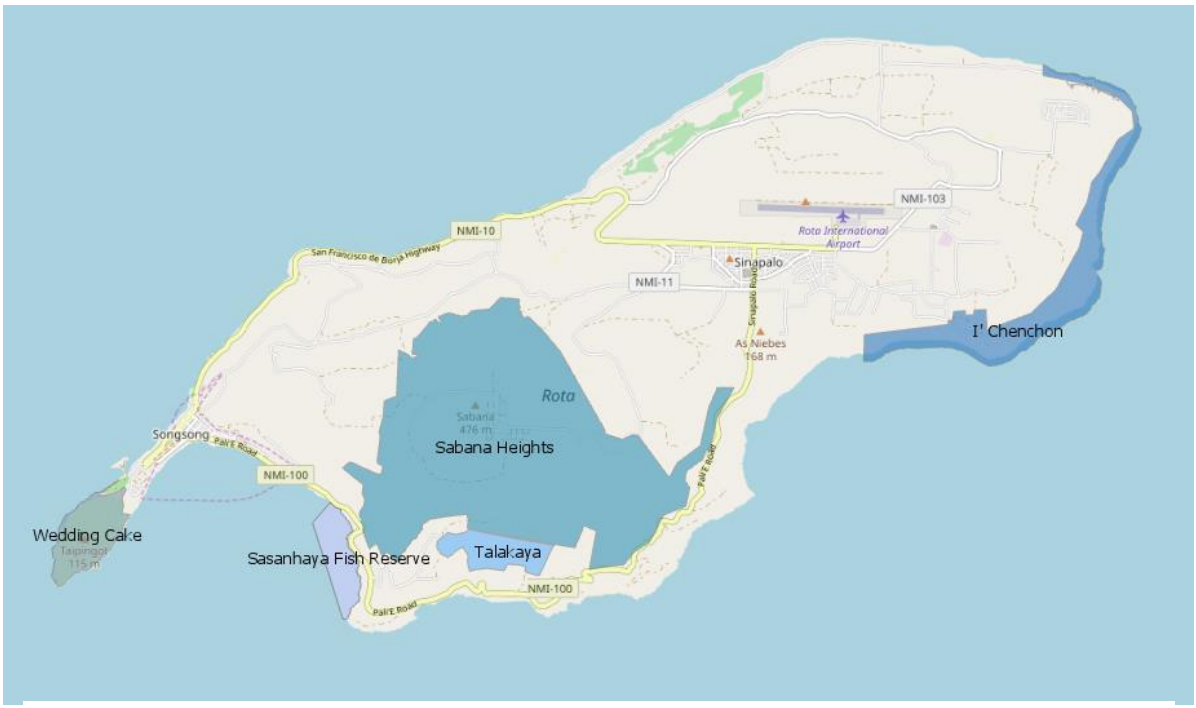


Figure 3. Conservation areas of Rota

Topography on Rota has five geomorphic subdivisions: the coastal lowlands, a northern plateau, a southern plateau (the Sabana), a volcanic area, and the western peninsula. On the north shore, coastal lowlands dominate and are bounded on the seaward side by a narrow reef margin. Sandy soils with

coconut palms (*Cocos nucifera*) occur in the inland areas, and strand vegetation dominates the coastal margin. The northern plateau, at an elevation of approximately 450 ft (137 m), comprises the eastern part of the island, with its south and east sides terminating in cliffs with rocky shoreline below. On the north side, the plateau slopes gradually toward the sea; this is the location of Mochong Beach, the largest beach on Rota. The Sabana plateau has an elevation exceeding 1,400 ft (426.7 m). Its western side is marked by cliffs that form low plateaus. On the northeast side, less pronounced cliffs and slopes lead gradually to the northern plateau. The southern and a portion of the northern boundaries of the Sabana terminate in dramatically shaped precipitous cliffs. In the northern part of the Sabana, Mt. Sabana is the highest point at 1,627 ft (495.9 m). The volcanic area of the island is very different in appearance from the other geomorphic subdivisions. Streams have eroded the area into deeply etched ridges and valleys predominantly covered by sword grass (*Misconthus floridulus*). The western peninsula is a narrow isthmus that connects Mt. Taipingot with the remainder of the island. Mt. Taipingot rises in terrace formations to approximately 460 ft (140.2 m), and the peninsula is bounded by precipitous cliffs. (NRCS 2007)

The Talakhaya area is located along steep terrain with slopes ranging from 5–99%. There are approximately twelve different soil map units within the watershed area. Much of the Talakhaya region is considered badlands, areas of saprolite (weathered volcanic bedrock) where the soil has been nearly or completely eroded. As badlands support little or no vegetation, they are actively eroding. Runoff is rapid and the hazard for water erosion is severe (Gavenda 2006, NRCS 2008).

The two springs that normally provide all the municipal water for Rota issue from the contact of the limestone and the underlying volcanic near the top of the Talakhaya. The Water Cave, also known as Matan Hanom, is located at 350 m elevation, 2 km directly south of the summit of the island on the Sabana. Based on its morphology, the Water Cave is thought to be a flank margin cave coincidentally developed at the contact and now intercepting a large part of the underground flow along the contact from the recharge area on the Sabana. Most of the water collected by the municipal system at Water Cave, several thousand liters per minute, appears inside the cave from impassable holes along the east wall. Municipal water is also collected at As Onan Spring on the contact at 350 m elevation, about 1.5 km east of the Water Cave (Stafford et al. 2002). The volcanic/limestone contact at the level of the Water Cave has many smaller springs that are not exploited for municipal water.

The upper plateau of both the island and the priority watershed, or the Sabana, consists of existing and historical agricultural areas within a mosaic of native forest. The Sabana was also the site of phosphate and manganese oxide mining prior to World War II. It is remotely possible that water recharged on the northern part of the Sabana drains to the south and discharges at the Water Cave and/or other springs along the Talakhaya contact. If the Water Cave and As Onan Spring are considered as contact caves (as opposed to flank margin caves) they are among the most significant hydrologic and cultural features on Rota since they are the source of water for the municipal system. There are other springs along the contact at the top of the Talakhaya that discharge a significant amount of water for at least part of the year. However, these springs are probably not suitable as municipal water supplies primarily because their flow is expected to be lowest during the dry season when they are most likely to be needed. Other negative considerations to developing these springs are cost and environmental impact (Keel 2005).

Talakhaya, the 1,100-acre limestone cliff and terraced formation below the Sabana, is highly dissected by streams that have eroded the volcanic soils at the cliff base. The streams are fed by springs and runoff sources originating from rainfall on the Sabana. Steep cliffs and benches surround the Talakhaya/Sabana area and are dominated by the native limestone forest community. Talakhaya contains the only perennial streams on Rota, and wetland areas exist within a riparian network. The stream flows are perennial, where a few of the streams are showing signs of being intermittent, with flows greatly diminished during the dry season. Flows have been substantially curtailed and possibly eliminated by increased use of the water for community water supply, specifically in the sealing of the water caves, as well as the potential impact from climate change (WRAS 2003, Golabi 2018).

60% of the Talakhaya area is comprised of the akina soil series, which consists of moderately deep, well-drained soils on volcanic uplands. The soil unit is characterized by 20 to 40 inches of soil over highly weathered rock (saprolite), is acidic with few nutrients, and may have plant-toxic levels of soluble aluminum (NRCS 2007). Much of the Talakhaya region is considered badlands, areas of saprolite where the soil has been nearly or completely eroded. These soils, as confirmed by soil tests done by UOG, lack available nutrients to establish large vegetation (Golabi & Manibusan 2014).

2.5. Biological

Vegetation on Rota consists of mixed second-growth forests, grassy savannas, and dense thickets of introduced tangantangan (*Leucaena leucocephala*). Approximately 60% of the land area of Rota still remains native forest, although much is altered and not pristine. The best developed and most pristine native forest (including limestone forest) is on the slopes and cliffs of the Sabana (NRCS 2007). The Talakhaya area is dominated by introduced grasses with thickets of native vegetation surrounding some

of the stream areas. Vetiver grass (*Chrysopogon zizanioides*), bahia grass (*Paspalum notatum*), and acacia (*Acacia* spp.) are currently being introduced to the area by natural resource agencies through the revegetation program in order to secure the exposed soils in badlands. Ideally, once the soils are secured, resource agencies will expand their scope to revegetate using only native species.

The Talakhaya/Sabana area is home to some of the largest populations of introduced Philippine sambar deer (*Rusa marianna*) in CNMI. Hunting for the species is prohibited seasonally. The deer grazing habits are thought to be contributing to the deterioration of the native forest understory and have made the re-introduction of native plants significantly more difficult; however, the continued health of the deer populations is a conservation priority of the local community. Similarly, it has been noted that there is a growing population of feral goats (*Capra aegagrus*), originating from a small group that escaped previously. Although there are no signs that they are impacting the re-introduction of native plants, there are concerns that they may be generating erosion in previously uninvestigated areas. The goats are not yet considered a conservation priority and are not currently being targeted by hunters in Talakhaya.

Rota blue damselfly *(Ischnura luta*)

Osmoxylon mariannennse

Mariana crow (*Corvus kubaryil*)

Figure 4. Some protected species in the Talakhaya

Coconut crabs (*Birgus latro*) also exist throughout the entirety of the watershed. The crabs are a highly sought food source for both personal consumption and commercial sale; their hunting is permitted seasonally. The health of the populations is not known at this time. The Mariana fruit bat (*Pteropus mariannus*), Mariana crow (*Corvus kubaryil*), Rota bridled white-eye (*Zosterops rotensls*), green sea turtle (*Chelonia mydas*), disciplina fern (*Lycopodium phlegmaria var.longifolium*), *Osmoxylon mariannennse*, Rota blue damselfly (*Ischnura luta*), and fire tree (*Serlanthes nelsonii*) exist within the watershed and are all listed under the Endangered Species Act (Figure 4). Additionally, the critically endangered hawksbill sea turtle (*Eretmochelys imbricata*) has been tagged in the area and is thought to be present (UWA 1998). Many of these species have their own management plans associated with their conservation, requiring coordination between agencies with regards to their status in the watershed. It is important to note that there are currently a number of Mariana fruit bat, Mariana crow, Rota blue damselfly, fragile tree snail (*Samoana fragilis*), and native flora researchers conducting studies throughout the watershed. Their inclusion in the management planning process is essential for the integration of their respective plans. Habitat for the listed threatened and endangered species can be found in Appendix A.

Camacho et al. (1997) surveyed the Okgok Stream and classified the riparian flora in three separate reaches (lower, middle, upper). The lower reach included the cultivated species bananas (*Musa textiles)*, breadfruit (*Artocarpus* spp.), and bamboo (*Bambusa vulgaris*) as well as beach hibiscus (*Hibiscus tiliaceus*), coconut, screw pine (*Pandanus dubius*), and numerous ferns (e.g. *Asplenium nidus* and *Polypodium*

scolopendria). The riparian vegetation of the middle reach was comprised of typical ravine forest vegetation, which included most of the lower reaches species in addition to *ahgao* (*Premna obtusifolia*) and limeberry (*Triphasia trifolia*) (Fosberg 1960). In the upper reach near the Water Cave, water flows over the roads leading to a marshy community with the flora consisting primarily of swamp morning glory/kangkun (*Ipomea aquatica*) and taro (*Alocasia macrorrhiza*), in addition to Pacific almond (*Terminalia catappa*), *Colubrina asiatica*, and dense stands of bamboo and banana.

The coral reefs adjacent to Talakhaya watershed appear to be heavily impacted by sedimentation from roads and highly eroding soils, based upon comparisons with other sites around Rota. Unfortunately, no scientifically-sound, historical data exists to judge or date the perceived declines in coral reef resources as monitoring efforts started in 2000 when conditions were already compromised. Figures are briefly expounded upon in the next section, but current coral cover sits between 10 and 12% in these areas (Benavente 2018). Limited data exists to improve understanding of the fish assemblages in the Talakhaya region. Monitoring efforts initiated in 2000 by the DCRM Marine Monitoring Team (MMT) using standard belt transects showed low abundances of higher trophic level fish, and suggests a steady decline in herbivorous fish over the same period. However, since 2011 small-bodied acanthurids and small-bodied parrotfish make up the majority of total fish biomass throughout the years (Figure 5). Increases in biomass of large-bodied parrotfish were also observed (Benavente 2018). Because watershed restoration activities and natural disturbance events occurred within overlapping time frames, it is difficult to determine the individual factors driving coral reef dynamics at this time. Improved datasets are needed to unequivocally substantiate the trends shown in the existing data set, however, this process indicated that fishing occurs regularly, yet the exact amount of fishing pressure in the area remains unknown. Several subsistence and commercially favored species are present in the area, including parrotfishes (*Scarus* and *Chlorurus*), rabbitfishes (*Siganus*), and unicornfishes (*Naso*). Any spillover effects for the area related to the existence of the Sasanhaya Bay Fish Reserve are unknown.

2.6. Benthic

The Talakhaya monitoring site continues to be characterized by low coral cover and a predominance of turf and macroalgae. Benthic monitoring of the coastline below the Talakhaya watershed has been conducted since 2000, showing a steady decline in coral cover from 2000 to 2005, and a small increase in cover beginning in 2007. Throughout CNMI coral monitoring data show high activity of the corallivore crown-of-thorns (*Acanthaster planci*) from 2003 to 2006.

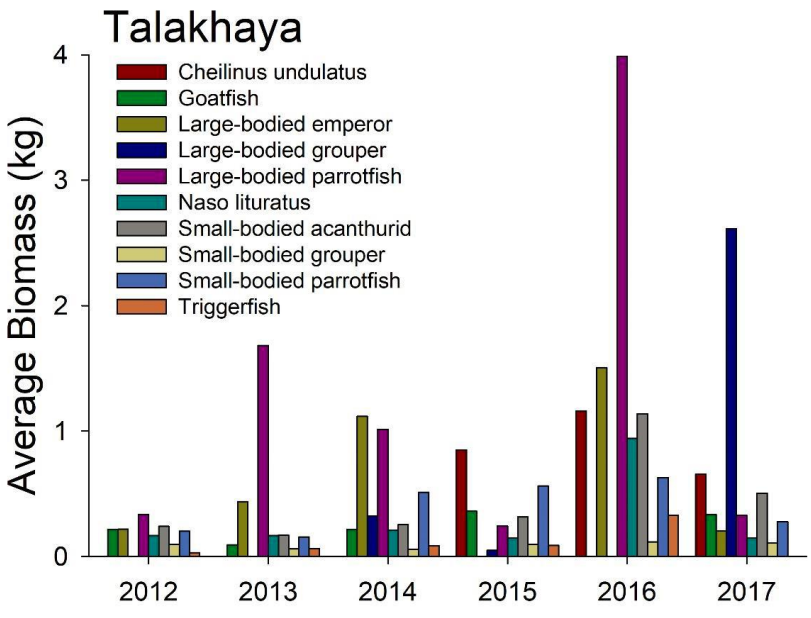


Figure 5. Total biomass of major food fish and functional groups.

Prior to the crown-of-thorns outbreak, the benthic substrate was more closely associated with coral communities. During disturbance years, community structure changed significantly to turf and macroalgal community but recovered to pre-disturbance levels by 2013. Although recovery has been observed, the occurrence of these disturbance and recovery events have left the benthic communities in an altered state.

Around 2008, significant inter-annual fluctuations in macroalgae and fleshy coralline algae are observed, which previously had remained low and relatively stable. In 2017, a greater association with reef accreting benthos was observed. Recovery has been observed at differential rates throughout the CNMI, and the difference is currently being tied with land-based pollution and herbivory levels. Houk and Wiles (2010) have shown that coral recovery from disturbances is correlated with water quality. Thus, the observed recovery of coral cover to pre-disturbance levels may have been a positive indicator of watershed health. The coral colony size data show an increasingly skewed population developing since 2004. This is also a sign of initial recovery, whereby new coral colonies (i.e. small size corals) recruit back onto the reef. Only continued monitoring can show if these initial, seemingly favorable trends, are valid.

			Coral Garden, Kokomo, Talakhaya	Mobil, E. Harbor, Teweksberry, W. Harbor, Storm drains	Vet Memorial, Teteto Beach	Swimming Hole
			R1-R2 R13	R3-R8	R9-R11	R12
		Rota				
WATER BODY SEGMENT ID		1	2	3	4	5
	Designated Use	Dugi/Gampapa/ Chenchon	Sabana/ Talakhaya/ Palie	Songsong	Uyulanhulo/ Teteto	Chaliat/Talo
Coastal Waters	Aquatic Life	*F*	*Poor Habitat*	*Poor Habitat DO% exceed*	Fair Habitat	*Fair Habitat*
	Fish Consumption	F	i	i	i	i
	Recreation	*F*	N	N	F	N
	Aesthetic enjoyment/others	F	F	F	F	F
	CALM Assessment Category	*1*	5	5	*3*	5
Streams	Aquatic Life		i			
	Fish Consumption		i			
	Recreation		i			
	Potable Water Supply		i			
	Aesthetic Enjoyment/others		F			
	CALM Assessment Category		2			
		Not Attaining Use Desig		Fully supporting Use Designation		
		Insufficient Information		No fresh surface water		

Figure 6. Assessment of Use Designations on Rota (BECQ 2016).

Under the most recent biological assessment, the Talakhaya watershed received a "poor" ranking in the 2018 305(b) Water Quality Assessment (Figure 6), which means it does not support the Propagation of Aquatic Life use designation (EPA 2017). However, if the potential environmental stressors that increased populations have on marine biological communities are considered, one would expect that the communities of the sparsely populated island of Rota would be in a better condition relative to the populated island of Saipan (BECQ 2018).

Research by Houk et al. (2014) demonstrated that Rota coral

reefs are more resilient to disturbances caused by crown-of-thorns, while Maynard et al. (2016) determined that the reefs of Saipan are more resilient to the threats caused by climate change. Therefore, it may be speculated that the present protocol for determining the status of marine biological communities may be more complex and insufficient for assessing the unique Rota setting. Biological monitoring data ranked the coastal habitat as "poor" for the 2018 reporting cycle. This decline and the lack of new nutrient data results in the Talakhaya watershed remaining on the impaired list for Propagation of Aquatic Life use designation. Additionally, bacteriological data had exceedances of the water quality standards for *Enterococci* spp. and therefore, this watershed remains impaired for the Recreational use designation. It is thought that the source of the *Enterococci* contamination may be freshwater seeps carrying human waste from failing septic systems and free-roaming livestock (BECQ 2018).

2.7. Riparian

The Talakhaya area of the watershed is comprised of steep terrain with slopes ranging from 5–99%, and reportedly contains the only streams on Rota, a total of eight. Although oral history from local community members has indicated that most of the streams were normally perennial, a few of the streams have become more intermittent in recent years while others only flow during the peak of the wet season after heavy rain. The streams of the watershed are fed by the Water Caves in Sabana, indicating the need for a holistic approach of ridge-to-reef management from the plateau to the reef flats. Of the eight streams, five have been numbered for monitoring purposes (TK0 – TK4), each demonstrating high variability between each other in natural vegetation, drainage basin size, stream dynamics, and land-use changes in the associated sub-watershed, which may not make it possible to draw comparisons between the stream systems (Figure 7).

Over the last decade, the streams have been subject to research from a combination of University of Guam (UOG) and the National Coral Reef Management Fellows located on the island (Golabi 2018, SLAR 2017). The analysis of the soil and water sampling from the re-vegetated areas of the watershed focusing on the introduction of vetiver grass has been compared with areas of the watershed without any revegetation, usually considered pristine native limestone forest, in order to evaluate the effectiveness of the decade long introduction of soil retaining grasses to the badlands of Talakhaya and the associated impacts on the coral reefs connected to the flowing streams. UOG researchers concluded that reductions in soil loss were observed based on turbidity and total suspended solids measurements; however, the differences between unvegetated and revegetated streams were not significant, indicating that more time was necessary for the plants to establish. During the first phase of the research, stream water quality was measured on a monthly basis, using turbidity as an indicator of sediment loading in the affected streams.

A fifteen-month gap in stream monitoring occurred after the conclusion of Phase 1, during which the revegetation efforts continued and land-use changes occurred in other parts of the watershed. Once monitoring was reinitiated, the methodology was adapted to account for the progress in the revegetation efforts, specifically to include a new control sub-watershed with the expansion of the DLNR revegetation area. Phase 2 concluded that despite the anecdotal evidence that the revegetation effort has improved stream water quality, there isn't enough data to make assertions with any certainty and that comparing water quality across sub-watersheds over time-based on stream monitoring is challenging. The Phase 2 Soil Loss Assessment (2018) provides a list of nine recommendations for improving the monitoring efforts of the streams and sub-watersheds that are incorporated into the monitoring plan of this TWMP.

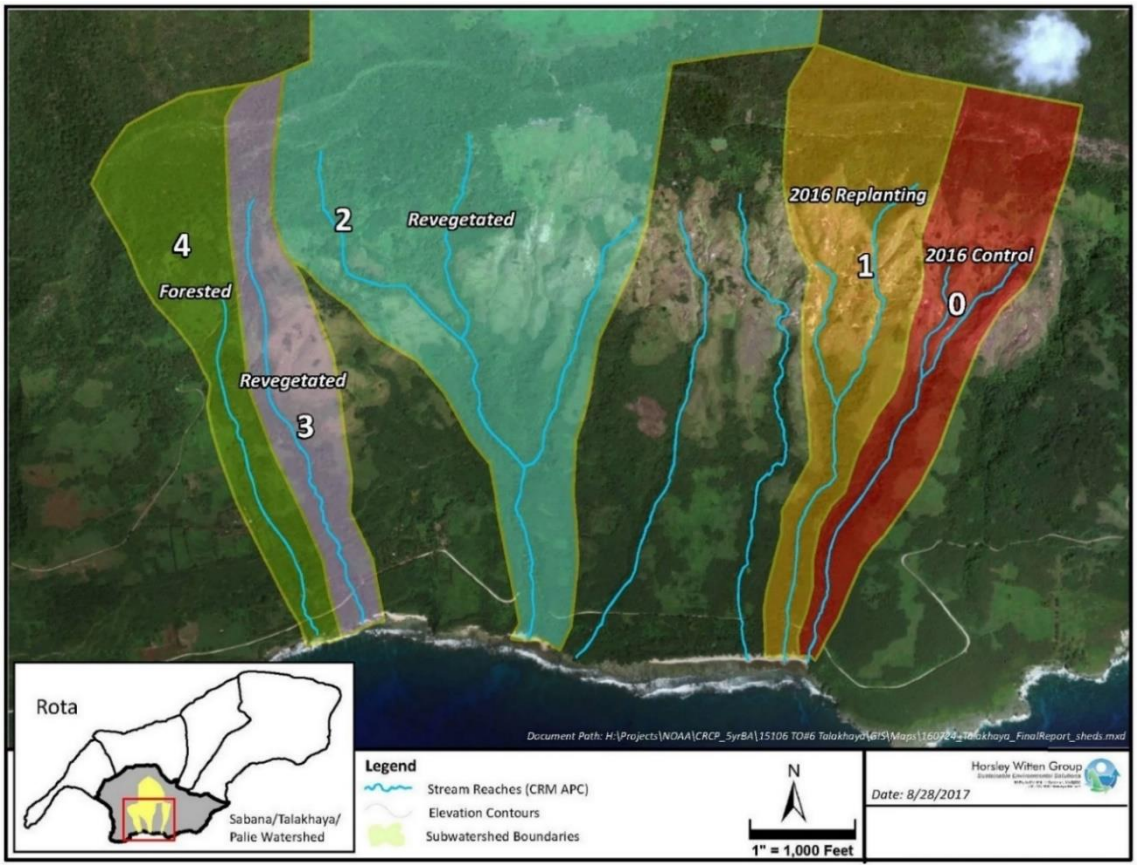


Figure 7. Streams and sub-watersheds of the Talakhaya (SLAR 2017)

Monitoring of the stream water quality continues to this day in addition to the inclusion of the BECQ stream visual assessment protocol (SVAP) of various sites along the streams that have shown high erosion post-storm events. These areas should garner additional attention as the badlands of the upper watershed continue to be revegetated. Extensive mapping of the riparian areas has exposed a number of unique features including more than 50 waterfalls greater than three meters and the presence of a number of riparian species: jungle perch (*Kuhlia rupestris*), freshwater prawn (*Macrobrachium lar*), freshwater gobies (*Stiphodon elegans* and *Sicyopus leprurus*), atyid shrimps (*Atyoida pilipes* and *Caridina typus*), and giant mottled eel (*Anguilla marmorata*) (Camacho et al. 1997). Many of these species have cultural values as natural resources that were once harvested regularly by the residents of Rota. However, interviews with users of watershed resources have revealed that although prawns, or *uhang*, continue to be harvested with some regularity, the presence of eels, or *Åsuli*, has decreased significantly over the last decade, possibly related to the changes in flow described by the differences in perennial and intermittency.

Based on the 2018 305(b) Water Quality Assessment Report, there is insufficient data collected about biological conditions, fish tissue and/or biota contamination, and general water quality parameters of its freshwater streams to assess attainment for any of the designated uses, including “Potable Water Supply” use designation. Therefore, the cumulative findings resulted in Talakhaya coastal waters retaining an EPA “Consolidated Assessment and Listing Methodology (CALM)” Category 5, and the streams a Category 2 (BECQ 2018). However, based on observations conducted regularly by CUC employees, water levels in the main Water Cave reached their lowest recorded levels during the dry season in early 2019, demonstrating

a theme of increasingly drier seasons having serious freshwater impacts (Peter Taitano, personal communication).

2.8. Cultural & Socioeconomic

Based on socioeconomic surveys conducted on Rota, most residents of Rota have lived on the island more than ten years (83%), consider their ethnicity Chamorro (75%), have completed at least high school (81%), and consider living on Rota as an important part of their identity (84%) (Schafer 2013, SEM-P 2014). When asked about their awareness of conservation areas in Rota, over half of all respondents were able to identify four of the conservation areas, including both Talakhaya/Sabana and Sasanhaya, and most participants demonstrated a very high awareness of what the conservation areas protect (e.g. specific species) and at least half of the survey group understood which activities were prohibited within the conservation areas. An exceptionally high percentage (91%) of respondents knew that burning is not allowed in conservation areas, similar findings were seen with regards to a Talakhaya focused survey.

The Talakhaya/Sabana area contains the only perennial streams on Rota and some of the most pristine forest in the CNMI. The use of the area is additionally important and highly valued within the community for passing on of traditional farming practices and medicinal plant collection. The endangered fire tree (*Serianthes nelsonii*), or *trongkon faia*, and *Osmoxylon mariannense* both exist in these areas and are culturally important. There are ancient Chamorro settlement sites in the area, particularly near the perennial streams. Spanish and Japanese historical sites are also present in the watershed (UWA 1998). Due to the importance of cultural values to the residents of Rota, it is necessary to further protect both the historic sites as well as the traditional practices of medicinal plant collection and agriculture. Integrating these aspects into management planning requires compromises as well as opportunities for stakeholders interested in preserving traditional ways of living on Rota.

The Sabana area and the lower parts of the Talakhaya area contain some of the more productive and economically important farms on the island. They contribute largely to both the commercial and the subsidence agricultural trade. Additionally, nearly all of the fresh water on the island comes from the water cave and the adjacent springs that sit within the project area (UWA 1998). Aside from the obvious importance of this water source, the cave itself has specific cultural importance that is recognized by the community.

In order to better understand the community valuation of natural resources of Rota, surveys should be conducted regularly to continue to detail the changes in knowledge, attitudes, and behaviors. Figure 8 shows that residents are aware of the biggest threats to natural resources, although, with regards to the watershed, only the residents of Talakhaya describe erosion as a threat to the environment. Watersheds should be a priority for outreach at all education levels, detailing their importance as well as the major threats and opportunities.

2.9. Conservation status

The Talakhaya watershed stands removed from the two major urban areas of Rota, the villages of Songsong and Sinapalo. Industry in the area is limited to small scale farming and ranching operations, the majority of which exist near the closer to the shoreline where the land flattens or on top of the plateau in the Sabana area, yet even in the higher elevations there continue to be land-use changes that may have an impact on the waters below. Some of the farming plantations that do run up the hillside of the watershed near the current revegetation areas consist mainly of betelnut ree (*Areca catechu*) plantations.

Hunting in the Sabana area is prohibited, however hunting for both the sambar deer (*Rusa mariannus*) and coconut crab (*Birgus latro*) in the Talakhaya area is a regular occurrence during the seasonally permitted months of the year (exact figures are unknown, knowledge based on user conversations). The marine areas associated with the watershed are used for fishing but are not considered to be an important or highly productive fishing area for the island. There is no accurate data on fish stock health or fishing pressure at this time, although conversations with stakeholders have discovered that a decrease in fishing pressure has occurred simultaneously with a perceived loss in fish biomass.

The majority of the watershed is on public land (80%), the remainder of which is private land (UWA 1998). As of 2019, some private landowners have been supportive of and amenable to management actions in the watershed. However, the support level may change if owners or management actions change. Managers should consider these issues before implementing any new actions. In an attempt to include landowners in the planning process, multiple meetings and interviews were conducted during the development of the plan. Stakeholders have been able to communicate both their perceived threats as well as their potential opportunities for activities to improve watershed health.

Prior to this document, three conservation plans were developed for the Talakhaya/Sabana area aimed at conservation. The Unified Watershed Assessment was completed by the Watershed Working Group in 1998. The assessment aimed to prioritize watersheds within the jurisdiction needing management action. The Talakhaya/Sabana/Palie watershed was listed as a Priority 1 watershed in the report, meaning it requires restoration because its waters do not meet clean water requirements and other resource goals (UWA 1998). The Natural Resources Conservation Service (NRCS) developed a soils conservation plan for Rota in July 2007 (Appendix B). This plan aimed to evaluate the threats facing the soils in the watershed and mapped out strategic actions recommended to be taken to conserve them. The current revegetation and management programs are based primarily on this plan as well as on-the-ground assistance from NRCS staff. Lastly, the Talakhaya/Sabana CAP was developed in 2012 and revised in 2015, guiding watershed management on the island up through this point. The CAP successfully provided Rota with the necessary tools to manage Talakhaya, but in order to fully integrate all aspects of the watershed, a new management approach is necessary.

Additionally, there are a number of other management plans that have an impact on the watershed. As mentioned previously, the Sabana Land Use Management Plan (2018) seeks to address the watershed issues of the Sabana Wildlife Conservation Area. Species-specific management/recovery plans are in place for the: Mariana crow (*Corvus kubaryi*), Rota bridled white-eye (*Zosterops rotensis*), sambar deer (*Rusa mariannus)*, coconut crab (*Birgus latro)*, Mariana fruit bat (*Pteropus*

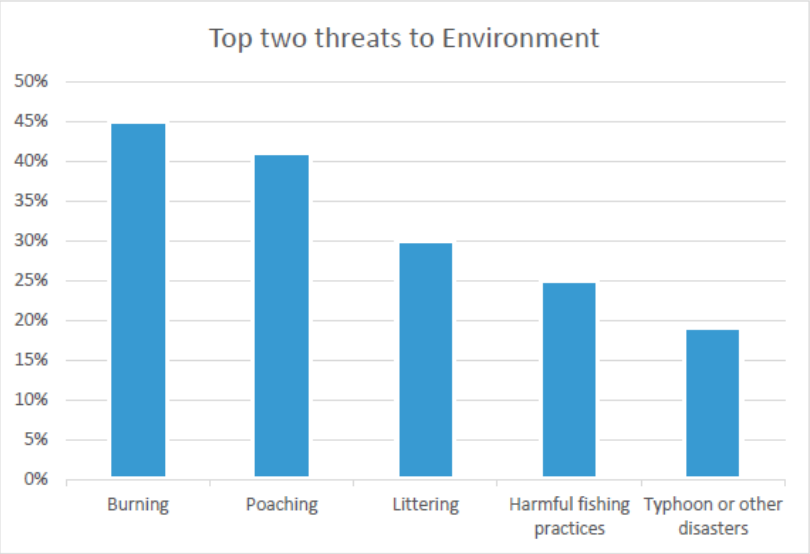


Figure 8. Top environmental threats on Rota (SEM-P 2014).

mariannus), Rota blue damselfly (*Enallagma cyathigerum*), fire tree (*Serianthes nelsonii*), and *Osmoxylon mariannense*.

2.9.1. Revegetation Effort

Revegetation of the badlands within the Talakhaya Conservation Area has occurred for the last 10 years (Figure 9). Each year, planters are hired using the Luta Livelihoods Project, which seeks to employ locals for temporary positions that benefit the island. Before the planting season (July through September), DLNR and BECQ conduct site assessments at locations with exposed soils to evaluate the feasibility of replanting. Since the beginning of the project, volunteers and agency personnel have planted over 25,000 seedlings each year in the highly eroding areas of the watershed. Due to the poor quality of the soil and the large loss of topsoil, a mix of non-native species adapted to these conditions has been used, primarily vetiver grass (*Chrysopogon zizanioides*), bahia grass (*Paspalum notatum*), and *Acacia confusa*. The current method involves creating hedgerows with vetiver grass and filling the areas in between with Bahia grass. Rock check dams are also used to help slow runoff velocity and prevent gullies during large rain events.

Managers from the DLNR forestry program have mapped out long-term strategies to reintroduce native forest to the area as these revegetated areas mature. Pilot sites have been identified and methods for achieving these goals are being tested within them. These efforts focus mainly on thinning and lifting mature acacia and inter-planting native trees and shrubs that, through continued thinning, will come to dominate the area. Over the last five years, the project has begun a transition into planting native tree species grown in a nursery prior to the planting months. The team is currently conducting research to determine the most resilient species to both herbivores and in the exposed cliff-side habitats of the watershed, as well as looking at various fertilizer options to maximize survival rates. In order to restore the habitat of the watershed to historic baselines, it is necessary to continue the revegetation project towards complete native tree species cover.

Revegetation efforts have been hampered significantly by intentionally set fires. Fires occurred in the area in 2009, 2012, 2013, and 2017 complicating the revegetation efforts. Many of these fires are thought to be set by residents to reduce the protective cover favored by the introduced sambar deer, and attract deer to new grass shoots in the open areas created by the burning; here they are more easily taken by hunters. These fires resulted in damage to revegetated areas, encouraged invasive plants, and exposed the more erodible areas. Reducing, or even eliminating, these fires have been set as a management priority for the last several years. Collectively, Rota residents are aware of the problem of intentionally set fires, which has helped to reduce the number of fires set since the development of the Talakhaya CAP.

Another reoccurring challenge for the revegetation project is the lack of reliable access to planting areas, which are increasingly further and higher than previous years in order to focus on the remaining badland. All of the access roads require permission from private landowners, who continue to be willing to assist DLRN and the volunteers, however, the roads are in poor shape and the local government agencies have limited ability to repair the steep, secluded roads. Funding for road repair expenses – including aggregate and fuel – have remained insufficient over the last few years, requiring DLNR to use their own resources to make temporary repairs every year. It is essential that planning involves the repair and/or reengineering of roads within the project site to ensure the longevity of vehicles used for revegetation and, more importantly, the safety of volunteers.

There currently is a lack of reliable mapping information to determine the extent of bare land or total acres planted. Planted area estimates are anywhere from 60 – 100 acres depending on the method. At a minimum, it appears evident that more watershed area is being stabilized with vegetation over time. It is estimated that approximately 60–70% of the Conservation Area has been revegetated, with varying degrees of success with regards to the establishment of the plants due to soil characteristics, storms, fires, and the landscape. Figure 7 demonstrates one method to measure the success of the revegetation project. In order to guarantee the success of the project, it has been determined that another 5-10 years of revegetation efforts are necessary to stabilize eroding soils and to reintroduce a sizable population of native species to the area.

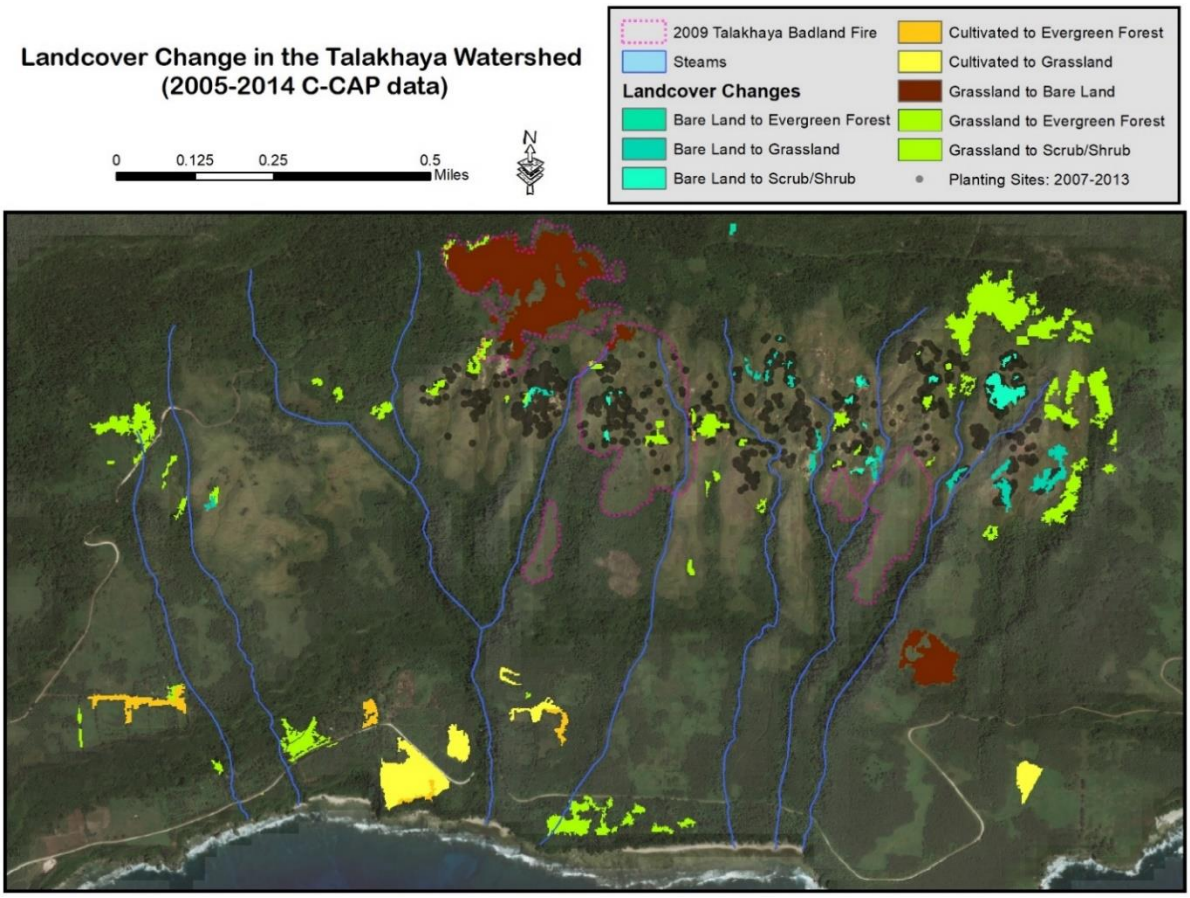


Figure 9. Land cover Change in the Talakhaya watershed (2005-2014) using Coastal Change Analysis Program (C-CAP) land cover data. Based on the imagery above, it is clear that there are positive trends in much of the conservation area seen by the location of all colors except the dark red. Both cultivated land and grasslands are showing a transition into forest and scrubland. Bare land (shades of teal) also indicate direct action from the revegetation project where exposed soils targeted by the revegetation project are transitioning into forest and grassland as well. The locations of a transition into bare land from grassland has a direct correlation to sites of badland fires from past years. Although these are locations of concern, the last four years have seen growth into grasslands not captured in the C-CAP data. Overall, managers tend to rely on the anecdotal evidence of landowners who have noticed significant

3. The Integrated Watershed Management Approach

As defined earlier, a watershed is a topographically defined area, a drainage basin, wherein the total area encompasses all the water that drains into a single body of water (e.g. stream, pond, ocean). Watersheds are also hydrological response units, biophysical units, and holistic ecosystems in terms of the materials, energies, biota, knowledge, cultures, histories, futures, and assemblages that flow through them (Wang et al. 2016). Given the geological and biological relevance of watersheds as units for physical analysis, following the global efforts for using watersheds as socioeconomic-political units for management and planning, this plan recommends a shift towards the integrated approach of management that incorporates the relationships between institutions, humans, and non-humans – including soil, water, landscape, seascape, flora, and fauna.

Watershed management has existed throughout the world for thousands of years and was likely a critical component of the First People of the Marianas, utilizing freshwater resources to determine community locations and for agricultural benefits. The California Department of Conservation (2015) defines watershed management as "the study of the relevant characteristics of a watershed aimed at the sustainable distribution of its resources and the process of creating and implementing plans, programs, and projects to sustain and enhance watershed function that affect the plant, animal, and human communities within a watershed boundary." Integrated watershed management builds upon the foundational principles of watershed management to integrate various social, technical, and institutional dimensions, as well as conservation, social, and economic objectives (German et al. 2007).

"Integrated Management is an adaptive, comprehensive, integrated multi-resource management planning process that seeks to balance healthy ecological, economic, and cultural/social conditions within a watershed. It serves to integrate planning for land and water; it takes into account both ground and surface water flow, recognizing and planning for the interaction of water, plants, animals, and human land use found within the physical boundaries of a watershed"
(Red Deer River Watershed Alliance 2015)

3.1. Principles of Integrated Watershed Management

In a summary of integrated watershed management approaches in Canada (2016), the Canadian Council of Ministries of the Environment generated a list of eleven principles of Integrated Watershed Management (IWM) that this management plan has incorporated into the planning, implanting, and evaluating processes:

1. **Geographical Scale**: The Talakhaya watershed is the planning boundary at an appropriate scale to address the issues under consideration in a way that recognizes its connectedness to upstream and downstream systems.
2. **Ecosystem Approach**: An interconnected process that uses the best available knowledge, considers cumulative impacts, and promotes watershed and sub-watershed approaches.
3. **Adaptive Management**: Flexible and continuous improvement and adaptation of approaches, policies, and management are undertaken by incorporating new knowledge and innovative design, practices, and technology.
4. **Integrated Approach**: Land, water, and infrastructure planning; investment and management considering the direct, indirect, or potential impacts and their interdependencies.
5. **Cumulative Impacts**: Planning considers the cumulative effects on the environment and the interdependency of air, land, water, and living organisms.
6. **Precautionary Principle and No Regrets Actions:** Caution is exercised to protect the environment when there is uncertainty and environmental risk.
7. **Proactive Approach:** Environmental degradation is prevented because it is better for the environment and more cost-effective to prevent than to clean up after the fact.
8. **Shared Responsibility:** The responsibility for policy and program development and implementation is shared within the mandate of all actors at the appropriate scale.
9. **Engaging Communities and Indigenous Peoples:** The IWM process recognizes and supports the identity, culture, and interests of local communities and indigenous peoples, as well as enabling meaningful participation and incorporating traditional ecological knowledge and practices.
10. **Sustainable Development:** The right to development equally meets the economic and societal needs without compromising the environment for present and future generations.
11. **Natural Capital:** Natural capital is protected and managed to reduce short- and long-term negative financial impacts; natural systems provide goods and services of environmental, economic, social, cultural, and spiritual value (refer to Table 1).

3.2. Evolution from CAP

The planning process for this management plan started after discussions between the local, commonwealth, and federal stakeholders identified the need to transition from a CAP to an integrated WMP approach for Talakhaya in 2017. In April of 2018, an initial workshop was held on Rota to engage the community and lay out the planning process. A follow-up meeting was conducted in June of 2018 to discuss the threats and opportunities in Talakhaya to better inform policy recommendations. Additionally, a number of interviews, surveys, and conversations were led with various community members to ensure the inclusion of locals in the planning process. Building on the work of the revised Talakhaya/Sabana CAP published in 2012, the TWMP utilizes the conservation targets, previously identified threats, prioritized conservation goals, and list of creating strategies to ensure watershed planning continues smoothly over the next five and ten years.

During a final workshop in March of 2019, stakeholders discussed concerns over the continued lack of enforcement and while this threat has specific solutions outlined in later sections, it reiterates the need for the community to encourage enforcement from relevant agencies rather than staying silent after witnessing infractions. The workshop also focused heavily on the concerns of future funding for any watershed related activities. While the local government relies on USDA-NRCS funds for specific projects (e.g. stream/culvert clearing post-typhoons), the success of this entire plan and the future of the watershed necessitates financial commitments from each agency. The primary example of this commitment, which was agreed upon by multiple stakeholders, was the creation of a watershed manager position to implement the TWMP, likely housed under DLNR. Section 3.3 includes the "managers" as relevant stakeholders.

Since the reevaluation of the CAP in April of 2015, a significant amount of scientific and socio-economic data has been collected, allowing for an expansion on the current status of the natural resources of Talakhaya as well as a reorientation of strategic actions to address developing threats. Ideally, this information, as well as that of each agency, can be found in a single repository for ease of access. The process as a whole has integrated the technical staff, resource managers, infrastructure managers, other government agencies, political actors, and multiple community stakeholders to guarantee the shared responsibility of the management plan.

3.3. Stakeholders & Partnerships

Engaging with stakeholders has been essential for the development of this management plan. Besides the workshops conducted on Rota, there exist a number of partnerships that have either been in place or have formed to better manage the resources of Talakhaya. What follows is a list of the various stakeholders (in **bold**), partnerships, funding sources (in *italics*), and shared responsibilities that ensure the successful implementation of this management plan. These partnerships need to be continually readdressed to ensure integration of stakeholders:

Stakeholders discussing threats at workshop

- **Landowners** act as the main arbiters of the plan by providing ecological knowledge of the watershed, implementing some of the various actions presented in Section 6., and working closely with **managers** to ensure their interests and goals are reflected in any conservation efforts. It is expected that **landowners** will communicate concerns/issues that arise and offer support in informal agreements with managers.
- **Researchers** from University of Guam, University of Washington, and other institutions, focusing on the watershed and engaged with other topics – including the Mariana crow, Mariana fruit bat, Rota damselfly, other endangered flora/fauna, soil erosion, etc. –, provide the necessary data to inform the

success of management activities while also offering *in-situ* findings of problem areas throughout the watershed and areas of particular concern identified by the presence of endangered/endemic species.

- The **Commonwealth Utilities Corporation (CUC)** is responsible for the monitoring, evaluation, and distribution of Rota freshwater resources, as described in the CUC Master Plan for Rota (2015). This includes analysis of the current water levels from the water caves that are the source of water for both households and the streams in Talakhaya. **CUC** will play an active role in the implementation of the plan and offer their management expertise in the continued planning process. **Managers** will also work closely with **CUC** to build partnerships with **landowners** in order to ensure access to critical infrastructure.

- The **Department of Public Works (DPW)** is the entity responsible for the repairs, improvements, and clearings of roads throughout Talakhaya and are regularly contacted for issues like clogged culverts or road erosion due to storm events. As an essential partner in the management of the resources, **managers** will work closely with DPW to guarantee their involvement in the planning process, assist in building **landowner** relationships, and engage in knowledge exchange with regards to road maintenance and stream management.

- **Hunters** and **poachers** have remained a relevant stakeholder since the development of the CAP, particularly with regards to their role in the intentionally set fires throughout Talakhaya. Despite the steady reduction in annual fires, it is essential that **managers** work closely with **hunters** to identify alternatives to burning when hunting in the conservation area and to continue with the "Real Hunters Don't Burn" outreach campaign. In-person discussion can help alleviate the potential for future burnings.

- The **CNMI Public School System (PSS)**, **private elementary schools**, and **Northern Marianas College (NMC)** play a critical role in the successful outreach and education of watershed threats and opportunities on the island. **Managers** will work closely with these institutions to develop curricula specific to watershed management and conservation, assist in incorporating that into the educational objectives, and help plan field trips into the watershed to both explore the environment and actively participate in restoration projects.

- The **Department of Lands and Natural Resources (DLNR)** is an invaluable partner in the implementation of Talakhaya conservation efforts. The **Forestry Service** is responsible for the nursery and propagation of grasses and seedlings in barren areas of the watershed, specifically through the **Luta Livelihoods Project** annual revegetation project started in 2007 (as described in Section 2.9.1.). The **Division of Fish and Wildlife (DFW)** implements the Wildlife Action Plan, assists with enforcement in the watershed, conducts research on a number of endangered species, and provides feedback on threats throughout the conservation area. The DLNR **Sabana Working Group** is also responsible for the development and implementation of the Sabana Land Use Management Plan (2018).

- The **USDA Natural Resources Conservation Service (NRCS)** has provided technical assistance in the revegetation efforts by analyzing data collected each year and providing reports on the current status of the project. An additional partnership exists through the *Environmental Quality Incentives Program (EQIP)*, which "helps **agricultural producers** confront those challenges – all while conserving natural resources like soil, water, and air." **Managers** and other partners will offer technical assistance to

develop goals that meet the needs of both **landowners** and NRCS in order to secure funding for implementing innovative conservation practices.

- **USDA Forest Service** *Landscape Scale Restoration (LSR) Competitive Grant Program* offers a potential major funding source with many partners listed above as well as the likes of **Micronesia Islands Nature Alliance (MINA)**, **The Bureau of Environmental and Coastal Quality (BECQ)**, and others. This program could fund larger scale restoration efforts in both Talakhaya and Sabana for 2-3 years at a time. Beyond the current revegetation efforts, this funding source could support additional activities (included in Section 6.) and guarantee the implementation of key features of this management plan. **Managers** will work with partners to ensure this funding source is actualized.
- **Coral Reef Conservation Program (CRCP)** has had a long-standing involvement in the conservation of Talakhaya and served as the primary funding mechanism for both the revegetation project as well as the monitoring of Talakhaya. Additionally, the program has provided backing for education and outreach efforts related to the CNMI "Ridge to Reef" program. It is expected that the **Coral Reef Initiative (CRI)** will continue to support outreach into the future, regardless of priority watershed designation changes.
- In addition to the major stakeholders above, **mangers** will work closely with: the Rota **Mayor's office** who will provide assistance in hosting events and encourage community engagement; **DFEMS** will provide the support agreed upon in the CAP to help monitoring wildfires in the watershed; **contractors** (including Horsley Witten Group and Upstream) will make available additional resources when contracts are available for technical support (pollutant loads, landscape change monitoring, etc.); and any interested party willing to provide assistance will be welcomed in ensuring the successful implementation of the TWMP.

Figure 10. Chart demonstrating the various stakeholders involved in the Talakhaya WMP

4. Mission/Vision

The vision for the Talakhaya watershed was developed by the management team of the CAP in 2007:

"*Protehi i rikesan i tano yan i tasi*" – "*Protect the wealth of our land and sea*"

Additionally, through the watershed management planning process of 2018, a number of mssion statements for the future of Talakhaya stood out and have been highlighted throughout this document:

1. Ensure the value of the watershed (including the ecosystem services, economic benefits, cultural components, etc.) are equitably distributed to the entire community (as defined by both the human and non-human objects found in and around a watershed);
2. Guarantee the integration of watershed protection, conservation, and management with the necessary provision of safe drinking water (particularly in the context of limited water resources on small islands);
3. Establish the role stakeholders and managers play in ensuring a resilient and productive watershed for future generations (without sacrificing the needs of the present or undervaluing the impact of today on the future of the watershed); and
4. Reflect the indigenous values – relatedness, respect, and reciprocity – and the traditional ecological knowledge – via landowners, residents, elders, and managers – throughout the planning process and allowing space for all stakeholders to contribute to the continued management of the watershed.

4.1. Conceptual Model

The conceptual model (Figure 10) was developed in the initial CAP planning process in 2007 and shows: conservation targets in the green bubbles (on far right), the threats linked to relevant conservation targets in red boxes (in middle) and the contributing factors linked to relevant identified threats in orange (on far left). Progress has been made in addressing the threats over the last decade, however, this model remains informative for the TWMP by demonstrating the importance of dealing with multiple threats in conjunction in order to reach established conservation goals and objectives.

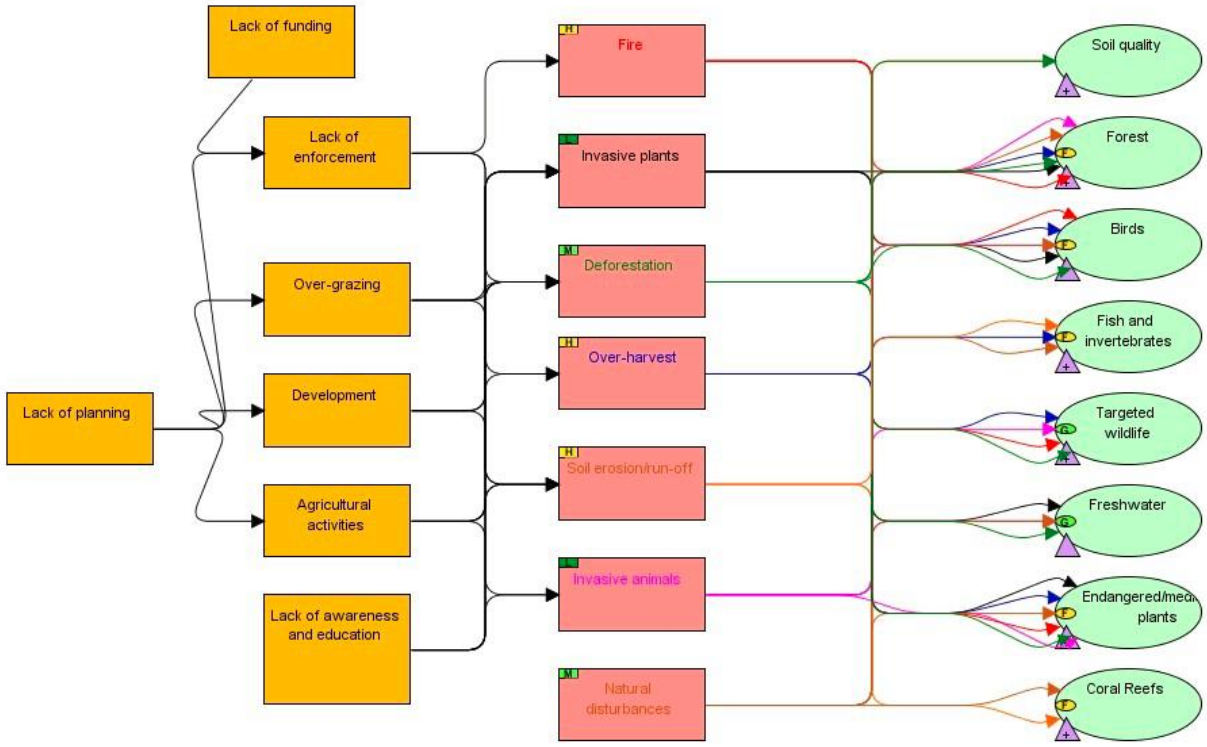


Figure 11. Conceptual Management Model (CAP 2007)

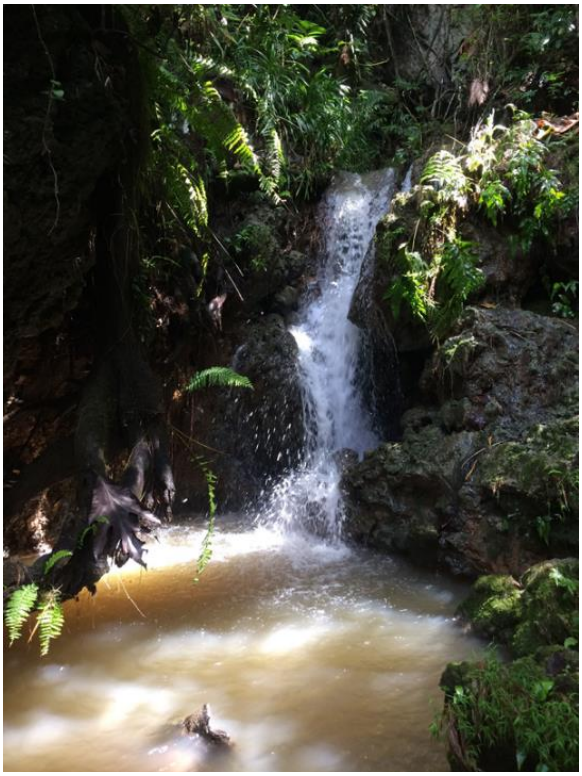
4.1.1. Conservation Targets

In addition to the vision and mission statements identified by the CAP planning process, nine conservation targets were identified by stakeholders in in the 2012 and 2015 CAPs as essential aspects of the watershed that need to be protected. These conservation targets remain relevant when considering the future of the watershed and the ways in which Talakhaya is connected with other aspects of the island. What follows are the nine targets previously identified with explanations as to their significance in the current planning process:

Birds – In addition to the protected avian species, birds remain a critical component of the native limestone forests of Rota. Birds act as both seed dispersers and trophic keystones in maintaining balance in the terrestrial ecosystem. Within Talakhaya, there are a number of species present, including the Mariana crow and Rota white-eye, as well as seabirds, like the Pacific reef heron (*Egretta sacra*), which forage in streams and along the coastline, and transport vital nutrients from the coast inland. Nearby to the south, Guam is struggling with the impact of the brown tree snake (*Boiga irregularis*) that has decimated native and endemic bird populations throughout the island. Currently, Rota has been vigilant in preventing the introduction of the invasive snake species allowing for a fair level of species diversity and expanding the presence of endemic/endangered species.

Coral reefs – The initial development of watershed management on Rota was through the ridge-to-reef approach, with a focus on solving terrestrial threats in order to improve coral reef quality. Funding for Talakhaya watershed management has primarily been through the Coral Reef Initiative, so there remains a particular interest in addressing the land-based sources of pollution as a major threat to coral reef health.

Endangered/medicinal plants – There are two specific species listed as endangered plants that have been of particular focus throughout the planning process: fire tree and *Osmoxylan mariannense* (Sabana). Forestry Services has put in considerable work to document the know locations of these species as well as introducing seedlings of both as part of the ongoing revegetation project. Additionally, there are numerous culturally important species that are present throughout Talakhaya that should be included under the medicinal plant target.



Turbid water from upstream erosion

Fish and invertebrates – Fish and invertebrates in the original CAP focused exclusively on the abundance and population size of human food resources in the marine environment (i.e. edible shells and catch-per-unit-effort of food fish). While these are normal metrics for measuring the status of fish dynamics, it is important to expand the targets beyond exclusively human-use targets as well as solely within the marine environment. High-biodiversity of fish species results in more diverse and resilient reef ecosystems (Knowlton et al. 2010). Additionally, as mentioned in section 2.7., the streams of Talakhaya are vital ecosystems for a number of fish and invertebrate species, some of which also fall under the "human-use" moniker as they are harvested with regularity.

Forests – The ecological history of the Talakhaya watershed is one of complete native limestone forest cover, whereas in the present, only the riparian corridors maintain native forest cover. In the case of this management plan, the future of the watershed is one that increases the percent cover of critically eroding areas, decreases the grass cover to canopy cover ratio, and vastly expands the tree species diversity throughout the watershed (with a particular focus on the revegetated areas). Through the transition from grasses to trees, the revegetation project will take a particular focus on developing indicators for future forest coverage.

Freshwater – As identified in Section 1, integrated protection of the watershed with the provision of safe drinking water remains a major priority for management. Currently, freshwater resources are drawn from the water caves located on the upper cliffs of Talakhaya via pipelines maintained by CUC. The freshwater is also used by a number of landowners in the watershed for agricultural purposes. Additionally, the target of freshwater extends beyond the direct human-use and includes the continued baseflow throughout the streams and the associated benefits for flora and fauna. It is essential for managers to explore innovative methods to monitor and evaluate water quality (including the continuation of regular water sampling and data collected from in-stream loggers).

Soil quality – NRCS estimated in 2010 that the status for both the percent organic matter by weight and soil carbon index for Talakhaya were "fair." However, the primary concern with soil quality in the watershed is the decline due to erosion, which has been the focus of multiple reports (i.e. Soil Loss

Assessment Reports 1 & 2). Findings from both show that erosion of savannah areas is likely decreasing due to the revegetation project. Streambank erosion is increasingly becoming a serious threat to both soil quality and freshwater targets.

Protected wildlife – In addition to the key bird species identified as targets for Talakhaya, other protected wildlife species were selected as indicators for watershed health, including coconut crabs, fruit bats, sea turtles, and sambar deer. The coconut crabs and deer populations are estimated based on reports from DLNR in coordination with hunters while fruit bat sightings do not have established monitoring as of yet, however, they are regularly seen throughout the watershed, both in the upper and lower areas. The is also no recent data on the presence of sea turtles along the beaches of Talakhaya.

Asuli or giant mottled eel (Anguilla marmorata)

Genetic diversity – Preserving the genetic variation of endemic Rota species and preventing the severe inbreeding of small populations, which suffer from higher rates of extinction and are more susceptible to climatic events, is essential in maintaining the biodiversity of Talakhaya. A number of species are currently being researched with regards to genetics: Mariana fruit bat, Mariana crow, and Rota blue damselfly, with more being added. This is particularly relevant in the aftermath of typhoons, wildfires, and the potential increase in development around the island.

4.1.2. Health Status

In order to establish metrics for monitoring and evaluation, the current status of each conservation target has been assessed for viability (Table 2). The assessment follows the targets and indicators identified in the CAP process. Utilizing data collected throughout the TWMP process combined with conversations with stakeholders in relevant agencies, each conservation target has received a health ranking with the following scale:

> **Very good** – The factor is functioning at an ecologically desirable status and requires little human intervention.
> **Good** – The factor is functioning within its range of acceptable variation; it may require some human intervention.
> **Fair**- The factor lies outside its range of acceptable variation and requires human intervention. If unchecked, the target will be vulnerable to serious degradation.
> **Poor** – Allowing the factor to remain in this condition for an extended period will make restoration or preventing extirpation practically impossible

Conservation Targets	Indicators	Status	Data Source
Birds			
Species Diversity	Bird species per station	Good	DFW
Presence of key species	Presence of listed species	Good	DFW
Coral reefs			
Population structure and recruitment	Diversity per unit area	Fair	MMT (DCRM)
	Size class distribution	Fair	MMT (DCRM)
Community Structure	Percent of reef accreting substrate	Poor	MMT (DCRM)
Presence of key species	Presence of proposed listed species	Good	MMT (DCRM)
Endangered/Medicinal plants			
Number of plants	Abundance of *Serianthes*	Fair	DLNR-Forestry
	Abundance of *Osmoxylon*	Fair	DLNR-Forestry
Fish and invertebrates			
Abundance of food resources	Density of edible shells	Good	MMT (DCRM)
	Density of grazing urchins	Fair	MMT (DCRM)
	CPUE of food fish	Unknown	NOAA Creel data
Population size and dynamics	Number of grazing fish	Fair	MMT (DCRM)
Forests			
Community structure	% cover of critically eroding areas	Fair	BECQ/DLNR-Forestry
	Grass cover to canopy cover ratio	Fair	BECQ/DLNR-Forestry
Native species richness	Tree diversity in critically eroding areas	Good	DLNR-Forestry
Freshwater			
Water quality	Fecal coliform violations	Poor	BECQ
	Turbidity	Poor	BECQ
Water quantity	Flow rate	Unknown	BECQ
	Base flow and availability	Unknown	CUC
Soil Quality			
Organic matter content	% organic matter by weight	Fair	NRCS
	Soil carbon index	Fair	NRCS
Decline due to erosion	Rate of sediment transport	Poor	BECQ
Protected Wildlife			
Wildlife Abundance	Coconut crab catch	Poor	DLNR
	Fruit bat sightings	Good	DFW
	Turtle nests per beach	Unknown	DFW
	Deer sightings	Good	DLNR
Genetic Diversity			
Endemic diversity	Number of endemic species	Good*	DFW
Invasive prevalence	Number of invasive species	Poor*	DFW

Table 2. Conservation target health status.

*Genetic diversity has not been assessed official at the time of this publication. However, as noted in previous sections, there is both a high presence of endemic/endangered species in Talakhaya as well as a high presence of invasive species. Based on this information the good and poor statuses have been assigned respectively.

5. Key Threats/Issues

The threats and issues in the following section relate directly to the conservation targets in Section 4.1.1 as well as to the goals/objectives/actions of this WMP. Under the conceptual model, threats have a direct impact on targets while having multiple contributing factors. Seven threats were identified in the initial CAP and expanded upon in the 2015 revision:

Fire – Invasive plants/animals – Deforestation – Over-harvest – Soil erosion/run-off – Natural disturbances – Poaching

In 2018, a series of stakeholder workshops included discussions on the current threats to the watershed, from which twelve were identified. Many of these threats are similar to the previous CAP list. The following sections organize the major threats into critical categories, made up of multiple sub-threats that impact various aspects of the watershed. These sub-threats have been broken down and described below in an attempt to better inform managers and stakeholders as to the full extent of the issues facing Talakhaya. Each threat below includes comments on the potential contributing factors, stakeholder perceptions, and the possible impacts to the watershed.

5.1. Terrestrial

Badlands erosion: The main focus of the annual revegetation project has been to solve the issue of badlands erosion. There continue to be patches of exposed soils that are likely eroding with successive rains resulting in more exposed soil. This threat is directly related to the issue of ungulate populations, where the presence of deer can result in greater levels of erosion as well as the consumption of soil stabilizing trees. The continued funding for the revegetation project is essential in ensuring a solution to this threat, particularly with regards to the transition to native tree species.

Turbidity: High levels of turbidity in the streams during the wet season has resulted in sediment plumes onto reef flats, smothering corals and threatening the reefs. The MMT has seen some changes in biomass and corals in the associated reef flats early in 2018, however, there is no indication that the revegetation project is responsible for these changes. Although these are not highly productive fishing grounds, it is essential that the coral reefs continue to be a focus of management and innovative solutions, which are sought to both determine the source of the sediments on the reefs and ways to prevent sedimentation in the first place.

Clogged culvert eroding roads

Road erosion: The closet source of sediments to the coral reefs are the roads and culverts in the lower portions of the watershed. Storm events regularly clog culverts and cause roads to quickly erode away, requiring replacement of substrate that can be seen actively eroding into the stream with other storm events. Without the consistent maintenance of the culverts, additional erosion occurs along the streambanks above roads.

Streambank erosion: Despite revegetation efforts streambanks remain eroded, and some of the descriptions of impacts on private land were actually quite drastic with entire shifts/changes in stream course from large storm events. In some cases, the severity of erosion warrants management intervention measures, like flood zone buffers (i.e. floodable, vegetated areas alongside the banks). Additionally, the recent impact of typhoons in 2018 has resulted in an increase in erosion along streams. This threat requires extensive monitoring to determine the impact on stream quality.

5.2. Biological

Ungulate populations: There are currently two ungulates that are actively present in the watershed; deer and goats. While the deer population is protected for hunting, they continue to be a source of erosion and destruction of out-planted native tree species. The goats, while not protected, are not actively hunted so residents have seen their populations rise into sizable herds. The goat populations have the potential to spiral out of control in 3-5 years if their populations are not controlled in the near-term, resulting in a much more serious threat to the watershed.

Burn area after 2017 fire

Invasive species: As part of DLNR efforts to introduce seedlings of native tree species from nurseries throughout the island, it is important that they monitor the threat of invasive species. There currently is no biosecurity plan for the island, nor is the extensive documentation on the impact of invasive species. Invasive species of both flora and fauna have factors make them effective colonizers (e.g. fast propagation, high dispersal rates, wide environmental tolerance range). These species can overwhelm natives and, in some cases, prevent the establishment of endangered species. Islands are particularly susceptible to invasive species, but few tools are accessible in eradication of invasive species. Although it is unlikely that total removal of invasive species is possible, this threat could work synergistically with other threats to overwhelm native vegetation and fauna, necessitating mitigation efforts.

5.3. Socio-economical

Private land access: Land tenure and ownership poses one of the biggest challenges to the community or government-led initiatives to restore the watershed, and there will need to be a consistent partnership with landowners moving forward. Most agreements made with landowners were made either before the current management or with only one stakeholder involved in the management of the watershed. Presenting the current status of watershed management (and conservation research as a whole) in public forums can help ease tensions between landowners and conservationists.

Agricultural practices: Stream water quality monitoring has found that each stream may have their own unique threats, with TK4 being directly linked to most of the remaining agriculture in the Talakhaya. The SLUMP guiding document also raised concerns about the impacts of agriculture (i.e. nutrients and pesticides) in the Sabana on water quality. There are currently no efforts to monitor agricultural land in

the watershed or evaluate the potential for watershed-friendly practices. Farmers that have participated in stakeholder workshops are interested in the support this plan can provide.

Politics: Political issues are described by stakeholders as one of the primary barriers to progress with regards to the conservation of Talakhaya. Stakeholders noted that when issues become politicized, whether it be related to land tenure or government-led planning/management, it becomes very challenging to forge productive partnerships. This appears to be another instance that warrants heavy participation from private residents and stakeholders in the planning process, so the end plan is not entirely dependent on leadership or management decisions.

Lack of awareness: Since the initial CAP process, Rota has seen a steady increase in knowledge with regards to the conservation status and value of Talakhaya, as seen in surveys conducted and in impromptu discussions. As the planning process continues, there remains a need to increase the awareness of all residents as to the importance of the watershed and what actions are being taken currently. Outreach needs to be tailored to stakeholder groups in order to address the knowledge gaps.

5.4. Environmental Disturbances

Burning/Fire: Intentionally set fires continue to be a major concern for stakeholders. Fires have the potential to set back the revegetation effort by multiple years, reducing large areas of the watershed to blackened scars. Through a combination of outreach campaigns and dry-season monitors, the incidences of fires have been reduced over the last decade, with only one fire occurring in 2017. A major challenge for fires is the lack of a response plan as well as the challenge of accessing fires with equipment that could help reduce them. Neighboring islands have used fire breaks to prevent fires from spreading to neighborhoods, however, there are few homes located near any of the previous burn areas, making this an unfeasible solution.

Climate change: Changing climates will likely be the greatest threat to watershed health in the future, with impacts of warmer years, resulting in intensified seasonal variation that is already manifesting throughout Talakhaya and beyond. The CNMI Climate Change Vulnerability Assessment (2015) determined that the potential impacts could include: changes to the water budget, extreme erosion from storm events, and drought-related threats (i.e. wildfires). Additionally, climate change causes changes in water chemistry, particularly around coral reefs, with higher pH concentrations and warmer waters resulting in bleaching. While the other threats in this section can be addressed through behavior change and effective management, responding to climate change requires both preparedness and resiliency. If contingencies are not in place and monitoring is lacking, climate change will have drastic impacts from the coral reefs to the ridges of Sabana, threatening the livelihoods of numerous residents and the existence of native/endemic species.

Okgok waterfall with an average flow versus the same fall during the peak of the dry season (2018)

6. Goals, Strategies, Objectives, & Actions

During the previous CAP stakeholder process in both 2012 and 2015, five broad strategies were determined to best address the threats identified in the Conservation Action Plan:

A. Revegetation of critically eroding areas in the Talakhaya/ Sabana;
B. Implementation of engineering actions that would decrease erosion in the watershed;
C. Raising awareness and education of the Rota community about how fires and poaching are affecting the watershed;
D. Creation of effective enforcement measures for local laws; and
E. Collection of necessary species populations information in the area to allow for more informed policy decisions.

Although there has been significant progress throughout the watershed, many of the problems are still present or have altered in unexpected ways. While these broad strategies are not directly tied to the progress of the TWMP, they do offer guidance on the direction planning in the watershed has proceeded and allows for more focused aims. The following sub-sections identify the overarching goals for watershed planning, the actionable strategies for achieving those goals, the objectives for each strategy, and the recommended actions to guide managers and planners.

6.1. Goals

The introduction of this plan identified key features of watershed management which were expanded upon in Section 3, which detailed the integrated WMP approach. From there, mission and visions were developed and reflected by a conceptual model in section 4, developing a framework to address the key threats and issues in Talakhaya. Utilizing this material and informed by stakeholder participation, seven overarching goals have been identified for Talakhaya:

1. **Equitable distribution of watershed values;**
2. **Dedication to the restoration of the landscape;**
3. **Increased knowledge of watershed systems;**
4. **Reduction of erosion and sedimentation;**
5. **Commitment to meet future water needs;**
6. **Raised community awareness of watershed; and**
7. **Improved monitoring and evaluation of the watershed area.**

6.2. Strategies, Objectives, and Actions

Through a combination of stakeholder meetings, conversations, findings from past data, analysis by watershed experts, and a comprehensive review of the previous CAP process, seven strategies were identified to address the threats listed in Section 5:

Strategy 1: Improved land management and enforcement in cooperation with local agencies and landowners of both the Sabana Wildlife Conservation Area and Talakhaya Conservation Area

- Objective 1.1: Update and institutionalize conservation and resource maps for the entire Talakhaya watershed, including the Sabana Conservation Area, private land areas, and target sites for management activities.

- Action 1.1a: By 2020, update the conservation area map for the entirety of both the Talakhaya and Sabana conservation areas.
- Action 1.1b: By 2020, institutionalize the updated map through agreements with all local agencies; or through the adoption of an official map through the TWMP.

- Objective 1.2: Establish partnerships with private landowners in order to implement watershed-friendly best management practices (BMPs) for both agriculture and grazing.
  - Action 1.2a: By 2021, work with NRCS to establish agreements with 100% of private landowners in the conservation area interested in receiving support (technical, financial) towards interventions and organic agriculture/BMPs.
  - Action 1.2b: By 2021, develop a list/worksheet of potential interventions and organic agriculture/BMPs based on the success of similar actions conducted on Saipan (e.g. wetland exchange, forest legacy, CELCP, land stewards).
    - This includes the regulation of allowable agricultural techniques within the Sabana Conservation Area in order to reduce agrochemical contributions to groundwater and surface waters as identified in the Sabana Land Use Management Plan.
  - Action 1.2c: By 2025, initiate interventions and organic agriculture/BMPs on 75% of interested private property owners in the conservation area.
- Objective 1.3: Develop watershed (ecotourism opportunities that benefit private landowners, local tourist guides, governing agencies, tourists, and encourage watershed conservation.
  - Action 1.3a: By 2021, establish partnership between MVA and private landowners with potential recreational/tourism opportunities (e.g. trails or waterfalls).
  - Action 1.3b: By 2022, develop Talakhaya tourism plan to delineate and open-up trails as well as the inclusion of regular cleanups in response to unregulated recreational activities.
- Objective 1.4: Improve monitoring and enforcement of the watershed in order to reduce the human impacts of intentionally set fires, illegal poaching, and littering/dumping.
  - Action 1.4a: By 2020, have at least two conservation officers trained in evidence collection, report writing, etc. who will act as monitors/enforcers of conservation regulations within Talakhaya in cooperation with current enforcement agencies (DLNR and DFEMS).
  - Action 1.4b: By 2021, codify any necessary regulations through Rota Local Laws to prevent current and future human impacts on the conservation areas.

Strategy 2: Continued support of Forestry revegetation efforts of badlands and expansion towards native reforestation

- Objective 2.1: Establish funding mechanisms for the revegetation project, continue annual summer planting activities, and improve upon existing revegetation procedures.
  - Action 2.1a: Before 2020, identify alternative sources of funding for revegetation efforts with current funding expected to expire in 2019.
  - Action 2.1b: By 2020, establish an alternative funding mechanism in cooperation with DLNR-Forestry and provide monitoring and evaluation to maintain funding through the duration of the project (related to Strategy 7).
  - Action 2.1c: Continue to conduct annual mass planting of seedlings during the summer in cooperation with DLNR-Forestry and Luta Livelihoods Project.
    - This includes a transition from planting a majority of grasses to acacia and native trees (e.g. *Serianthes* and *Osmoxylon*) as well as a review of the current planting procedures to reduce predation by ungulates (e.g. use of fencing around individual trees).

- Objective 2.2: Develop intra-archipelago partnerships with watershed coordinators/managers/researchers on Saipan, Tinian, and Guam to promote knowledge exchange and establish archipelagic connectivity.
  - Action 2.2a: By 2020, develop partnerships with neighboring islands to allow knowledge exchange with regards to restoration projects.
  - Action 2.2b: By 2021, conduct first archipelago watershed knowledge exchange to inform managers of future restoration opportunities.
- Objective 2.3: Improve remote sensing capabilities to improve reporting success of the revegetation project and better target sites for revegetation interventions.
  - Action 2.3a: By 2019, establish partnership with Upstream to conduct remote sensing of revegetation area.
  - Action 2.3b: By 2020, generate output from remote sensing to better inform future management activities and determine potential applications of technology.

Strategy 3: Increased understanding of the geomorphology of the watershed to better inform strategic actions and ensure effective issue response

- Objective 3.1: Develop Talakhaya watershed map that highlights key geomorphological features.
  - Action 3.1a: By 2020, prepare an official map that identifies accurate stream locations, existing key features (diversions, wildlife areas, etc.), and the potential erosion sources (associated with map developed for Objective 1.1).
- Objective 3.2: Conduct a streambank erosion monitoring plan to identify potential intervention locations and better inform management goals.
  - Action 3.2a: By 2020, begin streambank erosion monitoring project using erosion pins and surveyed cross sections at sentinel stations (at least one in each stream).
  - Action 3.2b: By 2023, present findings to stakeholders and report out the critical streambank erosion locations and potential management responses to be incorporated in updated TWMP.
- Objective 3.3: Conduct research on historical and future changes to streamflow to better inform management activities
  - Action 3.3a: By 2021, conduct research on historical records (e.g. during the Japanese occupation) to understand the historical changes in stream flow and alterations.
  - Action 3.3b: By 2023, produce a model of anticipated stream flow and alterations due to climate change and critical sites for intervention.
- Objective 3.4: Conduct a sediment trap project to establish the primary sources of erosion (i.e. badlands, streambanks, private land, etc.) and develop potential intervention actions based on findings.
  - Action 3.4a: By 2020, initiate sediment trap project immediately down-gradient of bare and planted areas to measure erosion rates.
  - Action 3.4b: By 2022, produce an initial report from sediment trap project and present alternative actions to address the multiple sources of erosion.

Strategy 4: Enhanced stabilization of roads and culverts to reduce sedimentation and improve access of Talakhaya for both landowners and the revegetation project

- Objective 4.1: Identify culvert issues, determine funding sources, and replace existing culverts along the lower Talakhaya to limit blockage and sedimentation.

- Action 4.1a: By 2020, identify culverts that regularly clog after storm events resulting in road erosion and determine funding source for intervention.
- Action 4.1b: By 2025, replace all the culverts along the lower Talakhaya road that get blocked regularly (refer to Objective 3.4) with box culverts to prevent a collapse of the roadway.

- Objective 4.2: Analyze flow, erosion, and other data in both the lower (Back Road) and upper (Water Cave Road) sections to generate hydrological models to improve engineering and design of Talakhaya roadways.
  - Action 4.2a: By 2020, collate existing data, identify data gaps, and conduct a literature review on riparian roads.
  - Action 4.2b: By 2021, generate hydrological models to estimate the required capacity, engineering, permitting, and design of the roadway (refer NRCS application in Appendix C).
- Objective 4.3: Implement unpaved road standards throughout Talakhaya in cooperation with DPW, CUC, DLNR, and BECQ
  - Action 4.3a: By 2025, fully adopt and implement the "Unpaved Road Standards" (also known as low-volume roads) provided by CRCP and Horsley Witten on all roads in the Talakhaya watershed.

Strategy 5: Bolstered collaboration with CUC & DPW to identify, monitor, and evaluate current and future water resources within the Talakhaya/Sabana/Sabana watershed

- Objective 5.1: Establish a partnership between watershed managers and CUC in order to focus infrastructure projects on areas that benefit both residents and the watershed.
  - Action 5.1a: By 2020, orient the watershed plan with the CUC Master Plan to compile information on both water supply and necessary infrastructure improvements.
  - Action 5.1b: By 2020, establish a partnership between watershed managers and CUC to allow feedback on any infrastructure projects conducted in Talakhaya.
- Objective 5.2: Develop right-of-way procedures between landowners and relevant watershed managing agencies to improve access and reduce conflict.
  - Action 5.2a: By 2022, Establish right-of-ways in cooperation with landowners along important infrastructure corridors to ensure that CUC, DPW, and other partners can access land.
- Objective 5.3: Conduct base flow study to determine average flow at sampling locations throughout the year (both dry and wet seasons), estimate effects of climate change on flow rates, and present recommendations for interventions
  - Action 5.3a: By 2021, initiate base flow study based on past data and climate change models to determine potential threats to both human-use and ecological flow.
  - Action 5.3b: By 2023, present findings of the baseflow study and offer recommendations to CUC and stakeholders with regards to water access for both humans and non-humans.

Strategy 6: Raised community awareness and educational outreach for both the planning process and the Talakhaya watershed more generally

- Objective 6.1: Conduct regular stakeholder meetings/workshops to provide a status update of implementation and gather information necessary to update TWMP.
  - Action 6.1a: Annually (or more frequently), conduct stakeholder meetings with marine and terrestrial biologists, other scientists and managers, representatives from relevant agencies, and community members with local ecological knowledge on Rota to incorporate scientific data

into TWMP, update stakeholders on watershed management progress, and ensure the continued success of planning activities.

- Objective 6.2: Develop educational resources (presentations, lesson plans, field trip opportunities) for local schools (elementary schools and Jr./Sr. high school).
  - Action 6.2a: By 2020, develop presentations for each school on Rota to present as part of the ongoing 4-H partnership with NMC.
  - Action 6.2b: By 2022, develop lesson plans for each grade on the value of watersheds, the shared connections to water, and the role of the TWMP in protecting both.
- Objective 6.3: Develop a series of outreach campaigns to communicate the role of the TWMP on Rota and inform the community of the importance of watershed management.
  - Action 6.3a: By 2022, develop outreach campaigns that can be replicated annually, outside of the classroom, to encourage community involvement and awareness of Talakhaya.
  - Action 6.3b: By 2021, organize a 'Goat Derby' (or similar outreach event) to garner community participation and address a watershed threat not currently covered in the strategic actions.

Strategy 7: Improved monitoring of watershed processes through the development of unified monitoring plans and partnerships

- Objective 7.1: Hire a full-time Watershed Technician based on of Rota to manage the implementation of the TWMP, continue the monitoring efforts, and ensure iterative community participation in the management of the watershed.
  - Action 7.1a: By 2020, establish a full-time employee in the DLNR Rota office to act as the manager of the TWMP.
  - Action 7.1b: By 2025, ensure consistent funding for Watershed Technician throughout the entire TWMP process.
- Objective 7.2: Continue and improve upon current monitoring procedures to include in updated TWMP and present analyzed data at stakeholder meetings.
  - Action 7.2a: Annually collate data collected in the field for analysis and present information at stakeholder meetings when possible. Current relevant data includes:
    - Fish – Continue DFW/NOAA Creel surveys and incorporate analyzed data
    - Marine/Coral Reef – Continue BECQ Marine Monitoring Team surveys at long-term monitoring sites
    - Wildlife – Continue monitoring efforts in cooperation with DFW and hunters for both protected and non-protected wildlife, including but not limited to: coconut crabs, Mariana fruit bat, sambar deer, Rota blue damselfly, stream fishes, Mariana crow, goats, and other endemic and/or listed flora/fauna.
    - Vegetation – Continue collecting GPS data of eroding streambanks, badlands, and revegetation areas (see Strategies 2 & 3).
    - Water Quality – Continue monitoring and collection of waters samples from downstream sites in conjunction with BECQ and incorporate findings from the DFW Rota blue damselfly study into data set.
    - Fires – Continue monitoring and record keeping (in cooperation with DFEMS and Forestry) of fires started within the Talakhaya watershed, including GPS data for burn areas, timeframe for length of burn, and extent of ecosystem damage.

- Action 7.2b: Review TWMP every 3-5 years, incorporating monitoring data, project findings, and strategic action updates into the plan with a focus on watershed needs, financial resources, and unexpected alterations within the watershed.

- Objective 7.3: Develop and finalize the remaining components of the TWMP based on stakeholder feedback and implementation capabilities.
  - Action 7.3a: By 2020, develop and finalize the Implementation Strategy for the TWMP with a focus on stakeholder partnerships, funding mechanisms, and technical methodology for implementing strategic actions.
  - Action 7.3b: By 2020, develop and finalize the Monitoring and Evaluation Strategy in cooperation with partners that includes the following components:
    - Reforestation and revegetation
    - Flow rates, baseflow, and water levels
    - Erosion and sediment sourcing
    - Marine/coastal health and alteration
    - Wildlife status and habitat quality
    - 303(d) and 305(b) reporting
  - Action 7.3c: By 2020, develop and finalize the Outreach and Education Strategy for the Talakhaya watershed to better inform both local schools and the larger community on the role of the TWMP and benefits of a healthy watershed. Utilizing the "Save our Soils, Save our Reefs" campaign as a central component that reflects the CRI ridge-to-reef approach towards coral reef conservation.

6.3. Strategic Actions

In order to successfully implement the strategic actions listed above, it is necessary that all the relevant stakeholders take responsibility for their relevant tasks. Specifically, as noted in actions 7-1a/b, the management, monitoring, and implementation of the TWMP requires a Watershed Technician based out of Rota who can work closely with community members and ensure that stakeholders are maintaining their implementation agreements. Additionally, it is expected that stakeholders will take the implementation of the plan seriously, working towards expressed goals and objectives without the continued pressure of a Watershed Technician, by taking the initiative and demonstrating their commitment towards integrated watershed management of Talakhaya.

6.3.1. Stakeholder roles in strategic action implementation

Table 3 further divides the preceding sections into the strategic actions, the expected timeframe for implementation, the estimated costs, and the relevant stakeholders responsible for implementation. It is important to note that although some stakeholders may not be currently listed as responsible, they will find relevancy in their implementation role based on changing landscapes and will be added to the TWMP during a future update to reflect such changes.

Various stakeholder categories will be identified in the following table as follows:

> Watershed Coordinator/Technician (**MGR**), Landowners (**LOs**), agriculture/cattle producers (**AGP**), Researchers/scientists (**RSC**), Hunters (**HNT**), Schools (**EDU**) [collective of CNMI Public School System (**PSS**), private elementary schools, and Northern Marianas College (**NMC**)/Cooperative Research and Extension Education Services (**CREES**)], and government/the Mayor's office (**GOV**)

Agencies and organizations with established acronyms will be identified accordingly:

> The Commonwealth Utilities Corporation (**CUC**), Department of Public Works (**DPW**), Department of Lands and Natural Resources (**DLNR**) [as well as Forestry (**FOR**), Luta Livelihoods Project (**LLP**), Division of Fish and Wildlife (**DFW**), and the Sabana Working Group (**SWG**)], Natural Resources Conservation Service (**NRCS**), The University of Guam (**UOG**), Marianas Visitors Authority (**MVA**), Micronesia Islands Nature Alliance (**MINA**), The Bureau of Environmental and Coastal Quality (**BECQ**), and the Coral Reef Conservation Program (**CRCP**)

Objective	Action	Years	Cost	Stakeholder
Strategy 1: Improved land management and enforcement in cooperation				
1.1a	Develop conservation area map to reflect TWMP plan objectives	1	-	MGR, RSC
1.1b	Institutionalize updated map through RLL	2	-	GOV
1.2a	Establish partnerships with 100% of landowners for targeted watershed interventions	1	$	NRCS -> LOs, AGP
1.2b	Develop worksheet on BMPs, organic agriculture, and watershed land stewardship	2-3	$	MGR, NRCS, DLNR
1.2c	Initiate BMPs interventions on 75% of designated properties within the watershed	2-5	$$$$	NRCS -> LOs, AGP
1.3a	Establish a partnership between MVA and landowners adjacent to relevant tourism areas	2	-	MGR -> MVA, LOs
1.3b	Develop Talakhaya tourism plan (i.e. worksheet with trails, regulated activities, signage, and management)	2-3	$	MGR, MVA, LOs
1.4a	Train at least two conservation officers to monitor and enforce conservation regulations	1	$$	DLNR
1.4b	Codify updated TWMP through the adoption of RLL (related to 1b)	1	-	MGR, GOV
Strategy 2: Continued support of Forestry revegetation efforts of badlands				
2.1a	Identify alternative sources of funding for revegetation efforts	1	-	MGR, FOR
2.1b	Establish an alternative funding mechanism and consistent monitoring to maintain funding (related to Strategy 7)	1-5	$	MGR, FOR
2.1c	Continue to conduct annual mass planting of seedlings during the summer	1-10	$$$$	MGR, FOR, LLP
2.2a	Develop partnerships with neighboring islands' watershed coordinators/managers/researchers	1	-	MGR, BECQ, UOG, DLNR
2.2b	Conduct first archipelago watershed knowledge exchange (e.g. conference call)	2	$	MGR, BECQ, UOG, DLNR
2.3a	Establish a partnership with Upstream to conduct remote sensing	0	-	MGR
2.3b	Generate output from remote sensing and incorporate into management planning toolkit	1	-	MGR

Objective	Action	Years	Cost	Stakeholder
Strategy 3: Increased understanding of the geomorphology of the watershed				
3.1a	Develop an official map that identifies key geomorphological features	1	-	MGR
3.2a	Initiate streambank erosion monitoring project using erosion pins in “concern” sites	1-3	$$	MGR, DLNR
3.2b	Present findings of the project to stakeholders and update TWMP to reflect analysis	3	$	MGR, DLNR
3.3a	Conduct research on the historical changes in stream flow and alterations	1-2	-	MGR, BECQ
3.3b	Produce a model of anticipated stream flow and alterations due to climate change	2-3	$	MGR, BECQ
3.4a	Initiate sediment trap project to determine sources of sediment entering streams	1-2	$$$	MGR, RSC
3.4b	Produce first report on sediment trap, and present potential intervention steps	2-3	$$	MGR, RSC
Strategy 4: Enhanced stabilization of roads and culverts to reduce sedimentation and improve access				
4.1a	Identify problem culverts and determine funding source to implement response	1	-	MGR, DLNR, DPW, NRCS
4.1b	Replace all the culverts along the lower Talakhaya with appropriate alternative	2-5	$$$	DLNR, DPW, NRCS
4.2a	Collate existing data, identify data gaps, and conduct a literature review on riparian roads	1-2	$	MGR, DPW, BECQ
4.2b	Generate hydrological models to estimate the required capacity, engineering, permitting, and design of roadway	2-3	$	MGR, DPW, BECQ
4.3a	Fully adopt and implement the “Unpaved Road Standards” throughout Talakhaya	2-5	$$$	DPW, CUC, DLNR, BECQ
Strategy 5: Bolstered collaboration with CUC & DPW to monitor current and future water resources				
5.1a	Orient the watershed plan with the CUC Master Plan and gather data on waters supply/infrastructure.	1	-	MGR, CUC
5.1b	Establish a partnership between watershed managers and CUC as part of the WMP process	1-2	-	MGR, CUC
5.2a	Establish rights-of-way in cooperation with landowners along infrastructure corridors	2	-	MGR, CUC, DPW, LOs
5.3a	Initiate base flow study based on past data and climate change models	1-2	$	MGR, CUC
5.3b	Present findings of base flow study and offer recommendations to CUC and stakeholders	2-3	$	MGR, CUC

Objective	Action	Years	Cost	Stakeholder
Strategy 6: Raised community awareness and educational outreach				
6.1a	Conduct regular stakeholder meetings to update community on implementation status	1-10	$	MGR
6.2a	Develop presentations for each school on Rota to present as part of the 4-H Riptide program	1-2, ->10	-	MGR, CREES, EDU
6.2b	Develop lesson plans for each grade on the value of watersheds, the shared connections to water, and the role of the TWMP	1-3, ->10	$	MGR, BECQ, EDU
6.3a	Develop outreach campaigns that can be replicated annually, outside of the classroom, to encourage community involvement	1-2, ->10	$$	MGR, BECQ
6.3b	Organize a 'Goat Derby' to garner community participation and reduce the ungulate threat	1-2	$$	MGR, DLNR, BECQ, GOV
Strategy 7: Improved monitoring of watershed processes through planning and partnerships				
7.1a	Establish a full-time employee in the DLNR Rota office to act as the manager of the TWMP	1	$$$	DLNR -> MGR
7.1b	Ensure consistent funding for Watershed Technician through TWMP lifespan	1-10	$$$	DLNR -> MGR
7.2a	Annually collate data collected in the field for analysis and present information at stakeholder meetings when possible	1-10	$$	MGR, RSC, DLNR, CUC, BECQ
7.2b	Review TWMP every 3-5 years, incorporating monitoring data and project findings	3, 6, 9	$	MGR
Strategy 7: Improved monitoring of watershed processes through planning and partnerships				
7.3a	Finalize Implementation Strategy	1	-	MGR
7.3b	Finalize Monitoring and Evaluation Strategy	1	-	MGR
7.3c	Finalize Outreach and Education Strategy	1	-	MGR

Table 3. Strategic action implementation.

6.3.2. Strategic actions requiring equipment/material acquisition

While many of the strategic actions are focused on increasing cooperation and improved monitoring techniques, some of the more tangible responses to land-based source of pollution (LBSP) require significant investments and the acquisition of both funds and materials. The following strategies require the acquisition of equipment/materials in order to implement. It is essential that the Manager works closely with the identified stakeholders to utilize expertise already present on the island as well as building off past successes. Included in this list are a few ideas surrounding these opportunities.

- 1.2c: BMPs on agricultural land – Through NRCS and NMC CREES program, there are a number of best management practices that have been identified and communicated through workshops on Rota. While most of the work by NRCS is on the larger agricultural lands around the island, there is an opportunity to utilize the priority watershed status of Talakhaya to seek additional funding. The Manager needs to further identify the active agricultural land in the watershed, the potential BMPs that could be implemented, and the ideal funding mechanism through which NRCS can support improvements.

- 2.1c: Revegetation project supplies – The current Talakhaya budget, funded through CRCP, has been essential in the continuation of the Revegetation project. With the end of the funding and transition into "trees only" through the LSR grant, some of the most valuable supplies may not receive funding, specifically supplies needed to continue growing grass seedlings for reducing and reversing erosion of the badlands. Additionally, supplies such as boots for volunteers or associated materials for ease of revegetation season, may fall to the wayside of grant specifics. Working closely with BECQ, the Manager may be able to leverage CRCP funds to continue to assist the revegetation project.
- 3.2a: Erosion pins – A relatively affordable method to assess the continuing streambank erosion is through the use of erosion pins. A few hundred "pins" should be purchased once there is a full time Manager who can assess the erosion changes over time in the designated high erosion areas. Within a few months it should become apparent the potential threat of streambank erosion and the necessity of intervention implementation.
- 3.4a: Sediment traps – A UOG project to monitor erosion in Talakhaya included the use of sediment traps, however, due to a number of issues this was never implemented. Based on reports and research from the watershed over the last few years, there continues to be discrepancies in the baseline data. As mentioned previously, the potential sources of sediment erosion have yet to be identified and the use of sediment traps would help determine the impacts from the badland areas of Talakhaya. Ideally, the Manager can develop a project with support from either UOG or NMC to set up traps and assist in monitoring.
- 4.1b: Replaced culverts – The continuing threat of clogged culverts and associated road erosion can be mitigated through two measures. DPW in cooperation with NRCS prepared a proposal under the Emergency Watershed Preparedness grant program to 1) clear all the culverts and 2) replace the culverts with more modern designs. The estimated cost to clear the culverts is $24,450 while the cost to replace the culverts is $19,580 (however, this number does not reflect the concern that many of these materials cannot be purchased on Rota and will need to be imported). While the clearing of culverts was approved, political issues surrounding DUNS numbers resulted in a collapse of the proposal resulting in no funding in September 2019. The replacement of the culverts was rejected based on the issue of material sourcing. Attached as Appendix C is the full proposal and it recommended that the Manager seriously pursues various funding sources to make sure the streambanks are cleared after major storms and the culverts are replaced.
- 4.3a: Improved roadways – In addition to clogging culverts, a regular issue highlighted as a major threat in Talakhaya is the road erosion and repair cycle. While it is still of the utmost importance that DPW adopts the Low-Volume Roads BMPs that was previously presented to their office following a two-day workshop on Rota, the opportunity to pave the back road has been recommended as an alternative option. It is unlikely the proposal will move quickly through the agencies and it will likely garner a high cost estimate, however, DPW has developed some preliminary proposals that will require extensive permitting review. The Manager should check in regularly with DPW officials to determine the seriousness of the proposal as well as the potential timeframe for implementation.
- 5.3a: Equipment to study flow – One major challenge for determining sediment loads in the watershed was a lack of stream flow data. The BECQ office on Rota does have flow meter that can be used for calculating flow, yet it requires two people to easily assess flow. Other instream flow monitors should be considered for purchase by the Manager in case there isn't anyone available from partner agencies to assist. DFW is currently investigating upper Talakhaya stream dynamics

who may have instream equipment that could be loaned or requests could be made to BECQ for capacity assistance to utilize the current flow meter.

- 6.3a: Outreach materials (banners, posters, etc.) – The previous CRCP funding included a line item for banners and posters to be printed as outreach materials. BECQ employees have drafts of various designs and CRI may continue to fund outreach material for Talakhaya. The Manager should work closely with BECQ to make sure these materials are printed, disseminated, and shown at the various festivals and fiestas on Rota.
- 6.3b: Prizes for Goat Derby participants – The Goat Derby was recommended by a number of stakeholders and will continue to be a necessity as long as the wild goat population continues to increase in the watershed. In order the fund this event, the Manager should speak with the current Mayor who is the ideal candidate to acquire these funds and to host the event.
- 7.1a/b: Employment for full-time **manager** – The most important strategic action identified in the TWMP is the establishment of a full-time Manager position for Talakhaya. This should be a salaried position based out of DLNR with associated benefits. This conversation should be broached with the DLNR Director regularly and often until resolved.

7. Implementation Strategy

Successful implementation of this Talakhaya Watershed Management Plan depends entirely on both community and stakeholder support and cooperation, particularly in the local context. The previous section identified an assortment of implementation strategies that will help ensure the goals and objectives determined by stakeholder input will be met. Implementation is determined by the foundations established in the adoption of the plan, particularly the responsible entities and legal requirements of participating agency partners. Additionally, the biggest hurdle to success for the TWMP will always be funding, which will require multiple sources in order to fully implement the various actions set forth throughout the plan. Utilizing information detailed in the Wahikuli-Honokōwai Watershed Management Plan Vol. 2 (2012), this section will consider the overall implementation of the TWMP in addition to the specific management strategies a Watershed Manager must consider.

7.1. Implementing A Watershed Management Plan

7.1.1. Responsible Entities

An overarching theme to Section 6 of this plan is the value of stakeholder coordination throughout the planning and implementation process. From the very conception of the earlier CAPs through the more recent integrated WMP procedures, stakeholders were encouraged to set forth specific connections between their current activities and those defined in the TWMP. Section 3.3 identifies who these key stakeholders and Section 6.3 highlights the expected roles stakeholders will take throughout the implementation phase of the plan. Talakhaya watershed management is a component of multiple agencies on Rota and throughout CNMI. Specifically, the management of the watershed encompasses the DCRM coral reef management priorities associated with addressing land-based sources of pollution, a DEQ mandate to ensure clean drinking water and a healthy environment, the DLNR responsibility to manage and conserve the natural resources of the island, Forestry goals of restoring the native forests of Rota, the DFW mission to monitor and protect the endemic and endangered species throughout CNMI, and the anticipated outcomes of numerous other local organization focused on encouraging a healthy environment.

Past implementation of the Talakhaya CAP was organized by the DCRM Watershed Coordinator in conjunction with the DLNR-Forestry local forester as well as the National Coral Reef Management Fellow based out of the BECQ local office. With the transition from CAP to TWMP, implementation of the plan will take a different form with Forestry being responsible for the continued revegetation efforts, BECQ responsible for the continued coral reef and freshwater monitoring, and DLNR for employing a local manager who will ensure the continued coordination between stakeholders. Expertise will continue to be provided by the Watershed Coordination who will act as a local resources and facilitator for watershed planning throughout CNMI and will guarantee the continued focus on Talakhaya watershed stakeholder cooperation in addition to outreach and education. The stakeholder group meetings that were held prior to the development of the TWMP is expected to continue under the supervision of DLNR and BECQ, which will actively engage with the implementation action plan and provide feedback with the intention of achieving the objectives detailed above.

The recommended strategic actions found in this plan could be required under regulation for implementation, however, as the political status stands at the writing of this plan, most actions will be implanted under a voluntary scheme, with individual agencies taking action on their own accord. As has been seen in other watershed management plan implementation efforts, cooperation between private and public entities will result in the greatest success. Conversely, many of the strategies listed fall upon the efforts of landowners to install actions to improve watershed health, which can be slow and result in marginal improvements. The "integrated" aspect of this plan highlights the fact that most cases will include more than one entity, particularly at different stages of the process, which requires continuous coordination and ideally a lead responsible party or representative to be identified. The local Watershed Manager and DLNR would be best suited to act as the lead entity.

7.1.2. Legal Requirements

The management of the Talakhaya watershed and the implementation of the strategic actions of this plan fall under overlapping legal requirements. Much of the land contained within the larger management area of Talakhaya are owned either by local landowners or by the Department of Public Lands. In both cases, there are specific regulations that come in play for any actions implemented. Primarily, DEQ/DCRM require permits before any action can be taken, such as clearing streams or replacing culverts. Additionally, the conservation areas of both Talakhaya and Sabana, in addition to the adjacent Sasanhaya Bay Fish Reserve, fall under a different set of regulations allowing for more leeway in the installation of recommended actions. What follows are a few of the key laws in place and the associated agencies that will be present for any strategic action implementation.

CNMI Public Laws:

- The DEQ was created through **Public Law 3-23 (1982)** to protect the right of each person to a clean and healthful environment. The primary role of DEQ in the implementation of actions will revolve around the streams and freshwater of Talakhaya.
- DCRM was established with the implementation of **Public Law 3-47 (1983)** in order to promote the conservation and wish development of coastal resources. DCRM regulations can be applied throughout Talakhaya based on the LBSP stipulations.
- CNMI **Coral Reef Management Priorities** (2019) specifies "Goal 1: Improve the conditions of CNMI's coral reef ecosystems by reducing the amount of sediment, nutrients, and other land-based sources of pollution in CNMI's watersheds", including Talakhaya.

- DLNR was established by **Public Law 1-8 (1978)** and was empowered by that law "To be responsible for the protection and enhancement of the natural resources of the islands..." Specifically, DLNR has the primary responsibility of managing the conservation areas.
- The DFW was created by **Public Law 2-51 (1980)**, later revised by **Public Law 10-57 (1997)** with its purpose to conserve fish, game, and wildlife and to protect endangered and threatened species. DFW is a primary participant in any permitting process to ensure there isn't unnecessary harm to endemic/endangered species.

Rota Local Laws:

- Large portions of public lands on Rota are currently protected under **Rota Local Law 9-1 (1994)** due to their high resource value; examples include sea bird sanctuaries and conservation areas for forests and wildlife. The monitoring and management of the protected areas under 9-1 falls to DLNR primarily with other agencies taking cooperating roles.
- **Rota Local Law 9-2 (1994)** established a marine protected area in Sasanhaya Bay on the southern portion of the island. While the DFW MPA manager is the lead entity in the management of Sasanhaya, DCRM and local NOAA representatives assist in implementation.
- The Talakhaya portion of the project area was added to the Sabana Conservation Area under **Rota Local Law 15-8 (2007)** and is given the same status and protection as the initially established area. DLNR holds the most responsibility in the conservation of the watershed under 15-8.

National Laws:

- **National Environmental Policy Act of 1969 (NEPA)** establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment and it provides a process for implementing these goals within Federal agencies. NEPA requires Federal agencies to consider the potential environmental consequences of their proposals, to consult with other interested agencies, to document the analysis, and to make this information available to the public for comment before the implementation of the proposals.
- **Clean Water Act of 1972 (CWA)** establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. EPA delegated the responsibility of CWA implementation to states and territories, providing guidance and financial support.

7.2. Financing Implementation

With then end of CRI funding for the Talakhaya Watershed Project in 2019, the need to seek alternative and additional sources of finding is compulsory. The implementation of the TWMP requires funds for installing on-the-ground development projects, ensuring continued monitoring/evaluation, maintaining coordination of stakeholders, and guaranteeing education and outreach.

7.2.1. Financial Resources

Funding for watershed management planning efforts – on-going planning, strategic action implementation, monitoring, education and outreach – can come from a range of sources including Federal, State, local, and private entities. Funding mechanisms will include contracts, private funds, community grants, cost-share agreements, and volunteer efforts. The previous CRI funding was distributed primarily between the annual revegetation project and for limited watershed planning efforts,

with additional support for education and outreach. It is expected that funding for the revegetation project will continue for the next three years (2020-2022) through the U.S. Forest Service Landscape Scale Restoration Grant and the Forest Stewardship Program.

The Talakhaya watershed, Sabana Wildlife Area, adjacent coral reef ecosystems are priority management areas for CNMI. The TWMP recommends a multiple funding source approach that links specific funding sources both with defined projects and the relevant management agency. The following list of funding resources can be directed towards projects and agencies in relevant timeframes.

7.2.2. Specific Funding Resources

National Oceanic and Atmospheric Administration

Primary contacts: CNMI Coral Reef Management Liaison, USCRTF local Point of Contact (DCRM Director), NOAA CRCP office, NOAA OCM Pacific Islands Region manager

- *Coral Reef Conservation Program (CRCP)* – Funding and cooperative agreement assistance for coral reef conservation activities. CRCP priorities have been refined and redirected in 2018 to refocus program investments on three existing pillars which include the most pressing threats to coral reefs: land-based sources of pollution, sustainable fishing management, and climate change; and a new fourth pillar: restoration. Much the current DCRM efforts are funded through CRCP, including staff, capacity building, monitoring, and evaluation as well as outreach and education. Talakhaya continues to be important for CNMI, so it is important to seek a fraction of the annual CRCP funds to continue approved projects.
    - The State and Territorial Coral Reef Conservation Cooperative Agreements sustain coral reef management and monitoring in the states and territories, including CNM. The competition runs biennially. Applications can request between $200,000 – $900,000 per proposal. The average award size is $500,000 per year.
    - The Non-Governmental Organization (NGO) Partnership Coral Reef Conservation Cooperative Agreements provide funding to NGOs with specialized experience in supporting the ongoing coral reef conservation efforts of state and territorial partners. This competition runs every 2 to 4 years. Applications can request between $100,000 – $700,000 per year (approximately $100,000 per state or territory).
    - https://coralreef.noaa.gov/conservation/funding_welcome.html
- *Coastal and Marine Habitat Restoration Grant (CMHR)* – The Community-based Restoration Program supports restoration projects that use a habitat-based approach to rebuild productive and sustainable fisheries, contribute to the recovery and conservation of protected resources, promote healthy ecosystems, and yield community and economic benefits. DFW is the most relevant agency to seek funds under this grant given their role in managing endangered species.

Two nearly identical proposals were submitted by both DLNR and DPW to utilize USDA-NRCS Emergency Watershed Protection Program funds to clear debris above the main culverts to limit wet-season clogging. The duplicate proposals slowed down the process and after realizing neither local agency had DUNS numbers (required for the allocation of funds), the $19,000 earmarked for the project by NRCS was unable to be disbursed and the project fell through.

Example 1: Funding Challenges (2019)

- Eligible applicants are institutions of higher education, non-profits, commercial (for profit) organizations, U.S. territories, and state, local and Native American tribal governments. The annual grant competition includes a pre-proposal deadline in January with final proposals due in April. Applications can request between $100,000 – $900,000 per year (with an average award of $100,000 per project).
- Examples of previously funded projects that would be applicable for Talakhaya include addressing sediment from unstabilized dirt roads and reducing land-based sediment runoff in the watersheds (e.g. erecting fencing, removing feral goats from the landscape, and revegetating riparian corridors with native trees and shrubs).
- https://www.fisheries.noaa.gov/grant/coastal-and-marine-habitat-restoration-grants

- *Coastal Zone Management Programs (CZM)* – CZM works with coastal states and territories to address some of the most pressing coastal issues, including climate change, ocean planning, public access enhancement, and planning for energy facilities and development. CZM projects can include green infrastructure construction, water quality assessments, coastal hazards planning, resilience planning, improved wetland and watershed management, and culvert vulnerability assessments.
  - The Coastal Zone Enhancement Program provides incentives to states to enhance their state programs within nine key areas: wetlands, coastal hazards, public access, marine debris, cumulative and secondary impacts, special area management planning, ocean and Great Lakes resources, energy and government facility siting, and aquaculture. The annual grant is for eligible projects under Section 309 strategies with funding ranging from $70,000 – $300,000.
  - The Coastal Nonpoint Pollution Control Program (CNPs) ensures that participating states have the necessary tools to prevent and control polluted runoff. Areas for funding under Section 6217 include staffing, monitoring and evaluating implementation, and implantation of on-the-ground priority management projects on both public and private lands. Funding amount is stipulated by territory and EPA approval. CNMI currently does not participate in this program.
  - https://coast.noaa.gov/czm/about/

U.S. Forest Service

Primary contacts: Rota Forester, CNMI State Forester, Pacific Island Liaison (Region 5)

- *Forest Stewardship Program (FSP)* – Provides assistance to owners of forest land where good stewardship, including agroforestry practices, will enhance and sustain multiple forest resources and contribute to healthy and resilient landscapes. FSP projects fall under three categories: assisting landowners to actively manage their land and related resources, keeping land in a productive and healthy condition for present and future owners, and increasing the economic benefits of land (timber harvesting, for example) while conserving the natural environment. DLNR-Forestry is currently working with USFS to secure revegetation project funding for 2020 of approximately $60,000.
  - The FSP depends on the development of Forest Stewardship Management Plans (which is currently under development in CNMI). Some applicable elements in Talakhaya for funding resources beyond revegetation include promoting soil stability and water quality, providing diverse habitats, forest-oriented recreational activities, and streamside management zones as well as wetland restoration, fire management, cultural site protection, invasive species control, and carbon sequestration.
  - USFS funding stipulates out planting **only** trees rather than the previously used soil-securing grass species for the annual revegetation project

- https://www.fs.fed.us/managing-land/private-land/forest-stewardship
- *Landscape Scale Restoration Grant (LSR)* – A competitive grant program that promotes collaborative, science-based restoration of priority forest landscapes and furthers priorities identified in State Forest Action plans to address large-scale issues such as wildfire risk reduction, watershed protection and restoration, and the spread of invasive species, insect infestation and disease. CNMI Forestry has previously received LSR funding for mangrove area monitoring, terrestrial forest monitoring and invasive forest ant management. On Rota, an application for 2021 and 2022 LSR funding is currently under review by USFS to continue funding the annual revegetation project.
  - Landscape Objectives for successful projects address: reducing the risk of uncharacteristic wildfires; improving fish and wildlife habitats, including for threatened and endangered species; maintaining and improving water quality and watershed function; mitigating invasive species, insect infestation, and disease;o improving important forest ecosystems; measuring ecological and economic benefits including air quality and soil quality and productivity. Pacific island agency projects that are successful and are less than $200,000 per project will be funded via set-aside funding of up to $300,000 and can indicate a multi-year implementation timeframe, up to three (3) years. Funding, however, will be delivered in the fiscal year of the application.
  - USFS funding stipulates out planting **only** trees rather than the previously used soil-securing grass species for the annual revegetation project.
  - https://www.fs.fed.us/managing-land/private-land/landscape-scale-restoration

Environmental Protection Agency

Primary contacts: CNMI Division of Environmental Quality, EPA Region 9 CNMI Program Manager, EPA Pacific Islands Contact Office

- *Clean Water Act (CWA) Section 319 Grant Program* – Territory funding that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. Projects fall under two main categories, addressing nonpoint source pollution or watershed-based planning that stipulates the need for integrating total-maximum daily loads into plan implementation. DEQ is the main recipient of previous §319 funds and would be the primary agency responsible for seeking future funds with regards to Talakhaya watershed management and Sabana source water protection.
  - Funding is awarded by EPA to states in accordance with a state-by-state allocation formula that EPA has developed in consultation with the states. Proposals are developed in consultation with EPA representatives at the beginning of the year with project approval dependent on feasibility and legality of activities. Project funding can be incorporated into current monitoring efforts and provide technical assistance in determining TMDLs. EPA encourages NPS monitoring programs to coordinate with current efforts and relevant agencies with technical capacity.
  - https://www.epa.gov/nps/319-grant-program-states-and-territories
- *Healthy Watershed Consortium Grant (HWCG)* – The program supports working forest and ranchland protection, innovative finance in collaboration with water utilities, and capacity for local and regional watershed groups. Projects will be either healthy watershed program development projects or local demonstration/training projects. Funding for each sub-award may range from $50,000 to $150,000 per project. No HWCG funds have been previously awarded to projects in the

CNMI and it is necessary for agencies (DEQ and DCRM) work closely with the Region 9 EPA representative in order to pursue any future funds.
    - Examples of projects include development of state, interstate, or tribal healthy watersheds strategies or plans that employ a systems-based, integrated approach to protection; environmental flows assessments; and public outreach and education on the importance of protecting healthy watersheds. For local demonstration/training projects, examples include protection of forested drinking water sources in headwaters, restoration of hydrologic connectivity, development of local conservation zoning and easement program plans.
    - https://www.epa.gov/hwp/healthy-watersheds-consortium-grants-hwcg
- *Environmental Finance Centers (EFC)* – Deliver targeted technical assistance to, and partner with states, tribes, local governments, and the private sector in providing innovative solutions to help manage the costs of environmental financing and program management. CSUS offers project support in a number of topics including stormwater data assessments, small community capacity assistance, stormwater management funding, water resources modeling, resiliency planning, and training materials of all kinds. While there are no specific details on funding sources, connecting with the EFC would provide added benefits and support for continued watershed management activities.
    - Region 9 focuses on supporting and improving the capabilities of the region by providing resource tools and on-site training and technical assistance related to financing and planning of environmental and public health programs in areas such as drinking water, wastewater, stormwater, groundwater, and solid waste management.
    - http://www.efc.csus.edu/
- *Water Infrastructure Finance and Innovation Act (WIFIA) Program* – Accelerates investment in the national water infrastructure by providing long-term, low-cost supplemental loans for regionally and nationally significant projects. WIFIA is most relevant to CUC and DPW for infrastructure related activities, yet these funds have never been investigated on Rota.
    - Plans that can be funded by WIFIA include drought prevention, reduction, or mitigation projects; development phase activities, including planning, preliminary engineering, design, environmental review, revenue forecasting, and other pre-construction activities; and construction, reconstruction, rehabilitation, and replacement activities. $5 million is the minimum project size for small communities (population of 25,000 or less), however funds exist as loans and must be paid back to the federal government.
    - https://www.epa.gov/wifia

USDA Natural Resources Conservation Service

Primary contacts: Saipan District Conservationist, NRCS-USDA Pacific Islands Area State Office

- *Agricultural Conservation Easement Program (ACEP)* – Helps landowners, land trusts, and other entities protect, restore, and enhance wetlands, grasslands, and working farms and ranches through conservation easements. While there are both viable wetlands and agricultural land areas in Talakhaya that would qualify for ACEP, the historical land ownership issues in CNMI has made landowners hesitant to enter into such contracts. NRCS representatives from Saipan have brought up the program in past presentations, yet few landowners have voiced interest. Direct contact with landowners in Talakhaya who are not actively using their land could help facilitate the expansion of this program.

- Easements fall under either Wetland Reserves or Agricultural Land, with enrollment contracts lasting 30-years, with payments ranging from 50–100% of the value of the easement based on contract stipulations. Application inquiries can be made at the local USDA Service Center in Saipan.
- https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/

- *Conservation Stewardship Program (CSP)* – Helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resource concerns. CSP provides two possible types of payments through five-year contracts: annual payments for installing new conservation activities and maintaining existing practices; and supplemental payments for adopting a resource-conserving crop rotation. CNMI NRCS office is interested in expanding this program throughout the islands.
  - Applicants may include individuals, legal entities, joint operations, or Indian tribes that meet the stewardship threshold for at least two priority resource concerns. Application deadline for the annual project is in May for following year funding. Application inquiries can be made at the local USDA Service Center in Saipan. All CSP contracts will have a minimum annual payment of $1,500.
  - https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/
- *Emergency Watershed Protection* – Allows communities to quickly address serious and long-lasting damages to infrastructure and to the land. The Emergency Watershed Protection Program authorities offer NRCS the flexibility to act quickly to help local communities cope with adverse impacts resulting from natural disasters. Natural disasters need to be federally declared, such as Typhoon Yutu, in order to qualify for Emergency Watershed Protection funding. DLNR and DPW previously sought funds from this program for culvert construction and stream clearing, however the grant was unsuccessful.
  - Potential projects include: Remove debris from stream channels, road culverts and bridges; reshape and protect eroded streambanks; correct damaged or destroyed drainage facilities; establish vegetative cover on critically eroding lands; repair levees and structures; repair conservation practices. In case of future disasters, the NRCS office in Saipan should be contacted to determine eligibility for projects.
  - https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/
- *Environmental Quality Incentives Program (EQIP)* – Provides technical and financial assistance to producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion, and improved or created wildlife habitat. CNMI NRCS representatives have been actively working with farmers and ranchers on Rota to implement EQIP, however, there remains minimal focus on Talakhaya landowners.
  - Farmers, ranchers, and forest landowners who own or rent agricultural land are eligible. EQIP assistance can be used on all types of agricultural operations, including: Conventional and organic; Specialty crops and commodity crops; Forestry and wildlife; Historically underserved farmers; and Livestock operations. Application inquiries can be made at the local USDA Service Center in Saipan. Payments are determined by the type and size of implemented projects.
  - https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
- *Healthy Forest Reserve Program (HFRP)* – Helps landowners restore, enhance and protect forestland resources on private lands through easements and financial assistance. HRFP aids the recovery of

endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity and enhances carbon sequestration. Similar to ACEP, this program has not been implemented in CNMI although it would be ideally suited in Talakhaya given the presence of multiple endangered species in the watershed including on privately owned land.
    - The HFRP provides financial assistance in the form of easement payments and costs-share for specific conservation action completed by the landowner including both 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. Application inquiries can be made at the local USDA Service Center in Saipan.
    - https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
- *Regional Conservation Partnership Program (RCPP)* – Promotes coordination of NRCS conservation activities with partners that offer value-added contributions to expand the collective ability to address on-farm, watershed, and regional natural resource concerns. Once projects are selected, NRCS works with partners to set aside a certain pool of funding for an awarded project. RCPP projects must be carried out on agricultural or nonindustrial private forest land or associated land on which NRCS determines an eligible activity would help achieve conservation benefits. This program is not currently being implemented in the CNMI.
    - RCPP projects may include a range of on-the-ground conservation activities implemented by farmers, ranchers and forest landowners. These activities include: land management/land improvement/restoration practices; land rental; entity-held easements; United States-held easements; and Public works/watersheds. Contact the NRCS office in Saipan to find out more information on the RCPP.
    - https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/

National Fish and Wildlife Foundation (NFWF)

Primary contacts: NFWF Western Regional Office, specific grant RFP staff members

- *Coral Reef Conservation Fund (CRCF)* – A competitive grant program administered on behalf of the NOAA Coral Reef Conservation Program by the National Fish and Wildlife Foundation (NFWF), implements a long-standing public-private partnership that was created to support coral reef conservation projects both domestically and internationally. Projects a considered under the following categories: 1) assessment and prioritization efforts in order to identify priority reef tracts for conservation action, 2) implementation of priority activities identified in watershed management plans, marine protected area plans or fisheries management plans, 3) fill specific gaps in coral conservation and management, and 4) establish case studies, or models, that help address common coral reef threats in island jurisdictions.
    - Grants will be awarded to reduce land-based sources of pollution, advance coral reef fisheries management, support recovery and resiliency of coral reef systems and improve watershed management planning. This is an annual competition running between January and March of each year. Average grant awards range from $40,000 – $150,000. Applications can cover up a 12 – 18-month period.
    - Priority will be given to management needs for reef tracks and adjacent watersheds that have been prioritized by the U.S. Coral Reef Task Force and Talakhaya has **not** been identified as a USCRTF priority watershed.
    - https://www.nfwf.org/coralreef/Pages/home.aspx
- *National Coastal Resilience Fund (NCRF)* – The program will capitalize on extensive threat and vulnerability assessments and regional/local coastal planning efforts that are completed to date and

focus investments on advancing prioritized projects through feasibility assessment and site design and supporting implementation and project restoration. Given the scope and flexibility with both project deign or restoration project funding, this grant should be high on the list for potential sources for Talakhaya TWMP implementation.
    - While there is no minimum or maximum limit on the size of grants under this focus area, grants are expected to average around $125,000 for "project site assessment and preliminary design" projects, $250,000 for "final project design and permitting", and between $1,000,000 – $3,000,000 for restoration and monitoring depending upon the scale and scope of the project
    - https://www.nfwf.org/coastalresilience/Pages/home.aspx
- *Emergency Coastal Resilience Fund (ECRF)* – Related to the NCRF program. Established to increase the resilience of coastal communities located within federally declared disaster areas impacted in 2018 including Typhoon Yutu. The fund supports conservation projects that strengthen natural systems at a scale that will protect coastal communities from the future impacts of storms, floods and other natural hazards.
    - The ECRF seeks to fund shovel-ready projects to improve community resilience and recovery both in and around impacted areas. Projects may include, but are not limited to, marsh, beach and dune restoration, living shorelines, stream restoration, including aquatic connectivity projects that reduce flood risk, and innovative stormwater management. Grants are expected to average around $125,000 – $250,000, depending upon the scale and scope of the project.
    - https://www.nfwf.org/coastalresilience/emergency/Pages/home.aspx

Federal Emergency Management Agency (FEMA)

Primary contacts: FEMA Region IX office (Grant Division)

- *Pre-disaster Mitigation Grant Program (PDM)* – Designed to assist States, U.S. Territories, Federally-recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard mitigation program. The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. In addition to providing planning assistance, this grant can fund "Resilient Infrastructure" projects at the community level. FEMA has had an increased presence in CNMI since Yutu, which provides more opportunities to leverage these funds.
    - Funding for this annual grant are based on the activity type (planning vs. projects) with no grants exceeding $575,000. As a small, impoverished community, projects in CNMI are eligible for up to a 90% Federal cost share for their mitigation planning and project sub-applications in accordance with the Stafford Act.
    - https://www.fema.gov/pre-disaster-mitigation-grant-program
- *Hazard Mitigation Grant Program (HMGP)* – Hazard mitigation measures are any sustainable action taken to reduce or eliminate long-term risk to people and property from future disasters. The HMGP supports cost-effective post-disaster projects and is the longest running mitigation program among the three FEMA grant programs. FEMA provides up to 75% of the funds for mitigation projects while the remaining 25% can come from a variety of sources.
    - There are a number of qualifying mitigation projects including: hazard mitigation planning, aquifer storage and recovery, floodplain and stream restoration, flood diversion and storage, or green infrastructure methods may support communities in reducing the risks associated with the impacts of flood and drought conditions. Local governments should contact their State

Hazard Mitigation Officer to inquire about potential HMGP funding with applications accepted on a rolling basis.
    - https://www.fema.gov/hazard-mitigation-grant-program
- *Flood Mitigation Assistance Grant Program (FMA)* – Provides funding to states, territories, federally-recognized tribes and local communities for projects and planning that reduces or eliminates long-term risk of flood damage to structures insured under the NFIP. FMA funding is also available for management costs. FEMA requires state, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance.
    - Funding for this annual grant are based on the activity type (planning vs. projects) with $100,000 available per applicant for mitigation planning as well as upwards of $200,000 for community flood mitigation projects.
    - https://www.fema.gov/flood-mitigation-assistance-grant-program

Other Potential Funding Sources

- *Private funding* – Private land owners could fund strategic actions on their lands (e.g. agricultural entities, resorts). In most cases the recommended actions will benefit the local environment as well as contribute to the health of the larger ecosystem. This seems unlikely for most landowners on Rota, even larger landowners like the Rota Resort. However, in coordination with NRCS programs, landowners may be more likely to contribute their own funds for projects.
- *Tourism Tax/Fee* – It has been discussed in the CNMI government for the potential introduction of a tourism tax, similar to that levied by Palau. A local tax on 'luxury items and services' or occupancy' could fund infrastructure, services, and programs related to improving water quality and coral reef health. Additionally, the initiative would be beneficial to the tourism industry. CNMI House Bill 21-72, HS1, passed unanimously (2019) which would create a $10 entrance fees for tourists visiting Marpi public land sites (e.g. The Grotto).
- *Rota Conservation Fund* – Surveys and interviews conducted on Rota demonstrated that there is some willingness-to-pay for the conservation of water resources. Results determined that a voluntary fee of approximately $5/month would be widely accepted by residents, as long as the money was managed by a non-government agency. Assuming only 500 residents pay the fee all twelve months, about $30,000 would be available for conservation projects. Implementation of such a fee would take significant political action, yet would provide local ownership over both natural resources and conservation projects.
- *Guidebook of Financial Tools: Paying for Environmental Systems* – For additional ideas and options for leveraging various mechanisms (including taxes, fees, loans, grants, lowering costs, and public-private partnerships) refer to the following 2008 EPA document: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100179D.PDF?Dockey=P100179D.PDF

Every year, prior to the start of the revegetation season in the summer, BECQ employees (traditionally the Watershed Coordinator) would submit requests from multiple vendors for materials including seeds, plastic seedling bags, and tree-carrying shoulder bags. None of these items can be sourced locally, amounting to more than $10k in shipping costs and multiple months of delay, despite ordering from the same vendors every year. Multiple funding sources will increase this issue.

Example 2: Funding Challenges (2019)

7.2.3. Implementation Costs

The primary costs to implement strategic actions fall under two general categories: constructed and non-constructed. Examples of constructed projects include paving roads, replacing culverts, and the various revegetation and land-use change activities, while non-constructed actions include hiring personnel, conducting outreach, and continued monitoring of the management plan. The necessary financial resources required to implement either strategic action type can vary considerably, with specific funding sources tied either to planning *or* construction. Additionally, the responsible parties for implementing actions have differing expertise, where DPW would be ideal in handling culvert replacement while DLNR is better suited for monitoring and evaluation of management plan implementation.

In general, costs to implement constructed strategic actions include the following:

- Engineering design, including all plans, drawings, biddable plans and permit acquisition
- Product purchase, including shipping cost
- Construction installation
- Construction management
- Annual maintenance

For actions that are non-constructed costs to implement may include the following:

- Site-specific testing and creation management plan
- Cost of materials specified in plan
- Site management
- Annual maintenance

One of the main challenges facing Rota with regards to constructed actions is a lack of locally available materials. This issue was highlighted during the Emergency Watershed Protection funding request from DPW that included culvert replacement. Upon review, NRCS made the decision to exclude that portion of the project from the official request due to their rules concerning the need to use materials that are local rather than imported. Even actions such as installing sediment traps or erosion pins requires additional paperwork and justification to import to Rota, which has previously been a major setback with regards to the revegetation project.

In order to select the best options for strategic actions, the costs of equipment/materials, operations/maintenance, and the time/training required for constructed projects will be considered. Ideally, stakeholder meetings would serve as a valuable venue for selecting the best options rather than individual agencies making their own decisions. A cost-benefit analysis will be the main avenue for comparison, specifically looking at the projects benefits for reducing the identified threats. Another consideration is initial cost versus long-term maintenance costs.

7.3. Technical Implementation of Strategic Actions

Successful implementation of the strategic actions identified in this plan is contingent on detailed design and planning documentation based on available technical resources, extensive data gathering, and cooperative review by qualified partners. Current resources will need to be expanded by managers, coordinators, and agencies to address the factors required for implementation including design complexity, conditions of each site, regulatory and permitting requirements, unintentional outcomes, and availability of resources. With regards to structurally-based actions (e.g. culvert replacement), the

development of engineering plans, specifications, and cost estimates will result in a relatively high cost for each site while other actions, such as plan development, are less resources intensive.

7.3.1. Data and Analysis Recommendations for Design of Strategic Actions

Design data relevant to the specific site under consideration is important to ensuring proper construction of the action; determining realistic operations and maintenance requirements; and establishing monitoring protocols to ensure the action operates as intended for the duration of its life span. Examples of recommended design data and analysis that could influence the successful implementation of a given action include the size of the associated sub-watershed, soil sources and erosion dynamics, land ownership and land-use practices, presence of endangered/endemic species, and relevancy of strategic action in reducing sedimentation or other watershed threats. The Wahikuli-Honokōwai Watershed Management Plan Vol. 2 (2012) includes recommendations for various design data and analysis considerations for selected practices, however, these should be seen more as guidance rather than prescription for strategic actions in Talakhaya. The only actions that have comprehensive data and analysis currently available are culvert redesign (see Appendix C) and the revegetation project (refer to DLNR-Forestry expertise). During the selection, planning, and implementation of other strategic actions, costs will need to include contracting relevant experts to assist with engineering design in addition to other local capacity gaps. Contractors with expertise and knowledge of installing practices are a vital technical resource for the implementation. Each site has specific characteristics and constraints that must be taken into consideration before a detailed design is developed for a specific strategic action location.

7.3.2. Technical Resources

Technical resources necessary to implement strategic actions are a function of the complexity of the engineering design, land ownership issues, permitting requirements, preparation of construction plans and drawings, and development of a post-installation operation and maintenance procedures. Engineering design includes, but is not limited to, assessing the physical condition of the installation site (e.g. geotechnical analysis, locating utilities, inspecting structures, and hydrologic analysis), sizing and designing actions, preparing construction plans and cost estimates, preparing detailed installation drawings, acquiring permits, and construction management by relevant agencies. In addition to the engineering elements, there are logistical issues associated with taking a strategic action from the concept design phase to the implementation phase, which will necessitate the involvement of persons familiar with the technical elements of the design, the regulatory issues, and construction aspects of installation.

Given the local capacity gaps present on Rota, action implementation will require outside contractors to participate in the design, construction, and monitoring of implementation. In this regard, it will be increasingly important for local managers and agencies to communicate past and present conditions of action sites due to the limited time and presence availability contractors are likely to encounter. While this plan presents a characterization of the watershed, each potential site will require coordination between local stakeholders to ensure designs are based on the best available information.

7.4. Adaptive Management

As previously identified in the Section 3.1, adaptive management is crucial for the success of plan implementation. Adaptive management is defined as a systematic process for continually improving management policies and practices by learning from the outcomes of past and current management activities. In the case of the Talakhaya TWMP, adaptive management will be used to adjust priorities and actions should goal progress not be achieved (e.g. lack of reduced erosion). Adaptive management

recognizes that there is a level of uncertainty about the 'best' policy or action for a particular management issue, and requires that each management decision be revisited in the future to determine if it is providing the desired outcome. The approach builds upon prior results, both positive and negative, and allows managers to continually reassess and incorporate new knowledge into management practices.

Monitoring before and after installation might assess the effectiveness of a management practice. Once an action has been completed, the next, equally important step in an adaptive management protocol is to assess its effectiveness. A review and evaluation of the results allows managers to decide whether to continue the action or to change course. This investigational approach to management means that regular feedback loops guide managers' decisions and ensure that future strategies better define and approach the objectives of the TWMP. By setting up regular stakeholder meetings, results can be reviewed before, during, and after implementation in order to guarantee actions are meeting the objectives agreed upon in this plan.

With the establishment of Sabana as a Wildlife Conservation Area, certain activities present on the plateau became illegal. However, a lack of specific planning actions, enforcement capacity, and adaptive management recommendations allowed for many of these activities to persist. Ten years after its establishment, farming, poaching, and trespassing continue to exist as issues. By establishing regular reviews of the status of the area, such as those recommended both in this plan and the Sabana LUMP, current actions would be revised and new actions rerecommended. However, these require additional costs on limited financial resources.

Example 3: Funding Challenges (2019)

Adaptive management can be resource intensive, requiring additional capacity throughout all stages of implementation. This presents additional challenges on Rota where a lack of capacity limits potential strategic actions. Historically, many of the previous actions implanted both as part of the Talakhaya CAP and from other conservation plans have lacked any adaptive management plan. An adaptive management plan requires an extensive review of current scientific literature and existing management practices, and consultations with experts in the field. It also requires that the implementation of management practices and evaluation protocols be thoughtfully designed, and it must include feedback mechanisms for reassessing management strategies and changing them, if necessary.

8. Monitoring & Evaluation Strategy

The following section provides details and guidance for monitoring and evaluating the progress of TWMP implementation. The primary focus is to detail the expected activities associated with monitoring, with a focus on measuring performance of Strategic Actions in addition to continued baseline data collecting. Monitoring is compulsory for determining the success of watershed planning efforts and ultimately to secure funding beyond what is readily available. Therefore, establishing formal tracking and monitoring of future TWMP implementation is essential.

8.1. Measuring Effectiveness

Determining the success of watershed management planning efforts is integral to the entire process. Lack of relevant data, extraneous monitoring logistics, and an inability to compare pre- and post- project

implementation limits both the value of the planning process and the possibility of continuing the necessary project implementation needed to reduce threats within the watershed. In order to determine the success of project implementation, management practices need to be compared to explicit plan goals as well as performance metrics, such as cost efficiency and spatial/temporal frames. Ultimately, the primary factors relevant in determining success are reductions in sediment loads in the streams and the associated improvements to the health of the ecosystem including riparian, forest, and coral reef.

8.1.1. Management Practice Performance

To ensure the most effective watershed management strategies for Talakhaya, the success of Strategic Actions to reduce erosion, limit non-native impacts, prepare for climate change, resolve political challenges, and diminish the human impacts in the watershed must be regularly evaluated. Primarily, monitoring of the watershed will focus on the threat of erosion and sedimentation in the streams. In order to determine the progress being made towards meeting the seven goals, regular monitoring must occur. A status report (e.g. "State of the Watershed") should be developed by the watershed coordinator every year to document progress, challenges, and next steps. As was previously the case, funding sources for Talakhaya require annual updates to ensure implementation is following proposed outcomes.

Next steps in reporting will include a list of priority Strategic Actions to occur the next year, along with a realistic schedule that reflects available funding, equipment purchases, and personnel time. Comparison of the projected schedule with the actual schedule will enable better timeline estimates for future projects and will help determine if the scale and scope of the Strategic Actions slated for the following year(s) are appropriate.

Spatial data and associated databases (e.g. stream water quality, benthic health) will be essential for developing reports so data can be objectively analyzed and compared between years allowing for adaptive management. Information on challenges encountered with Strategic Actions, interesting outcomes, successes, failures, and ideas for improving management in the future should be kept on an accessible document and referenced by watershed managers throughout the implementation phase.

8.1.2. Watershed Health Targets

In general, the primary target for watershed management implementation is the reduction in sediment loads or other identified pollutants. As is the case for Talakhaya, the limited baseline data and persistence of data gaps since the conception of management activities prevents the establishment of specific reduction targets. Watershed health is not solely defined by the lack of sediment in its waterways, which is why multiple conservation targets were identified in Section 4.1.2. By integrating multiple metrics for the "health status" of Talakhaya, the lack of specific sediment reduction targets won't limit the ability for managers to qualify the "success" of project implementation.

8.1.3. Performance Metrics

Performance metrics for each of the seven watershed goals can be used to help evaluate the progress of TWMP implementation. However, monitoring and evaluating whether Strategic Actions are meeting these metrics can be subjective and dependent on established baseline (i.e. comparing action implementation to 2019 status vs. 2008 health estimates). The indicators and associated conservation targets will serve as triggers to indicate whether progress is being made and whether the implementation approach needs to be reevaluated. It is important to note that often, long and uncertain lag times occur between

implementation and response at the watershed level. This timing is accounted for in the monitoring and evaluation framework.

Table 4 provides an example of metrics to be reevaluated within the context of each Strategic Action:

Watershed Strategies	Metrics
1: Improved land management and enforcement in cooperation with local agencies and landowners of both the Sabana Wildlife Conservation Area and Talakhaya Conservation Area	- Use of TWMP as a model for other WMPs - Number of agencies incorporating TWMP in management activities - Number of landowners implementing watershed friendly BMPs - Number of tourists documented in watershed - Dollars spent on monitoring and enforcement (field agents)
2: Continued support of Forestry revegetation efforts of badlands and expansion towards native tree/forest revegetation	- Number of seedlings out-planted annually - Planting survival/growth - Acres reforested - Dollars spent on revegetation project activities - Area of sites treated with erosion control practices - Measured improvements in water quality - Number of meetings between watershed managers/coordinators
3: Increased understanding of the geomorphology of the watershed to better inform strategic actions and ensure effective issue response	- Establishment of official watershed management map - Number of erosion monitoring samples collected - Development of sediment source data set based on research
4: Enhanced stabilization of roads and culverts to reduce sedimentation and improve access of Talakhaya for both landowners and the revegetation project	- Length of roads inventoried and treated with erosion control practices - Measured improvements in water quality - Number of related Strategic Actions installed
5: Bolstered collaboration with CUC & DPW to identify, monitor, and evaluate current and future water resources within the Talakhaya/Sabana watershed	- Number of meetings held between agency stakeholders - Establishment of right-of-ways within watershed areas - Calculation of baseflow through entire stream reach
6: Raised community awareness and educational outreach for both the planning process and the Talakhaya watershed more generally	- Dollars spent on education and outreach - Number of volunteers participating in outreach activities - Number of attendees participating in workshops/site visits - Number of private landowners participating in TWMP efforts
7: Improved monitoring of watershed processes through the development of unified monitoring plans and partnerships	- Number of samples collected every two months - Regular review and update of TWMP - Measured improvements to water quality

Table 4. Example metrics for evaluating progress towards meeting watershed goals.

8.1.4. Monitoring & Data Collection Responsibility

Effective monitoring and data collection depend on the resources afforded by the agency stakeholders. As is the case for CUC and MMT, their data collection has not depended on residency on Rota nor the development of the TWMP. However, stream water quality and outreach activities, amongst other metrics, lack dedicated personnel on Rota at the time of writing this plan. In order for data collection to continue, employees from BECQ will need to dedicate time to collecting data in addition to conducting other activities on Rota. Once a permanent Watershed Technician is established they would become the lead responsible entity for data collection and monitoring. In the interim, the DCRM Watershed Coordinator will be responsible for coordinating data collection based on established metrics, targets, and objectives. It is also expected that other stakeholders will continue to collect data and contribute to the Talakhaya data repository.

8.2. Monitoring Logistics

Monitoring in Talakhaya has been sporadic over the last decade, with some years offering larger data sets than others, limiting the effectiveness of analysis and certainty of conclusions. The primary contributing factors include changes in monitoring entities, lack of capacity, and alterations to monitoring protocol. While the former two require commitments from responsible stakeholders, the latter can be resolved through the adoption of renovated monitoring protocol that incorporates a wide range of data sources. What follows are specifics on the drivers, sources, and recommendations for monitoring in Talakhaya. For specific details on the field sampling protocol, refer to the stand-alone document, 'TWMP Monitoring Protocol' in Appendix D.

8.2.1. Drivers for Monitoring

In the case of Talakhaya, local and CNMI laws recommend the need for conservation area monitoring, leaving protocols up to the relevant agencies (BECQ and DLNR). As part of their mandate, BECQ includes a number of prescriptions for watershed monitoring, contained within Coral Reef Initiative (CRI) priorities, currently implemented by the Watershed Coordinator. However, with the adoption of the TWMP stakeholders agreed to continue monitoring the watershed without the assistance of the National Coral Reef Management Fellow who has previously been the responsible entity for monitoring.

Water Quality

In the case of Talakhaya, local and CNMI laws recommend the need for conservation area monitoring, leaving protocols up to the relevant agencies (BECQ and DLNR). As part of their mandate, BECQ includes a number of prescriptions for watershed monitoring, contained within Coral Reef Initiative (CRI) priorities, currently implemented by the Watershed Coordinator. However, with the adoption of the TWMP stakeholders agreed to continue monitoring the watershed without the assistance of the National Coral Reef Management Fellow who has previously been the responsible entity for monitoring.

Revegetation Status

As the primary action implemented from the initial CAP, monitoring the revegetation project remains a primary driver for monitoring in Talakhaya. In coordination with DLNR-Forestry, at the end of the annual revegetation project the perimeter of the planted area is walked using GPS equipment to establish the total area revegetated. Procedures have changed since the first planting in 2007, which makes comparisons and data analysis difficult. For grant reporting purposes, the total area needs to be calculated as accurately as possible. While Forestry is taking over the revegetation sides of the TWMP, with funds

coming directly through their office rather than through DCRM, monitoring the area will still require a coordinated effort based on capacity and available equipment.

Coral Reef Health

THE CNMI Coral Reef Management Priorities (2019–2029) guiding document stipulates the continued and future need for monitoring coral reef health, particularly through the lens of reducing land-based sources of pollution (LBSP) in priority watersheds. Goal 1 of CNMI Coral Reef Priorities is to "improve the conditions of CNMI's coral reef ecosystems by reducing the amount of sediment, nutrients, and other land-based sources of pollution in CNMI's watersheds." DCRM previously managed and implemented the CAP, which included coral reef and benthic indicators as metrics in determining successful implementation.

8.2.2. Data Collection, Storage, and Reporting

All downloaded logger and rain gauge data should be archived as raw files within a shared document. Each raw file name should be saved in a folder with the location and date that the file was downloaded on. Raw data files should continue to be saved separately following each download to preserve data. After all raw files are archived and saved, logger data should be compensated with the air logger from each of the stream reaches utilizing the HOBOware™ software. Compensated logger data should be compiled into a separate working spreadsheet that will be updated following each month. Raw rain gauge data should also be saved under a separate worksheet for each location to establish a data archive, and then compiled in the "finished" data spreadsheet (Figure 12).

The "finished" data spreadsheet should also contain separate worksheets to record field monitoring data for each of the locations (see example below). As described above, monitoring data will only be collected at one station on each of the streams. Currently, sampling data is added to the "Talakhaya Watershed Streams.xlxs" document through the DEQ water quality office in Saipan. The entered data should be reviewed regularly to ensure consistency and accuracy of entry.

Date	Time	Season	Comment	Entero (MPN/100 ml)	Entero Moving Geomean	Single sample exceed 130	Moving Geomean exceeds 35	Advisory	Temp. (C)	Salinity (10%)	D.O. (%)	DO exceeds <75%	pH	pH Exceeds 6.5 or 8.5	Turb. (NTU)	TSS (mg/L)	TSS (mg/L) Exceeds 5mg/L
02/13/18												Exceeds		Exceeds			
02/22/18	0847	0		631		1	0	RED FLAG	24.79	0.14	97.4		7.63		1.30		
02/29/18	0906	0	No flow	389	495	1	1	RED FLAG	24.40	0.13	120.7		7.93		7.06		
03/09/18	0937	0	low flow	341	437	1	1	RED FLAG	23.05	0.14	52.9	Exceeds	7.69		9.19		
03/16/18	0949	0	low flow	262	385	1	1	RED FLAG	24.60	0.13	96.6		7.20		6.73		
03/22/18	1012	0	low flow	886	455	1	1	RED FLAG	25.12	0.15	87.2		7.70		3.61		
03/29/18	0902	0	low flow	3873	654	1	1	RED FLAG	24.71	0.14	36.0	Exceeds	7.74		2.41		
04/13/18	0910	0	low flow	2187	1184	1	1	RED FLAG	25.73	0.16	69.9	Exceeds	7.52		2.32		
04/19/18	0903	0	low flow	19863	3494	1	1	RED FLAG	25.69	0.15	76.5		7.44		4.91		
04/26/18	0906	0	low flow	1050	3646	1	1	RED FLAG	26.13	0.14	77.00		7.46		2.68		
05/04/18	0808	0	low flow	556	2244	1	1	RED FLAG	26.02	0.16	59.2	Exceeds	7.45		4.05		
05/17/18	0815	0	No flow	6488	2945	1	1	RED FLAG	26	0.15	40.30	Exceeds	7.23		5.87		
05/24/18	0838	0	low flow	4884	2074	1	1	RED FLAG	26	0.15	65.10	Exceeds	8		2.33		
06/07/18	0831	1	low flow	5794	5684	1	1	RED FLAG	25.68	0.13	92.9		7.48		6.75	4	
06/14/18	0830	0	low flow	402	2931	1	1	RED FLAG	25.98	0.14	78.8		7.4		16.0	3	
08/02/18	0841	1	medium flo	1236		1	0	RED FLAG	25.48	0.13	98.2		7.87		4.52	3.8	
08/09/18	0853	12	medium flo	11199	3720	1	1	RED FLAG	25.26	0.10	99.7		7.81		53.80	48.6	
08/17/18	0829	1	medium flo	24196	6945	1	1	RED FLAG	25.21	0.06	107.3		7.73		116	49	Exceeds
08/24/18	0840	1	medium flo	213	2906	1	1	RED FLAG	25.12	0.14	96.0		7.93		4.73	1.4	
08/30/18	1104	1	medium flo	498	2042	1	1	RED FLAG	26.01	0.12	79.7		8.10		6.60	7.8	Exceeds
09/06/18	0834	1	medium flo	886	1911	1	1	RED FLAG	24.84	0.12	89.1		7.82		8.72	x	Exceeds
09/20/18	0756	1	medium flo	17329	1130	1	1	RED FLAG	25.69	0.11	91.40		7.66		11.6	3.6	
09/28/18	0849	1	medium flo	1162	1726	1	1	RED FLAG	25.26	0.14	109.3		7.98		2.23	3.4	

Figure 12. Stream water quality data from Talakhaya.

Data Reporting

On a quarterly basis, data shall be compiled and evaluated for quality assurance/quality control purposes. Stream level data should be compiled and graphed separately and alongside each other to help identify any trends or outlying data points over the three-month period. Turbidity and total suspended solids sampling results shall be compared to stream stage and discharge measurements to establish a stage/sediment discharge relationship, and be plotted to provide a visual representation of the relationship over the three-month period.

During the initial study, UOG averaged rainfall data across the study area. Rainfall data were collected from each of the four rain gauges and compiled to represent three-hour, six-hour, 12-hour, and 24-hour average rainfall amounts. These data sets were then utilized to establish stage discharge relationships for each of the stream reaches. With stage discharge relationships already established, rainfall data should be averaged and plotted alongside stream level for the three-month period. More findings from the UOG study can be found in the 2018 article "Using Vetiver grass technology for mitigating sediment loads in the Talakhaya watershed areas in Rota, CNMI".

With the transition from the CAP to the TWMP, it is recommended that reporting data should occur both prior to and in the months following Strategic Action implementation. These findings should reflect the specific action (i.e. looking at changes in sedimentation due to stream debris clearing). Working closely with relevant stakeholders will be crucial in ensuring that interventions are fully monitored and reported out to the larger stakeholder group and reviewed for adaptive management.

8.3. Monitoring in Talakhaya

Monitoring is a process for managers and stakeholders to receive feedback and data to determine the successfulness of Strategic Action implementation and whether water quality, revegetation area, and coral reef health are improving. This plan will focus on four types of monitoring, each representing different frequencies, durations, intensities, and locations for their data collection. Data outputs from monitoring should help refine future Strategic Actions both for Talakhaya and other CNMI watersheds.

8.3.1. Trends

Trend monitoring is used to determine improvements in water quality, revegetation area, and coral reef health over time. As strategic actions to reduce LBSP are implemented, it is expected that coral reef coverage and marine life with responsive with positive trends. Additionally, reductions in sedimentation (measured through turbidity and total suspended solids) are expected. Currently, stream water quality, shoreline and coral reef surveying are being monitored by DEQ and DCRM respectively. Long-term trend monitoring of water quality and coral reef health can be used in conjunction with the efforts to monitoring implementation and effectiveness of the Strategic Actions recommended in the TWMP, with the idea that implementation of activities will, over time, reduce pollutants in streams and off-shore ecosystems, resulting in improved quality. Trend monitoring is reference site specific (current sampling locations), can be low frequency, requires long-term data collection, and entails low to moderate data analysis.

8.3.2. Baselines

One of the major issues with Talakhaya is the lack of baseline water quality data, making the calculation of sediment loads and pollutant concentrations difficult, a concern explicitly voiced in the Soil Loss Assessment Report 2. Throughout the duration of the TWMP process, water quality data was extensively collected, helping to provide some baseline data prior to plan implementation. However, there are a few

locations that require additional baseline data collection through the use of ground-based surveys, established photo points, installation of erosion pins, and collection of water samples in additional locations. This baseline data is necessary to determine the impact of any Strategic Action. Baseline monitoring is project site specific, can be low frequency, is short to medium term duration, and requires low to moderate data analysis based on project stipulations.

8.3.3. Implementation

For each Strategic Action project implemented in the watershed, information should be collected and reported to the relevant stakeholders, especially BECQ with regards to permitting activities and DLNR, which will be responsible for the continued monitoring of the watershed. Each project should be collected and maintained in a GIS database that will allow managers to reference where projects are proposed, being installed, or completed. Implementation monitoring is project site specific, is variable in frequency of measurements, runs for the duration of the project, and is low intensity data analysis.

8.3.4. Effectiveness

Once Strategic Action projects are installed, monitoring of the effectiveness of the activity should begin immediately. Effectiveness monitoring should be included in the design of any proposed project prior to implementation. Examples of effectiveness monitoring protocol include visual assessments, sediment volume assessment, grab samples, community collaborations, technical assessment of nutrients, and effluent sampling. Although a monitoring frequency of a set interval (for example, every six months or annually) is advantageous with respect to planning and resource efforts, the most beneficial data is usually obtained in inclement weather, typically during or after a rainfall event of significant intensity that tests the management practice under conditions for which it was designed. Results of effectiveness monitoring should also be maintained in a GIS database and/or relational database.

8.3.5. Data Gaps

As identified multiple times throughout this document, the issue of data gaps has prevented the certainty of conclusions based on limited data. The missing data falls into a few general categories:

- Long-term monitoring – Given that the newly planted grasses and trees will take several years to effectively stabilize the badlands and transition those areas into early successional forest, stream monitoring data will be valuable for years to come. Data for soil loss and water quality have been sporadic, so consistent data over the next five years is necessary to fill this gap.
- Sub-watershed geomorphology – The initial Phase 1 and Phase 2 Soil Loss Assessments made comparisons between the five monitored streams, using TK0 as a 'control' contrasted with the 'forested' TK4 stream. However, based on the limited findings, individual streams need more near-stream analysis to determine their behaviors (e.g. flow and erosion). Determining other potential sources of sediment in each sub-watershed will help to better understand trends and outliers. Better mapping of the stream systems will also help to understand similarities/differences between stream morphology and conditions that may affect sampling locations (e.g. backups caused by culverts, increased localized turbidity due to upstream waterfalls).
- Stream flow – Some preliminary and basic stream flow data was collected during the TWMP process; however, this was based primarily on SVAP rather than use of a flow meter. In order to determine sediment loads, specifically the EPA metrics for LBSP, stream flow needs to be further defined throughout the year and in association with event-based flow changes. Additionally, determining current base flow conditions can help plan for resiliency against climate change.

- Land cover and sediment sources – As the revegetation project transitions into a 'trees only' phase of the project, it is necessary to further define the sources of sedimentation including soil analysis of the badlands, roads, stream banks, and private lands. With alternative sources of sedimentation likely contributing to changes in water quality, filling this data gap will allow for targeting Strategic Actions towards relevant projects.

8.4. Recommendations for Monitoring

Following the development of the Conservation Action Plan, monitoring was set up to determine the impacts of the revegetation project. Over the last decade, the monumental effort of the Luta Livelihood volunteers and DLNR-Forestry is helping to stabilize over 100 acres of steep slopes with more than 300,000 seedlings, with the ultimate goal of restoring the landscape to limestone forest. The remote conditions and steep terrain present challenges to the volunteers who spend long hours in extreme weather conditions on exposed slopes, and logistical issues with transporting people, plants, and equipment up the rough, unpaved road. While reporting has yet to make significant findings on the ecological impact of the project, that should only bolster both the need for increased monitoring and continued support.

The primary methods for measuring watershed health is through a combination of stream monitoring and soil loss assessments. Quantifying soil loss via stream monitoring is problematic and the production of meaningful results are elusive particularly in smaller watersheds. Based on results from both Phase 1 and Phase 2 of the Talakhaya stream monitoring, there are too few data and too many issues to conclude that the soil loss previously associated with the exposed badlands has reduced with any certainty nor to conclude that the revegetation effort has improved downstream water quality conditions. Given the newly identified threats in the TWMP (i.e. alternative erosion sources), expanding the scope of watershed monitoring is essential to determine the full scope of both the revegetation project success and potential impact of future Strategic Action implementation.

While the previous sections detail the justification for stream and watershed monitoring as well as the logistics for current monitoring efforts, what follows are practical recommendations to fill the obvious data gaps limiting the effectiveness of monitoring. A non-exhaustive list for improving monitoring of the Talakhaya watershed includes:

8.4.1. Stream Flow

In order to determine how much sediment is being transported through each stream, it is necessary to calculate accurate flow rates. Currently, during regular water quality sampling events, a visual approximation of flow is recorded in the notes section of data sheets (utilizing a simple 'low', 'medium', 'high' categorization). This method was used due to the difficulties of calculating flow using the Hatch flowmeter (which requires a team of two to use precisely). Despite being a qualitative metric, it can help inform the flow behavior of each individual stream throughout the year and can yield information on the intermittent stream behavior. Additionally, during the dry season this information can be used to determine the extent of rheic flow fluctuations (particularly for both TK1 and TK2).

Stage-Discharge

The relationship between the amount of water flowing in a river or stream and stage at any particular point is usually known as stage–discharge relationship. Stage–discharge relationships for flow in rivers and channels are established by concurrent measurements of stage (y) and discharge (Q) and the results are fitted graphically or statistically to yield the development of rating curves (Kumar 2011).

The stage-discharge relationship is very important for a monitoring program. To develop significant curves for predicting flow with stage data, years of data should be collected during both wet and dry seasons, when flowing, and ideally, during rain events as safety permits. Sub-watershed land-use activities that would affect flow should be identified and quantified if possible (e.g. man-made water diversion, downstream culverts, bridges, etc.), as these can greatly affect monitoring results.

Water Cave Output

Water quality and flow estimations have occurred exclusively at the predefined monitoring sites. In order to gain a greater understanding of sub watershed behaviors, flow should be monitored throughout each stream. At the highest point of each stream along the Sabana cliff line, there are a number of caves that act as the primary source for each stream. Currently, CUC is collecting data on how much water is outflowing from the main Water Cave. However, this data is not being shared with watershed managers nor is it being incorporated into watershed monitoring data sets. Stakeholder cooperation is essential in determining the flow behavior of the streams throughout the season changes.

8.4.2. Erosion Sourcing

Determining other potential sources of sediment in each sub-watershed will help to better understand trends and outliers. For example, while TK4 is considered forested, better understanding the levels of farming/ranching in this area will help to understand sediment levels. Other sources of sediments include road and streambank erosion – there are a number of cases of mass slippage starting in 2017. Better mapping of the stream systems will also help to understand similarities and differences between stream morphology, and conditions that may affect sampling locations (e.g. backups caused by culverts, increased localized turbidity due to upstream waterfalls). Ideally, a comprehensive soil inventory should be pursued to determine the primary sources of sediments passing through monitoring locations.

- Erosion Pins – Streambank erosion and mass slippages have been identified as additional sediment sources within the watershed as opposed to the previous assumption of the impact of badland soil erosion. Over the course of the TWMP process, some streambanks demonstrated erosion rates at more than 1m/year, particularly after prolonged dry season and subsequent deluges. A fairly common monitoring protocol to determine streambank erosion is through the use of “erosion pins”. This involves placing flagged pins at precise intervals in noticeably eroding streambanks and regularly checking their position. As the streambank erodes the pins fall and allow for calculations on the extent of erosion.
- Sediment Traps – Installing temporary sediment traps closer to revegetated and bare areas and measuring deposition rates could help quantify soil loss rates more directly. Sediment traps were initially proposed in the CAP monitoring framework, however, due to capacity and funding issues, they were never implemented. Particle size distribution analysis of total suspended solids samples may be used in conjunction with results of UOG Phase 1 soils tests to determine source of sediment in streams (e.g. badland derived soils from stream bank erosion). Changes in the ratio of badland soils to other sources of sediment could be a measure of revegetation performance.

8.4.3. Stream Visual Assessment Protocol

Due to the differences in sub-watershed behavior and the difficulties in making comparisons between each, a comprehensive assessment is required. BECQ developed a Stream Visual Assessment Protocol (SVAP) (2018) which allowed for a number of simple calculations at preselected sampling locations (ranging from flow estimates to biota detailing). While the protocol is more relevant for the urban streams

of Saipan, a truncated version should be utilized in Talakhaya (e.g. utilizing secondary water quality indicators, such as environmentally sensitive macroinvertebrate species). Over the course of the planning process, a number of brief visual assessments were conducted throughout each stream to highlight important hydrogeological features (i.e. pools, waterfalls, and streambank erosion) in addition to determining the extent of relevant riparian species presence. Based on those findings, three-four sites should be chosen for each stream that highlight a diversity of stream behavior (e.g. confluences, large waterfalls). Visual assessments at those sites should be conducted at regular intervals (monthly or quarterly).

8.4.4. Other Recommendations

DFW is conducting studies within Talakhaya streams and wetlands, with most of their sampling occurring at the highest reaches of the relevant streams. Incorporation of their data into watershed monitoring as well as contributing past data to their research is necessary. Additionally, managers should investigate opportunities for citizen science to increase the community involvement in watershed management. Lastly, MMT is expected to continue collecting and contributing their findings to the TWMP data set.

9. Education & Outreach Strategy

The Education and Outreach section briefly describes strategies to educate and engage with residents of Rota in order to achieve conservation targets, which includes building public awareness and support, supporting implementation, engaging the community, and changing policy. Based on surveys conducted in 2018, residents of the island identified education as one of the top two solutions to the various threats against the natural resources. Education and outreach are priorities for all the natural resource management agencies in CNMI, each of which has stipulations for recommended activities. DCRM developed a Coral Reef Initiative Communications Plan (2018) that further refines the objectives related to the ridge-to-reef approach towards watershed and coral reef management. The details presented in this section are focused on meeting *Strategy 6: Raised community awareness and educational outreach for both the planning process and the Talakhaya watershed more generally*.

The lack of education, understanding, and awareness of water quality impacts, habitat destruction, and watersheds more generally is a major cause of many watershed threats. The successful implementation of the TWMP depends on stakeholder awareness, community involvement, and acknowledged ownership over the health of Talakhaya. Not only will some landowners change behaviors and seek support for BMP implementation when presented with education campaigns, but increased community awareness of the threats facing Talakhaya can help facilitate increased capacity to implement solutions. Education and outreach programs should (WHWMP 2013):

- Increase stakeholder awareness about the link between LBSP and coral reef ecosystem health.
- Increase stakeholders' knowledge about nutrient and sediment loading, and effects pm off-shore waters.
- Educate land-use decision-makers.
- Increase agency support for, and participation in, actions to reduce LBSP
- Engage the community in installation, monitoring, and maintenance of projects.
- Convey information about monitoring activities and results.

- Involve partnering with other groups to develop and implement a comprehensive education and outreach program addressing water quality, watershed management, and coral reef health issues.
- Develop targeted outreach activities and materials.
- Affect policy change.

9.1. Build Public Awareness & Support

A successful outreach and education strategy must emphasize community engagement to increase support towards an integrated approach to conserve watersheds and corals, as well as conservation on Rota more generally. Following the CRI ridge-to-reef approach, outreach will focus on developing public awareness about runoff, erosion, and water quality including their negative effects on coastal and marine environments. The "Save our Soils, Save our Reefs" educational campaign should be conducted to inform stakeholders and community members how they can reduce LBSP, ways in which they can reduce freshwater waste, and encourage engagement with the watershed to build connection with the more-than-human landscape. Outreach efforts must also focus on the structural and political issues contributing to watershed degradation. Watershed awareness and active stewardship among residents, community associations, businesses, and visitors can be promoted through education programs, recreational opportunities, and participatory watershed activities.

9.1.1. Key Themes and Messages

From elementary school students to local government officials, all stakeholders need to be included in outreach activities, which requires a focus on a set of key themes and messages that communicate the basics of the TWMP, the Save our Soils, Save our Reefs campaign, and watershed management more generally. The following themes provide a framework for understanding the connectivity between watersheds and coral reefs, the impact of LBSP on ecosystems, and the role of humans in conserving natural resources:

Coral reefs and watersheds are under threat

- Increased population and development over the past decade in the CNMI have exacerbated a number of threats to the coral reef ecosystems and has led to the destruction and reduced health of coral reefs and coral reef associated habitats.
- Watersheds are directly connected to coral reefs and have been declining at equally alarming rates due to land-use changes, habitat destruction, and lack of effective management.
- Without dramatic steps to restore favorable conditions, coral reefs and watersheds CNMI-wide risk rapid degradation.

Healthy watersheds and coral reefs are vital to our island lifestyle, economy, and culture

- Healthy watersheds recharge and purify water resources, preserve biodiversity, and protect the land and ocean from storm damage.
- Diverse reef ecosystems provide traditional and subsistence uses, production of commercial food products, recreational opportunities for a healthy tourist economy, physical protection of the coastal zone from storms, unique educational opportunities, and novel research applications.
- Healthy watersheds and reefs improve resilience to the effects of climate change.
- Coral reefs are integral to the rich spiritual and cultural heritage of CNMI and the people.

Talakhaya is a critically important and ecologically unique resource for Rota

- The Talakhaya watershed is the primary source of Rota freshwater resources on Rota, designating it as critical economic infrastructure (Figure 13).
- Talakhaya boasts the only visibly flowing streams on Rota, making it a biodiversity hotspot with more than ten endangered and endemic species having a presence within the drainage basin.
- Revegetation of Talakhaya has been a primary focus of local environmental agencies for the last decade, with more than 300,000 seedlings planted by Luta Livelihood volunteers.
- Conserving Talakhaya provides countless benefits for the people, economy, and ecology of Rota.

The goal of the Coral Reef Initiative is to restore and enhance the health and resiliency of coral reefs in CNMI and nearshore waters through the reduction of land-based sources of pollution

- Coral Reef Initiative (CRI) is a cross-agency initiative to protect and preserve CNMI coral reefs and to ensure the responsible management of the resources associated with those habitats.
- The CRI continually works to enhance public awareness, understanding, and appreciation of coral reef ecosystems and empowers the public to become active stewards of the marine environment.
- A primary goal of CRI is to better inform residents of CNMI of the threat of LBSP in watersheds on the health of coral reefs.

The Talakhaya Watershed Management Plan, a component of the CRI, is a community-based and stakeholder led effort

- The TWMP builds off of already established efforts underway and leverages resources across agencies and community groups to implement actions to reduce LBSP and conserve the watersheds health.
- The concentrated actions that have been implemented to date must now develop into a more comprehensive plan of action. Reducing LBSP is one of the single most important steps to help restore coral reef ecosystems.
- A number of partners have come together to work collaboratively to address and reduce impacts to CNMI reefs and watersheds: BECQ, DFW, DLNR, Forestry, NRCS, and NOAA.
- The TWMP will be implemented by both BECQ and DLNR, while Forestry and NRCS will continue managing the annual revegetation project.
- The TWMP will provide institutional support and funding resources to local agencies to implement on-the-ground Strategic Actions that can offer transferable lessons for the rest of protected watersheds in CNMI.

The TWMP "Save our Soil, Save our Reef" campaign focuses on reducing land-based sources of pollution, a major threat to coral reef health

- The islands and reefs are connected; events on land affect the reef.
- Declines in watershed health due to a multitude of threats limits the ability of the ecosystem to filter out LBSP, a natural feature of watersheds.
- LBSP includes erosion, compounds found in fertilizers and pesticides, human waste, runoff post-wildfire, and many other sources.
- Increased sedimentation associated with loss of forest land, historical agriculture practices, stream alterations, and human impacts (i.e. wildfires and development) has diminished coral reef health.
- LBSP causes coral reef decline by increasing nutrient loading and smothering the corals from increased amounts of sediment settling.

The outcome of the "Save our Soil, Save our Reef" outreach campaign will include stakeholder engagement and community support for reducing LBSP in Talakhaya and in its near-shore waters

- The initiative will include activities that agencies, organizations, and the community can undertake to restore watersheds and coral reefs.
- Strategies will include prioritized actions for community and group implementation.
- Recommended practices are voluntary with no regulatory requirement.

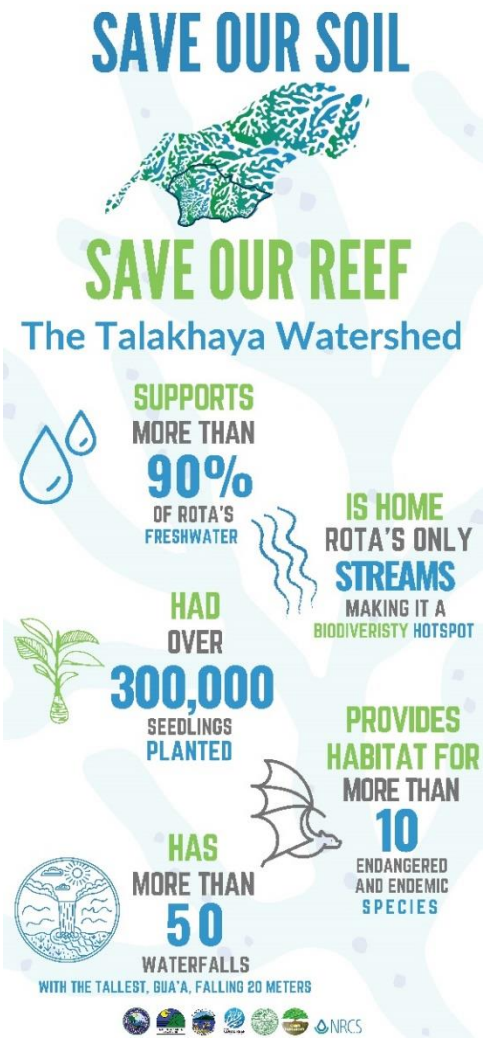


Figure 13. Example stand-up poster/bookmarks for Talakhaya key features.

9.2. Organizational Support for Outreach

The Coral Reef Initiative and other agency strategies for outreach and education about watersheds, coral reefs, and other natural resources in CNMI have received substantial support for many years. Building off the established organizational structures, implementation of Talakhaya outreach campaigns will fall under the work plans of two established positions. Additionally, established relationships with the NMC 4H Riptide program will allow access to elementary schools expecting watershed educational opportunities. Lastly, the local Watershed Manager based on Rota will offer the greatest sustenance of any Talakhaya outreach campaign due to their proximity to the landscape. These structural support components are described in more detail below.

9.2.1. CRI Education & Outreach Coordinator (DCRM)

The CRI Education and Outreach Coordinator is the primary point of contact for coral reef and watershed related outreach. Based out of the DCRM branch of BECQ, they have the lead responsibility in developing outreach materials, organizing campaigns with community groups, and ensuring the goals of the CRI

Communications Plan are fully actualized. While the Talakhaya CRI funding ended in 2019, there remain stipulations for continued outreach and education within the watershed as part of the Outreach Coordinator work plan.

9.2.2. Watershed Coordinator (DCRM) & Watershed Working Group (WWG)

The Watershed Coordinator is tasked with implementing watershed management throughout CNMI, with a focus on continuing existing plans and developing new management mechanisms, such as the TWMP. Based out of the DCRM branch of BECQ, they will be the primary implementor of any watershed related activities on Rota. They are responsible for hosting regular Watershed Working Group (WWG) meetings on Saipan, which can help develop refined outreach campaigns tied to current watershed efforts.

9.2.3. NMC CREES & 4-H Riptide Program

The NMC 4-H Riptide program is the youth outreach program from the Land Grant Universities, Cooperative Extension Services, and USDA. The 4-H Name & Emblem is intended to represent the ideals of the program with its focus on Head, Heart, Hands, and Health. "The program provides community-specific and culturally-focused experiential learning opportunities that encourage personal development and build capacity amongst participants in order to foster a desire to learn, appreciate life, lead and meet their full potential" (via the CREES website). Talakhaya outreach activities have previously involved presentations and activities about watersheds and coral reefs in all of the Rota schools.

9.2.4. Watershed Technician and Local Stakeholders

Once established on Rota, the local Watershed Technician will be responsible for conducting outreach campaigns in schools and at community events. They will also be tasked with giving presentations to relevant agency stakeholders who are serve as an important audience with regards to watershed management. Outreach activities led by the Technician can include waterfall hikes, revegetation opportunities, and other CRI approved actions (e.g. Watershed Warriors, Eco Camps, CNMI Snorkels). Working closely with the Talakhaya stakeholder working group, the Technician is expected to develop innovative, community-based, activities to improve understanding of LBSP and the role community members play in improving the health of the watershed.

9.3. Engage the Community

Community engagement focuses education, enforcement, and technical resources on changing behaviors that threaten watershed and coral reef health. Many outreach campaigns focus on simply sharing information, however, offering more engaging activities that train the community to change behaviors will likely result in greater awareness and continued support. While most residents of Rota are not directly contributing to LBSP in Talakhaya, their actions at home and in their offices can help reduce strain on the already stressed resources. Public engagement is key to success as implementation of recommendations will, in part, be accomplished through community projects (Table 5). The Save our Soils, Save our Reefs campaign also includes a focus on individual behavior change in a community context (Appendix E).

9.3.1. Outreach Tools & Methods

A wide range of stakeholder engagement tools and methods are required to reach the highest number of stakeholders and engage with all awareness levels. The CRI Communications Plan (2018) includes a list of target audiences, their current and emerging needs, and relevant approaches for addressing their issues. Engagement with the diverse audiences of Rota requires coordination between agencies. Current methods used for outreach and education include public meetings and workshops, outreach at fiestas and

related events, and information publicized both online and through outreach materials (i.e. posters, stickers, and bookmarks). In addition, EPA has developed a *NPS Outreach Toolbox*, which contains a variety of resources to help develop an effective and targeted outreach campaign to educate the public on non-point source pollution or storm water runoff. The following examples detail how specific outreach methods and tools are presently utilized:

Public meetings and workshops

Public meetings and workshops are used as a tool for sharing and gathering information specific to the stage of the planning efforts. A number of workshops were conducted during the TWMP process, allowing for public comments on various aspects of the plan. Future meetings need to be more broadly announced to gain participation beyond a few landowners and relevant agency stakeholders. A public forum about natural resource conservation on Rota was held in 2019 and was well received by the community. Similar events are necessary to keep residents aware of the ongoing conservation efforts in and around Talakhaya as well as the whole island.

Type	Tasks	Notes
Rain gardens	Design, permitting, installation	Conducting rain garden workshops will offer community members easier access to installation activities in homes and on public property
Illicit dumping	Debris removal, signage	Communicating the role locals play in reducing illicit dumping in addition to more frequent community sponsored clean-ups
Household practices	Focus on both pollutant runoff and water saving strategies	Need to incorporate understanding of individual impacts on watersheds and reefs within existing outreach efforts
Native vegetation	(Re)vegetation planting in Talakhaya CA and adjacent lands	Bringing community members up to the annual revegetation project as well as detailing BMPs for Talakhaya landowners
Relationship building	Watershed hikes	Community members have expressed a desire for more opportunities to spend time in Talakhaya and learn more about the wildlife and habitats
Monitoring	Water quality sampling, coral reef surveys	Should be conducted as part of an overall plan for the area to insure that quality data is obtained.
Public policy	Work with government agencies to develop and achieve policy changes	Regulations increasing protection for Talakhaya and supporting landowners in the watershed in addition to bolstering enforcement of existing laws

Table 5. Potential projects for community members.

Outreach at fiestas and related events

Previously, curing fiestas and community events, BECQ has staffed tables to present information about coral reefs and watersheds as well as offering outreach materials. The CRI Education and Outreach Coordinator and the Watershed Coordinator will plan to visit Rota to staff similar tables in the future with a focus on the Save our Soils, Save our Reefs campaign. Additional activities should be developed to garner more participation and engagement with residents (e.g. coral reef videos, conservation games, watershed diagram, etc.).

Website and outreach materials

With the development of the SOS outreach materials, there will be increased opportunity for outreach. These materials have been presented to teachers, agency directors, and active community members. Including posters and stickers, the outreach materials encourage community members to find out more information by visiting the DCRM website, which will highlight the Talakhaya Watershed Management Plan as a critical component of CNMI coral reef conservation efforts.

9.4. Change Policy

While a few laws and regulations are in place with regards to the management and conservation of Talakhaya and the adjacent coral reefs, the implementation of most of the TWMP will depend on voluntary effort from relevant stakeholders. In general, watershed management has become the responsibly of the most dedicated community members and for Talakhaya that reliance has fallen on the shoulders of James Manglona of DLNR-Forestry. However, as stated by most stakeholders and detailed under the "political" threat in earlier sections, improving the enforcement of existing laws and developing more explicit regulations would assist in resolving the many issues threatening the watershed. Future stakeholder workshops should focus on potential regulatory mechanisms to increase the effectiveness of TWMP implementation and permit requirements to limit the impact of potential development.

10. Conclusion

The Talakhaya Watershed Management Plan provides a comprehensive assessment of the existing watershed conditions, an outline of the integrated management approach, a review of the mission of Talakhaya management, an exploration of the major issues threatening the ecosystem, and a detailed examination of the goals, objectives, and strategies necessary for achieving a healthy watershed. A significant level of effort was invested in compiling existing data and outlining necessary future data collection, which has determined the full extent of management priorities to reduced land-based sources of pollution and improve the health of both the watershed and adjacent coral reefs. The action plan and management recommendations developed for this WMP exist at the conceptual level, allowing for a larger framework for site-specific projects to follow. Additional quantitative data and field assessments will be necessary before and after any implemented project, much of which is beyond the current scope of monitoring protocol.

Watersheds are constantly changing, making a determination of management "success" difficult. Throughout the TWMP process, new findings would result in both an expansion of the scope as well as the need to fill added data gaps. In this regard, the plan lacks analysis of "ready-to-implement" projects or solutions, but rather aims to guide future projects that will ultimately depend on funding, capacity, and commitments from local stakeholders. Future watershed management plans in CNMI should utilize this existing framework and focus on project-specific analysis and design in order to quickly transition from the planning phase to implementation. While the science, policy, and theory that grounds this plan are essential for prioritizing problems and focusing attention on the larger implications of watershed management, the watersheds of Saipan would be best served by concentrating on implementable solutions.

Watersheds serve as distinct management units, more-than-human landscapes, tangible drainage divides that incorporate numerous conservation foci. The integration of watershed components results in a wide

scope for management priorities (Figure 14). For Talakhaya, watershed management provides an opportunity to support human uses, restore ecological benefits, and generate resiliency in the face of climate change. The TWMP presents a pathway forward to address problems relevant to both the human and non-human residents of the landscape.

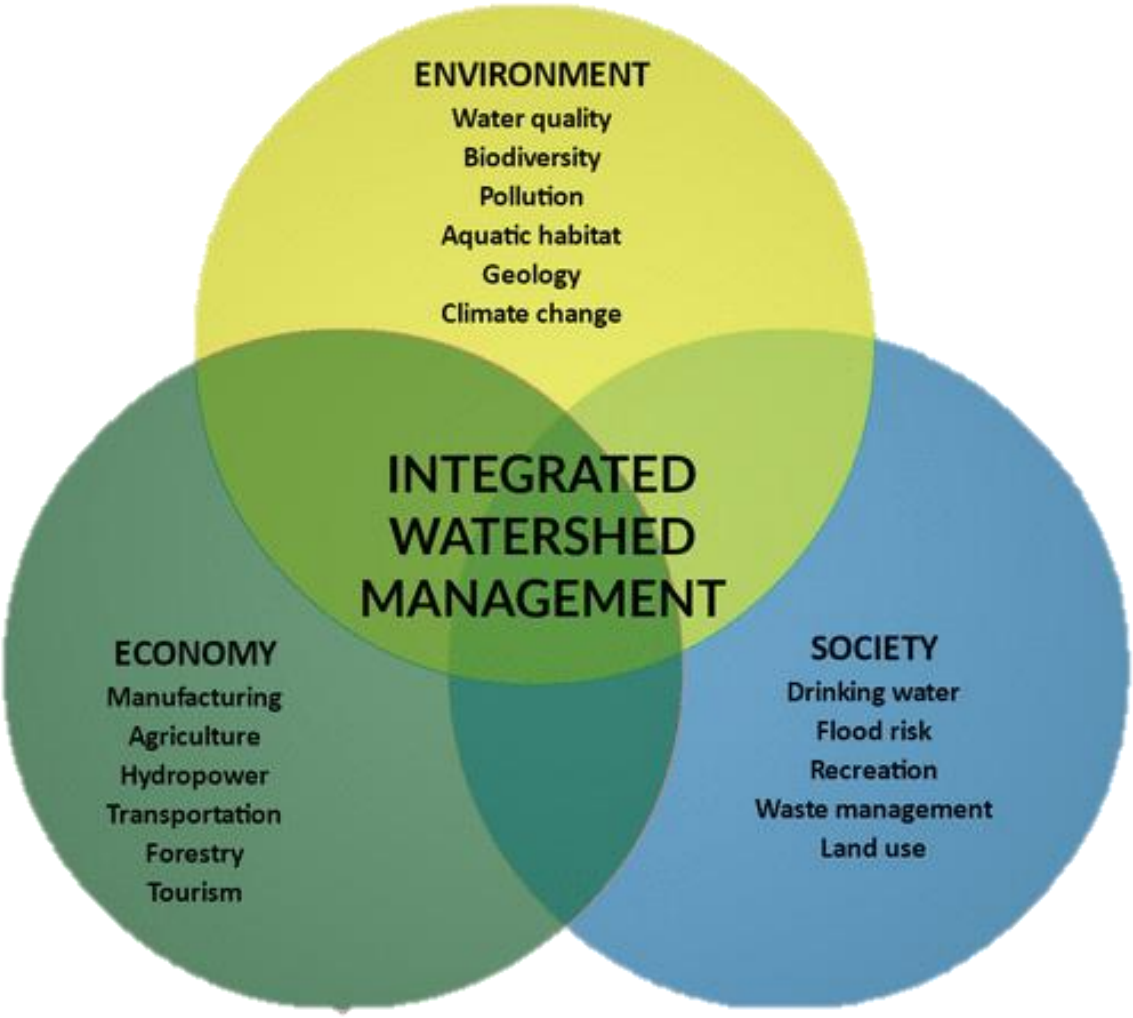


Figure 14. Components of integrated watershed management.

11. Implementation Schedule

Strategic Actions	Year 1		Year 1		Year 2		Year 2		Year 3		Year 3		Year 4		Year 4		Year 5	
Strategy 1	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Develop official map																		
Institutionalize map																		
Landowner partnerships																		
Develop BMPs for landowners																		
Implement BMPs																		
MVA partnership																		
Develop Tourism plan																		
Conservation officers																		
Codify TWMP via RLL																		
Strategy 2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Identify funding sources																		
Established funding																		
Revegetation Project																		
Archipelago partnerships																		
Knowledge Exchange																		
Remote sensing outputs																		
Strategy 3	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Develop official map (monitor)																		
Streambank monitoring																		
Streambank report																		
Historic stream flow study																		
Anticipated streamflow																		
Sediment trap study																		
Flow and sediment report																		

Strategic Actions	Year 1		Year 1		Year 2		Year 2		Year 3		Year 3		Year 4		Year 4		Year 5	
Strategy 4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Culvert funding sources																		
Replace culverts and roads																		
Review road erosion data																		
Hydrological modelling																		
Unpaved road standards																		
Strategy 5	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Orient TWMP with CUC MP																		
CUC & DPW Partnership																		
Establish rights-of-way																		
Initiate baseflow study																		
Report and CUC recommendations																		
Strategy 6	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Stakeholder meetings/workshops																		
Develop 4-H Riptide presentations																		
Present for 4-H Riptide at schools																		
Develop watershed lesson plans																		
Refine outreach campaign																		
Conduct outreach campaign																		
Organize and hold 'Goat Derby'																		
Strategy 7	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Establish full-time Watershed Manger																		
Review funding options																		
Data collection and analysis																		
TWMP review and adaptation																		
Finalize Implementation, M&E and O&E Strategies																		

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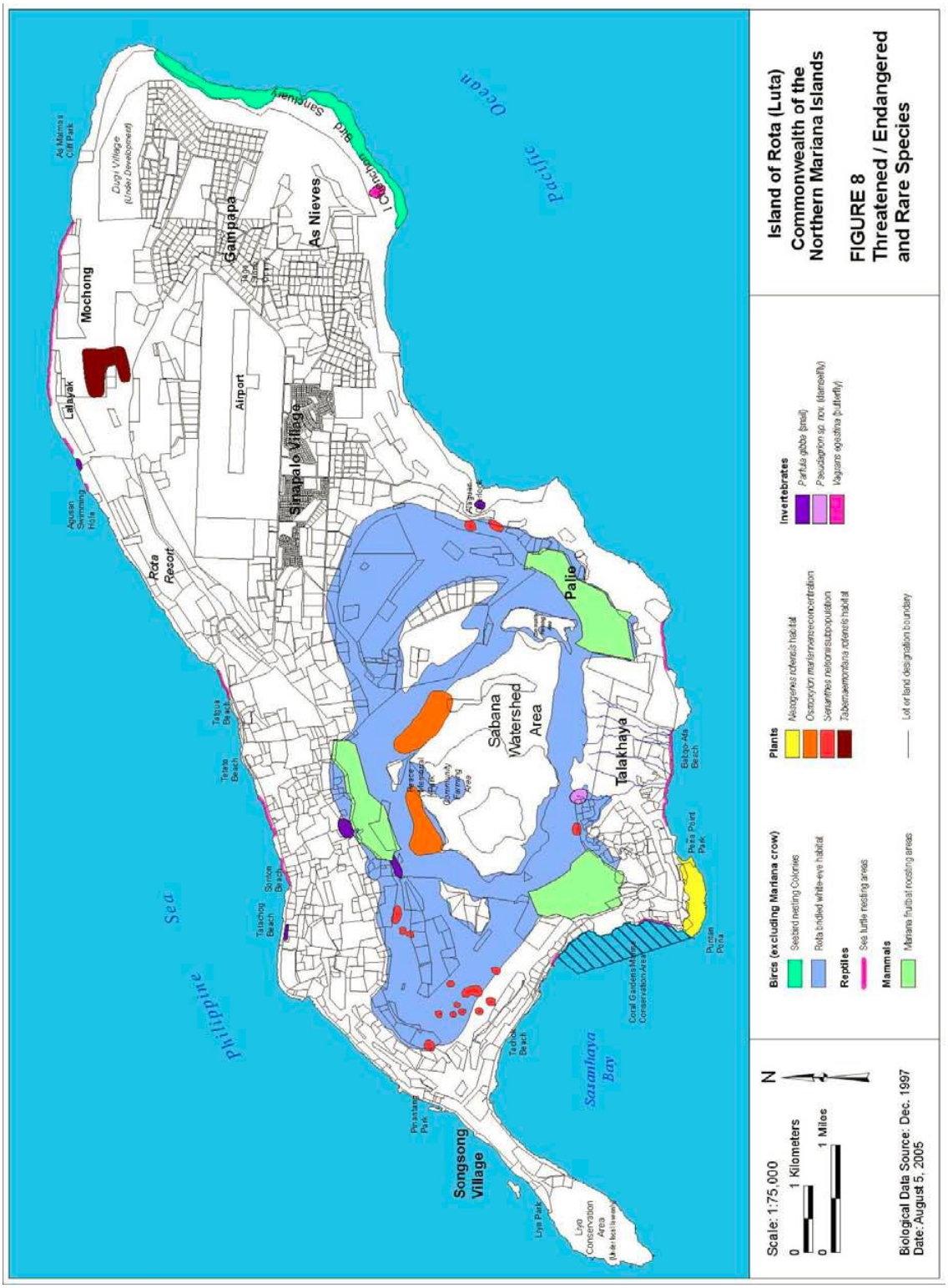
13. Appendix

Appendix A – Threatened and Endangered Species Habitats



Threatened, endangered, and rare Rota species habitats.

Appendix B – NRCS-USDA Conservation Plan (2007)

United States Department of Agriculture

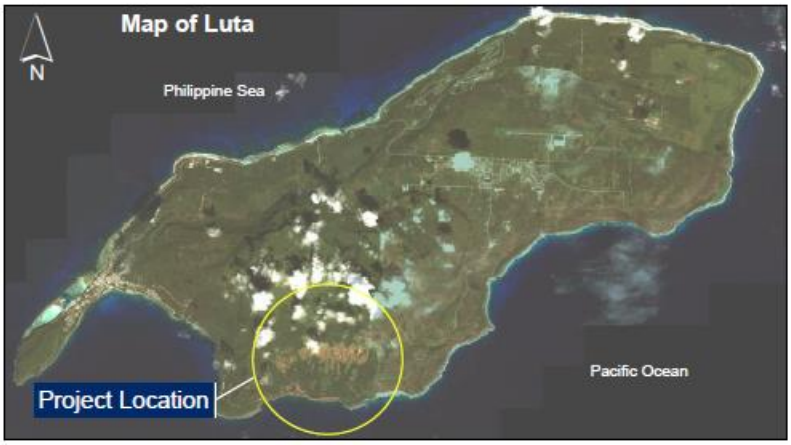
NRCS Natural Resources Conservation Service

Saipan Field Office
P. O. Box 5082-CHRB
Saipan, MP 96950
670.236.0888 phone 670.236.0889 fax

Conservation Plan

Island of Rota

Commonwealth of the Northern Mariana Islands
Project Location Map

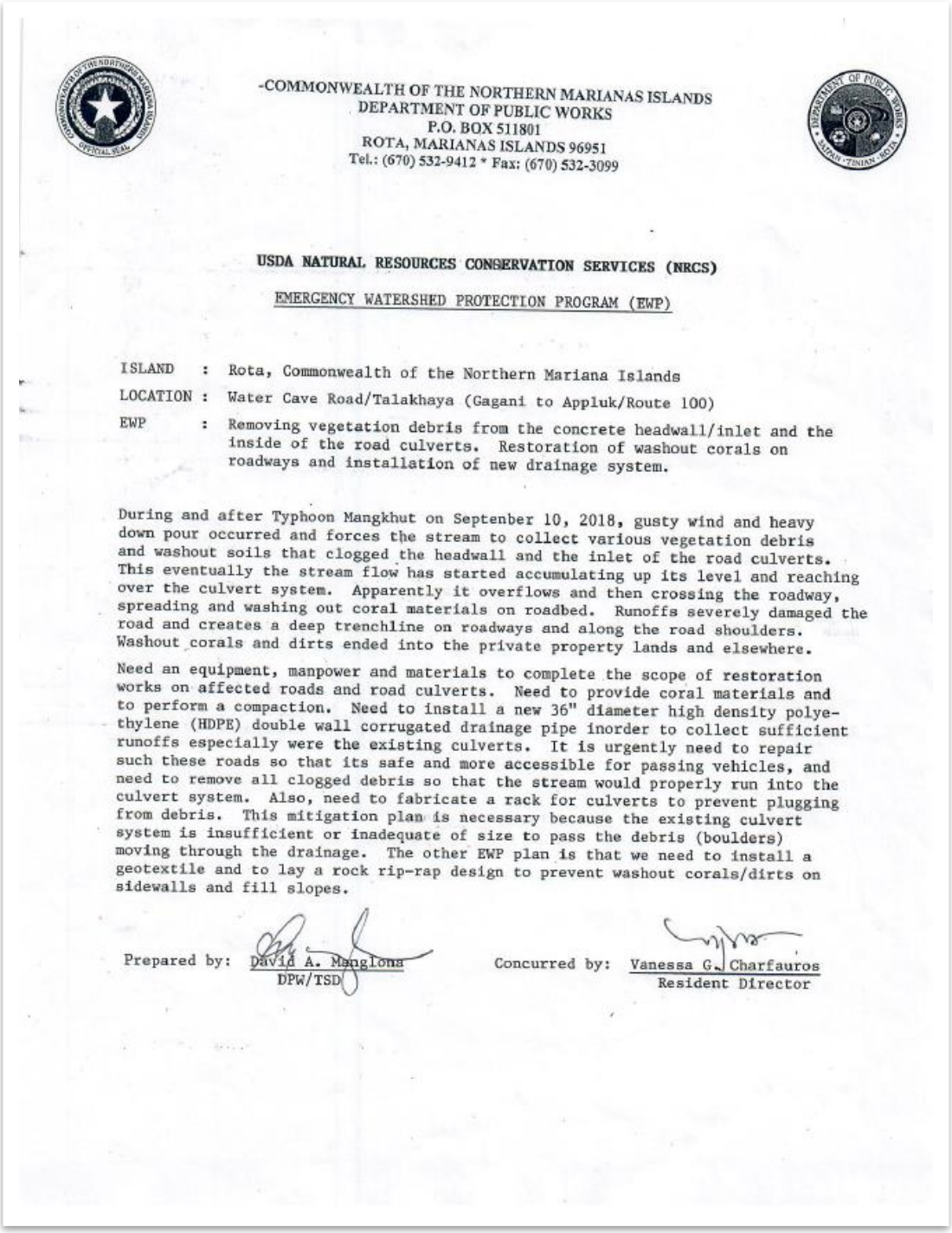


No Scale
Talakhaya, Rota

Prepared by
United States Department of Agriculture
Natural Resources Conservation Service
Pacific Islands Area – West
July 2007

NRCS Conservation Plan_2008.pdf

Appendix C – NRCS-USDA Emergency Watershed Protection Grant Application



-COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS
DEPARTMENT OF PUBLIC WORKS
P.O. BOX 511801
ROTA, MARIANAS ISLANDS 96951
Tel.: (670) 532-9412 * Fax: (670) 532-3099

USDA NATURAL RESOURCES CONSERVATION SERVICES (NRCS)

EMERGENCY WATERSHED PROTECTION PROGRAM (EWP)

ISLAND : Rota, Commonwealth of the Northern Mariana Islands

LOCATION : Water Cave Road/Talakhaya (Gagani to Appluk/Route 100)

EWP : Removing vegetation debris from the concrete headwall/inlet and the inside of the road culverts. Restoration of washout corals on roadways and installation of new drainage system.

During and after Typhoon Mangkhut on Septenber 10, 2018, gusty wind and heavy down pour occurred and forces the stream to collect various vegetation debris and washout soils that clogged the headwall and the inlet of the road culverts. This eventually the stream flow has started accumulating up its level and reaching over the culvert system. Apparently it overflows and then crossing the roadway, spreading and washing out coral materials on roadbed. Runoffs severely damaged the road and creates a deep trenchline on roadways and along the road shoulders. Washout corals and dirts ended into the private property lands and elsewhere.

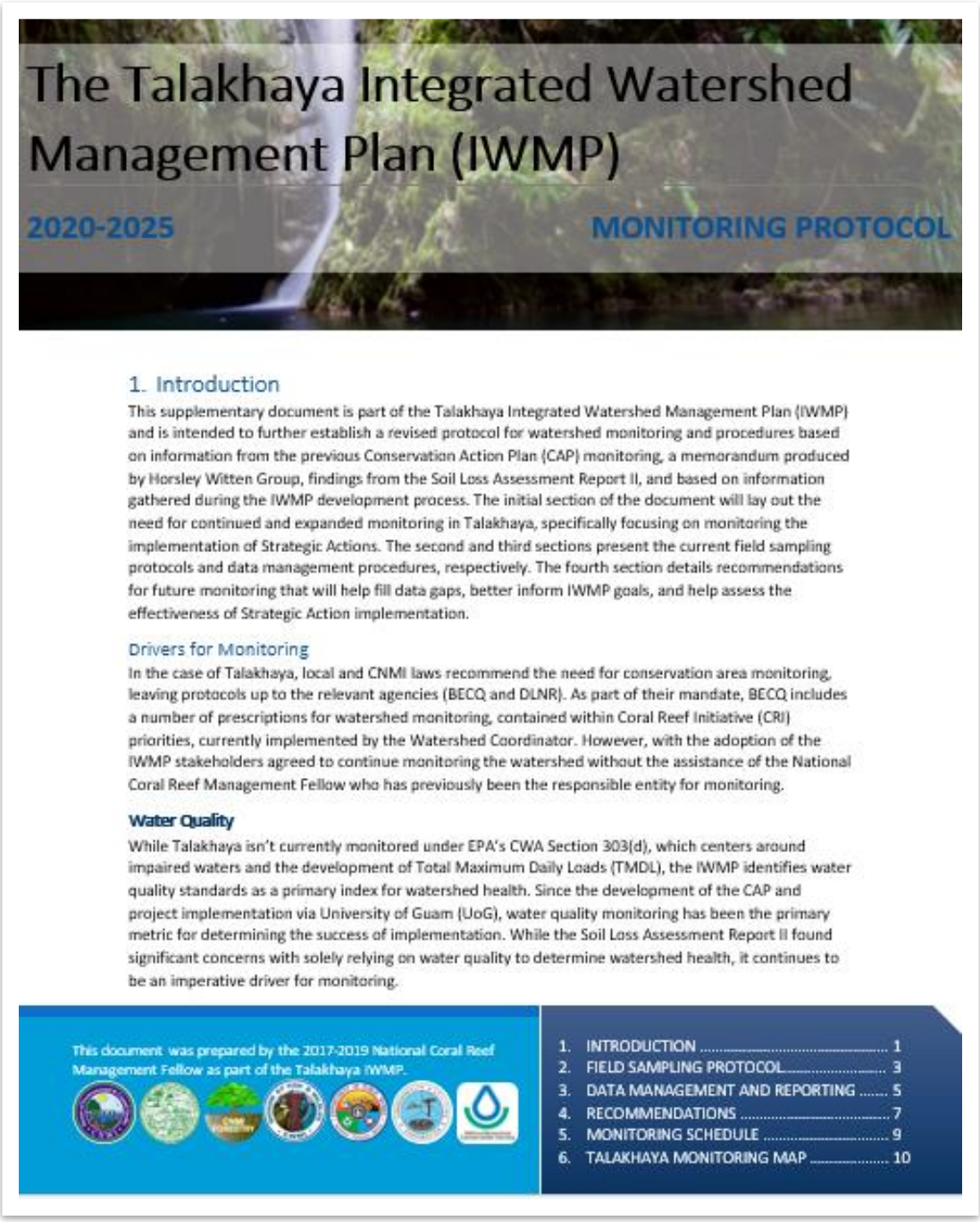
Need an equipment, manpower and materials to complete the scope of restoration works on affected roads and road culverts. Need to provide coral materials and to perform a compaction. Need to install a new 36" diameter high density polyethylene (HDPE) double wall corrugated drainage pipe inorder to collect sufficient runoffs especially were the existing culverts. It is urgently need to repair such these roads so that its safe and more accessible for passing vehicles, and need to remove all clogged debris so that the stream would properly run into the culvert system. Also, need to fabricate a rack for culverts to prevent plugging from debris. This mitigation plan is necessary because the existing culvert system is insufficient or inadequate of size to pass the debris (boulders) moving through the drainage. The other EWP plan is that we need to install a geotextile and to lay a rock rip-rap design to prevent washout corals/dirts on sidewalls and fill slopes.

Prepared by: David A. Manglona
DPW/TSD

Concurred by: Vanessa G. Charfauros
Resident Director

Culvert Construction.pdf

Appendix D – TWMP Monitoring Protocol



The Talakhaya Integrated Watershed Management Plan (IWMP)

2020-2025 **MONITORING PROTOCOL**

1. Introduction

This supplementary document is part of the Talakhaya Integrated Watershed Management Plan (IWMP) and is intended to further establish a revised protocol for watershed monitoring and procedures based on information from the previous Conservation Action Plan (CAP) monitoring, a memorandum produced by Horsley Witten Group, findings from the Soil Loss Assessment Report II, and based on information gathered during the IWMP development process. The initial section of the document will lay out the need for continued and expanded monitoring in Talakhaya, specifically focusing on monitoring the implementation of Strategic Actions. The second and third sections present the current field sampling protocols and data management procedures, respectively. The fourth section details recommendations for future monitoring that will help fill data gaps, better inform IWMP goals, and help assess the effectiveness of Strategic Action implementation.

Drivers for Monitoring

In the case of Talakhaya, local and CNMI laws recommend the need for conservation area monitoring, leaving protocols up to the relevant agencies (BECQ and DLNR). As part of their mandate, BECQ includes a number of prescriptions for watershed monitoring, contained within Coral Reef Initiative (CRI) priorities, currently implemented by the Watershed Coordinator. However, with the adoption of the IWMP stakeholders agreed to continue monitoring the watershed without the assistance of the National Coral Reef Management Fellow who has previously been the responsible entity for monitoring.

Water Quality

While Talakhaya isn't currently monitored under EPA's CWA Section 303(d), which centers around impaired waters and the development of Total Maximum Daily Loads (TMDL), the IWMP identifies water quality standards as a primary index for watershed health. Since the development of the CAP and project implementation via University of Guam (UoG), water quality monitoring has been the primary metric for determining the success of implementation. While the Soil Loss Assessment Report II found significant concerns with solely relying on water quality to determine watershed health, it continues to be an imperative driver for monitoring.

This document was prepared by the 2017-2019 National Coral Reef Management Fellow as part of the Talakhaya IWMP.

IWMP Monitoring Protocol.pdf

Appendix E – Example Outreach Materials

Appendix F – TWMP Workshop Participants

Nick Songsong

Ephrem Taimanao

Martin Atalig

Chris Taitano

Prodencio Manglona Jr.

Thomas Songsong

Noel Calvo

Ike Mendiola

David Manglona

Ricky M. Lizama

Josh Santos

Ray T. Cabrera

Jack Igisair

Royce Hocog

Peter Tiatano

Bill Pendergrass

Charles Mendiola

James Manglona

Janice Castro

Jay Doronila

Peter Camacho

Martin Mendiola

Becky Furey

Robbie Green

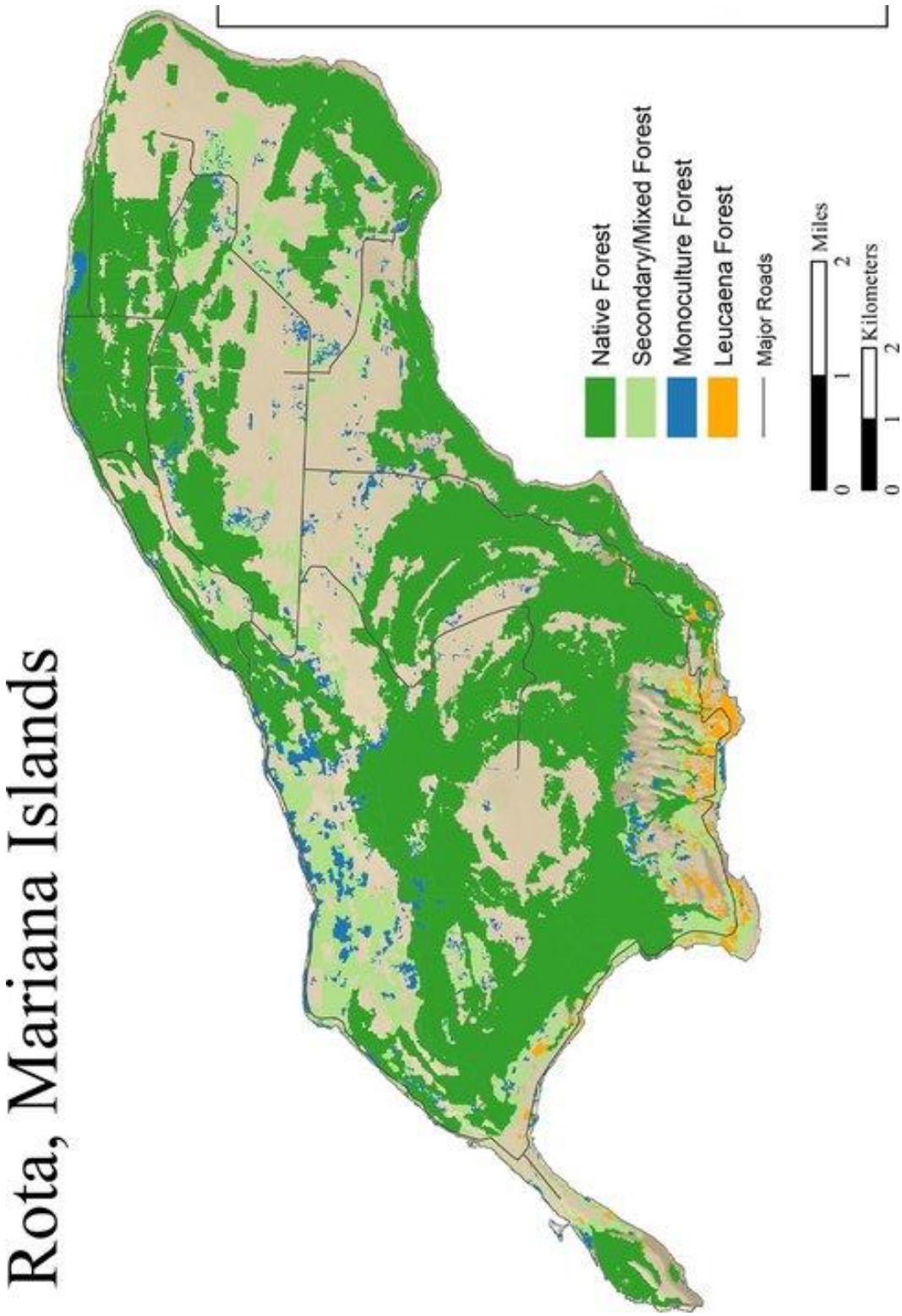
Sarah Farege

Amanda Reyes

Barbara Albert

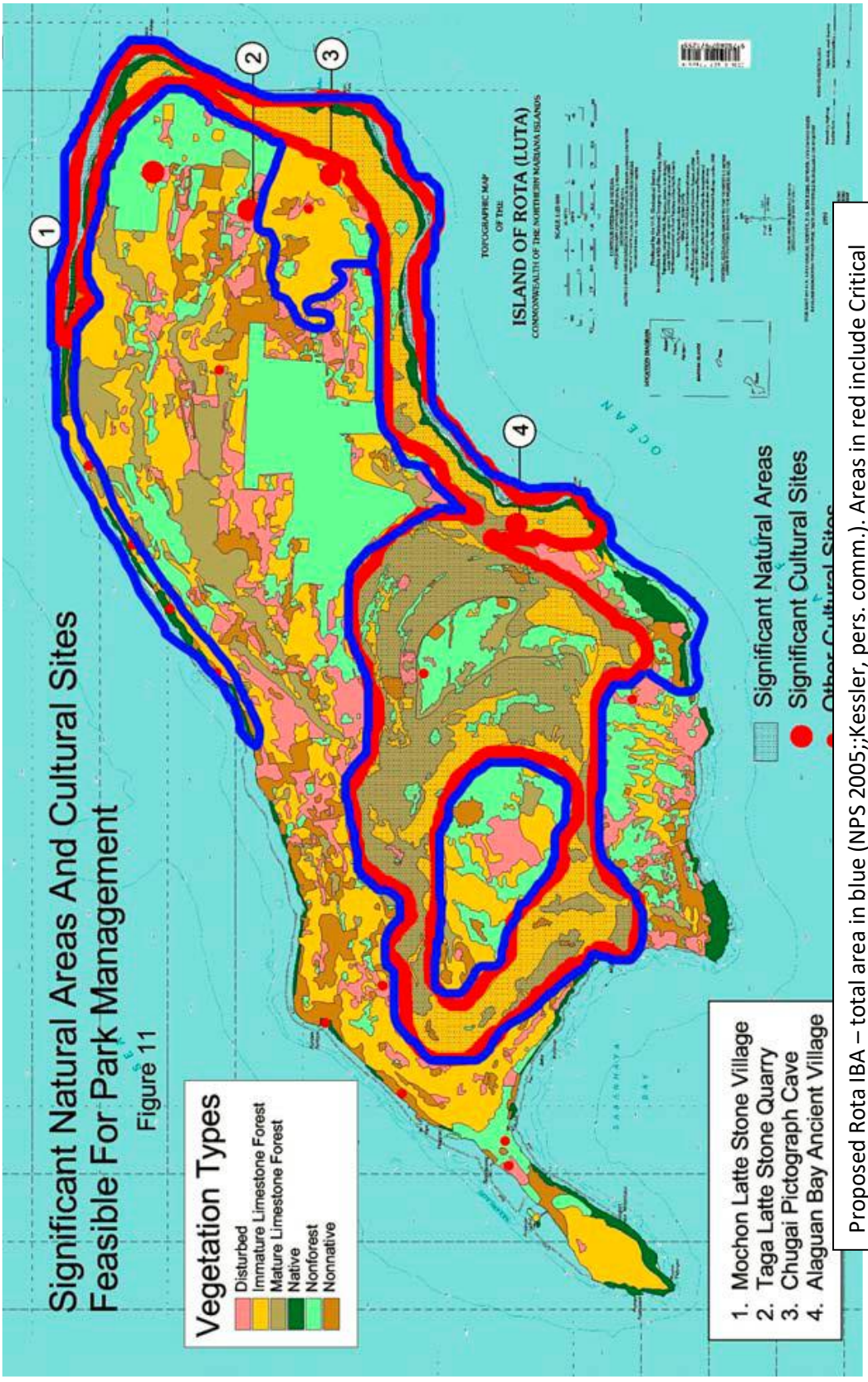
Josh Guilbert

Appendix G – Forest Coverage and Type of Rota



Forest coverage and type on Rota. From Willsey, Tyler & Kwon, James & Reeves, M. & Amidon, Fred & Miller, Stephen. (2019). Mariana Islands Forest. 10.1016/B978-0-12-409548-9.12012-3.

Appendix H – Proposed Important Bird Areas on Rota



Proposed Rota IBA – total area in blue (NPS 2005;;Kessler, pers. comm.). Areas in red include Critical Habitat and proposed parklands. Additional areas in blue are areas of remaining coastal forest or limestone forest (Lalayak mochong area) that are known to be home to nesting Mariana Crow pairs.

Appendix I – Land-Use and Conservation Areas on Rota

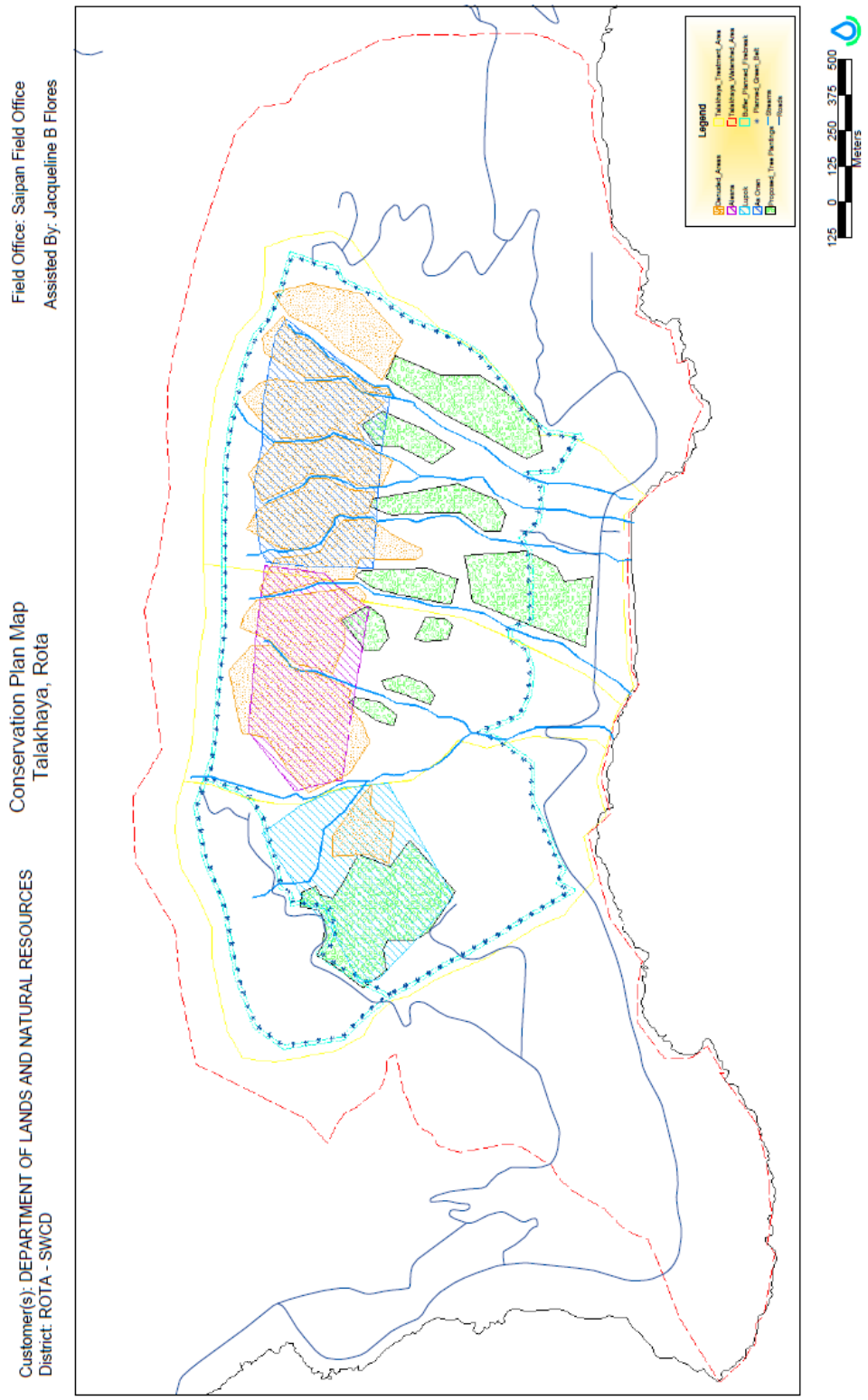
Land-use and conservation areas in Rota, CNMI .(source NPS)

Appendix J – Benthic habitat Map

B

Benthic marine habitats surrounding Rota.

Appendix K – Full NRCS-USDA Conservation Plan Map



Full NRCS-USDA Conservation Plan map (2007)