Guam Environmental Protection Agency

2022-2024
INTEGRATED REPORT

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PHYSICAL & MAILING ADDRESS
3304 Mariner Avenue, Bldg. 17
Tiyan, Guam 96913

Tel: (671) 300-4751
Fax: (671) 300-4530

Visit us online at epa.guam.gov

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Abbreviations and Acronyms

AAFB	Anderson Air Force Base
AOC	Area of Concern
BRAC	Base Realignment and Closure
CB	Construction Battalion
CCU	Consolidated Commission on Utilities
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CMS	Comprehensive Monitoring Strategy
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CZMP	Coastal Zone Management Program
DAWR	Division of Aquatic Wildlife Resources
DMR	Discharge Monitoring Report
DoD, IRP	Department of Defense, Installation Restoration Program
ECP	Erosion Control Plan
EDB	Ethylene Dibromide
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facilities Compliance Agreement
FSCMP	Fish and Shellfish Contaminant Monitoring Program
FIFRA	Federal Insecticide, Fungicides, and Rodenticide Act
GCA	Guam Code Annotated or Guam Coastal Assessment
GCMP	Guam Coastal Management Program
GEMAP	Guam Environment Monitoring and Assessment Program
GHS	Guam Hydrologic Survey
GIAA	Guam International Airport Authority
GIS	Geographic Information System
GWA	Guam Waterworks Authority
GWSA	Guam Wadeable Stream Assessment
GWMS	Guam Water Monitoring Strategy
GWQS	Guam Water Quality Standards
IR	Integrated Report
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Levels
MPWQAP	Marine Preserve Water Quality Assessment Program
MSWLF	Municipal Solid Waste Landfill Facility
NARS	National Aquatic Resource Surveys
NGLA	Northern Guam Lens Aquifer
NOAA	National Oceanic and Atmospheric Administration
NOV	Notice of Violation
NPDES	National Pollution Discharge Elimination System

NPL	National Priority List
NPS	National Park Service
NRCS	National Resources Conservation Service
NWI	National Wetlands Inventory
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PWSS	Public Water Supply System
QA/QC	Quality Assurance/Quality Control
RBMP	Recreational Beach Monitoring Program
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SDWA	Safe Drinking Water Act
STMP	Status and Trends Monitoring Program
SWMS	Surface Water Monitoring Strategy
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
TMDL	Total Maximum Daily Load
UIC	Underground Injection Control
UOG	University of Guam
USACE	United States Army Corps of Engineers
USGS	U.S. Geological Service
WERI	Water and Environmental Research Institute
WMP	Wetlands Monitoring Program
WPC	Watershed Planning Committee

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Preface: An Overview of Guam

The Island of Guam is a self-governing unincorporated territory of the United States. It is the westernmost point of the U.S., lying at latitude **13.444304** and longitude **144.793732,** a strategic location in the North Pacific Ocean. Air travel distances from Guam to nearby destinations are:

- 1,571 miles south of Tokyo, Japan
- 1,599 miles east of Manila, Philippines and
- 3,805 miles west and slightly south of Honolulu, Hawaii, USA.

Figure 1. Guam Location Map

Guam has an area of approximately 210 square miles (544 sq. km) and measures about 30 miles (51 km) long with widths from 11 miles (25.3 km) in the south to 4 miles (7 km) in the center and 8 miles (18.4 km) in the north. The population, estimated as of January 3, 2024, is 173,544[1] people. Guam's population density is 830 people per square mile.[2]

GWA provides water to all the civilian population of Guam. They also provide sewer service to a large percentage of the civilian population, Andersen Air Force Base and several smaller United States Navy facilities. During FY2022, GWA served an average of 43,242 water customers and 30,488 wastewater customers.[3]

"COVID-19 Pandemic. The Guam Economic Development Authority update of January 20, 2021, summarized this situation as follows: The outbreak of COVID-19, a respiratory disease caused by a new strain of coronavirus, was first detected in China, and has since spread globally, including to Guam. On March 11, 2020, the World Health Organization (WHO) declared the COVID-19 outbreak to be a pandemic. It dramatically altered the behavior of businesses and people in a manner that is having negative effects on the global and Guam economies. The pandemic, and governmental actions in response to the pandemic, have caused, and are expected to continue to cause, a significant disruption of daily life and business activity globally, nationally, and on Guam. These disruptions include the cancellation and prohibition of public gatherings, the prohibition of non-essential workers working outside of their homes, and the closure of some government buildings, schools, gyms, religious institutions, bars, dine-in restaurants,

[1] Source: *worldometers.info/world-population/guam-population*
[2] Ibid.
[3] GWA Citizen-Centric Report FY 2022. Issued October 2023.

and other commercial facilities. The COVID-19 pandemic and related consequences have also disrupted supply chains and could disrupt or delay construction activities. The pandemic has had its most considerable impact on tourism and on local businesses, employment, and resident expenditures and activities as well."[4]

"Economic Outlook for Guam FY 2024. Guam's economy is expected to continue expanding and recovering throughout Fiscal Years 2023 and 2024. This economic expansion and partial recovery began in 2021 and 2022, restoring Guam's growth trend. This upsurge in anticipated economic activity is the result of simultaneous increases in three areas; the progression of the Camp Blaz Marine Corps base construction activity nearing its planned peak, a record level of off-base construction projects, and continued recovery in the tourism sector, which remains severely depressed from COVID-19 and related past international travel restrictions.

The three primary sources of inflows of funds to Guam are from **tourism, federal expenditures, and construction capital investment**. Tourism began a partial rebound from the pandemic virtual shutdown in March 2020, continuing into 2022. There is a solid upside for an increased tourism forecast with little downside. Federal expenditures are likely to remain well above recent levels due to the Marine Corps base projects and increased non-defense appropriation levels in general and for Guam specifically. Construction is almost certain to increase substantially; that is supported by private, Government of Guam, and Federal projects already contracted, increasing appropriation levels, workload backlogs and eased federal restrictions on imported workers to meet the demand. Guam's location in the Pacific will continue to provide a fundamental advantage for defense and support the long-term trend of tourism expansion.

The economic performance for 2023, continuing through 2024, will be heavily influenced by progress in controlling the coronavirus pandemic with its emerging variants in Guam and internationally, government responses to the virus, and its effect on tourism recovery.

As always, a myriad of uncertainties regarding global health developments, economic or political issues, military conflicts, and potential natural disasters could enhance or impair the anticipated continued growth scenario.

This outlook focuses on identifying and providing measures of the significant economic factors influencing revenues in preparation for the Government of Guam's Executive Branch annual budget. Other factors, such as changes in tax rates and timing of the receipt of various payments, may also have measurable impacts on realized revenue during the fiscal year. The global, national, and regional economic environment is reviewed as Guam's economy functions and is influenced by myriad interrelated influences."[5]

[4] Economic Outlook 2022.Gary Hiles, Chief Economist, Guam Department of Labor.
[5] Economic Outlook 2024.Gary Hiles, Chief Economist, Guam Department of Labor.

Guam is divided into two distinct geological formations by a central fault line. The northern half is mainly a broad sloping limestone plateau, which is bordered by steep seaward cliffs and fringed by narrow coral reefs.

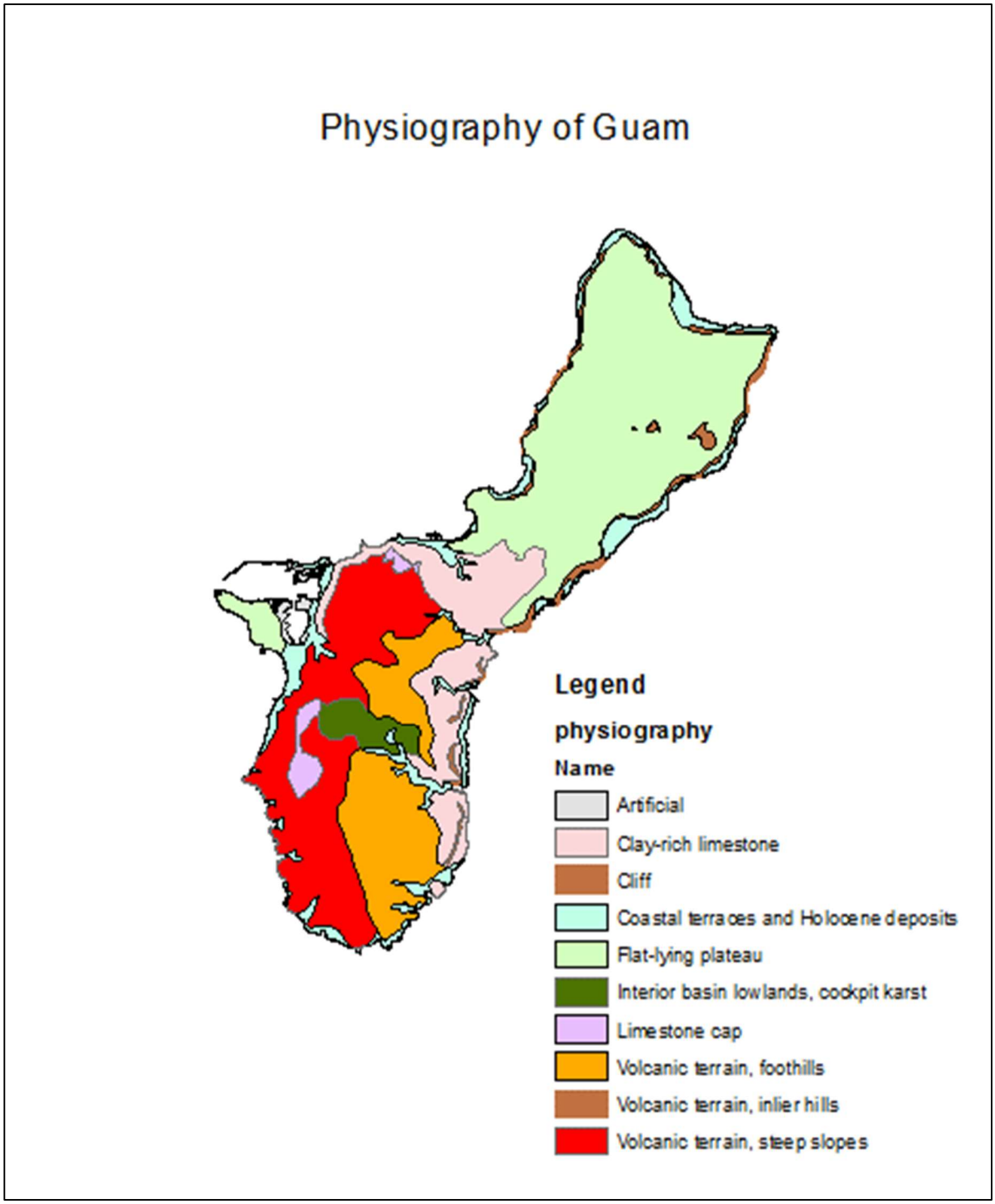
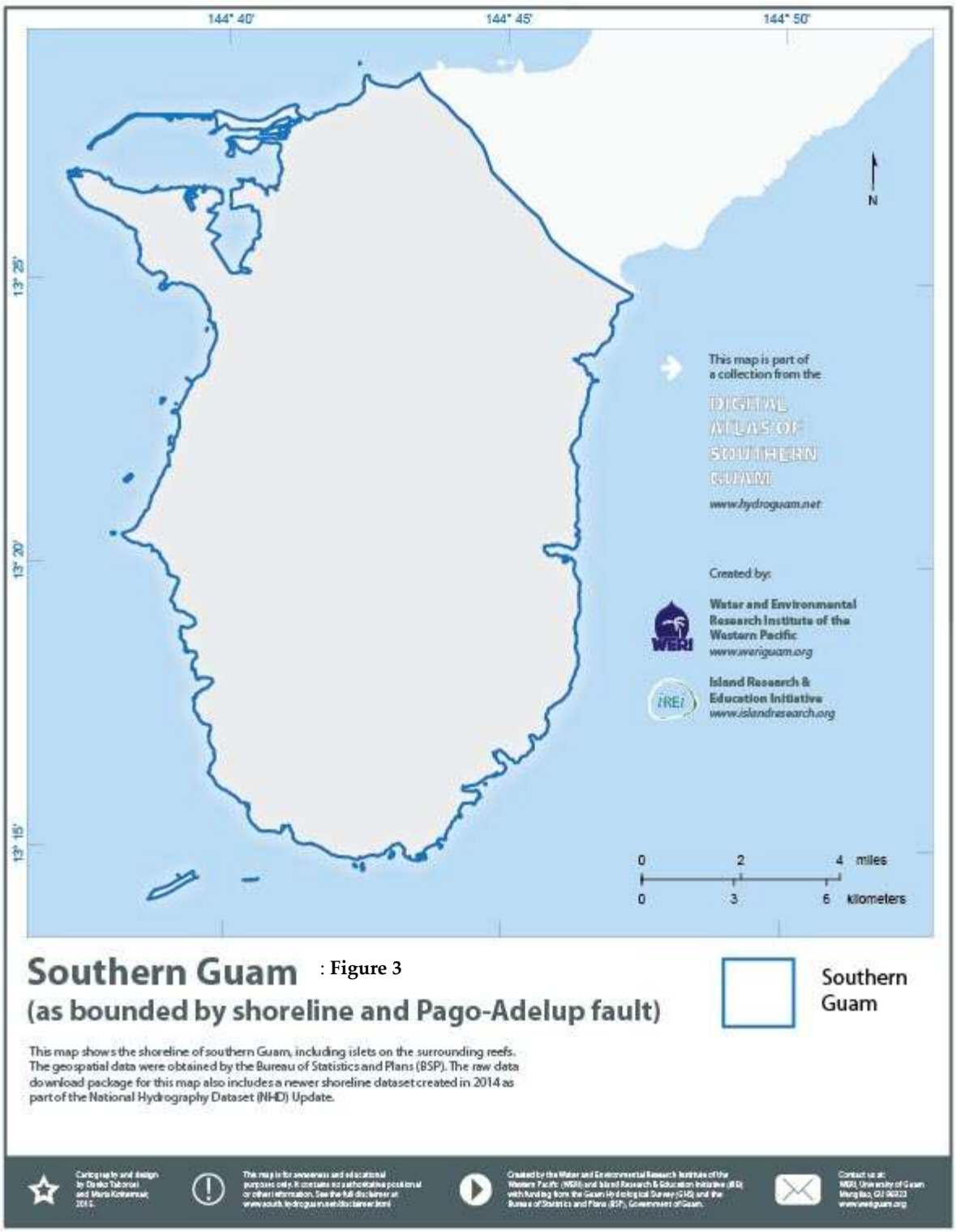


Figure 2. Physiography of Guam
(Pacific Islands Data Portal Coastal and Marine Spatial Planning. pacificislandsprb.org.)

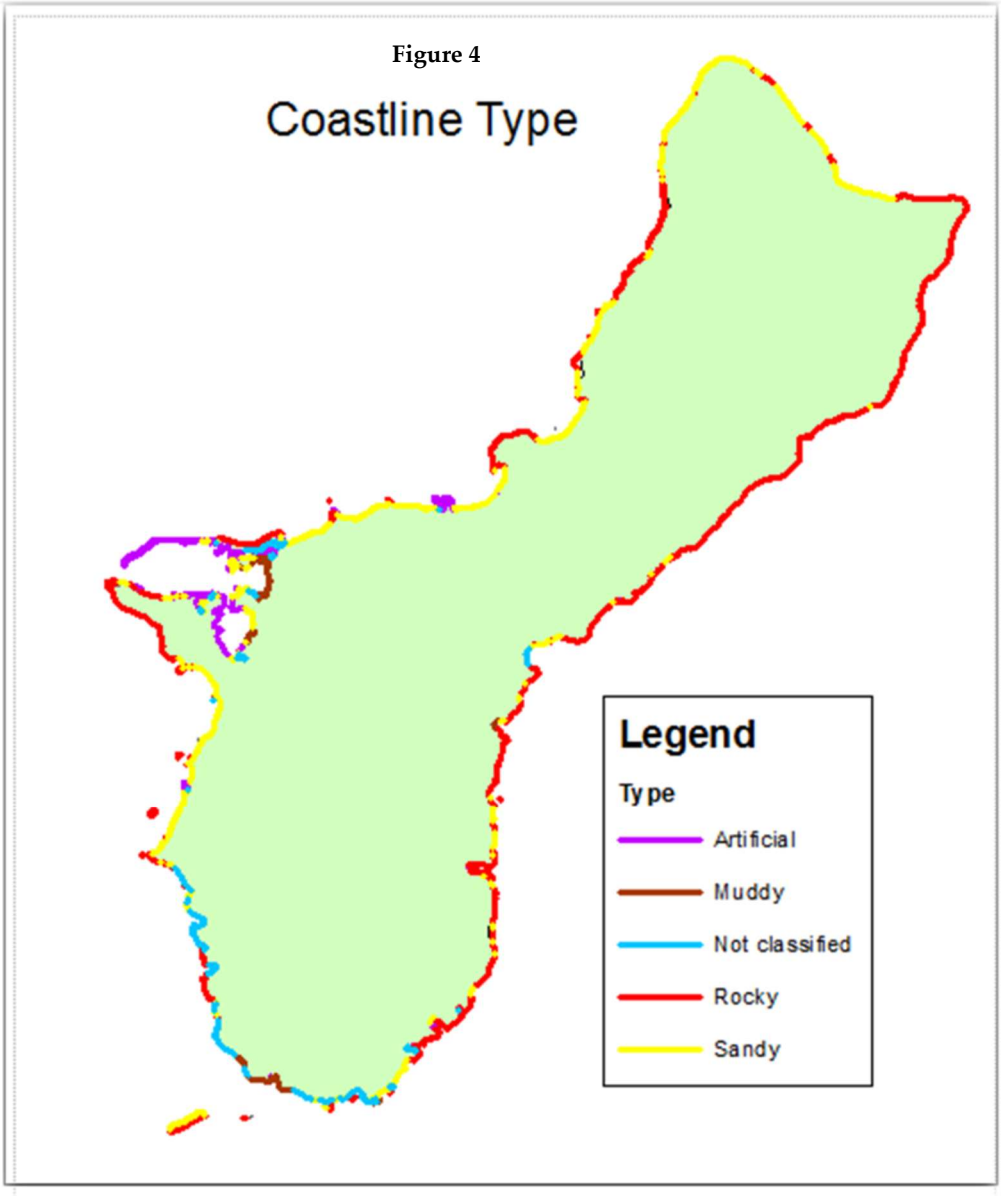


The southern half of the island is generally composed of eroded volcanic mountainous formations with numerous rivers and streams. These tropical streams and those of most Pacific islands are typically short in length and have very low mineral concentrations. These concentrations are similar island to island because the underlying geological formation is usually basalt. Another important characteristic of short

tropical island streams is that photosynthesis by primary aquatic producers is not the dominant source of food. The major source of food for island stream ecosystems is usually the vegetation that falls into the streams from the plants along the banks as well as those that overhang the stream.

The fauna, fish, shrimp, eels, worms, and snails found in island streams were originally marine organisms that adapted to freshwater conditions. Larvae from many of these organisms still develop in the ocean and return to freshwater streams as adults. But the insects and algae found in tropical island streams are truly freshwater organisms, unique to the islands. Also, many of the freshwater fauna are morphologically adapted for climbing and can migrate through all the reaches of the stream, even up waterfalls.

Figure 4



Pacific Islands Data Portal Coastal and Marine Spatial Planning. pacificislandsrpb.org.

The entire island of Guam is classified as a coastal zone. It is surrounded by 116.5 miles of shoreline divided into three distinct classifications: rocky coastline, sandy beaches, and mangrove mud flats. The rocky coastline classification surrounds the northern end of the island with a few isolated stretches in the south. It is approximately 72.5 miles in length or 62% of the total shoreline. Sandy beaches are scattered intermittently around the island and comprise 35.9 miles of shoreline or 31% of the total. The remaining 8.1 miles or 7% of the total shoreline are classified as mangrove mud flats and are centered mainly within Apra Harbor and Merizo. There are also approximately 14.2 square miles of coral reefs, 0.55 square miles of seagrass beds, 1.43 square miles of estuarine systems, and 21.73 square miles of marine bays.

Shallow fringing coral reefs with outer slopes and margins supporting live coral colonies surround most of Guam. The bordering fringing reefs in the south are broader than in the north. The width of these reefs ranges from very narrow benches (as narrow as 10 to 20 feet) on the northeastern coast, to broad reef flats forming the popular recreational and fishing areas in Tumon, Hagatna, Agat, and Asan Bays and on the shore side of Cocos Lagoon. These reefs are extremely valuable in terms of marine life, aesthetics, food supply, recreation and protection of Guam's highly erodible shorelines from storm waves, currents, and tsunamis. Two large barrier reef systems occur at Cocos Lagoon and at Apra Harbor. Cocos Island Lagoon and its reefs form an atoll-like environment about four square miles in area, with a greatest lagoon depth of approximately 40 feet. The uplifted limestone plateau of Orote, Cabras Island and a large artificial breakwater, which was built on a shallow reef platform and adjacent submerged bank, bound the much deeper lagoon of Apra Harbor, with depths over 120 feet.

Seaward, the reef front slopes gently downward to a terrace at a depth of approximately 20-30 feet. Here, submarine channels cut the surface of the reef. These channels are lined with living corals and contain the richest fauna (animal life) to be found in any reef zone. The submarine terrace slopes gently downward to a depth of 30-50 feet. This zone supports many scattered coral colonies.

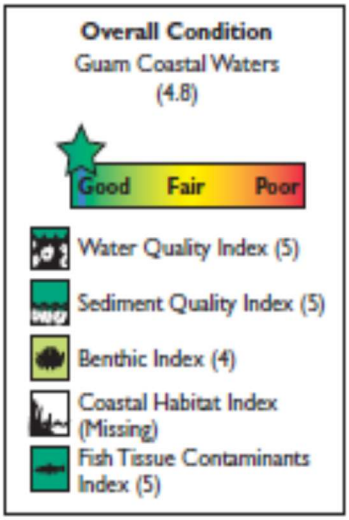
The North Equatorial Current, driven by northeast trade winds, generally sets in a western direction around Guam with a velocity of 0.5 to 1.0 knot. Guam tides are semi-diurnal with a mean range of 1.6 feet and diurnal range of 2.3 feet. Extreme predicted tide range is about 3.5 feet.

EXECUTIVE SUMMARY

Section 305(b) of the Clean Water Act (CWA) requires states to monitor, assess, and report on the condition of their waters, including the extent of waters that support the goals of the Act. Under Section 303(d), states identify waters that are impaired because they do not meet state water quality standards, and then typically develop a Total Maximum Daily Load (TMDL) to define pollution sources and control needs.

National Aquatic Resource Surveys (NARS)

The National Aquatic Resource Surveys (NARS) are statistical surveys designed to assess the status of and changes in quality of the nation's coastal waters, lakes and reservoirs, rivers and streams, and wetlands. Using sample sites selected at random, these surveys provide a snapshot of the overall condition of the nation's water. Because the surveys use standardized field and lab methods, results



from different parts of the country and between years can be compared. EPA works with state, tribal and federal partners to design and implement the National Aquatic Resource Surveys. When Guam participates in NARS, the authorized resulting survey data is used in applicable integrated reports.

The NARS are made up of four individual surveys that are implemented on a rotating basis:

- National Coastal Condition Assessment
- National Lakes Assessment
- National Rivers and Streams Assessment
- National Wetland Condition Assessment

(See: https://www.epa.gov/national-aquatic-resource-surveys/background-national-aquatic-resource-surveys)

1.0 Overall Water Quality

1.1 Marine Waters

Guam's 305b inventory of marine waters include Marine Bays and Beaches (Coastal/Recreational waters). Water in this category must be of sufficient quality to allow for the propagation and survival of marine organisms, particularly shellfish and other similarly harvested aquatic organisms, corals and other reef-related resources, and whole body contact recreation. Other important intended uses include mariculture activities, aesthetic enjoyment and related activities (Guam Water Quality Standards, GWQS). Guam's marine waters are generally "good". The figure above summarizes the overall condition of Guam Coastal Waters as concluded in the ***2012 EPA Report: Fourth National Coastal Conditions Report*** – *NCCR IV*.

NCCR IV assessed the condition of the nation's estuaries and coastal embayments, including coastal waters of the conterminous United States, Southeastern Alaska, Hawaii, American Samoa, Guam, Puerto Rico, and the US Virgin Islands. The assessment primarily used EPA's National Coastal Assessment (NCA) Program data collected between 2003 and 2006. Use the link below to access NCCR IV summary information.
https://www.epa.gov/national-aquatic-resource-surveys/national-coastal-condition-report-iv-factsheet

Coastal Waters and Reef Flats. The National Coastal Condition Assessment (NCCA) is an ongoing environmental survey developed by the USEPA to assess the condition of the coastal waters of the United States. The survey design utilizes multi-tiered, integrated monitoring of selected environmental indicators. Guam has participated in NCCA surveys conducted in 2005, 2010, and 2015. The NCCA provides a 'snapshot' of conditions of US coastal waters. For Guam and the Pacific Islands, the condition of our coastal and reef flat resources is important to determine support of designated uses as defined by the Clean Water Act.

Marine Bays

Guam's Marine Bays inventory consists of **66** waterbodies classified under the following assessment categories for reporting years 2022-2024. The number of impaired marine bays remains unchanged from the 2020 reporting period. The inventory of Guam's Marine Bays is in **Appendix** A.

MARINE BAYS: IR REPORTING CATEGORY	WATER SIZE (Square Miles)	ASSESSMENT UNIT COUNT
2 : meets some designated uses but more data is needed to make a use determination	7.31	8
3: not assessed	28.02	47
5: impaired	14.76	11
Total	**50.09**	**66**

2022-2024 303(d) LIST - IMPAIRED MARINE BAYS			
Assessment Unit ID	Waterbody Name	Size (square miles)	Status
1. GUG-010B-1	Agat Bay 1	0.63	Fish Advisory
2. GUG-010A	Tipalao Bay	0.10	Fish Advisory
3. GUG-008A-2	Apra Harbor 2	4.61	Fish Advisory
4. GUG-008A-1	Apra Harbor 1	0.05	Fish Advisory
5. GUG-042	North Orote Peninsula Sea Cliffs	0.23	Fish Advisory
6. GUG-043	South Orote Peninsula Sea Cliffs	0.02	Fish Advisory
7. GUG-20A-1	Cocos Lagoon 1	5.70	Fish Advisory
8. GUG-20A-2	Cocos Lagoon 2	0.34	Fish Advisory
9. GUG-003A	Pago Bay	0.70	>10% of samples exceed WQS
10. GUG-001B-2	Tanguisson Beach 2	0.40	Seafood Consumption Advisory
11. GUG-001C	Tumon Bay	1.98	Waters not Attaining Designated Uses
TOTAL:	**11 Impaired Waterbodies**	**14.76 square miles**	

Coastal/Recreational Waters

Guam coastal/recreational waters were assessed only for the Goal "Protect and Enhance Public Health" and the Use "Primary Contact/Swimming and Secondary Contact". The inventory of coastal/ recreational waters consists of 114 waterbodies classified under the following assessment categories for reporting years 2022-2024. The 303(d) list of impaired recreational waters remains unchanged from IR reporting year 2020 with GabGab Beach as the only listed coastal water. The inventory of Guam Coastal/ Recreational Waters is in **Appendix A.**

COASTAL WATERS: IR REPORTING CATEGORY	WATER SIZE (Miles)	ASSESSMENT UNIT COUNT
3: not assessed	26.80	68
4a[6]: impaired and TMDL has been developed	16.65	45
5: impaired – **GabGab Beach**	0.65	1
Total	**44.1**	**114**

1.2 Fresh Waters

Navy Fena Reservoir[7]

In 1951, the U.S. Navy completed a dam that formed a major reservoir on the Fena River in south-central Guam. Fena Reservoir was constructed to provide a dependable water supply for both Navy personnel and residents living in villages near the base in southern Guam. The reservoir is contained in the flooded canyon. Three rivers, the Almagosa, Imong, and the Maulap, flow into the reservoir from the south and west. Streamflow discharge on all three of these rivers is monitored by USGS stream gages. The watershed draining to the reservoir does not extend far to the east, and there are no major tributary rivers on the east side. Water exiting the reservoir over the spillway enters the Maagas River and eventually drains east to the Pacific Ocean.

The total drainage area at the dam (85 ft high and 1,050 ft long) is 5.88 square miles. Data collected during June 2014 indicates a total storage capacity for Fena Valley Reservoir of about 6,915 acre-feet, which is a loss of about 1,450 acre-feet, or 17 percent, with respect to the original design-survey estimate of 8,365 acre-feet. Storage capacity has been reduced because of sediment accumulation.

The watershed is within the Naval Base Guam Ordnance Annex (formerly the Naval Magazine), which is one of many facilities that are a part of Naval Base Guam, a consolidated U.S. Navy installation. Although there are a few roads and facilities in the watershed, it remains largely undeveloped. Soils in the watershed are primarily of volcanic origin and are covered with dense tropical vegetation intermixed with grasses. Occasional bare areas occur throughout the watershed. At times, large areas of grassland

[6] 42 EPA approved Bacteria TMDLs developed by TetraTech, Inc. dated 2010 & 2015, respectively.

[7] Sedimentation Survey of Fena Reservoir 1979. William F. Curtis USG WRIR 84-4125 July 1984; Storage Capacity of Fena Valley Reservoir 1990. Lenore Y. Nakama. WRIR 92-4114 1992.

are set on fire by poachers with attendant loss of ground cover. Erosion of the denuded ground contributes to the sediment load in the streams.

Fena Reservoir is the only inland body of water on Guam and is supplemented by Almagosa and Bona Springs. Water from the reservoir and springs is processed at the Navy Water Treatment Plant before distribution.

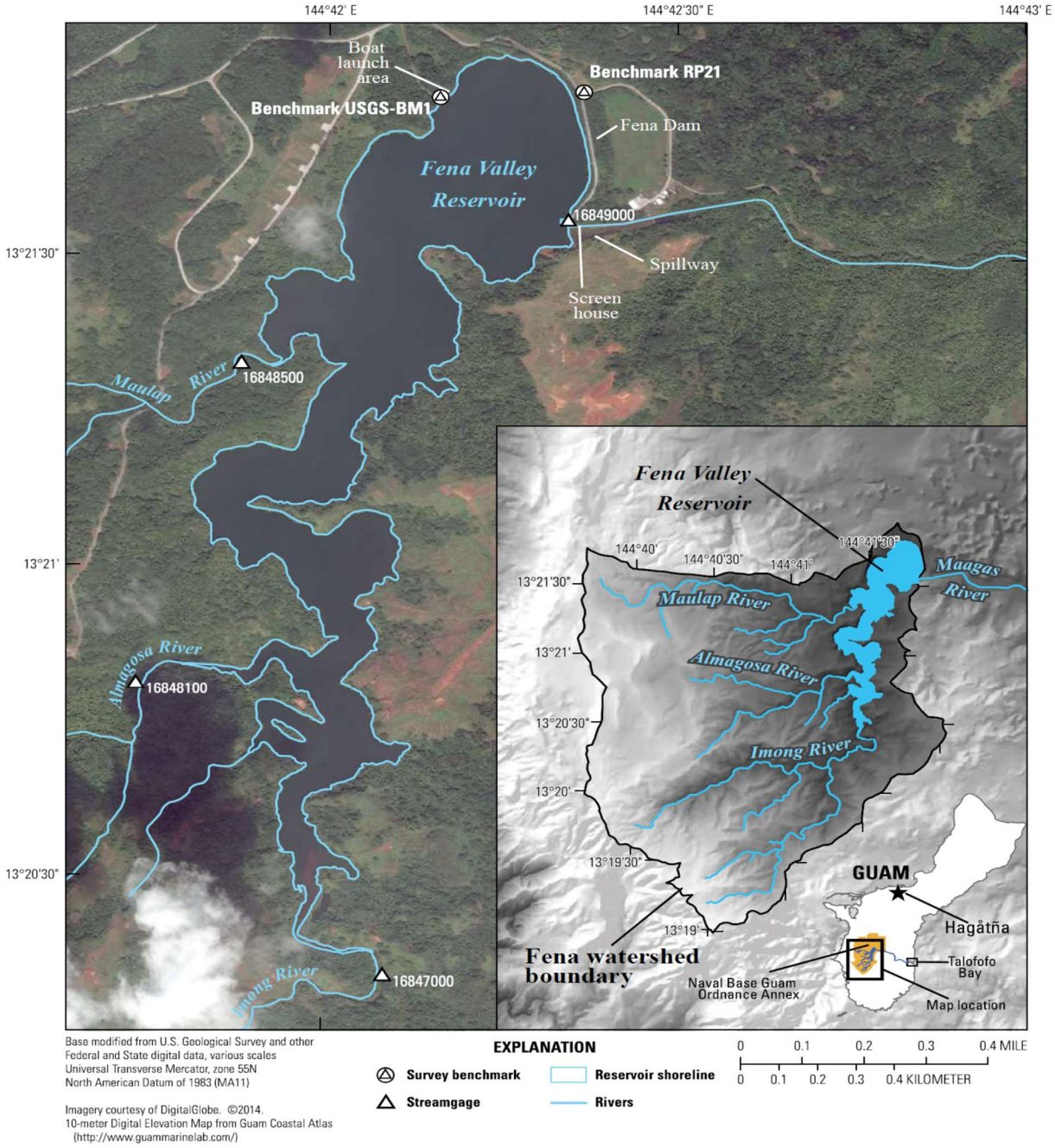


Figure 5: Fena Valley Reservoir and Watershed, Guam
Marineau, M.D., and Wright, S.A, 2015, Storage capacity of the Fena Valley Reservoir, Guam, Mariana Islands, 2014: U.S. Geological Survey Scientific Investigations Report 2015–5128, 31 p.

No water quality assessment data for the Almagosa, Imong, and Maulap Rivers is included. The latest Navy water system report (January 1 to December 31, 2023) provided water quality monitoring results for detected contaminants in comparison with the established drinking water standards. Four violations were recorded.

Rivers and Streams

Guam has an inventory of one hundred fifty-one (151) freshwater assessment units (Appendix A) which represent two-hundred one (201) Guam rivers/streams and tributaries. Of the eighteen (18) river waterbodies 303(d) listed as impaired (Category 5), ten were carried forward from the 2020 reporting cycle. Eight (8) additional units were assessed as impaired during the 2022-2024 reporting cycle.

RIVERS/STREAMS: IR REPORTING CATEGORY	WATER SIZE (Miles)	ASSESSMENT UNIT COUNT
2: meets some designated uses but more Data is needed to make a use determination	25.20	18
3: not assessed	162.86	110
4a[8]: impaired – TMDL Developed **Ugum River**	7.48	5
5: 303(d) listed - impaired waters	22.77	18
Total	**218.31**	**151**

2022-2024 303(d) LIST - IMPAIRED RIVERS AND STREAMS			
Assessment Unit ID	Waterbody Name	Size (miles)	Status
1. GUAGRA-3	Agana River 1	0.52	Fish Advisory
2. GUAGRA-2-1A	Agana River 2	0.67	Fish Advisory
3. GUPGRP-1-51-A	Pago River 1	0.06	>10% of samples exceed WQS
4. GUPGRP-2	Pago River 2	4.74	>10% of samples exceed WQS
5. GUAGRD	Storm Drain	0.21	>10% of samples exceed WQS
6. GUPGRL-2	Lonfit River 2	1.07	Consent Decree
7. GUPGRP-1-51B	Lonfit River 3	0.04	Consent Decree
8. GUMZRAJ	Ajayan River	3.95	>10% of samples exceed WQS
9. GUMZRL	Liyog River	1.83	>10% of samples exceed WQS
10. GUMZRSY	Sumay River	1.06	>10% of samples exceed WQS
11. GUINRAP-46B	Aslinget River 3	0.18	>10% of samples exceed WQS
12. GUMZRML	Manell River	2.77	>10% of samples exceed WQS
13. GUMZRT-2	Toguan River 1	0.20	>10% of samples exceed WQS
14. GUPGMPW	Pago River 4	0.52	>10% of samples exceed WQS
15. GUAGRF-2	Fonte River 1	1.16	>10% of samples exceed WQS

[8] EPA approved Ugum Watershed Sediment TMDL developed by TetraTech, Inc. dated February 2007.

2022-2024 303(d) LIST - IMPAIRED RIVERS AND STREAMS (continued)			
Assessment Unit ID	Waterbody Name	Size (miles)	Status
16. GUSURW	West Surface Drainage	0.36	>10% of samples exceed WQS
17. GU6TINAGO	Tinago River	2.93	>10% of samples exceed WQS
18. GUTURTG-1C	Togcha River 5	0.50	>10% of samples exceed WQS
Total		**22.77 miles**	

Wetlands

Guam has an inventory of nineteen (19) Guam wetlands (Appendix A) classified under the following assessment categories for the 2022-2024 reporting period. One wetland is a marine waterbody; and the remaining wetlands are fresh waterbodies. **Agana Swamp** is the only 303(d) listed/impaired wetland.

WETLANDS: IR REPORTING CATEGORY	WATER SIZE (Acres)	ASSESSMENT UNIT COUNT
3: not assessed	1789.04	18
5: impaired – **Agana Swamp**	6.40	1
Total	**1795.44**	**19**

Northern Guam Lens Aquifer (NGLA) -Guam Sole Source Aquifer

The overall water quality of the NGLA is good. However, it is significantly vulnerable to contaminants from beneath the aquifer and from the land surface. Because of its designation as Guam's Sole Source Aquifer and because of the magnitude of incidences observed in which the levels of pollutants exceed GWQS, action to restore, protect, and sustain the NGLA remains a high priority. Threats to the NGLA water quality include unmanaged salinity, sewage, and PFAs/PFOs. Annual State of the Aquifer Reports are available from the Guam Hydrologic Survey web site or via the link below.

https://guamhydrologicsurvey.uog.edu/index.php/state-of-the-aquifer-reports/

2.0 Causes and Sources of Water Quality Impairments

2.1 Marine Waters

Applicable categories of causes or stressors for impaired marine waters are respectively listed in the following table and include Pesticides, PCBs, Dioxins, Nutrients, Pathogen indicators, and Dissolved oxygen.

The pollutant causing **recreational beach** impairments is **enterococcus,** a pathogen indicator. GabGab Beach, 0.65 miles of coastal waters located within a military installation, is impaired by PCBs in fish tissue. It is the only recreational assessment unit on the 303(d) list for this reporting period.

Suspected source categories include *municipal point sources, combined sewer overflows, agriculture, urban runoff/storm sewers, contaminated sediments, and groundwater seeps/springs*. The source of PCBs continues to be investigated.

Total Sizes of Marine Waters Impaired by Various Cause/Stressor Categories

Cause/Stressor Category	Impaired Marine Bays (square miles)	Impaired Coastal/Recreational Waters 2020 (shoreline miles)	2021 (shoreline miles)	2022 (shoreline miles)	2023 (shoreline miles)
Cause/Stressor Unknown	0	0	0	0	0
Unknown Toxicity	0.40	0	0	0	0
Pesticides	2.61	0	0	0	0
Priority Organics	0	0	0	0	0
Non-priority Organics	0	0	0	0	0
PCBs	11.68	0.65	0.65	0.65	0.65
Dioxins	0.63	0	0	0	0
Metals	0	0	0	0	0
Ammonia	0	0	0	0	0
Cyanide	0	0	0	0	0
Sulfates	0	0	0	0	0
Chloride	0	0	0	0	0
Other Inorganics	0	0	0	0	0
Nutrients	0.70	0	0	0	0
pH	0	0	0	0	0
Siltation	0	0	0	0	0
Organic Enrichment/low DO	0.70	0	0	0	0
Salinity/TDS/Chlorides	0	0	0	0	0
Thermal Modifications	*	*	*	*	*
Flow Alterations	0	0	0	0	0
Other Habitat Alterations	0	0	0	0	0
Pathogen Indicators	0.70	16.65	16.65	16.65	16.65
Radiation	*	*	*	*	*
Oil and Grease	0	0	0	0	0
Taste and Odor	*	*	*	*	*
Suspended Solids	0	0	0	0	0
Noxious Aquatic Plants (Macrophytes)	0	0	0	0	0
Excessive Algal Growth	0	0	0	0	0
Total Toxics	0	0	0	0	0
Turbidity	0	0	0	0	0
Exotic Species	0	0	0	0	0
Other (specify)					
Secchi Visibility	0	0	0	0	0

Notes:
zero (0) = Category applicable, but size of water in category is zero
dash (-) = Category applicable no data available
asterisk (*) = category not applicable

2.2 Fresh Waters

Impaired Guam rivers and streams and one wetland are listed below. Associated pollutants and suspected source(s) of pollutants are identified.

Rivers and Streams	***(assessment unit id)***	***(size)***
Pago River segments:	GUPGRP-1-51-A	0.06 miles
	GUPGRP-2	4.74 miles
	GUPGMPW	0.52 miles
Pollutants:	E. coli, Dissolved Oxygen, Turbidity	
Source:	Urban runoff, storm sewers, contaminated sediments	
Lonfit River segments:	GUPGRP-1-51B	.04 miles
	GUPGRL-2	1.07 miles
Pollutants:	Salinity, Temperature, Total Coliform, E. coli, Enterococcus, Iron, Turbidity	
Source:	Ordot Dump	
Agana River	GUAGRA-3	0.52 miles
	GUAGRA-2-1A	0.67 miles
Pollutants:	Enterococcus, Dissolved Oxygen; PCBs in fish tissue	
Source:	Agana Swamp for PCBs; urban runoff, storm sewers, contaminated sediments	
Storm Drain	GUAGRD	0.21 miles
Pollutants:	E. coli, Dissolved Oxygen, Nitrate, Total Suspended Solids, Turbidity, Salinity	
Source:	Urban runoff, storm sewers, contaminated sediments, sewer system/manhole overflows	
Sumay River	GUMZRSY	1.02 miles
Pollutants:	Dissolved Oxygen, Orthophosphates, Nitrates, Suspended Solids	
Source:	Runoff, agricultural activities, septic systems	
Liyog River	GUMZRL	1. 81 miles
Pollutants:	Dissolved Oxygen, Orthophosphates, Suspended Solids, Nitrate	
***Source*:**	Runoff, agricultural activities, septic systems	
Ajayan River	GUMZRAJ	3.86 miles
Pollutants:	Dissolved Oxygen, Orthophosphates, Suspended Solids	
Source:	Runoff, agricultural activities, septic systems	
Toguan River 1	GUMZRT-2	0.20 miles
Pollutants:	Orthophosphates	
Source:	leaky septic systems, sewer overflows, pit latrines, animals, and erosion from badlands	

Manell River GUMZRML 2.77 miles
Pollutants: Nitrate, Orthophosphates
***Source*:** leaky septic systems, sewer overflows, pit latrines, animals, and erosion from badlands

Fonte River 1 GUAGRF-2 1.16 miles
Pollutants: Nitrate
Source: leaky septic systems, sewer overflows, pit latrines, animals, and erosion from badlands

Aslinget River 3 GUINRAP-46B 0.18 miles
Pollutants: Orthophosphate
Source: leaky septic systems, sewer overflows, pit latrines, animals, and erosion from badlands

Togcha River 5 GUTURTG-1C 0.50 miles
Pollutants: Nitrate
Source: leaky septic systems, sewer overflows, pit latrines, animals, and erosion from badlands

Tinago River GU6TINAGO 2.93 miles
Pollutants: Orthophosphate
Source: leaky septic systems, sewer overflows, pit latrines, animals, and erosion from badlands

West Surface Drainage GUSURW 0.36 miles
Pollutants: Iron, Nitrate, Total Suspended Solids
Source: Ordot dump, stormwater runoff

Ugum River * GUTURU2 1.05 miles
(five segments - GUTURU-1B 0.18 miles
*4a category GUTUETU-48H 0.39 miles
impaired water GUTURU-1C-48H 1.43 miles
delisted 2007) GUTURU-1A-48H 4.43 miles
Pollutants: Sediment
Source: Soil Erosion

<u>*Wetlands*</u>
Agana Swamp: GUG1-B 6.40 acres
Pollutants: PCBs in fish tissue
Source: Agana Power Plant

3.0 Comprehensive Monitoring Strategy (CMS) for All Waters

Guam EPA Monitoring Goals and Objectives are to:

- Conduct a comprehensive assessment of water quality throughout the island using a rotating basin approach
- Complete a thorough evaluation of monitoring data
- Evaluate if the quality of island waters is suitable for their designated uses
- Evaluate if the Guam Water Quality Standards are appropriate and relevant to present conditions in the waters of the island
- Coordinate new approaches to improving and protecting the island's water resources through the implementation and enforcement of nonpoint source programs.

To meet all federal and local reporting requirements, the CMS for the island of Guam includes ten distinct individual monitoring plans. Although programs are developed for each of these plans, some programs remain inactive because of funding/staffing constraints.

1. Status and Trends Monitoring Program (suspended)
2. Guam Environmental Monitoring and Assessment Program (active)
3. Recreational Beach Monitoring Program (active)
4. Wetlands Monitoring Program (suspended)
5. Fish and Shellfish Consumption Monitoring Program (suspended)
6. Groundwater Assessment Monitoring Program (active)
7. Marine Preserve Water Quality Assessment Program (active)
8. Nonpoint Source Pollution Monitoring Program (active)
9. Underground Injection Control Monitoring Program (active)
10. Man-Made Impoundments Monitoring Program (inactive)

4.0 Programs to Correct Impairments

Guam EPA has programs in place to correct, prevent or minimize the impairment of waterbodies, fresh or marine. These programs are mandated by local and federal statutes and are implemented to the maximum extent possible. Programs applied by Guam EPA and partner Agencies include but are not limited to:

Guam Water Quality Standards	Guam Comprehensive Monitoring Strategy
Section 401 Water Quality Certification	NPDES Permitting
Individual Wastewater System Permitting	Sewer Connection Permitting
Soil Erosion and Sediment Control Regulations	Clearing, Grading, and Stockpiling Permitting
Environmental Protection Plan Requirement	Water Quality Monitoring Requirement
Erosion Control Plan Requirement	Section 319 NPS Programs
Coastal NPS Pollution Program	Feedlot Waste Management Program

Wellhead Protection Program	Well Licensing Program
Pesticides Enforcement Program	Air Pollution Permitting Program

Groundwater Programs or Activities listed in Table 28
Land Use and Wetland Use Permitting under the Guam Land Use Commission
Seashore Protection Permitting under the Guam Seashore Protection Commission

5.0 Trends

The quality of Guam's waters will vary considerably, depending on a variety of factors including geology, human population density, level of coastal and urban development, level and types of uses of marine, surface and groundwater resources, to include frequency of natural disturbances, such as typhoons and earthquakes.

A primary water quality concern on Guam is the persistence of Per- and Polyfluorooctane sulfates (PFAS) in the water, and subsequent bioaccumulation in humans. Using appropriated funding, the Agency will conduct a multi-phase project intended to protect public health for all residents by improving Territorial and Regional capacity to monitor for and respond to emerging contaminants (ECs), and to characterize A and Brownfields ("Green Parcels") programs to plan for, prevent, and respond to emerging contaminants and other, similar environmental threats.

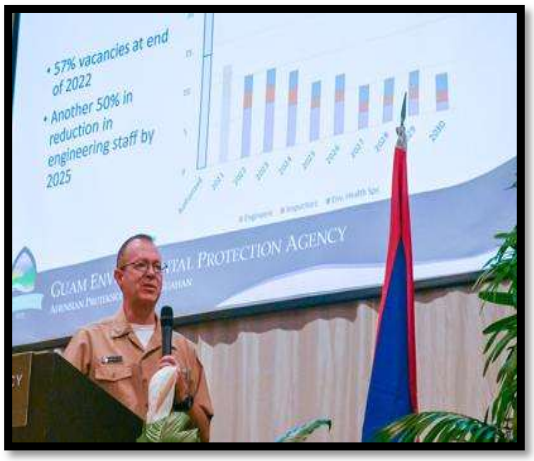
Approximately 62.6% of water customers are connected to the public sewer with the remainder utilizing an on-site wastewater disposal system (cesspools and septic tanks). Discharge from cesspools and septic tanks contain biological and chemical contaminants, including nitrogen constituents, personal care products, and medicines and can percolate through the limestone in northern Guam and reach the NGLA. Monitoring of Guam's production wells shows that nitrate levels are increasing and action towards connecting unsewered properties to the public sewer system will protect the NGLA from onsite disposal system contaminants. Guam EPA will continue to collaborate with GWA and seek support from its Board and the Legislature to establish controls within the Groundwater Protection Zone (GPZ) to provide more public sewage service, address the "parental subdivision" loophole, allow for higher technology, and provide overall management of septic systems over the NGLA.

Guam EPA's online permitting system is performing well, trending 80% faster permitting processing times for building permits. WALTERS (Water Air Land Territorial Electronic Record System) is a spatially linked electronic document storage system and the Agency's go to product for data storage, access, management, and sharing. Grant funding allows the Agency to modernize and fine tune specific program permitting needs including integration with USEPA data reporting systems and information platforms. Guam EPA is working to make WALTERS a fully digital process that allows an applicant to go online and provide personal contact information to upload their project file.

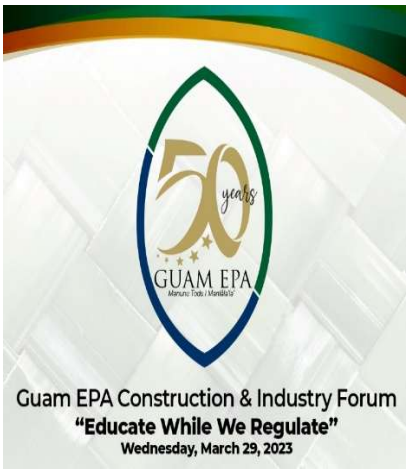
<u>Guam EPA Water Quality Protection Activities and Programs</u>

Agency activities and programs which support the protection and improvement of water quality on Guam include but are not limited to:

- The continuing development of programs under the Comprehensive Monitoring Strategy and the implementation of Coastal Monitoring, Wadeable Streams Assessment, and Recreational Beach Monitoring, to include cooperative efforts with DAWR to complete the Marine Preserve Monitoring Plan;
- Ensuring a sustained Safe Drinking Water Program so that potable water produced by GWA and other purveyors continues to meet Safe Drinking Water Act requirements;
- Providing training opportunities for Agency employees and other partner agency personnel, i.e., 2023 Guam EPA Construction & Industry Forum "Educate While We Regulate".
- Meeting reporting conditions/requirements, i.e. Guam's CWA 303(d) list of impaired waterbodies; developing and implementing TMDLs for impaired water bodies;
- Funding needed water studies/research projects. Resulting data/information is important in validating the development or modification of strategic source water protection programs and programs targeted to ensure the sustainability of the NGLA;
- Developing and/or updating environmental policy, plans, statutes, rules/regulations to strengthen compliance and enforcement capacity and minimize negative impacts to the environment;
- Maintaining regulatory oversight of local environmental restoration efforts undertaken by the Department of Defense (Navy and Air Force) under the DSMOA program;
- Conducting the triennial review of the GWQS; and implementing information and outreach programs that cause community action to protect and sustain clean air, water and land for Guam.



Guam EPA conducted an educational refresher for stakeholders discussing major permitting and construction issues critical to help better protect the environment and minimize delays in project approval and implementation.



Guam EPA's Monitoring Program perform wetland delineation studies and characterize organisms, soils and hydrology in Santa Rita. Agency personnel were joined by US Army Corp of Engineers and Guam Department of Agriculture.

Guam EPA joined Department of Agriculture's Forestry & Soil Resources Division for a tree planting project in As-Gadao, Malesso'. With DOAg's assistance, Guam EPA personnel planted 200 dodonaea trees to stabilize soil, prevent erosion and runoff.

I. INTRODUCTION

The purpose of the Integrated Water Quality Monitoring and Assessment Report

The Clean Water Act (CWA) requires states to provide every two years an assessment of the quality of all their waters (section 305(b)) and a list of those that are impaired or threatened (section 303(d)). The U.S. Environmental Protection Agency (EPA) subsequently condenses all information from state reports into one summary document which it sends to Congress.

Guam submitted its first Integrated Report (IR) in 2006, which was developed in accordance with *2006 Integrated Water Quality Monitoring and Assessment Report Guidelines (USEPA, July 2005).* All future reports shall be developed in accordance with updated EPA guidelines or directives. Beginning in 2018, all IR submissions (both attribute and geospatial data) will be submitted electronically via ATTAINS (**A**ssessment **T**MDL **T**racking **A**nd **I**mplementatio**N** **S**ystem) data exchange.

A summary of CWA reporting requirements for sections 303(d), 305(b), and 314, is provided below:

Section 303(d) – a list of impaired and threatened waters still requiring Total Maximum Daily Loads (TMDLs); identification of the impairing pollutant(s); and priority ranking of these waters, including waters targeted for TMDL development within the next two years.

Section 305(b) – a description of the water quality of all waters of the state (including, rivers/streams, lakes, estuaries/oceans and wetlands). States may also include in their section 305(b) submittal a description of the nature and extent of ground water pollution and recommendations of state plans or programs needed to maintain or improve groundwater quality.

Section 314 – in each section 305(b) submittal, an assessment of status and trends of significant publicly owned lakes including the extent of point source and nonpoint source impacts due to toxics, conventional pollutants, and acidification.

In satisfying the above reporting requirements, Guam EPA also satisfies the 305(b) reporting requirement for section 106 grant funds. Guam has the means to monitor water quality and annually update water quality data which is included in this submittal.

This IR will report on the water quality standards attainment status of all waters, document the availability of data and information for each water, identify certain trends in water quality conditions, and provide information to managers and others in setting priorities for future actions to protect and restore the health of our island's water resources.

II. BACKGROUND INFORMATION

This section discusses Guam's total waters, the Agency's Water Pollution Control Program, actions needed to achieve objectives of the CWA, and special concerns and recommendations.

A. Overview of Guam's Water Resources

The categories of water established in the Guam Water Quality Standards (§5102, 2017 Revision) are Groundwater, Marine waters, and Surface waters.

1.0. Groundwater

This water category encompasses all subsurface water and includes basal and parabasal water, perched water, all water below the groundwater table, water percolating through the unsaturated zone (vadose water), all saline waters below and along the perimeter of the basal fresh water body (freshwater lens), and water on the surface that has been collected with the specific intent of recharging or disposing of that water to the subsurface by means of injection, infiltration, percolation, etc. The Northern Guam Lens Aquifer, (NGLA) which is the Principal Source Aquifer, and any other groundwater resources, as they are identified, shall continue to receive protection under the Guam Wellhead Protection Program and other applicable groundwater regulations (GWQS).

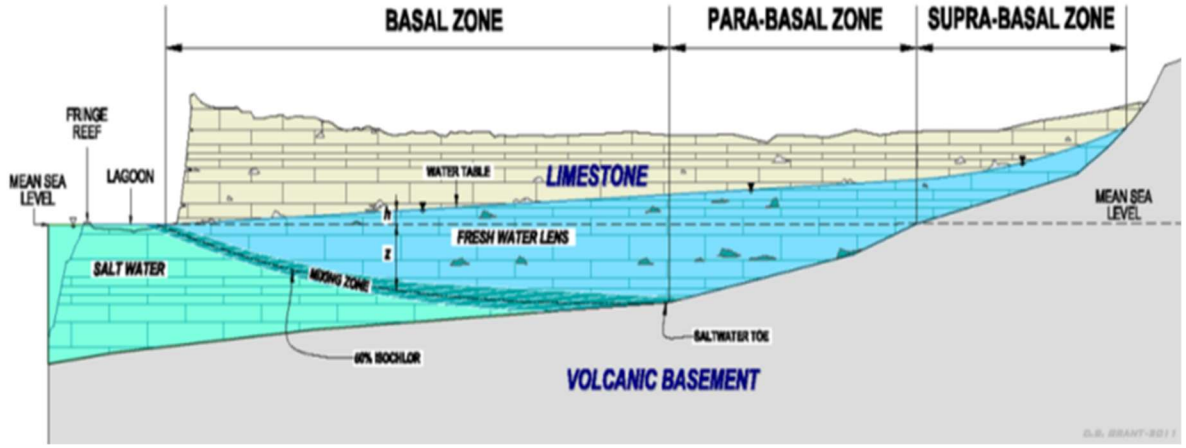


Figure 6. Volcanic basement beneath limestone aquifer defines three groundwater zones: 1) the basal zone, where the freshwater lens is underlain by sea water, 2) the para-basal zone, where the fresh water is underlain by the volcanic rock, and 3) the supra-basal zone, where the fresh water moving down-slope toward the para-basal zone lies above sea level. (WERI, CWMP FY 2012 Status Report. November 2012)

The northern half of Guam, considered the Northern Watershed, has no perennial streams because of the porosity and permeability of its calcareous rock formations. Rainfall percolates rapidly through the limestone to the freshwater lens or aquifer which is in contact with seawater below it. This fresh groundwater provides approximately 80% of the public drinking water supply. The aquifer is estimated to have a total average daily recharge of 111.9 million gallons and a sustainable yield of up to 60 million

gallons per day (MGD). It is divided into six basins shown below (**Hagatna, Mangilao, Upi (Anderson), Machanao (Agafa Gumas), Finegayan, and Yigo-Tumon) containing 47 management zones.**[9]

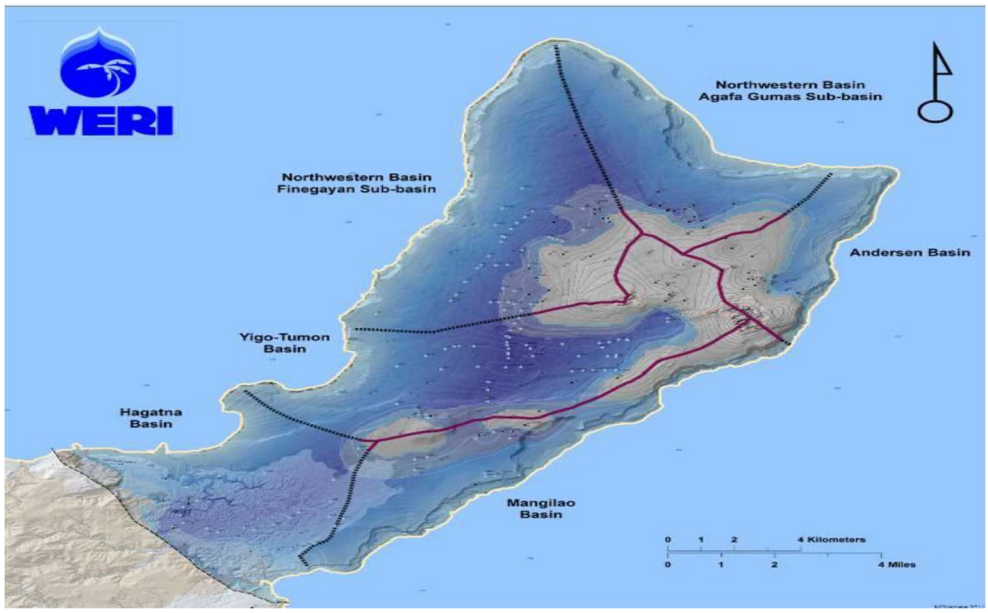


Figure 7. Revised contour map of the volcanic basement underlying the limestone Plateau in northern Guam. Northern Watershed Sub-basins. (WERI, CWMP 2012 Status Report. November 2012)

An updated NGLA map can be found at:
https://guamhydrologicsurvey.uog.edu/wp-content/Maps/WERI2018-NGLAMap1.pdf

Over 100 ponding basins associated with developments in northern Guam collect stormwater runoff which subsequently percolates into the lens.

2.0. Surface Waters

This category consists of all surface freshwater including (1) waters that flow continuously over land surfaces in a defined channel or bed, such as streams and rivers; (2) standing water in basins, such as lakes, impoundments, and reservoirs, either natural or man-made; and (3) all waters flowing over the land as runoff confined to channels with intermittent flow (GWQS).

The southern half of Guam contains the island's surface freshwater resources. Its volcanic slopes are deeply channeled by 97 streams (16 are major streams) with a total stream length of 228.65 miles. Western slope streams are short with steep gradients and drainage areas of less than three square miles each. The eastern slopes are steep in their upper reaches with long gently sloping streambeds that terminate in wide flat valleys.

The largest inland body of water on Guam is the Fena Reservoir constructed by the Navy as a drinking water supply. Its watershed is 5.88 square miles in area with 195 acres of water surface when full and 6,915 acre-feet of water storage (1949 original design: 8,365 acre-feet). It is the main

[9] Northern Guam Lens Study , Guam EPA 1982

drinking water source for the Navy. Fena Reservoir water is treated (to reduce turbidity) and chlorinated.

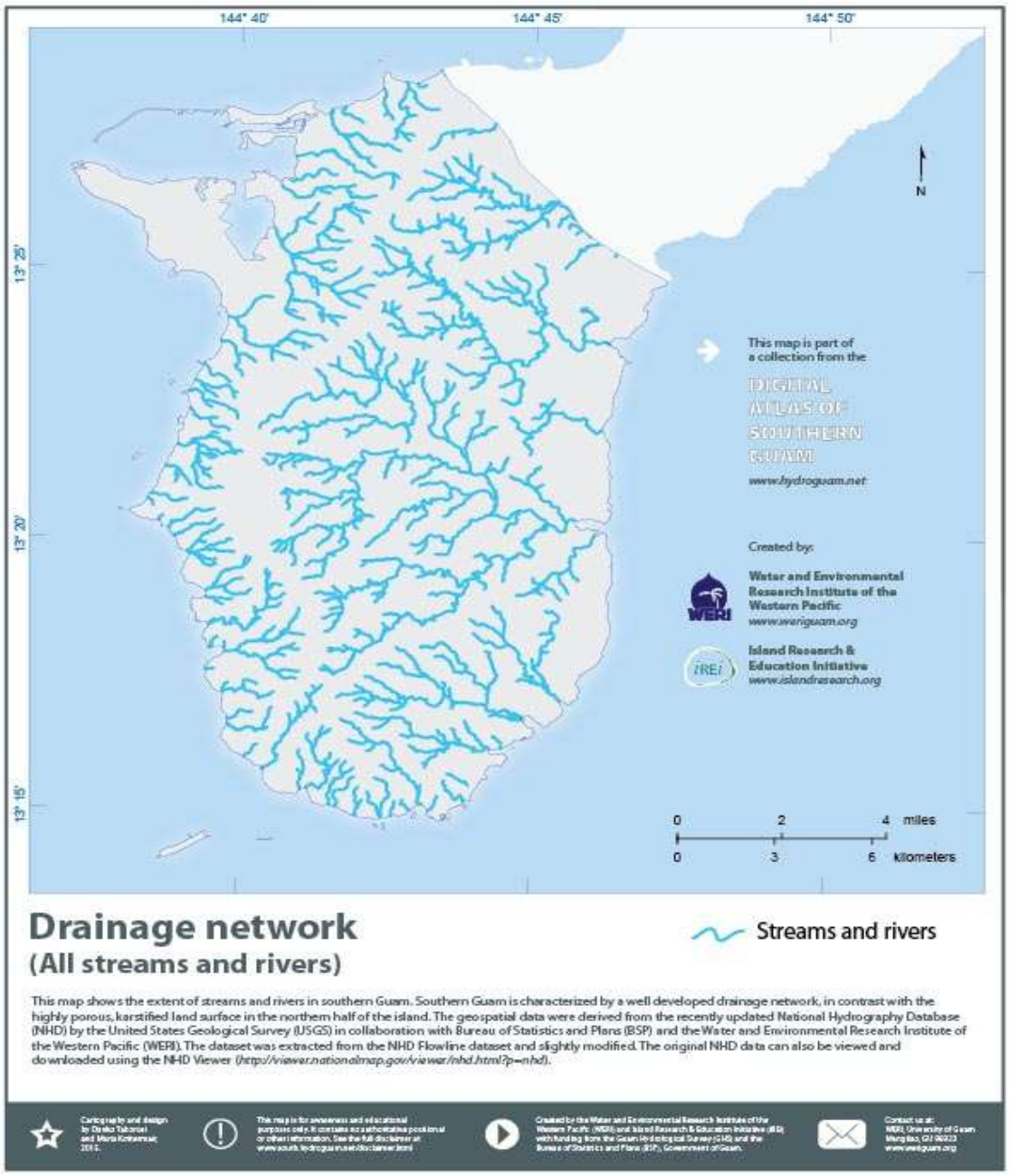


Figure 8. Streams and rivers in southern Guam from *Digital Atlas of Southern Guam WERI Map Collection*, HydroGuam.net

2.1. Wetlands

"Guam's wetland resources provide values to our community which are often over-looked or misunderstood. Many island residents who own wetlands believe it is an impediment to their use of private property. To some degree this is true since wetlands are both federally and locally protected by the "Federal Clean Water Act", and local Executive Order 90-13. However, the benefits which accrue

from wetlands result in a combination of the highest and best uses for all residents and for larger ecosystem diversity. Guam has inventoried more than 14,000 acres of wetlands (1983 National Wetlands Inventory), half of which are coral reefs. Inland freshwater wetlands make up only 3.8% of the total land area of Guam."[10]

Wetlands include swamps, marshes, mangroves, springs, and forested river valleys and are seasonally, but more often, permanently inundated with water or have soil that is saturated at the surface. Some wetlands dry up completely for several months each year. Guam wetlands are identified, for jurisdictional purposes, in accordance with the U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual[11]. This manual employs a multi-parameter approach, which requires the combined presence of hydric soils, wetland hydrology and hydrophytic vegetation. The Guam Land Use Commission/Guam Seashore Protection Commission (Title XVIII and XIV of the Government Code of Guam) expands the federal definition to include ponds, estuaries and surface springs, and refers to aquatic life in addition to aquatic vegetation.

Guam has considerably more wetlands and a wider variety of types than any of the other Mariana Islands. All its rivers and nearly all wetlands occur in the southern and central parts of the island, where clay or argillaceous limestone soils retard water percolation and permit surface waters to accumulate. Many interior wetlands are located along the upper drainages of rivers and smaller tributaries. In contrast, the northern limestone plateau allows rapid water seepage, and consequently only a few marshy areas and ephemeral streams exist in the vicinity of Mt Santa Rosa. [12]

Significant losses of wetland have occurred historically on Guam, although it is difficult to quantify the extent of the losses. Reclamation of wetlands by the U.S. military was extensive in and around Apra Harbor from 1945 to 1950 during the expansion of port facilities by the Navy. An estimated 500 ha of land area was filled during this period (U.S. Navy, 1978) and involved the destruction of mangrove communities fringing the eastern harbor and freshwater wetlands along the Sasa, Atantano and Namo Rivers and at the present-day Naval Station. Smaller fills have also occurred more recently at several of these sites, one of which was the expansion of a garbage dump into the Naval Station Marsh. At the Agana Swamp, filling along the edges was a chronic problem until about 1980. The original building of a coastal highway around the southern half of Guam by the Spanish, and subsequent improvements, resulted in the laying of a roadbed across wetlands next to river mouths and likely altered natural drainage patterns. From the 1970s to mid-1980s, several sets of aquaculture ponds were constructed in wetlands along the Talofofo, Agfayan and Ajayan Rivers, and resulted in vegetation loss.[13]

A substantial number of wetland systems have been accurately delineated for Section 404 jurisdictional purposes since the 1983 National Wetland Inventory was conducted. Such maps have been digitized and added to Guam's Inventory by the Guam Coastal Management Program.

[10] "Wetlands" A Valuable Island Resource, R.L. Sablan, former GEPA Planner.
[11] 1987 Wetland Delineation Manual.
[12] Wetlands of Guam, Gary J. Wiles and Michael W. Ritter. January 1993.
[13] Ibid.

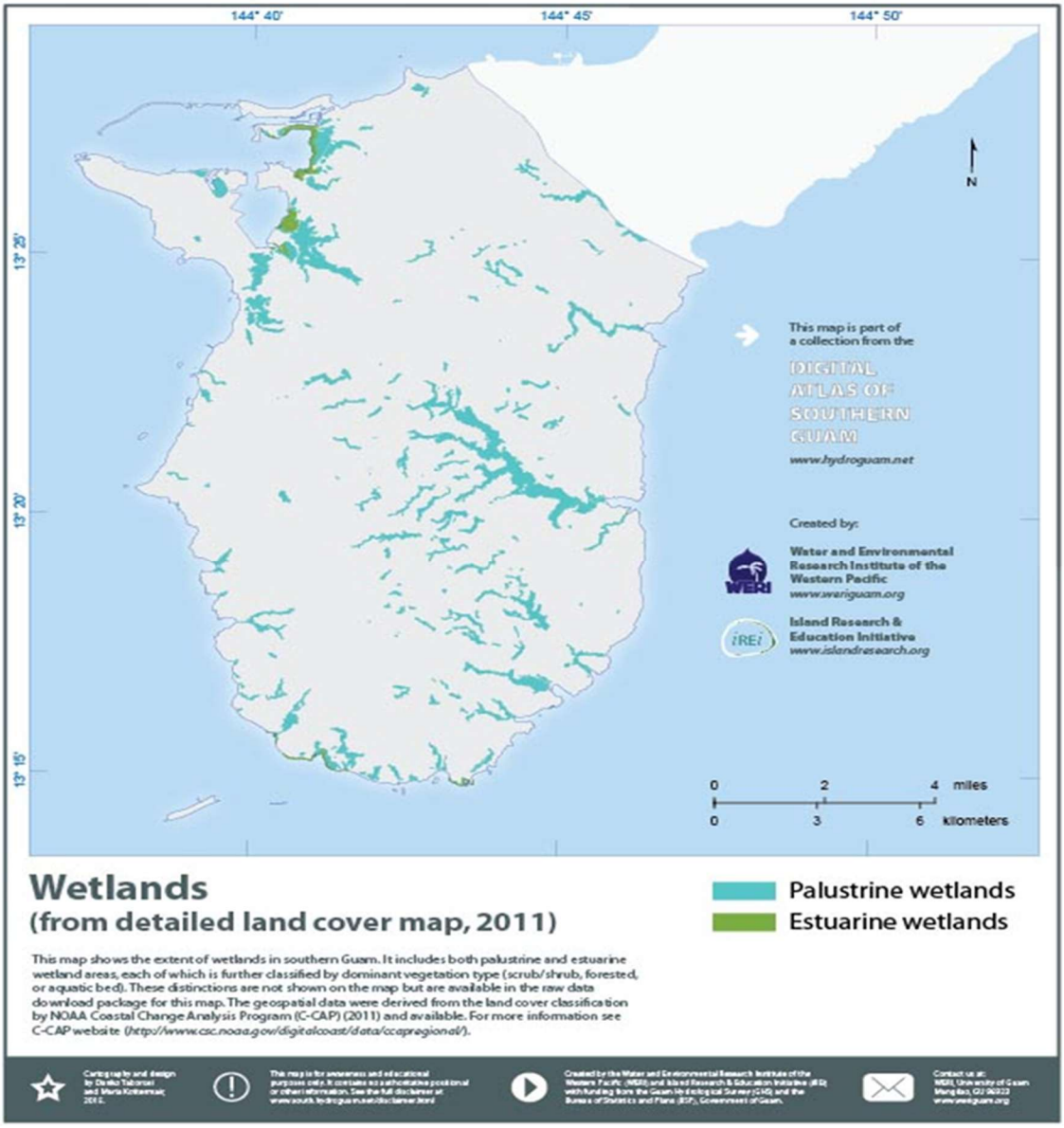


Figure 9. Wetlands in southern Guam from *Digital Atlas of Southern Guam*, HydroGuam.net

Guam EPA maintains copies of jurisdictional wetland delineation maps. Wetland delineation verifications and determinations continue to be made, mostly involving small wetland systems (less than 1 acre). Most of these determinations and field verifications are required to facilitate development activities. As much as possible, Guam EPA recommends modifications to land development plans which circumvent impacts to wetlands.

In May 2014, the U.S. Fish and Wildlife Service announced the completion of the most comprehensive and detailed U.S. wetland data set ever produced. The *Wetlands Inventory Mapper* (fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/) digitally maps and makes publicly available wetland in the lower 48 states, Hawaii and dependent territories – **GUAM** included, as well as 35% of Alaska. Per Executive Order 90-13, the official, interim wetland map for Guam shall be the

National Wetlands Inventory map published by the United States Fish and Wildlife Service. All Government of Guam agencies shall utilize this map in the review of physical development projects.

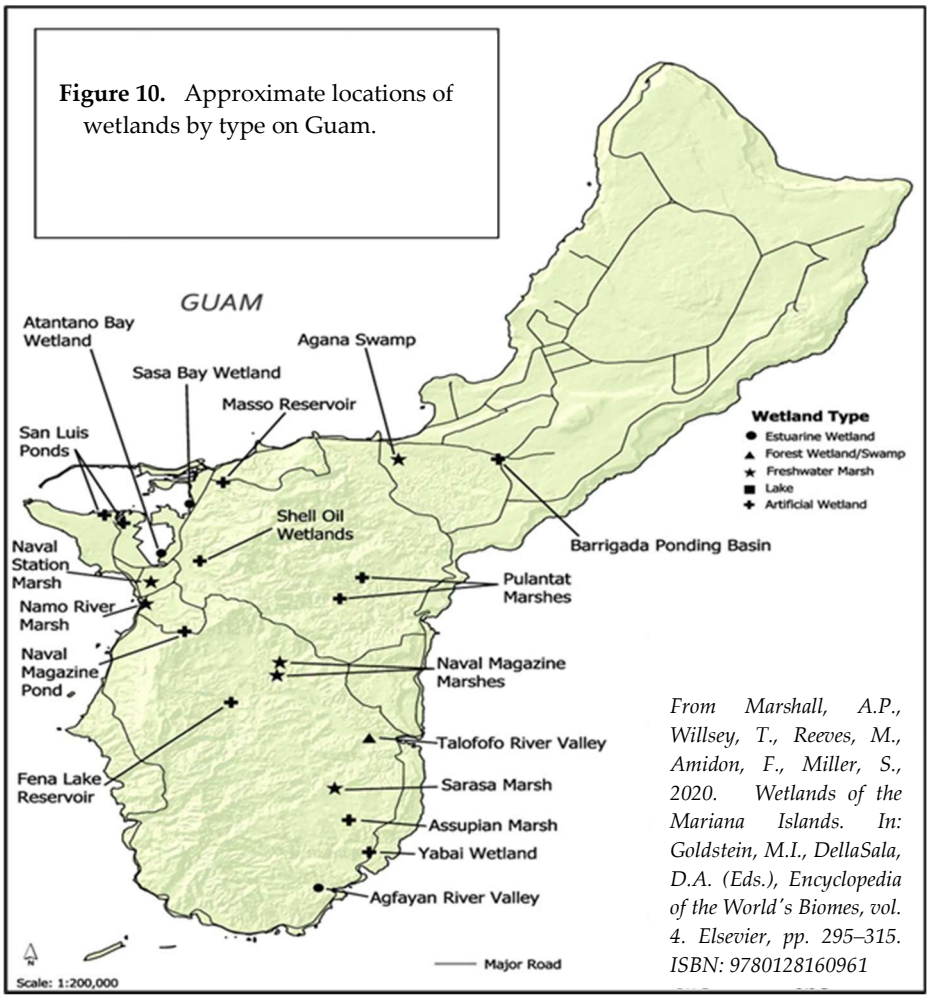


Figure 10. Approximate locations of wetlands by type on Guam.

From Marshall, A.P., Willsey, T., Reeves, M., Amidon, F., Miller, S., 2020. Wetlands of the Mariana Islands. In: Goldstein, M.I., DellaSala, D.A. (Eds.), Encyclopedia of the World's Biomes, vol. 4. Elsevier, pp. 295–315. ISBN: 9780128160961

3.0. Marine Waters

This category includes all coastal waters offshore from the mean high-water mark, including estuarine waters, lagoons and bays, brackish areas, wetlands and other special aquatic sites, and other inland waters that are subject to ebb and flow of the tides (GWQS).

The entire island of Guam, classified as a coastal zone under the U.S. Coastal Zone Management Act, is comprised of 210 square miles of land surrounded by 116.5 miles of shoreline. This shoreline is divided into three distinct classifications: rocky coastline, sandy beaches, and mangrove mud flats. The rocky coastline classification outlines the northern end of the island and isolated areas in the south. Rocky coastline represents approximately 72.5 miles in length or 62% of the total shoreline. Sandy beaches are scattered throughout the island and comprise 35.9 miles or 31% of total shoreline. The remaining 8.1 miles or 7% of shoreline are classified as mangrove mud flats and are located primarily within Apra Harbor and in Merizo.

Shallow fringing coral reefs with outer slopes and margins supporting live coral colonies encircle most of Guam. The width of these reefs ranges from very narrow benches (as narrow as 10 to 20 feet) on the northeastern coast, to broad reef flats forming the popular recreational and fishing areas in Tumon, Hagatna, Agat, and Asan Bays and on the shore side of Cocos Lagoon. These reefs are extremely valuable in terms of marine life, aesthetics, food supply, and recreation. Reefs also protect Guam's highly erodible shorelines from storm waves, currents, and tsunamis. Barrier reefs occur at Apra Harbor and Cocos Lagoon. Cocos Island Lagoon and its reefs form an atoll-like environment approximately four-square miles in area. Bound by the uplifted limestone plateau of Orote, Cabras Island and a large artificial breakwater (built on a shallow reef platform and adjacent submerged bank) is the much deeper lagoon of Apra Harbor.

The North Equatorial Current, driven by northeast trade winds, generally sets in a western direction around Guam with velocities ranging from 0.5 to 1.0 knots. Guam tides are semi-diurnal with a mean range of 1.6 feet and diurnal range of 2.3 feet. Extreme predicted tide range is approximately 3.5 feet.

Surface sea temperatures average close to 80 degrees Fahrenheit year-round.

B. Water Pollution Control Programs

Protecting and Restoring Guam's Waters[14], September 1999, addresses Guam EPA's overall approach for managing water resources. Guam uses an approach that emphasizes both island-wide nonpoint source programs and on the ground management of individual watersheds where waters are impaired and/or threatened.

The watershed approach is focused over a relatively small land area which is necessary to address problems at a watershed scale. Guam EPA also maintains core programs which are island-wide, covering both point and nonpoint sources of water pollution. These programs are discussed in the following.

1.0. Watershed Approach - Executive Order 2004-04 and the 1998 Clean Water Action Plan for Guam: *Unified Watershed Assessment*

In 1998, President Clinton announced a new clean water initiative to speed the restoration of our nation's waters. This initiative, called the Clean Water Action Plan (CWAP), aimed to achieve clean water by encouraging federal and nonfederal agencies, other organizations and interested citizens to work in a collaborative manner to restore our highest priority watersheds.

Guam responded to this federal initiative through Executive Order 99-09, which re-established an interagency work group called the **Water Planning Committee (WPC)**[15]. The 1998 WPC used an NRCS

[14] Document submitted to achieve compliance with updated requirements for Section 319 of the federal CWA and related NPS Program and Grants guidance dated May 1996.

[15] The Water Planning Committee is now known as Watershed Planning Committee (WPC). It was originally formed in August 1987 under §57034, Title 10, Guam Code Annotated, Public Law 17-87. The WPC became inactive in 1989, was re-established in June 1998 then, promulgated through E.O. 99-09. E.O. 2004-04 rescinded the former executive order and restructured the WPC and its goals.

map delineating Guam watersheds to organize the watersheds by category based on (1) national criteria (2) the data available for each watershed, and (3) the severity of environmental impact suffered by each watershed. That work group decided that addressing the drinking water impairment criterion (by protecting the Island's drinking waters) was a high priority. Drawing on experience and best professional judgment, three watersheds containing key drinking water resources were selected as the WPC's highest priority watersheds; and these three watersheds, the Northern, Ugum, and Talofofo watersheds, were targeted for initial CWAP restoration during 1999-2000.[16] They remain high priority watersheds.

A second set of priority watersheds identified in the CWAP share the common characteristic of experiencing impacts to the marine environment.

The following narratives present projects and activities (federally, locally, privately funded) which are planned for implementation, already implemented, or in progress. These undertakings aim to protect, maintain, restore, and/or sustain Guam's natural resources in priority and targeted watersheds.

1.1. Northern Watershed

Projects and activities undertaken to bring attention to the value of and impacts to natural resources in the Northern Watershed include:

a. *The Wastewater Revolving Loan Fund Program*: This program was developed via a Memorandum of Understanding between Guam EPA and GWA. $75,000 was initially granted to GWA in 2010 to design and implement a mechanism for eligible applicants to abandon their septic tank leaching field system and connect their houses to the public sewer system.[17] GWA is required to submit quarterly progress reports. Guam EPA (in coordination with GWA) targeted the assessment of about 144 houses in the Agafa Gumas area towards implementing this "sewer hookup" program. These homes are located over the Northern Guam Lens Aquifer, the island's primary source of drinking water. A map of the subdivision is shown on the next page.

b. *2021: GWA Cesspool Septic Tank Elimination Study*:[18] "*(Impacts of Onsite Wastewater Systems on the Northern Guam Lens Aquifer).* GWA provides potable water service to most of the island's civilian population of approximately 165,000 residents. Groundwater from the Northern Guam Lens Aquifer (NGLA) provides about 80% of Guam's drinking water. In 2015, wells pumped approximately 35 million gallons of water per day from the NGLA. The water lens is recharged primarily by rainfall infiltrating through the limestone aquifer. Limestone features, such as sinkholes and fractures, allow a quicker infiltration rate. The porous nature of limestone increases the risk of groundwater contamination from surface activities, such as cesspools and septic tanks.

[16] Clean Water Action Plan for Guam: *Unified Watershed Assessment*, September 15, 1998.

[17] Wastewater Revolving Loan Fund Program Fact Sheet.
https://guamwaterworks.org/documents/SewerFactSheet05192010.pdf

[18] The Public Utility Commission's stipulated provisions for Docket Number 19-08 require GWA to complete analytical studies that will support a FY2022 comprehensive review and update of GWA's financial plan and subsequent annual rate review process. Included in these studies is a *Cesspool and Septic Tank Elimination Study*.

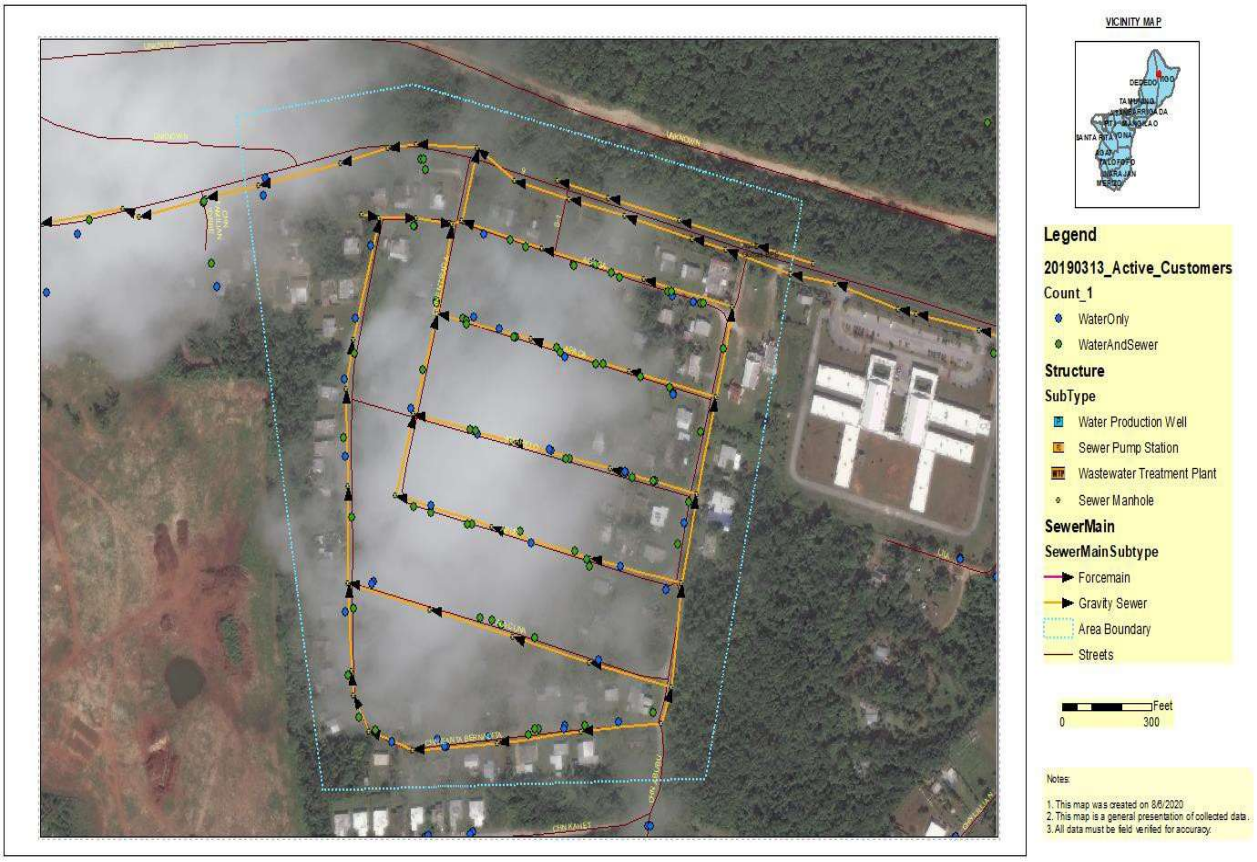


Figure 11. Agafa Gumas Subdivision (near Machananao Elementary School off Route 9), Yigo.
SOURCE: GWA 2021 Cesspool Septic Tank Elimination Study, Appendix C. Figure 9.

As of June 30, 2020, there were 42,224 residential and commercial customers with water accounts and 26,422 customers with sewer accounts. Approximately 62.6% of water customers are connected to the public sewer with the remainder utilizing an on-site wastewater disposal system (cesspools and septic tanks). Discharge from cesspools and septic tanks can percolate through the limestone in northern Guam and reach the water lens. Wastewater from cesspools and septic tanks contain biological and chemical contaminants, including nitrogen constituents, personal care products, and medicines.

Residential and commercial customers charged for water with sewer service and only water service

Area	Total Residential and Commercial Customers	Customers Charged for Water and Sewer Service	Customers Charged for only Water Service	Percentage of Customers Without Sewer Charges
Island-wide	42,224	26,422	15,802	37.4%
Sewered Subdivisions in Northern Guam	14,161	12,275	1,886	13%

Source: GWA 2021 Cesspool Septic Tank Elimination Study

Nitrate is a compound that forms when nitrogen combines with oxygen or ozone and can occur naturally in surface and groundwater at a level that does not generally cause health problems.

Nitrogen exists in the environment in many forms. Nitrogen is essential for all living things, but high levels of nitrate in drinking water can have adverse health effects, especially for infants and pregnant women. From the Centers for Disease Control and Prevention (2015, Water Research Center, Brian Oram, PG, n.d., "Nitrates and Nitrites in Drinking Water, Groundwater and Surface Waters"): *The primary health hazard from drinking water with high nitrate-nitrogen concentrations occurs when nitrate is transformed to nitrite in the digestive system. The nitrite oxidizes the iron in the hemoglobin of the red blood cells to form methemoglobin, which lacks the oxygen-carrying ability of hemoglobin. This creates the condition known as methemoglobinemia (sometimes referred to as "blue baby syndrome"), in which blood lacks the ability to carry sufficient oxygen to the individual body cells causing the veins and skin to appear blue. The health concern is primarily related to potential exposure through consumption by infants. Most humans over one year of age have the ability to rapidly convert methemoglobin back to oxyhemoglobin, therefore, the total amount of methemoglobin within red blood cells remains low in spite of relatively high levels of nitrate/nitrite uptake. However, in infants under six months of age, the enzyme systems for reducing methemoglobin to oxyhemoglobin are incompletely developed and methemoglobinemia can occur. This also may happen in older individuals who have genetically impaired enzyme systems for metabolizing methemoglobin.*

In 1962, the U.S. Public Health Service adopted drinking water standards and set the recommended limit for nitrate-nitrogen at 10 mg/L. Groundwater quality is monitored by GWA according to the requirements of Guam Primary and Secondary Safe Drinking Water Regulations (GPSSDWR). The GPSSDWR drinking water limit for nitrate-nitrogen is 10 mg/L. Nitrate-nitrogen can also be considered an indicator of other wastewater constituents that are not listed as a Safe Drinking Water standard, and are therefore, not typically tested for at production wells. Connecting unsewered properties to the public sewer system will protect the NGLA from contamination from onsite disposal systems. GWA's 2018 Water Resources Master Plan Update identifies a goal to construct 5,000 feet of sewer line each year into developed areas that are currently unsewered. Due to the large number of unsewered areas, a prioritization method is discussed further in Sections 5.1 and 5.3 of the Study.

"In the photo below, Well EX-11's close proximity to an elementary school underscores its significance. Sewer mains will need to be extended to the north and west henceforth surrounding water customers will be required to connect to the sewer system. Housing areas to the north will be smoke tested to verify customers who are connected to the system but not paying for sewer service. Also, nearby wells M-2, M-3, M-4, M-8, and M-9 also exhibit high concentration levels which may put this area and the cluster of wells atop the priority list." (*GWA 2021 Cesspool Septic Tank Elimination Study, Appendix B*) Note that all the wells are on the list of Top 12 Priority Production Wells (next page) on the previous page subject to increased nitrate-nitrogen concentrations by year 2029. This northern area is known as Adacao.

Study goals. The goals of GWA's *2021 Cesspool Septic Tank Elimination Study* are to protect Guam's main drinking water source by connecting onsite wastewater disposal systems to the public sewer system and to meet the requirements of PUC Docket Number 19-08.

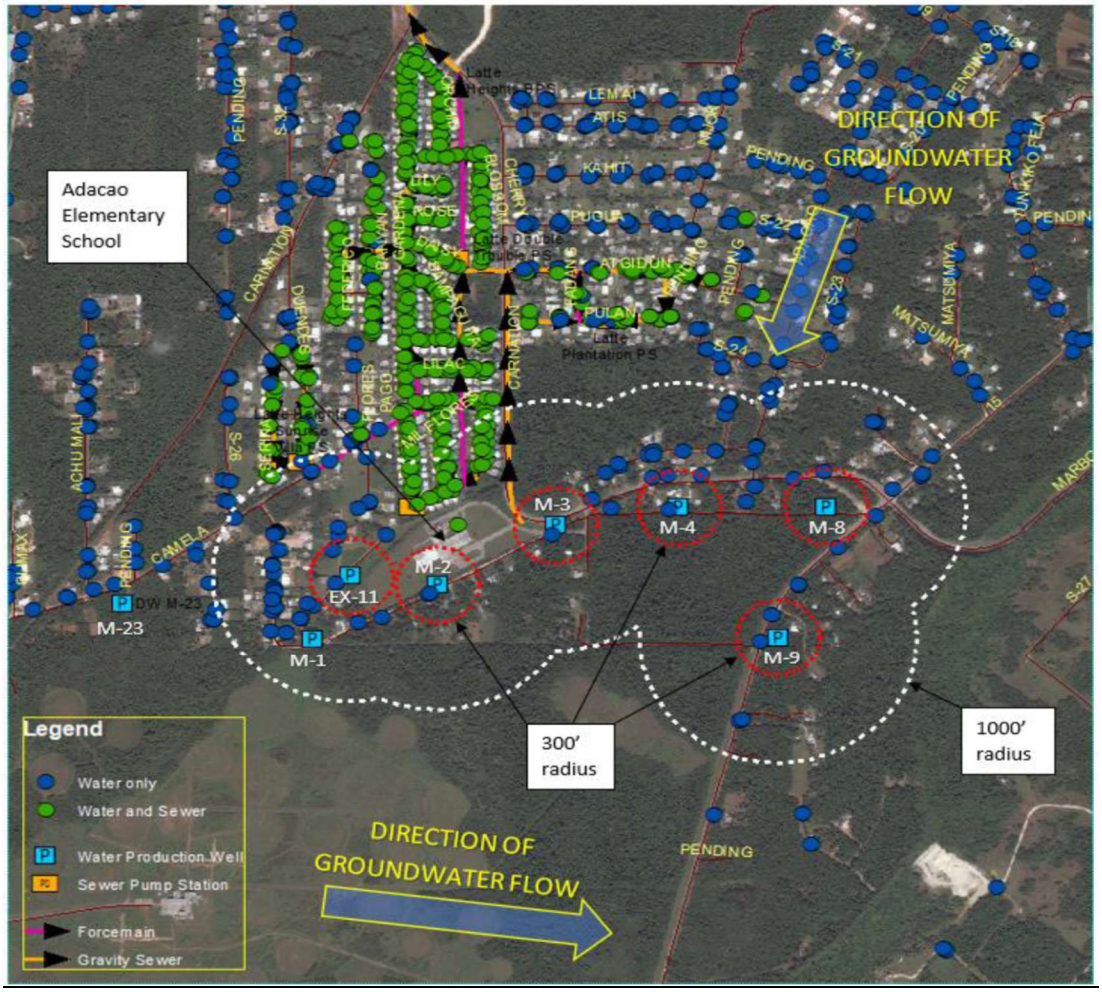


Figure 12. Priority Wells (Adacao) Mangilao **SOURCE:** GWA 2021 Cesspool Septic Tank Study

TOP 12 PRIORITY PRODUCTION WELLS
BASED ON THE LATEST AND PREDICTED NITRATE-NITROGEN CONCENTRATION
The table includes trends, maximum concentrations, projections and the number of water-only customers (WERI 2020)
SOURCE: GWA 2021 Cesspool Septic Tank Elimination Study, Appendix B.

Well	Groundwater Basin	Figure	Trending Significance	Latest Concentration (milligrams per liter)	Latest Sample Date	Maximum Concentration (milligrams per liter)	Maximum Sample Date	2029 Prediction (mg/L)	Number of water-only customers within 1000'	Number of water-only customers within 300'
EX-11	Mangilao	B1	Increasing	4.6	1/16/2019	4.9	1/1/2002 & 7/15/2018	6.5	48	2
F-18	Finegayan	B2	Increasing	4.7	7/15/2018	4.7	7/15/2018	6.3	18	0
M-15	Yigo-Tumon	B3	Increasing	4.4	1/16/2019	5	3/17/2013 & 3/18/2012	6.3	32	0
M-4	Mangilao	B1	Increasing	4.3	1/16/2019	5	3/1/2000	6.3	27	2
D-17	Yigo-Tumon	B4	Increasing	4.6	7/29/2018	4.6	7/29/2018	5.9	3	0
M-2	Mangilao	B1	Increasing	4.5	7/15/2018	4.6	10/14/2017	5.9	15	2
M-3	Mangilao	B1	Increasing	3.9	1/16/2019	4.9	7/15/2018	5.6	13	1
M-8	Mangilao	B1	Increasing	3.1	1/16/2019	4.8	7/15/2018	5.6	24	1
M-9	Mangilao	B1	Increasing	0.65	1/16/2019	4.9	4/7/2018	5.2	7	2
F-12	Finegayan	B5	Increasing	3.7	7/15/2018	4.7	2/8/2015	4.8	19	1
F-5	Yigo-Tumon	B5	Increasing	4.4	7/15/2018	4.4	7/15/2018	4.6	23	2
F-13	Finegayan	B5	Increasing	4.3	7/15/2018	4.4	3/23/2016	4.6	17	1

- Regulations will be revised to give GWA the authority to require customers to connect to the public sewer. Sewer connections will be conducted using a tiered approach: (1) Investigate areas that have sewer mains, where some customers are being charged for sewer service, but some are not. Customers with sewer connections but without sewer charges, will be billed for the service. Customers without sewer connections will be required to connect to the sewer. (2) Prioritize sewer main construction based on nitrate-nitrogen concentrations and trends at drinking water wells. Customers will be required to connect to the public sewer and discontinue cesspool/septic tank use to protect the island's primary drinking water source from contaminants typically found in wastewater.

- Per 28 Guam Administrative Rules and Regulations (GARR) Chapter 2 Article 1, customers are responsible for sewer connection costs. Qualified customers can defray connection costs by applying for a sewer loan through GWA's sewer loan revolving fund. System Development Charge (SDC) funds cannot be used to augment the sewer loan revolving fund and GWA is seeking United States Environmental Protection Agency (USEPA) grant funding to augment the loan fund. GWA is also seeking Guam Housing and Urban Renewal Authority (GHURA) and United States Department of Agriculture (USDA) grant funding for customer construction costs in areas where new sewer mains will be constructed. To assist customers with construction, GWA will offer customers the option of having GWA coordinate sewer connection permitting and construction activities.

- Given the current economic situation, a moderate approach to study implementation is recommended:
  1) In sewered areas: Pursue sewer investigations to capture uncharged revenue from sewer connections and base charges for meters serving more than one living unit. Buildings not connected to the public sewer will be identified and required to connect within 3 years of notification.
  2) For the area near the highest priority water well: Starting in 2021, pursue grant funding for private lateral construction. Begin outreach efforts and start work on sewer main and lateral construction after grants have been approved or the sewer loan revolving fund has sufficient capital to accommodate the first neighborhood. The start of construction is anticipated to be no later than 2026. Provide incentives for customers to connect to the public sewer in coordination with the GWA sewer main construction project, instead of waiting five years after the sewer main is available, as allowed by 10 Guam Code Annotated (GCA) 48 §48104."[19]

c. *Improvements to the GWA Wastewater Revolving Loan Fund*

(1 On September 12, 2022, Public Law 36-107 appropriated two million dollars ($2M) to the

[19] GWA 2021 Cesspool and Septic Tank Elimination Study.

GWA Sewer Loan Revolving Fund for the purpose of assisting customers with the cost of sewer connections.

(2 On January 24, 2023, the Consolidated Commission on Utilities (CCU)[20] adopted and approved (Resolution 08-FY2023) amendments to GWA's Wastewater Revolving Loan Program and increased the sewer hook-up loan amounts from $9,000 to $25,000. This action was in response to recommendations from the GWA 2021 Cesspool and Septic Tank Elimination Study and to encourage property owners to take advantage of the Wastewater Revolving Loan program and the increased funding available.

GWA Wastewater Revolving Loan Program Requirements and Proposed Changes [21]

Current Requirements	Proposed Requirements
$9,000.00 maximum loan	Increase maximum loan to $20,000.00
Rejection of a conventional loan application from two commercial banks	Waive requirement for customers registered in public assistance programs
10 year maximum loan term	Customers registered in public assistance programs can increase the term to a maximum of 15 years
Three contractor estimates are required	Waive the requirement if the sewer connection is part of a GWA capital improvement project
Payments to commence immediately upon loan issuance	Defer payments for five years for customers willing to construct their sewer lateral when a new sewer main is being constructed instead of waiting for five years, as allowed by 10 GCA 48 §48104.

d. *Guam Northern Watershed Bacteria TMDLs:* In 2010, U.S. EPA approved seventeen (17) Bacteria TMDLs prepared by Tetra Tech, Inc. These TMDLs contained individual beach assessments for 17 Tier 1 beaches located in the Northern Watershed, impaired due to exceedances of Guam Water Quality Standards for enterococci bacteria. Guam EPA's goal is to reduce the bacteria exceedances at these beaches by linking the TMDL to key Agency or partnering agency programs. An alternative option would be to implement TMDL projects using a request for proposal (RFP) process.

Guam EPA issued an RFP and awarded the selected contractor $109K to implement a nonpoint source project beginning in FY 2018. The focus of the project was to reduce Enterococci loads to Guam beaches through stormwater best management practices (BMPs), including structural methods, pollution prevention and source control. While implementation throughout the island of Guam was evaluated, this Project focused on Agana Bay and the Dungca stream.

[20] Established in 2002, the Consolidated Commission on Utilities (CCU) was established as the board of directors for both the Guam Power Authority and the Guam Waterworks Authority. The CCU is made up of five elected members and is vested with the same powers previously exercised by previous boards of directors.

[21] GWA 2021 Cesspool and Septic Tank Elimination Study. pp. 23-24

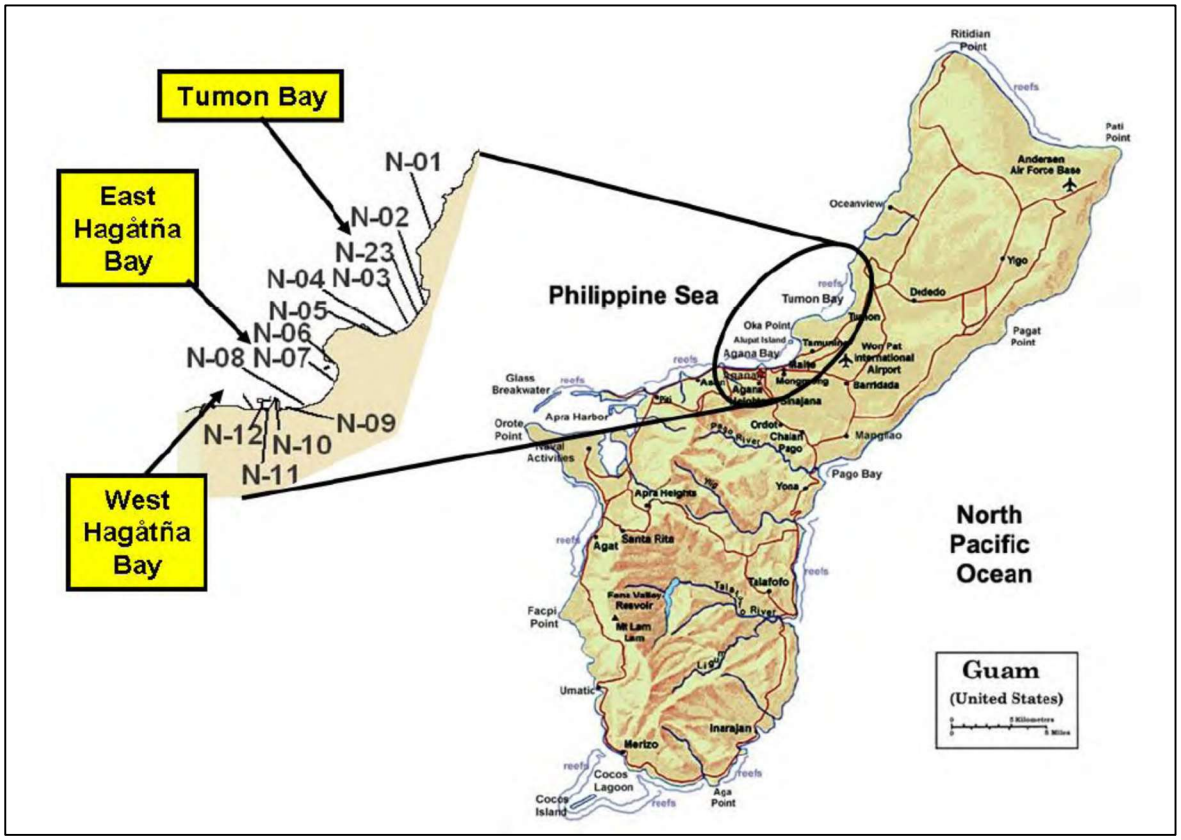


Figure 13. Location of Northern Guam TMDL Beaches. Source: Guam Northern Watershed Bacteria TMDLs. 2010

Guam EPA issued an RFP and awarded the selected contractor $109K to implement a nonpoint source project beginning in FY 2018. The focus of the project was to reduce Enterococci loads to Guam beaches through stormwater best management practices (BMPs), including structural methods, pollution prevention and source control. While implementation throughout the island of Guam was evaluated, this Project focused on Agana Bay and the Dungca stream.

The initial efforts identified and ranked potential structural BMPs for use on Guam to reduce bacterial loads in stormwater. The results of the ranking system indicated that the most effective BMPs, with respect to bacteria removal, are infiltration basins, wetland structures and bioretention structures. Local conditions are an important factor for the implementation of any structural stormwater BMP and as a result the Project ranking system would be used to select the most appropriate structural BMP.

With respect to the Dungca stream location, a constructed extended detention wetland is recommended to maximize bacterial removal. The BMP design and maintenance must maximize exposure to sunlight to provide optimal bacterial removal.

Of the evaluated non-structural stormwater BMPs, sanitary sewer source control measures can have the greatest impact in the Project study area. Collaboration to develop a cooperative and effective source control program is required among Guam EPA, Department of Public Works, and the Guam Waterworks Authority.

The next phase of the Agana Bay/Dungca stream nonpoint source project is the design, construction and implementation of recommended BMPs for stormwater treatment and bacteria removal and/or reduction at the selected beach.

e. *Tumon Bay TMDL Project:* Between August 2000 and August 2001, four (4) rounds of ground water sampling from eight springs in Tumon Bay were completed (*Summary Report of Tumon Bay Springs Sampling for Chemical Analysis, December 2002*). The purpose of the project was to characterize background concentrations and seasonal variations in contaminant concentrations resulting from varying rainfall conditions over an annual cycle.

USEPA funded a supplemental Tumon Bay study and TMDL project which began implementation in fiscal year 2020. The project scope of work included the following tasks through March of 2021:

- Collecting water, tissue, and Polyethylene Device (PED) samples for analysis
- Analytes of samples
- Completing specific sections of the TMDL
- Compiling data, identifying data gaps, and producing the report/sections
- Providing recommendations for completing the TMDL

The resulting draft TMDL addresses impairments in Tumon Bay for (total) chlordane and dieldrin which fail to attain the consumption designated use and contribute to impairment of the Bay's aquatic life use.

Table 1. Tumon Bay Causes of Impairment

Pollutant	Pollutant Group	Designated Use(s)	Designated Use Group
Chlordane	Pesticides	Consumption	Aquatic Life Harvesting
		Aquatic Life	Fish, Shellfish, and Wildlife Protection and Propagation
Dieldrin	Pesticides	Consumption	Aquatic Life Harvesting
		Aquatic Life	Fish, Shellfish, and Wildlife Protection and Propagation

Source: draft Tumon Bay Chlordane and Dieldrin TMDLs. PG Environmental, LLC, 2024.

These TMDLs focus on Tumon Bay, which is a 1.98 square mile crescent-shaped bay on the west coast of the northern portion of Guam. Tumon Bay is a popular tourist location on the island and is home to a significant commercial sector including numerous hotels and restaurants, which are dependent on maintaining the ecological condition and natural beauty of the Bay (Guam Water Resources Research Center, 2000). Given the area's important economic and ecological value, both interests must be actively managed to accommodate the tourists that visit each year while protecting the coastal environment.

Figure 14. Areas around Tumon Bay. Source: draft Tumon Bay Chlordane and Dieldrin TMDLs. PG Environmental, LLC, 2024.

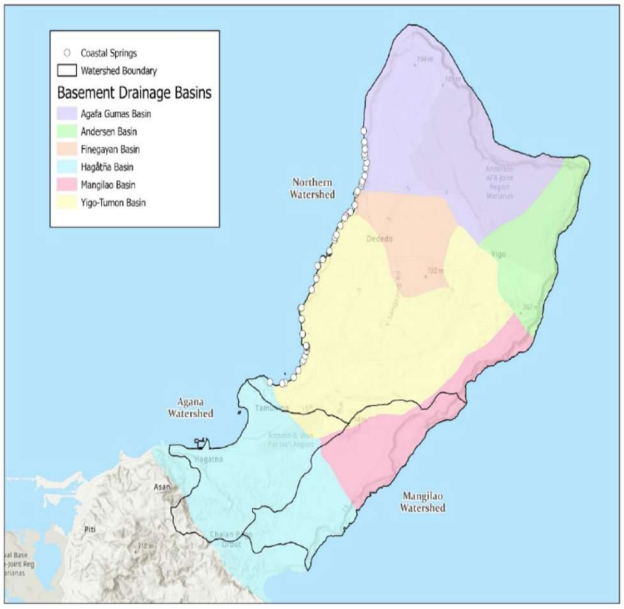


Figure 15. Northern Region Surface and Subsurface Drainage Basins

The northern region of the island is a relatively flat area with steep cliffs that drop down to the narrow coastal shelf. It has porous soils, high percolation rates, and very limited runoff since water that reaches the land surface quickly drains into the aquifer below. Because of the underlying geology, drainage in northern Guam is subterranean, forming several sub-surface (or "basement drainage") basins. Sub-surface flow to Tumon Bay occurs largely through the Yigo-Tumon basin (30 square miles; 19,369 acres), with the Hagåtña basin influencing the southernmost portion of the Bay (23 square miles; 14,514 acres)

The "*draft Tumon Bay Chlordane and Dieldrin TMDLs"* report presents physical conditions and potential sources in the Tumon Bay watershed as well as water quality criteria (WQC) and guidelines applicable to these waterbodies. In addition, the available fish tissue, sediment, and water quality data to support these TMDLs were compiled and reviewed. Sampling over the years has been conducted by PCR Environmental, Inc., the University of Guam Water Environmental Research Institute (WERI) in collaboration with Guam Waterworks Authority (GWA), and the military, among others. These studies have typically evaluated inputs to the Bay, in particular groundwater wells in the Northern Guam Lens Aquifer (NGLA) and the freshwater springs that discharge at several locations at or near Tumon Bay beaches. A recent study for GEPA and EPA Region 9 sampled springs discharging into the

Bay as well as many marine locations, seven sediment locations, and four fish species (PG, 2020). Analysis of these data indicate that the chlordane and dieldrin impairments persist in the Bay; however, inputs of the pollutants of concern into the Bay from the springs have decreased. TMDLs are developed for dieldrin and total chlordane because the latest sampling study supported the continued impairment status for the parameters of concern. The draft report has been submitted to USEPA for review and action.

Table 2. Marine Water Quality Concentrations (Draft Tumon Bay Chlordane and Dieldrin TMDLs

Station Name	Sample Date	Chlordane (µg/L)	Dieldrin (µg/L)
WQC	--	0.0022	0.00014
Gun Beach 1	7/30/2020	<0.0069	0.0016
Gun Beach 1	9/17/2020	0.053	0.0039
Fai Fai Beach 1	1/11/2021	<0.007	<0.00027
Hilton Hotel	1/11/2021	<0.007	0.00044
North Reef 1	1/11/2021	<0.007	0.0013
South Reef 1	1/11/2021	<0.007	<0.00027
Central Tumon Bay	5/3/2022	<0.0069	<0.00026
North Reef 2	5/3/2022	<0.007	0.00062
Central South Tumon Bay	5/4/2022	<0.0069	0.00045
Central South Tumon Bay	5/4/2022	<0.0069	<0.00026
Fai Fai Beach 2	5/4/2022	<0.0069	0.00048
Gun Beach	5/4/2022	<0.0069	<0.00026
Hilton Reef	5/4/2022	<0.0069	0.0017
South Reef 2	5/4/2022	<0.007	0.0017

Notes: Sample results in red are above the applicable WQC.

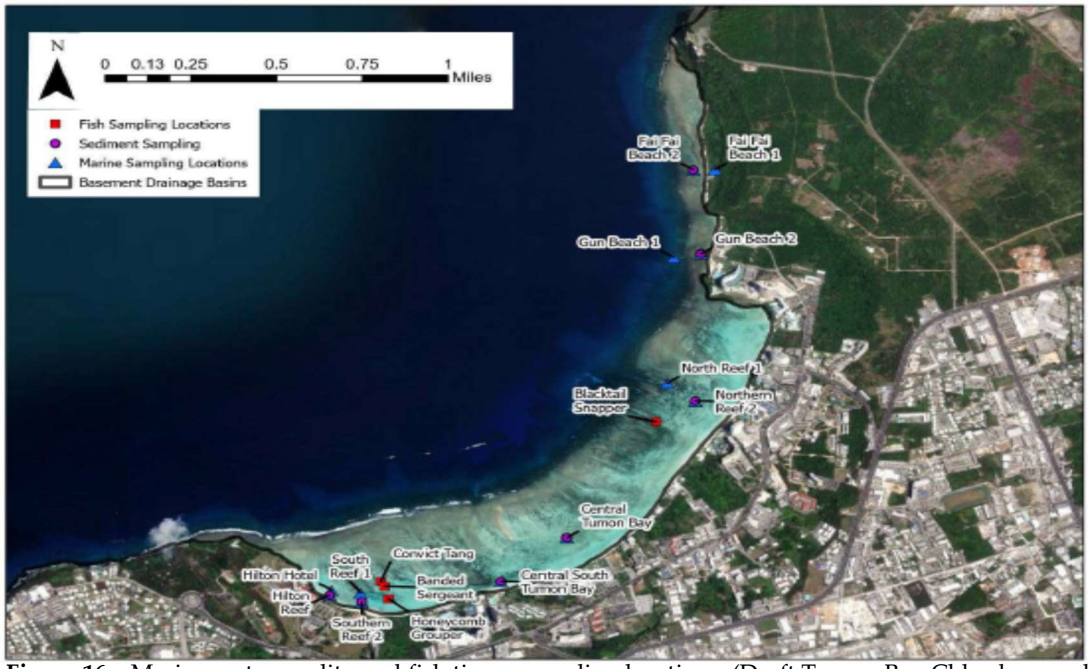


Figure 16. Marine water quality and fish tissue sampling locations. (Draft Tumon Bay Chlordane and Dieldrin TMDL)

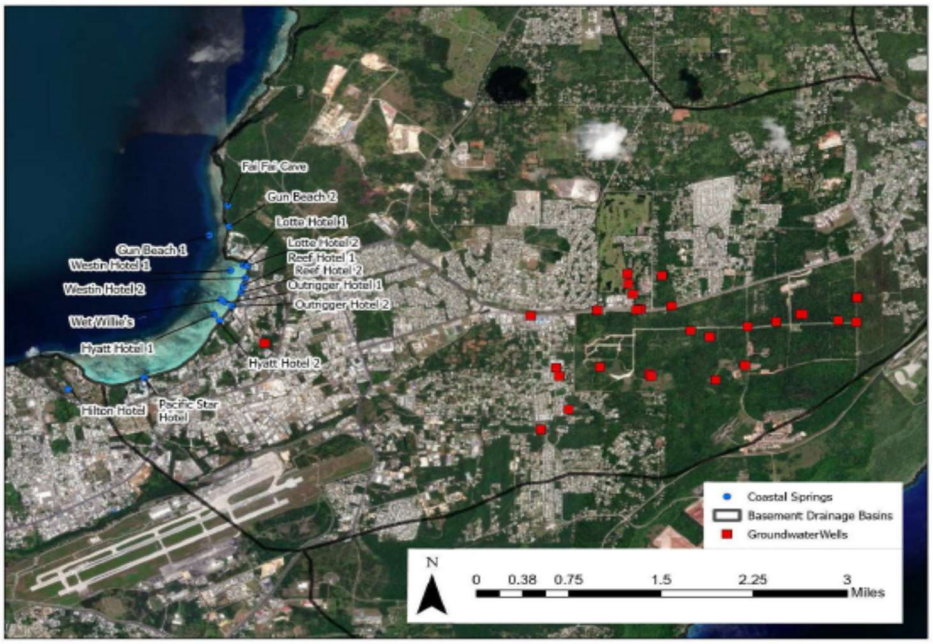


Figure 17. Coastal Springs and groundwater wells sampling locations (Draft Tumon Bay Chlordane and Dieldrin TMDLs)

Table 3. Spring Sampling Data Over Time (Draft Tumon Bay Chlordane and Dieldrin TMDL)

Spring Location	Sample Dates							
	8/30/00	2/27/01	6/6/01	8/20/01	7/30/20	9/17/20	1/11/21	6/28/22
Chlordane (total) (Groundwater WQC = 2 µg/L)								
Fai Fai Cave	–	–	–	–	–	–	0.078	–
Gun Beach 1	<0.1	<0.338	<0.2	<0.2	0.13	0.048	–	–
Hilton Hotel	<0.1011	<0.338	0.2	<0.2	–	–	–	–
Hyatt Hotel 1	<0.1	<0.338	<0.2	<0.2	0.059	0.032	–	–
Lotte Hotel 1	–	–	–	–	0.069	0.17	–	–
Outrigger Hotel 1	<0.1	<0.338	<0.2	<0.2	<0.0069	0.055	–	–
Pacific Star Hotel	<0.1	<0.338	<0.2	<0.2	0.0755	0.0425	–	–
Reef Hotel 1	<0.1	<0.338	<0.2	<0.2	0.19	0.015	–	–
Westin Hotel 1	<0.1	<0.338	<0.2	<0.2	0.23	0.2	–	–
Wet Willie's	<0.1	<0.338	<0.2	<0.2	–	–	–	–
Gun Beach 2	–	–	–	–	–	–	–	0.078
Hyatt Hotel 2	–	–	–	–	–	–	–	0.043

Spring Location	Sample Dates							
	8/30/00	2/27/01	6/6/01	8/20/01	7/30/20	9/17/20	1/11/21	6/28/22
Lotte Hotel 2	–	–	–	–	–	–	–	0.26
Outrigger Hotel 2	–	–	–	–	–	–	–	0.074
Reef Hotel 2	–	–	–	–	–	–	–	0.051
Reef Hotel 2	–	–	–	–	–	–	–	0.064
Reef Hotel 2	–	–	–	–	–	–	–	0.048
Westin Hotel 2	–	–	–	–	–	–	–	0.24
Dieldrin (WQC = 0.056 µg/L*)								
Fai Fai Cave	–	–	–	–	–	–	0.017	–
Gun Beach 1	<0.1	<0.1	0.16	<0.1	0.014	0.008	–	–
Hilton Hotel	0.169	0.23	0.26	<0.1	–	–	–	–
Hyatt Hotel 1	<0.1	0.15	<0.1	<0.1	0.022	0.018	–	–
Lotte Hotel 1	–	–	–	–	0.032	0.016	–	–
Outrigger Hotel 1	<0.1	0.15	0.14	<0.1	0.016	0.028	–	–
Pacific Star Hotel	<0.1	0.23	0.16	<0.1	0.008	0.007	–	–
Reef Hotel 1	<0.1	0.14	<0.1	<0.1	0.025	0.0085	–	–
Westin Hotel 1	<0.1	0.18	0.15	<0.1	0.038	0.024	–	–
Wet Willie's	<0.1	0.15	0.14	<0.1	–	–	–	–
Gun Beach 2	–	–	–	–	–	–	–	0.0098
Hyatt Hotel 2	–	–	–	–	–	–	–	0.018
Lotte Hotel 2	–	–	–	–	–	–	–	0.034
Outrigger Hotel 2	–	–	–	–	–	–	–	0.069
Reef Hotel 2	–	–	–	–	–	–	–	0.023 / 0.027 / 0.0049
Westin Hotel 2	–	–	–	–	–	–	–	0.04

Notes: The Pacific Star Hotel location includes the Marriott Spring location in the PCR study (2002). Sample results in red are above the applicable groundwater WQC. "–" indicates no data available.
* A groundwater WQC has not been adopted for dieldrin, therefore the freshwater chronic aquatic life surface water criterion has included as an alternative.

1.2. Ugum Watershed

The objective of the initial Ugum restoration strategy was to improve the drinking water quality and the ecosystem functioning of the Ugum Watershed. Erosion was the most significant challenge in achieving these objectives.

Watershed partners find that the most effective means of preventing and minimizing soil erosion is to encourage actions which maximize vegetative cover, particularly for forests.

A coordinated implementation effort via the Ugum Watershed Action Team continues in the watershed to include:

- Planting acacia and native tree seedlings in the Layon and Ugum-Atate regions of the watershed. To date, over 1500 such seedlings have been planted.
- Conducting information and outreach efforts; engaging with private landowners to implement conservation practices using partner agency programs such as EQIP, Forest Stewardship Program, wetland protection program, etc.

The most recent project supported by Guam EPA in the Ugum Watershed is sponsored by the University of Guam (UOG) Sea Grant Program, known as the Guam Restoration of Watersheds (**GROW**) Initiative. To enhance local stakeholders' understanding of environmental stressors, the GROW Initiative conducts outreach and research. Guam EPA has committed to assisting with water quality sampling at established Ugum River monitoring sites for the GROW project in the Ugum Watershed. The focus of the project is to plant stands of acacia trees/ native plants and install other amendments, in a selected Ugum watershed location, maximize vegetative cover (and improve soil health) then, evaluate the impact of the applied restoration practice on river water quality. A Conservation Innovation Grant (CIG) was awarded to UOG Sea Grant by NRCS/USDA for GROW (9.30.2018-3.31.2021) to address through new innovative technologies, several human activities that accelerate the erosion process, including inappropriate road construction, off-road vehicle traffic, and arson-induced fires. Specifically, the purpose is to address the serious soil erosion problem in the Ugum watershed and its associated turbidity that have been adversely affecting water quality in the Ugum River.[22] "As of 2023, GROW completed a total of seventeen tree planting events including three community outplanting events; 486 volunteers worked alongside the initiative in 2023 successfully planting 4,836 trees surpassing 2022's count of 4718 trees. According to ecotree.green, as the number of 2023 trees planted begin to mature, they have the potential to absorb approximately 266,539 pounds of carbon a year. (One tree can absorb about 55 pounds of carbon dioxide emissions annually)."[23] A *Sediment TMDL for the Ugum Watershed* was approved by USEPA in 2006.

1.3. Talofofo Watershed

The Talofofo River Watershed is the largest watershed on the island. The watershed is comprised of two sub-basins, an upper and a lower drainage area. The 23 square mile watershed is partially regulated at the upper end of the drainage by the Fena Reservoir, which also acts as a sediment

[22] https://cig.sc.egov.usda.gov/projects/guam-restoration-watersheds-grow-ugum-watershed
[23] https://guamgreengrowth.org/grow-initiative-continues-to-thrive-into-new-year/

trap and diversion for the island's drinking water supply (WERI UOG, 1998, verbal communication). The flow from the Fena drainage is controlled at the spillway by the amount of pumpage from the reservoir and storage within Fena Lake. All flow thereafter is otherwise affected by the combined flow of the Maagas and the Tolaeyuus or Lost Rivers. The lower Talofofo "sub-watershed" is comprised of deeply weathered volcanic derived sediments with thicker sections of alluvial deposits near the lower sections (USGS Hydrology of Guam, Ward, Hoffard, and Davis, 1985)[24]

1.3.1. Upper Sub-basin: Fena River Sub-watershed

The Fena River sub-watershed is a river reach in the western sector of the Talofofo drainage area. It is comprised of the Imong, Almagosa, and Maulap Rivers. Total drainage area of the dam spillway is 5.9 square miles. It is a relatively hilly to very steep, undeveloped watershed, except for the Navy's munitions storage area. The western part is a limestone karst terrain with a very thin granular clayey cover.[25]

(a. Technical Experts (Working Group) for the Guam Water Resources Development Group:

To ensure Guam's water resources are well managed and protected, the GWA continues the effort to foster continued cooperation and sharing of information with its partners and critical stakeholders.[26] Guam EPA has participated in the technical experts working group meetings since 2014. Memoranda of Understanding (GWA and the Navy; GWA and UOG-WERI)[27] have resulted in key studies, among other efforts, several which provide updated information for the Fena surface water resource. These studies can be found at https://www.usgs.gov/search?keywords=fena and include:

(1) Storage capacity of the Fena Valley Reservoir, Guam, Mariana Islands, 2014. Published in 2015. To determine the current storage capacity, the United States Geological Survey in cooperation with the United States Navy resurveyed the bathymetry of the reservoir in February 2014. Preliminary analyses of the bathymetric data indicate that the reservoir currently has 6,916 acre-ft of storage capacity. The original 1951 reservoir storage capacity was estimated at 8,365 acre-ft. Thus, between 1951 and 2014, the total storage capacity decreased by 1,449 acre-ft (a loss of 17 percent of the original storage capacity), and an average decrease of 23.0 acre-ft/yr.[28]

(2) Daily reservoir sedimentation model: Case study from the Fena Valley Reservoir, Guam, Published in 2017. A model to compute reservoir sedimentation rates at daily timescales is presented. The model results show that the highest rate of deposition occurred during two typhoons (Typhoon Alice in 1953 and Typhoon Tingting in 2004); each storm decreased reservoir capacity by approximately 2–3% in only a few days. The presented

[24] Clean Water Action Plan for Guam: *Unified Watershed Assessment*, September 15, 1998.
[25] Ibid. A model to compute reservoir sedimentation rates at daily timescales is presented.
[26] Evangeline Lujan, GWA Senior Regulatory Analyst. Working Group Meeting Email 10-13-2014.
[27] Navy-GWA MOU signed 7-14-2010; GWA-UOG/WERI MOU signed 10-23-2014.
[28] Marineau, M.D., and Wright, S.A, 2015, Storage capacity of the Fena Valley Reservoir, Guam, Mariana Islands, 2014: U.S. Geological Survey Scientific Investigations Report 2015–5128, 31 p., http://dx.doi.org/10.3133/sir20155128.

model can be used to evaluate the impact of an extreme event, or it can be coupled with a watershed runoff model to evaluate potential impacts to storage capacity as a result of climate change or other hydrologic modifications.[29]

(3) Fena Valley Reservoir watershed and water-balance model updates and expansion of watershed modeling to southern Guam, First Published in 2017; revised 2019. In 2014, the U.S. Geological Survey, in cooperation with the U.S. Department of Defense's Strategic Environmental Research and Development Program, initiated a project to evaluate the potential impacts of projected climate-change on Department of Defense installations that rely on Guam's water resources. A major task of that project was to develop a watershed model of southern Guam and a water-balance model for the Fena Valley Reservoir.

Two important surface-water resources for the U.S. Navy and the citizens of Guam were modeled in this (updated) study; the extended model now includes the Ugum River watershed and improves upon the previous model of the Fena Valley watersheds. Surface water from the Ugum River watershed is diverted and treated for drinking water, and the Fena Valley watersheds feed the largest surface-water reservoir on Guam.

The new Fena Valley Reservoir water-balance model is useful as an updated tool to forecast short-term changes in the surface-water resources of Guam. Furthermore, the now spatially complete southern Guam watershed model can be used to evaluate changes in streamflow and recharge owing to climate or land-cover changes.[30]

(4) Water resources on Guam—Potential impacts of and adaptive response to climate change, Published 2019. The goals of this joint U.S. Geological Survey, University of Hawaii, University of Guam, University of Texas, and East-West Center study were to (a) provide basic understanding about water resources for U.S. Department of Defense installations on Guam and (b) assess the resulting effect of sea-level rise and a changing climate on freshwater availability, on the basis of historic information, sea-level rise projections, and global-climate model temperature and rainfall projections.[31]

1.3.2. Lower Fena Sub-basin:

Where the river discharges to Talofofo Bay, and in the adjacent estuary, recreational activities in the form of fishing, swimming, and river cruises occur. Impacts from the Talofofo Watershed to Talofofo Bay occur regularly in the form of concentrations of bacteria which exceed USEPA standards for primary recreational marine beaches. (Table 1 below lists Talofofo beaches). Guam EPA uses the enterococci standard as the indicator species for bacteriological quality of primary

[29] Marineau, M.D., Wright, S.A., Daily Reservoir Sedimentation Model: Case Study from the Fena Valley Reservoir, Guam, ASCE Journal of Hydraulic Research, Vol 143(9), DOI: 10.1061/(ASCE)HY.1943-7900.0001344.

[30] Rosa, S.N., and Hay, L.E., 2019, Fena Valley Reservoir watershed and water-balance model updates and expansion of watershed modeling to southern Guam (ver. 1.1, February 2019): U.S. Geological Survey Scientific Investigations Report 2017–5093, 64 p., https://doi.org/10.3133/sir20175093.

[31] Gingerich, S.B., Johnson, A.G., Rosa, S.N., Marineau, M.D., Wright, S.A., Hay, L.E., Widlansky, M.J., Jenson, J.W., Wong, C.I., Banner, J.L., Keener, V.W., and Finucane, M.L., 2019, Water resources on Guam—Potential impacts of and adaptive response to climate change: U.S. Geological Survey Scientific Investigations Report 2019–5095, 55 p., https://doi.org/10.3133/sir20195095.

recreational marine beaches.[32]

(a. *Bacteria TMDLs for 25 Guam Beaches, Tetra Tech, Inc., December 2013.*
(Approved by USEPA in 2015.)

Table 4. Bacteria TMDLs: Talofofo Beaches

Site ID	Station Name	Village	Water	Beach	Shore Access (miles)	Features
S-11	Talofofo Bay	Inarajan/Talofofo	Talofofo Bay	Head of Talofofo Bay	0.21	Talofofo Beach Park
S-18	First Beach-Talofofo	Talofofo	Beach at Asanite Point (Talofofo)	First Beach	0.06	
S-12	Ipan Beach	Talofofo	Mana Bay		0.30	Ipan Beach Park
S-13	Togcha Bay-Talofofo	Yona	Togcha Bay	Beach north of Togcha River	.27	

Data collected through Guam's Recreational Beach Monitoring Program (RBMP) served as the basis to place all RBMP sites on Guam's §303(d) list of Impaired Waters in 2006 due to exceedances of Guam's Water Quality Standards (GWQS) for enterococci bacteria. Guam's Integrated Report indicates that a priority action is to work towards developing Total Maximum Daily Loads (TMDLs) for impaired Tier 1 beaches. This TMDL report summarizes information for 16 beaches located in the Southern Guam Watershed and nine beaches located along the southeast coastline of the Northern Watershed, and describes the approach used to develop TMDLs for these impaired waters. Four of these 25 beaches (listed in Table 4) are located along the Talofofo coastline. The (25) beaches have been removed from Guam's 303(d) Impaired Waters List because respective Beach Bacteria TMDLs have been approved by EPA. However, these beaches remain impaired and are assigned an impairment "category 4a"[33] until such time that they meet GWQS f enterococci bacteria.

(b. *Microbial Source Tracking (MST) Project for Talofofo Bay (RBMP station S-11)*
The Agency developed a proposal in 2017 to collect and test water samples from four (4) beaches with bacteria TMDLs and five additional sites on Guam's 303(d) impaired waters list to determine whether the dominant source of Fecal Indicator Bacteria (FIB) is human[34] or non-human.[35] This sampling approach is considered a screening to help Guam EPA get a better understanding of the human fecal pollution contribution. See Appendix A, Section II. Assessment Methodology, for the list of quantified and observed markers and the Fecal Indicator Bacteria results.

[32] Clean Water Action Plan for Guam: *Unified Watershed Assessment*, September 15, 1998.
[33] Impaired waters without a TMDL are assigned an impairment "category 5".
[34] From sewage or septage.
[35] From cow, water buffalo, chicken/bird, deer, dog, and/or pig.

Talofofo Bay (RBMP station S-11) had the most advisories in both 2015 and 2016. In 2016, S-11 had 82% frequency of advisory where 21 advisories were released during the dry season and 25 were released during the wet season. [In 2016, n= 51, Min conc: ND, Max conc: 15,531 MPN].

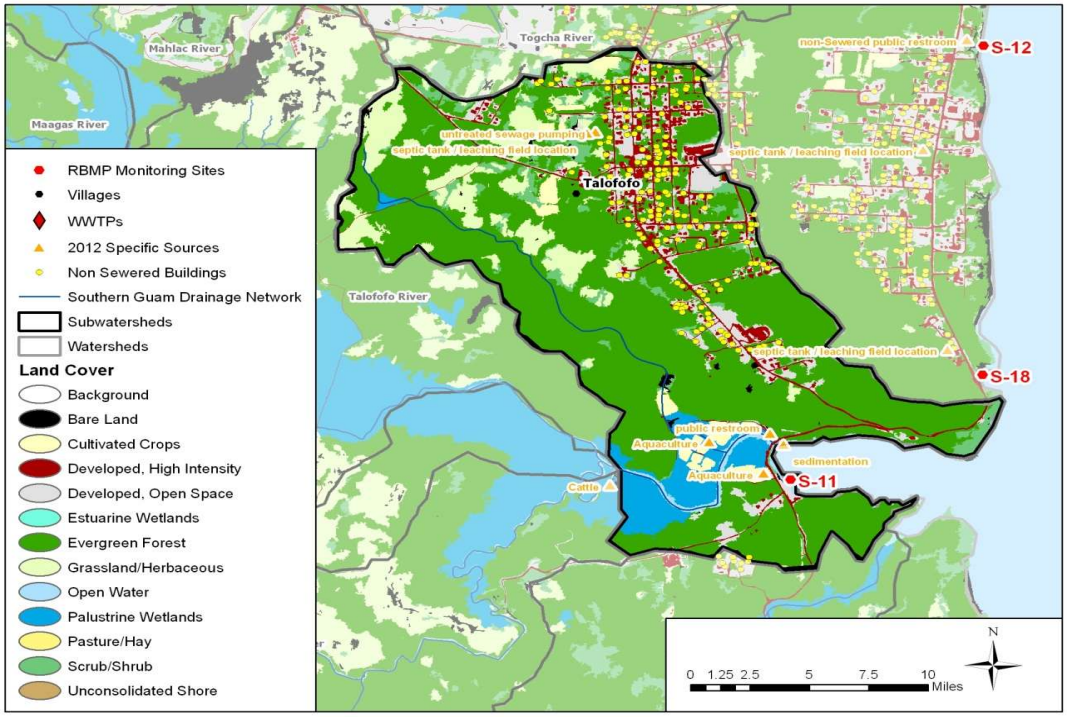


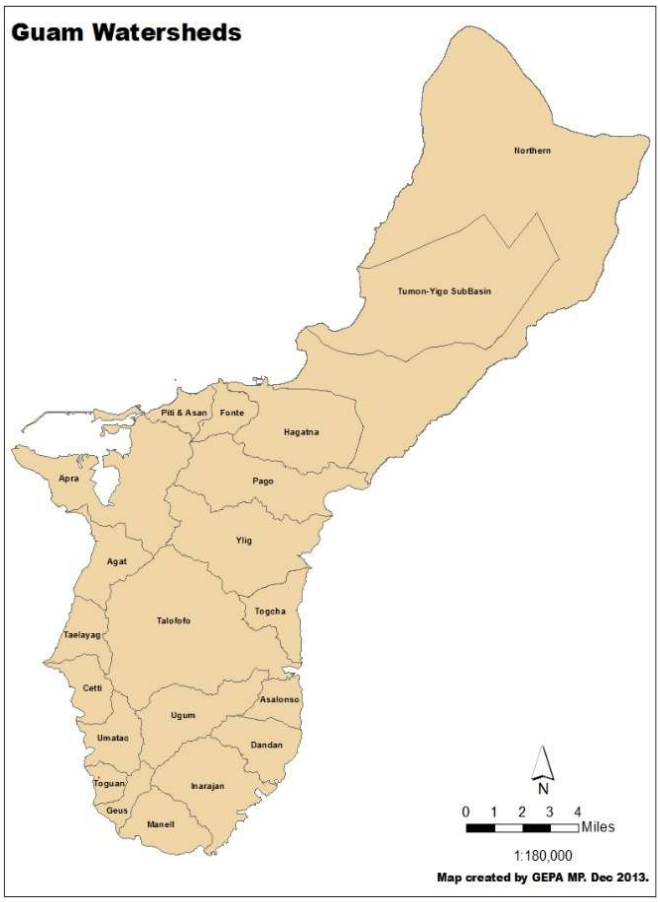
Figure 18. (2013 TMDL). Land cover and location of Talofofo Bay relative to potential source areas.

The information below is from the document *Development of Bacteria TMDLs for Twenty-five Guam Beaches, 2013*.

Table 5. Potential Pollutant Sources for Talofofo Bay Beach

Station	Wastewater: Septic systems	Wastewater: SSO	Wastewater: WWTP	Wastewater: Sewer line block/break	Wild life	River discharge	Storm water runoff	Storm drains
Talofofo Bay (S-11)	X	X			X	X	X	

1.4. Other Priority Watersheds



Guam watersheds, as delineated in the 1998 Guam Unified Watershed Assessment, are depicted in the adjacent map. More recent WERI watershed maps have grouped southern Guam's many small drainage basins into fourteen large watersheds.

The same *Unified Watershed Assessment* identified a second set of priority watersheds which shared the common characteristic of experiencing **impacts to the marine environment**. Marine impacts from this group of watersheds were in the form of exceedances of Guam Water Quality standards for biological parameters (Guam Water Quality Report to Congress, 1998, Federal Water Pollution Control Act Section 305b). Coastal impacts also resulted from high sedimentation loads during periods of high runoff. These impacts were determined to be most pronounced in areas used most heavily for recreational activities (Agana, Pago, Ylig, Togcha, Agat, and Inarajan Watersheds). Pago Watershed was of additional concern because it serves as a recharge area to the northern aquifer. The following narrative provides brief summaries of restoration or related activities in Guam watersheds over the last five years.

1.4.1. *Hagatna Watershed* (Sub-Basin in the Northern Watershed)

Watershed size: 10.3 square miles. The Hagåtña Watershed includes parts of the municipalities of Hagåtña, Agana Heights, Mongmong / Toto / Maite, Chalan Pago / Ordot, Mangilao, Barrigada, Tamuning and all of Sinajana. Guam EPA has established water quality (WQ) monitoring and biological assessment sites in the Hagåtña Watershed. These are shown in the figure on the following page and include: Six (6) river WQ sites, seven (7) marine WQ sites, and two (2) biological marine water assessment sites.

(a. *Impaired Waterbodies in the Hagatna Watershed*

1.4.1.1 ***Agana Swamp*** – Wetland, 6.40 acres assessed.
Pollutant - PCBs in fish tissue. Pollutant Source: former Agana Power

Plant. (Category 5)[36]

Background. When the Navy started remedial investigation in 1998, it Found out that the soil in the power plant, as well as fish from the swamp and river, had high concentrations of polychlorinated biphenyls, or PCBs, according to the Navy. What's now known as the Agana Power Plant is located adjacent to the northern border of the Utan arm of Agana Swamp. Runoff from the power plant site drains into Agana Swamp via an outfall located along the site's southern border. The Agana Swamp and River empties into Agana Bay near Paseo de Susana Park in Hagåtña.

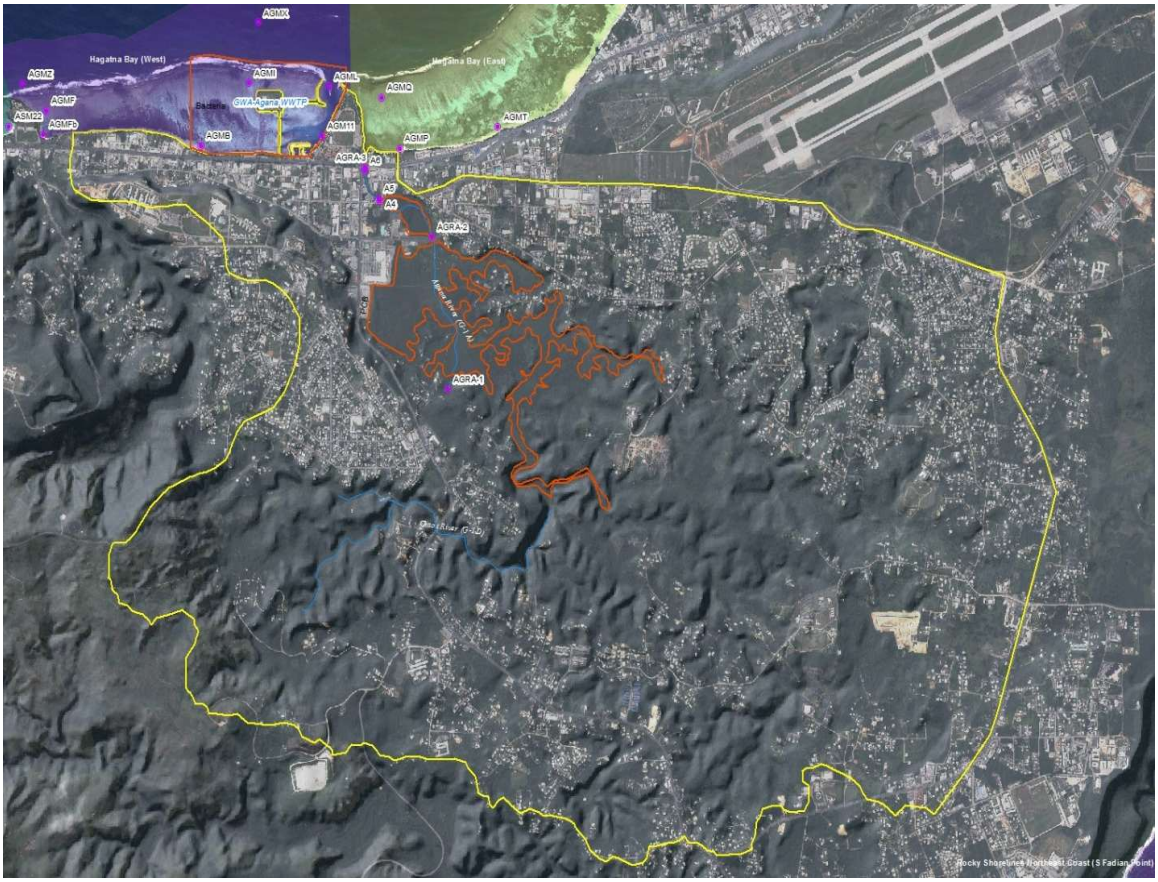


Figure 19. Hagåtña Watershed. Base map imagery from Guam Bureau of Statistics and Plans (GIS_Data_BSP\Imagery\guam_wv2_rgb_ps_02052011_v1_lut.sid). Elevation and Relief model from HydroGuam.net and derived from Digital Elevation Model (DEM) of Guam created by the U.S. Geological Survey. [GEPA 2013 STMP Surface Water Quality Assessment, Part 1 of 3]

In 1999 and 2000, the Navy excavated and disposed of PCB-contaminated soil. The Navy also found out that fish from the Agana Swamp and River had "elevated levels of PCBs." As a result, the Guam Department of Public Health and Social

[36] Impaired waterbody on Guam 303(d) List.

Services issued in 2000 a fish advisory, "warning people not to consume fish, eels, or shellfish caught in Agana Swamp or River."

In 2006, the Navy conducted a new round of fish sampling. It found out that "fish tissue PCB concentrations collected from 2006 increased compared to the fish collected in 2000 in the Agana River downstream and outlying areas, were about the same in the Agana River Channel, and decreased in the Utan Arm."

The U.S. Environmental Protection Agency, under its Brownfields Program, also cleaned up about 264 tons of PCB-contaminated soil in the Agana Springs area from 2011 to 2012.[37]

Update. December 2019. The Navy conducted a new round of fish sampling in the Agana Swamp and River to determine whether or not fish caught from it is safe to eat, "based on concentrations of PCBs."

The Naval Facilities Engineering Command Pacific led the project, with AECOM as its contractor. According to a December 2019 fish sampling work plan that NAVFAC provided, "if PCB concentrations are above 98 micrograms per kilogram, the data will be provided to Guam EPA for application to the Agana Swamp and River fish consumption advisory and the Navy will evaluate the need for further action." However, if PCB concentrations do not exceed 98 micrograms per kilogram, then the Navy and Guam EPA need to re-evaluate if any additional action is warranted at the site.[38] The Fish Advisory for the Agana Swamp and Hagatna River remain in effect.

1.4.1.2. ***Agana River*** – 2 river segments (Category 5)

Agana River 1 - 0.52 miles. Pollutants: Enterococcus, Dissolved Oxygen, PCBs in fish tissue.

Agana River 2 – 0.67 miles. Pollutant: PCBs in fish tissue. Fish Advisory in effect for these Agana River waterbodies since 2001.

Sources of pollution: Agana Power Plant, discharges from the Agana Swamp, urban stormwater runoff, discharges from the Chaot River. Agana River has been included in the series of Agana Swamp PCB assessments conducted by the Navy and USEPA.

1.4.1.3 ***"Storm Drain"*** – 0.21 miles. (Category 5)

Pollutants: E. Coli, Turbidity, Salinity, Dissolved Oxygen, Nitrates, Total Suspended Solids.

Sources of pollution: Urban runoff, storm sewers, contaminated sediments, sewer

[37] "Agana Swamp fish sampling to check if they're still PCB-contaminated", Haidee Eugenio Gilbert. Pacific Daily News, December 10, 2019.

[38] Ibid.

system/manhole overflows.

The impaired waterbody is shown in the vicinity map, Figure 20 on the following page. It remains one of several sampling sites under investigation in GEPA's East Hagatna Bay Bacteria TMDL project. The goal is to design and install recommended Best Management Practice(s) (BMPs) that will reduce the high concentration of bacteria discharged into the nearby marine waters, especially during rain events.

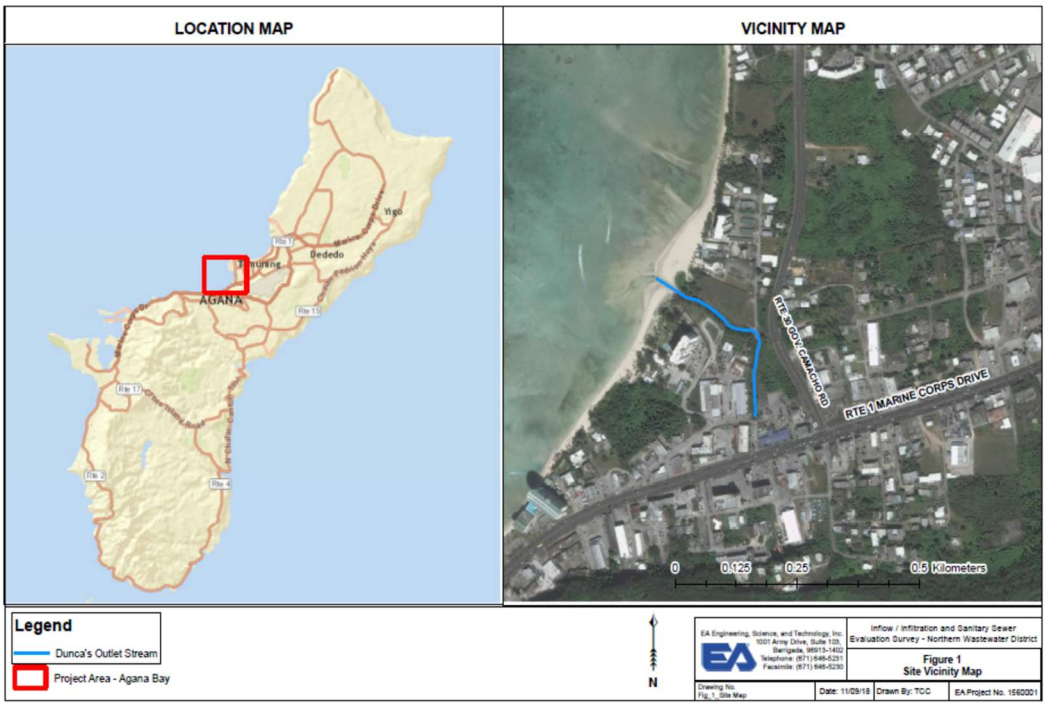


Figure 20. Site Vicinity Map: "Storm Drain"

1.4.1.4. ***Recreational/Coastal Waters (Beaches)*** (Category 4b)[39]

Bacteria Impairment.
Hagatna Marina – 0.43 miles
Trinchera Beach (East Hagatna Bay) – 1.16 miles
West Hagatna Beach – 1.11 miles
Dungca's Beach (East Hagatna Bay) – 0.99 miles

Approved EPA Bacteria TMDLs for these beaches identify potential sources of pollutants to these coastal waters which include storm drain runoff, wastewater, sewage overflow, and stormwater runoff. Other more site-specific sources are the Hagatna Marina, lack of on-site drainage, failing or no oil water separators, and stormwater UICs. Mitigation projects:

- ***Bacteria TMDL project East Hagatna Bay and Dungca's stream***

[39] Impaired waters delisted from Guam 303(d) List because a TMDL has been developed.

- ***GEPA Microbial Source Tracking (MST) Project for Hagatna Boat Basin (RBMP station N-12)***

The Agency developed a proposal in 2017 to collect and test water samples from four (4) beaches with bacteria TMDLs (including 5 additional sites on Guam's 303(d) list) to determine if the dominant source of Fecal Indicator Bacteria (FIB) is human[40] or non-human.[41] This sampling approach is considered a screening to help GEPA better understand the human fecal pollution contribution. A list of quantified and observed markers and FIB results are included in Appendix A.

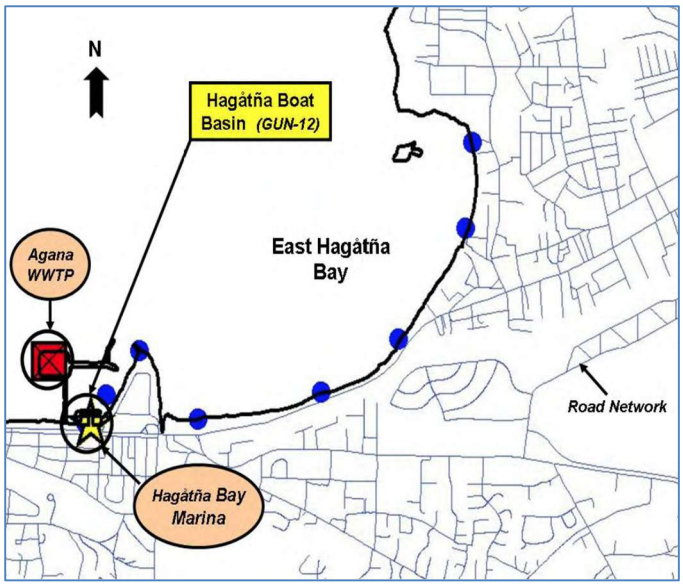


Figure 21. Hagatna Boat Basin Coastal Site

Hagatna Boat Basin (coastal station N-12) is included in this MST project. In 2016, N-12 had 71% frequency of advisory where 11 advisories were released during the dry season and 25 were released during the wet season. [In 2016, n= 51, Min concentration: ND, Max concentration: 10,462 MPN].

Table 6. Potential Pollutant Sources for Hagatna Boat Basin Site *(Bacteria TMDL for 25 Guam Beaches, 2013)*

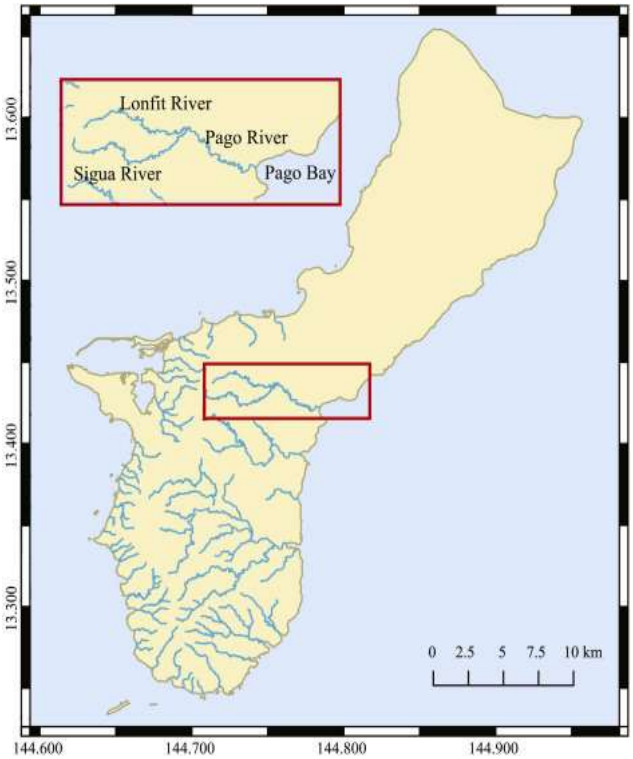
Station	Wastewater: Septic systems	Wastewater: SSO	Wastewater: WWTP	Wastewater: Sewer line block/break	Wildlife	River discharge	Storm water runoff	Storm drains
Hagatna Boat Basin (N-12)		X	X				X	X

(b ***U.S. Army Corps of Engineers (ACOE) Agana River Civil Works Study***[42]

The study will focus on significant flood inundation damages and road closures within the Agana River floodplain during and after recent tropical cyclones, including significant flooding issues in the downtown Hagatna area. The three-year, $3 million study is 100 percent federally funded and will be managed by ACOE Honolulu District's Civil and Public Works branch. The ACOE civil works team started initial analysis and survey of the Agana River area in early March 2020.

[40] From sewage or septage.
[41] From cow, water buffalo, chicken/bird, deer, dog, and/or pig.
[42] USACOE News Release No. 20-014. Published March 17, 2020.

1.4.2. *Pago Watershed*



The Pago watershed is in the east of central Guam. It has a drainage area of 10.35 sq. miles. The main rivers in the watershed include Sigua River, Lonfit River, and Pago River with approximate lengths of 4.79 miles, 3.81 miles and 2.81 miles respectively. Sigua River and Lonfit River discharge from west to east to Pago River, and then to Pago Bay in the Pacific Ocean.[43] The adjacent Guam Map highlights rivers that drain the Pago watershed. (GIS data: University of Guam, Water and Environment Research Institute.)

Figure 22. Map of Guam Featuring Pago Watershed Rivers

(a *Impaired Waters in the Pago Watershed*

1.4.2.1. ***Pago Bay*** – ***(marine waters)*** .70 square miles (Category 5).
Pollutants: Enterococcus, Dissolved Oxygen, Nitrate.
Sources of pollutants: Urban runoff, storm sewers, contaminated sediments.

1.4.2.2. ***Pago River***
3 freshwater segments (Category 5).
Pago River 1 0.06 mi Pollutant: E. coli
Pago River 2 4.74 mi Pollutant: E coli, Dissolved Oxygen
Pago River 4 0.52 mi Pollutant: turbidity
Sources of pollutants: Urban runoff, storm sewers, contaminated sediments.

1.4.2.3. ***Lonfit River***
2 freshwater segments. (Category 5).
Lonfit River 2 1.07 mi
Lonfit River 3 0.04 mi

[43] https://south.hydroguam.net/watersheds-pago.php

*Both w*aterbodies are impaired by the following pollutants: Salinity, Temperature, Total Coliform, Enterococcus, and E. coli; Lonfit River 3 is additionally impaired by Iron and Turbidity.
Source of pollutants: Ordot Closure Facility

1.4.2.4 ***Recreational Waters (Beaches)*** (Category 4b).
Beach at Pago Bay – 0.96 miles.
Pollutant source: Wastewater, squatters, and river discharge. This recreational beach site, S-15, is the most northern site on the east coast of Guam.

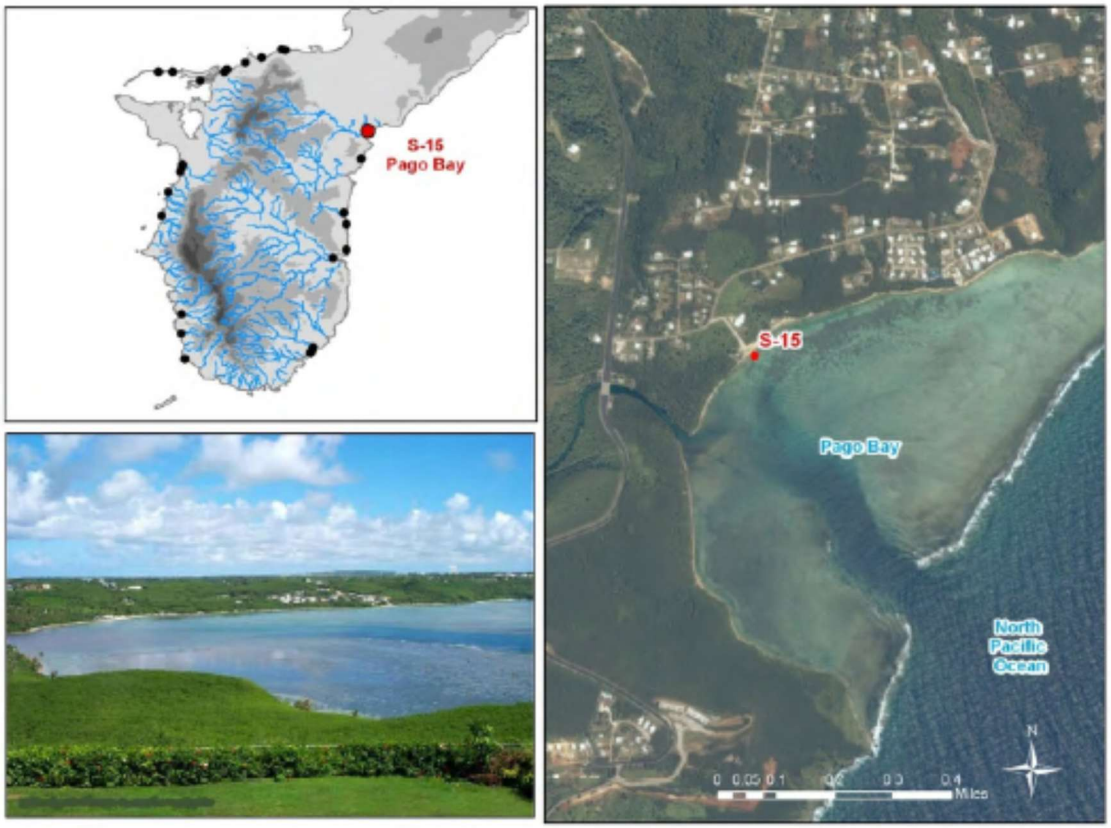


Figure 23. Location of the Beach at Pago Bay relative to other RBMP sites.

(b. ***Pago Watershed Restoration Activities***
The most recent projects and activities in the watershed investigated terrestrial natural resources, marine and freshwater quality, and the habitat and aquatic life in these environments. The data and outcomes of such projects continue to support the protection and restoration of Pago watershed resources.

- ***Ordot Dump Post-closure activities.*** Situated on 63-acres of land, the Ordot Dump had been the sole disposal facility for Guam's waste since the 1940s. Undocumented materials including unexploded ordnance and leachate discharge had hampered closure efforts for years. Brown and Caldwell led the investigation and design team that developed the closure plan and ended an era of long-running environmental issues, including releases of contaminated leachate into local water

bodies, methane gas emissions, and odor problems. The plan included a path to achieving Subtitle D and Clean Water Act compliance, converting a portion of the site to a public park, and using landfill gas to generate up to 500 KW of power. Brown and Caldwell is continuing post-closure activities by performing inspections, O&M, and implementation of the site post closure monitoring plan.[44] Of priority importance to Guam EPA are the results obtained from continued water quality monitoring of the Lonfit River. With the closure of the Ordot Dump, it is expected that the health of the river will gradually improve.

- ***Physical dynamics of the reef flat, channel, and fore reef areas of a fringing reef embayment: An oceanographic study of Pago Bay, Guam,*** *(Published 2019).* Long-term observations of oceanographic patterns and processes provide necessary context for integrative ecological studies and for assessing and mitigating anthropogenic impacts to coastal ecosystems. The oceanographic patterns and processes of Pago Bay, Guam, a tropical coral reef system with a small estuary, were observed for one year. An array of 50 sensors including current profilers, temperature and dissolved oxygen loggers, and water quality sensors were deployed throughout Pago Bay from 0–26 m depth...[45] Highlights:
  - Circulation in the Pago Bay reef flat and channel is strongly driven by wave height.
  - Circulation on the fore reef is affected by wave height and wind.
  - The reef flat experienced diel temperature shifts with a range as large as 12.8 ◦C.
  - Pulses of relatively cooler water were observed at 16-26 m depth.
  - Heavy rain events can cause dramatic changes in channel water quality.

1.4.3. ***Agat Watershed***

The Agat watershed is in the southern coast of southern Guam, and south of Apra Harbor. It has a drainage area of 4.36 sq. miles. The main rivers in the watershed include Namo River, Gaan River, Togcha River, Finile Creek and Salinas River with approximate lengths of 2.62 miles, 1.30 miles, 1.17 miles, 0.94 mile, and 0.56 mile respectively. These rivers discharge to Agat Bay from east to west.

(a. *Agat Watershed Impaired Waters*

1.4.3.1 ***Agat Bay 1*** 0.63 square miles. (Category 5).

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[44] https://brownandcaldwell.com/project/ordot-landfill-closure/

[45] Christina M. Comfort [a,*], Gordon O. Walker [a], Margaret A. McManus [a], Atsushi G. Fujimura [b], Chris E. Ostrander [c], Terry J. Donaldson [b]
a Department of Oceanography, University of Hawaii at Manoa, Honolulu, HI 96822, USA
b Marine Laboratory, University of Guam, Mangilao, GU 96923, USA
c University of Utah, Salt Lake City, UT 84112, USA
∗ Correspondence to: Department of Oceanography, University of Hawaii at Manoa, 1000 Pope Road, Honolulu, HI 96822, USA. E-mail address: ccomfort@hawaii.edu (C.M. Comfort).
https://doi.org/10.1016/j.rsma.2019.100740

The pollutants are PCBs, Chlordane, and Dioxin in fish tissue.

Orote Seafood Advisory: A seafood advisory issued in 2001 for the west side of Orote Peninsula (Rizal Beach to Spanish Steps- this includes a section of Agat Bay) and Gabgab Beach in Apra Harbor remains in effect. Seafood caught in these areas may contain polychlorinated biphenyls (PCBs), chlorinated pesticides or dioxins at levels that are not safe to eat. This includes fish, shellfish and algae or sea grapes.[46]

1.4.3.2 ***Recreational Waterbodies (Beaches)*** (Category 4b).

Togcha Beach (aka Agat Beach) 0.79 miles
Nimitz Beach 0.49 mile
Bangi Beach 1.47 miles

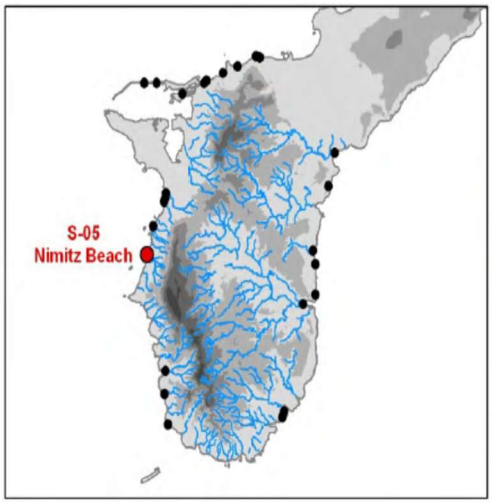

Figure 24. Nimtz Beach

Figure 25. Togcha Beach Monitoring Sites

Pollutant: Enterococcus

Sources: Wastewater, storm water, and river discharges. Specific sources for Nimitz Beach: Marina and recreational boating, and boat discharge.

Nimitz Beach is located on the southern edge of Agat on the shore of Taleyfac Bay. It is a popular site and recreational area. (Bacteria TMDL for 25 Guam Beaches, 2013).

(b ***Agat Watershed Project: GEPA Microbial Source Tracking (MST) for Bangi Beach***

The Agency developed a proposal in 2017 to collect and test water samples from four (4) beaches with bacteria TMDLs to determine whether the dominant source of Fecal Indicator Bacteria (FIB) is human [47] or non-human. [48] This sampling approach is considered a screening to help Guam EPA get a better understanding of the human fecal

[46] Guam EPA Fish Advisory language for Orote.
[47] From sewage or septage.
[48] From cow, water buffalo, chicken/bird, deer, dog, and/or pig.

pollution contribution. A list of quantified and observed markers and FIB results are included in Appendix A.

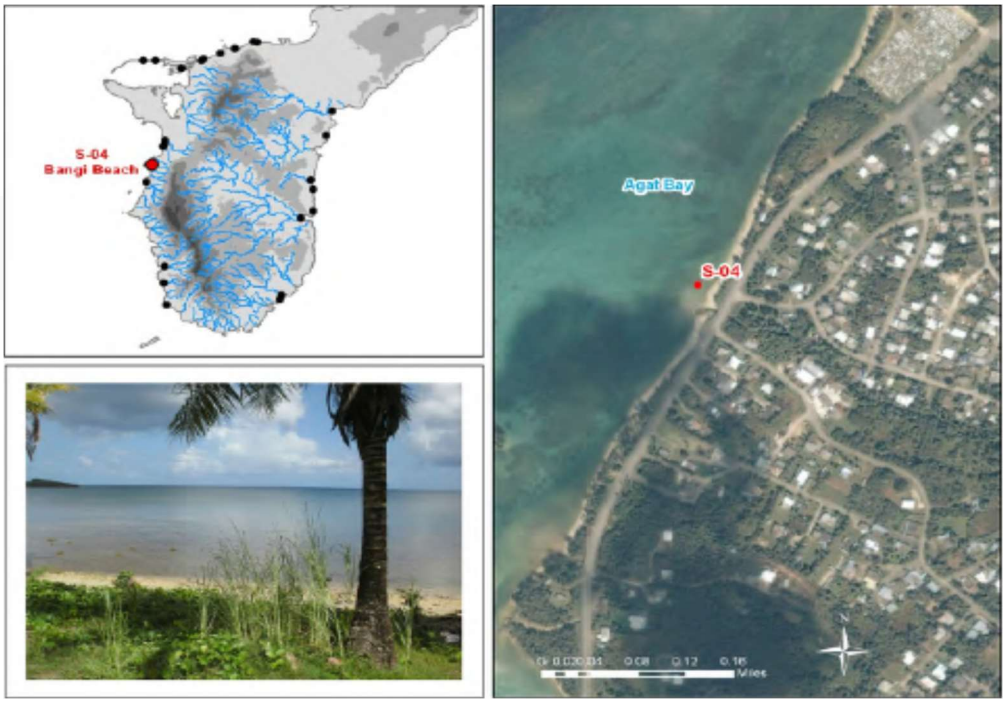

Figure 26. Location of Bangi Beach (S-04) and an aerial view of the area.

Table 7. Potential Pollution Sources for Bangi Beach

Station	Wastewater: Septic systems	Wastewater : SSO	Wastewater : WWTP	Wastewater : Sewer line block/break	Wildlife	River discharge	Storm water runoff	Storm drains
Bangi Beach (S-04)		**X**		**X**	*	**X**	**X**	

* This suspected potential source is not listed in the 2013 TMDL.

In 2016, S-04 had 57% frequency of advisory where 8 advisories were released during the dry season and 21 were released during the wet season. [In 2016, n= 51, Min conc: ND, Max conc: 11,199 MPN]. (Beach information from *Bacteria TMDL for 25 Guam Beaches, 2013*.) Potential sources of pollution are identified in Table 7.

1.4.4. Apra Watershed

Apra watershed is in the southern coast in the middle of Guam, including Apra Harbor. It has a drainage area of 13.65 sq. miles. The main rivers in the watershed include Atantano River, Sasa River, Aguada River, Big Guatali River, Aplacho River, Maggo River, Guatali River, Laghas River, Tenjo River and Paulana River with approximate lengths of 2.65 miles, 2.48 miles, 2.42 miles, 2.42 miles, 2.32 miles, 2.17 miles, 1.36 miles, 1.18 miles, 1.15

miles and 0.93 miles respectively. These rivers discharge to Apra Harbor from east to west.[49]

(a. *Impaired waters*

Figure 27. Impaired Marine Bays: Apra Watershed. Orote Seafood Advisory Study: Orote Landfill Site COMNAVMAR, Guam. Fact Sheet No. 2, August 2002

1.4.4.1. ***Marine Bays*** - Category 5
These Bays are subject to a Fish Advisory.

Apra Harbor: 2 waterbodies
Apra Harbor 2 4.61 mi²
Apra Harbor 1 0.05 mi²
North Orote Peninsula Sea Cliffs 0.23 mi²
South Orote Peninsula Sea Cliffs 0.02 mi²
Tipalao Bay 0.10 mi²

Pollutant: PCBs in fish tissue.
A seafood advisory issued in 2001 for the west side of Orote Peninsula (Rizal Beach to Spanish Steps) and Gabgab Beach in Apra Harbor remains in effect. Seafood caught in these areas may contain Polychlorinated biphenyls (PCBs), chlorinated pesticides or dioxins at levels that are not safe to eat. This includes fish, shellfish and algae or sea grapes. [50] Source of pollutants: Orote Landfill and surrounding area. The Landfill was used for disposal of residential, commercial, and industrial waste from approximately 1944 to 1969.

1.4.4.2. ***Recreational Waters (Beaches)*** (Category 4b, except for Gabgab Beach Category 5)

Gabgab Beach 0.65 miles **Subject to Fish Advisory for PCBs**
Outhouse Beach 0.46 miles
Family Beach 0.15 miles
Port Authority Beach 0.46 miles

Sources of Pollutants: Gabgab Beach - Orote Landfill and surrounding area;
The sources of pollutants for the three remaining beaches include: wastewater from septic systems and permitted discharges from industrial point sources; stormwater runoff; and for Family beach, recreational and tourism activities. (*Bacteria TMDL for 25 Guam Beaches, 2013*).

[49] http://south.hydroguam.net/watersheds-apra.php
[50] Guam EPA Fish Advisory language for Orote.

1.4.5 Piti/Asan Watershed

The Piti-Asan Watershed consists of two Sub-Watersheds: the Piti Watershed outlets flow into Piti Bay and the Asan Watershed flows directly into Asan Bay. Furthermore, the watershed is divided into several sub-basins identified in Figure 27. These sub-basins collect runoff which is deposited into their respective rivers. The major contributors of runoff to the Piti-Asan Watershed are the Asan River in the Asan sub-basin of the Asan Sub-Watershed and the Masso River in the Masso sub-basin of the Piti Sub-Watershed.[51]

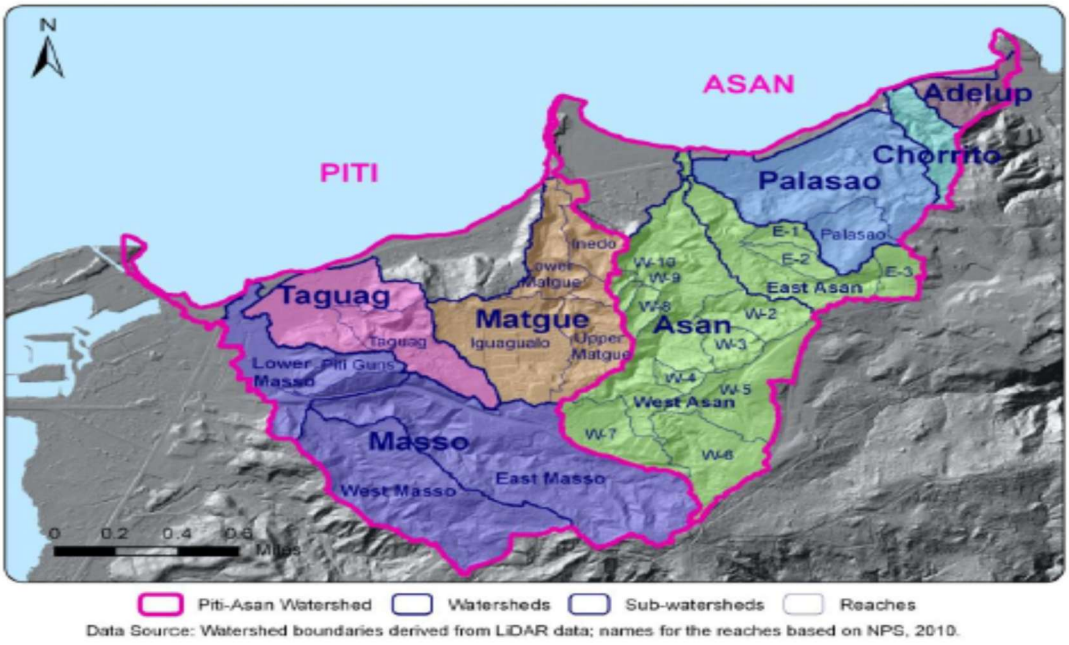

Figure 28. Piti-Asan Watershed Sub-basins (WERI Technical Report No. 138, 2012)

The watershed has an area of about three-square miles. Large areas are under conservation status in the watershed including three War in the Pacific National Historic Park Units and the Masso Conservation Area. The main pollutants impacting water quality in this watershed are sediments and bacteria (fecal coliform). The major threats posed to the overall health of the watershed and specifically to water quality are erosion and associated sedimentation, development, wildland fires, invasive species, and pollutants.[52]

(a ***Impaired Waters in the Piti-Asan Watershed***

[51] Khosrowpanah, S., Lander, M., Golabi, M., Manibusan, S. 2012. A GIS-BASED WATERSHED MANAGEMENT PLAN FOR THE PITI-ASAN WATERSHEDS. Technical Report No. 139, Water and Environment Research Institute, University of Guam.

[52] Kottermair, M., 2012. Piti-Asan Watershed Management Plan. Technical Report 138, Water and Environmental Research Institute, University of Guam.

1.4.5.1 ***Recreational Waterbodies (Beaches)*** (Category 4b)

Asan Bay Beach	0.46 miles
Tepungan Beach	1.08 miles
Santos Memorial Park	0.26 miles
USO Beach 2	0.26 miles

Table 8. Specific Piti-Asan Beach Potential Source Summary.

Site	Type of Source	Notes
Asan Bay Beach N-14	Wastewater	Septic system
	Stormwater	Highway maintenance & runoff
	Recreation and Other	Recreation & Tourism activities
		River discharge
Tepungan Beach (Piti Bay) (N-15)	Wastewater	Septic system
	Stormwater	Highway maintenance & runoff
	Recreation and Other	Recreation & Tourism activities
		River discharge
USO Beach 1 (Santos Memorial Park Beach) (N-16)	Wastewater	Septic system
	Stormwater	Stormwater runoff
	Other	Historical combined animal feedlot (chicken)
		River discharge
USO Beach 2 (United Seamen's Service) N-17	Recreation and Other	Recreational & tourism activities

Source: *Bacteria TMDLs for 25 Guam Beaches, 2013).*

(b. ***Inventory and Monitoring at War in the Pacific National Historical Park (Asan)***[53]

"While primarily a World War II historical park, the seven units of War in the Pacific National Historical Park (Guam) encompass coral reefs, seagrass beds, tropical savanna grasslands, a mahogany forest, limestone forests, bogs, streams, coastal and forest wetlands, and offshore islets. These outstanding environments provide homes for rare animals and provide a laboratory for scientific inquiry and research.

What's Monitored Here? Benthic Marine Communities, Climate, Marine Fish, Plant Communities, Streams, and Water Quality. Guam EPA is most interested in the water quality information obtained for Guam's marine and fresh waters connected with the local National Park Service sites."

The NPS provides the following description and rational for water quality monitoring. "The quality of surface waters, marine waters, and groundwater is fundamental to the ecosystems across the Pacific islands. Parks must determine the quality of their water resources, strive to avoid human-caused pollution occurring within and outside of

[53] https://www.nps.gov/im/pacn/wapa.htm

park boundaries, and maintain surface waters and groundwaters as essential components of park aquatic and terrestrial systems.

All pacific island national parks are also concerned about effects of adjacent land uses and increasing development in watersheds connected to the parks' marine, freshwater, and groundwater resources.

The four core parameters chosen for monitoring by the NPS Water Resources Division (temperature, conductivity/salinity, pH, and dissolved oxygen) provide baseline data for water quality assessment. In addition, turbidity, total nitrate, total nitrogen, total phosphorous, and chlorophyll are monitored by the Pacific Island Network for their ecological significance."

Guam EPA has used NPS water quality reports and data to support Guam water quality monitoring and assessment integrated reporting (biannually) to USEPA. The most recent Guam NPS surface and marine water quality reports include:

- Raikow DF and Others. 2017. Marine water quality in in War in the Pacific National Historical Park Summary Report 2009-2014. Natural Resource Data Series. NPS/PACN/NRDS—2017/1122.National Park Service. Fort Collins, Colorado

- Raikow DF and Farahi A. 2014. Water quality in the Asan River, War in the Pacific National Historical Park: Summary report 2007–2012. Natural Resource Data Series NPS/PACN/NRDS—2014/662. National Park Service, Fort Collins, Colorado. Natural Resource Data Series. NPS/PACN/NRDS—2014/662. Fort Collins, Colorado

1.4.6 Cetti Watershed

Cetti watershed is located south of Talofofo Village, occupying a small southern part of Agat village and a small northern part of Umatac Village. It has a drainage area of 3.07 sq. miles. The main rivers in the watershed include Cetti River, Agaga River, Sella River, Asmafines River and Madofan River with approximate lengths of 1.32 miles, 1.21 miles, 1.03 miles, 1.02 miles and 0.76 mile respectively. Cetti River discharges to Cetti Bay, Sella River and Asmafines River discharge to Sella Bay, and Agaga River and Madofan River discharge to the Philippine Sea in the north of Sella Bay.[54]

(a. ***Cetti Watershed Restoration: Cetti Bay Reforestation Project***

On June 5, 2008, the Cetti Bay Watershed Agreement was signed by the U.S. Navy and Government of Guam officials. The agreement provided funding from the Navy for a $4.7 million reforestation project of eroded areas in Cetti Bay. The Navy negotiated the effort in consideration of coral reef affected by planned extensions of Kilo Wharf at U.S. Naval Base Guam.

The U.S. Fish and Wildlife Service, the U.S. National Marine Fisheries Service, U.S.

[54] http://south.hydroguam.net/watersheds-cetti.php

Environmental Protection Agency, U.S. Forest Service and the U.S. Army Corps of Engineers partnered with the Navy and GOVGUAM for the planning and implementation of this project.[55]

Background:[56]

"The Cetti Bay watershed reforestation project is the Navy's preferred mitigation action... a mutual consensus was reached between Navy and GOVGUAM that the Cetti Bay watershed reforestation project will consist of reforestation of up to 500 ac (202 ha) of savanna grasslands and/or badlands within the Cetti Bay watershed, located on the southwestern coast of Guam, approximately 9 miles (14.4 kilometers) south of Apra Harbor.

As stated in the Guam Department of Agriculture (GDOAG) reforestation plan, the bay's coral reef resources have been heavily degraded over the past few decades. One of the factors is believed to be upland erosion caused primarily by road construction, wildland fires, and feral ungulates (unrelated to Navy activities). Reforestation of the savanna grasslands and/or badlands within the Cetti Bay Watershed will reduce terrigenous sediment loads entering Cetti Bay, thereby improving water quality. This may have an indirect beneficial effect on the coral reef habitat in the receiving waters. Reducing sediment flow is intended to support and enhance the terrestrial and marine ecosystems, including fish and wildlife habitat within Cetti Bay and the Cetti Bay watershed.

The following provides examples of the actions included in the reforestation project: (1) Conversion of savanna grasslands and/or badlands to forest lands around Cetti Bay; (2) reforestation of the area's badlands; (3) fencing of identified reforested areas to provide ungulate control; and (4) implementation of erosion BMPs....

GDOAG will be responsible for the implementation and long-term management of the reforestation projects....The Navy will fund a third-party contractor to conduct the terrestrial and marine monitoring at Cetti Bay as prescribed in the Mitigation Plan."

1.4.7 Umatac Watershed

The Umatac watershed is located in the southwest coast of Guam, north of Merizo and south of Agat. It has a drainage area of 3.84 square miles. The main rivers in the watershed include La Sa Fua River, Laelae River, Madog River, Chagame River and Astaban River with approximate lengths of 2.11 miles, 1.9 miles, 1.59 miles, 1.02 miles and 0.2 miles

[55] Jesse Leon Guerrero, U.S. Naval Forces Marianas Public Affairs. Story Number NNS080623-04 6/23/08.
[56] Record of Decision for Kilo Wharf Extension (MILCON P-502) at Apra Harbor Naval Complex, Guam, Mariana Islands. 1/9/08. https://www.federalregister.gov/d/E8-103

respectively. Chagame River flows from north to south, and merges to La Sa Fua River which discharges to Fouha Bay in the Philippine Sea. Astaban River discharges to Madog River, which merges to Umatac River. Laelae River drains from east to west to Umatac River. Umatac River discharges to Umatac Bay.

(a. *Impaired Waters in the Umatac Watershed*

1.4.7.1 *Umatac Bay Beach* 0.14 miles.
Sources of pollution are stormwater runoff and river discharge.
The rocky shore of this recreational beach, S-06, offers a scenic walk, tables, benches, and a basketball court for visitors and recreational users. Umatac Bay Beach is located on the eastern shore of Umatac Bay, a popular spot for many Umatac Bay visitors.

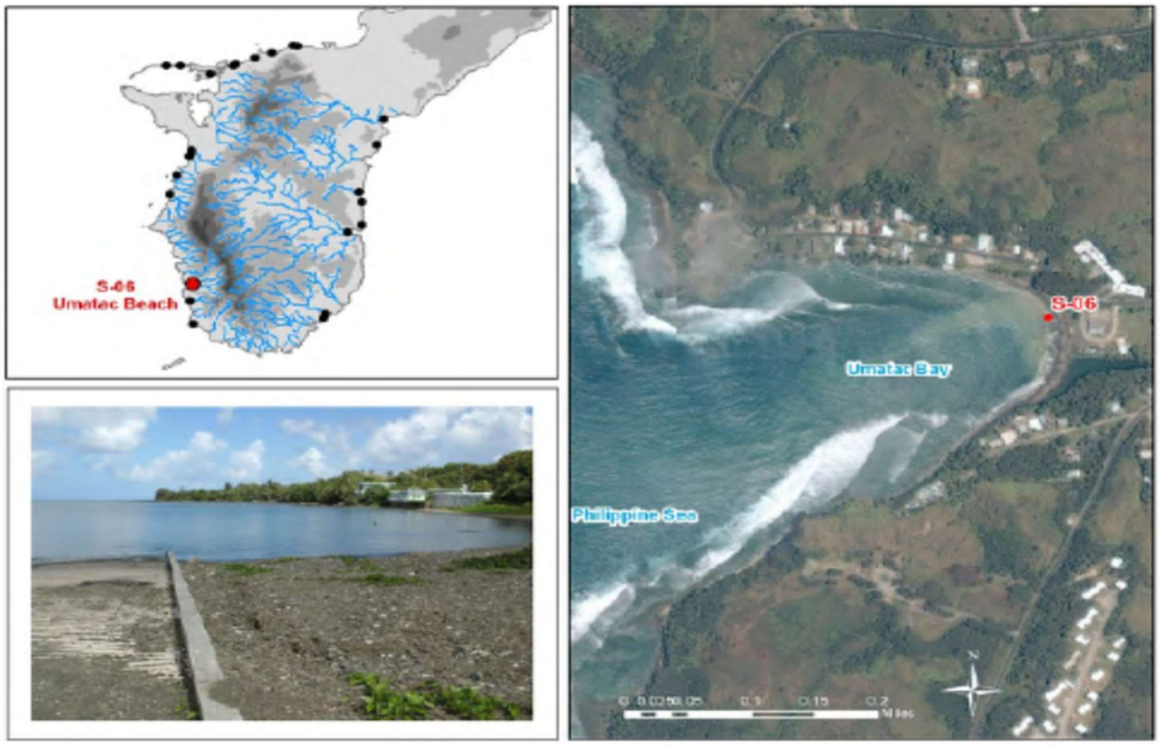

Figure 29. Location of Umatac Bay Beach relative to other TMDL beaches

(b. ***Umatac Watershed Restoration Activities***

(1) ***Humatak Community Foundation (HCF)*:**

The HCF was created in September 3, 2011, as a public, non-profit corporation, for the people of the village of Humatak (Umatac) as well as family and friends living on and off the island of Guam to work together towards sustainable natural and cultural resources for our people and our future. It is a volunteer based-organization comprised of diverse community leaders of business, government policy, non-profit

management, preservation & conservation, education, and technology.[57]

Foundation results include:

- *Umatac Coral Reef Ambassadors:* A conservation program comprised of adult and youth mentors and youth ambassadors, created to provide the community with a life-long learning experience in the conservation of our natural resources through awareness, personal growth, teamwork, leadership skills, and a traditional and environmental mindset for the future.
  - Training to monitor coast reef off Humatak Bay, Fouha Bay, and Cetti Bay;
  - Conservation learning exchanges with other islands.

- *Umatac Village Heritage Museum:* A component of the "Heritage Mission" of the HCF, proposed to be located in the F.Q. school facility (registered historic site) and managed by the HCF and community volunteers. One of the four goals is to showcase the people and history of Umatac village in its natural and cultural environment.
  - Portable Exhibition- "Umatac by the Sea". Also available for viewing at www.humatak.org.
  - Humatak Heritage Walking Tour – trained docents (guides) walk visitors through the historic streets of the village;
- *Initiative for developing a village charter school: Francisco Quinata Sanchez Community Charter School.*

(2) **The Humatak Project: "Reviving Guam, one bay at a time"**[58]

"...The Humatak Project became a community-led with numerous partner organizations in the government, the university and high schools, and non-governmental organizations. Project Coordinator Austin Shelton was a marine biology Ph.D. student and a research assistant to Dr. Robert Richmond at the University of Hawaii Marine Laboratory. Scientific guidance and coordination for the Project's community restoration effort was provided under a NOAA grant.[59]

Components of the Humatak Project (https:www.humatakproject.org)

- *Educational Outreach*
  Educational projects designed to increase environmental awareness in the community.
- *Watershed Management*
  Implemented erosion control projects (planted tree seedling and installed sediment filter socks on the slopes of the Fouha watershed) that promoted

[57] www.humatak.org

[58] Stories from Oceania. "Guam – the Humatak Project", Author Regina Gregory, September 2013. https://www.ecotippingpoints.org/our-stories/region-oceania.html

[59] NOAA grant entitled: "Science to Conservation: Linking Coral reefs, coastal watersheds, and their human communities in the Pacific Islands."

community volunteerism and discouraged arson by deer hunters.

- *Scientific Research*
  Implemented projects fulfilling need for long-term comprehensive data (engaged partners to monitor the health of the reefs—including coral habitat and associated biological communities);
  Completed study of sedimentation in Fouha Bay (collected turbidity, temperature and salinity data for comparative study).

1.4.8. Manell-Geus Watershed

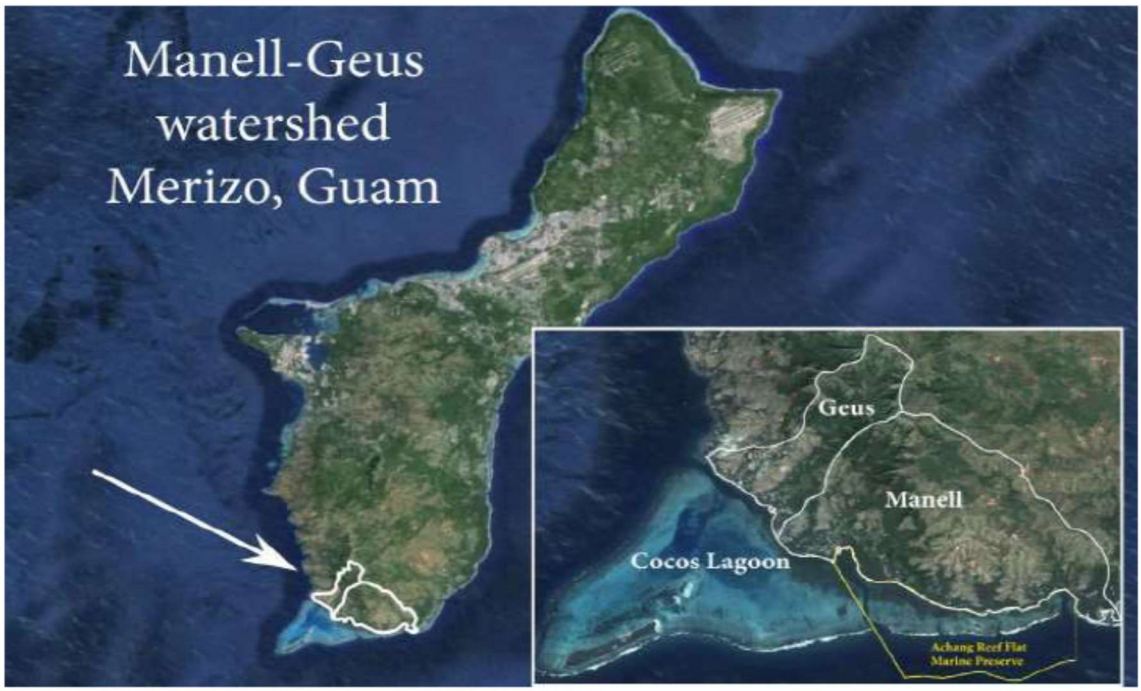

Figure 30. Manell-Geus Watershed (www.noaa.gov/habitatblueprint)

Manell watershed is located in the south of Guam. Most of the watershed is in Merizo Village. It has a drainage area of 4.55 sq. miles. The main rivers in the watershed include Ajayan River, Nelansa River, Laolao River, Fintasa River, Liyog River and Asgadao Creek with approximate lengths of 2.91 miles, 2.01 miles, 0.98-mile, 0.77 mile, 0.72 mile and 0.5 mile respectively. Ajayan River discharges to Ajayan Bay in the Pacific Ocean, and the other rivers discharge directly to the Pacific Ocean.[60]

Geus watershed is in the southwest of Guam. Most of the watershed is in Merizo Village. It has a drainage area of 1.73 sq. miles. The main river is the Geus River with approximate length of 2.71 miles. Geus River discharges to the Philippine Sea.[61]

(a. ***Impaired Waters in Manell-Geus Watershed***

[60] http://south.hydroguam.net/watersheds-manell.php
[61] http://south.hydroguam.net/watersheds-geus.php

1.4.8.1 ***Marine Bays***

Cocos Lagoon 2 waterbodies Category 5
Cocos Lagoon 1 5.70 square miles
Cocos Lagoon 2 0.34 square miles
Pollutant: PCBs in fish tissue. The lagoon is under a Fish Advisory.

Cocos Lagoon is an atoll-like coral reef lagoon located on the southwestern coast of the island of Guam. The lagoon is separated from the open ocean by a series of fringing reefs and barrier islands, of which Cocos Island is the largest. Cocos Lagoon is a popular area for recreational activities including fishing, boating and diving, along with subsistence fishing.

Between 1944 and 1963, the U.S. Coast Guard (USCG) operated a Long-Range Navigation (LORAN) station on Cocos Island. Components from the LORAN station, including several transformers and capacitors containing PCBs, likely used in the operation of the station were found on land and in nearby waters. The USCG has since removed the PCB containing transformers and capacitors, along with a substantial amount of contaminated soil, but there is evidence that these chemicals have migrated into several marine matrices including fish and nearshore sediments. This is of concern to local managers and to the public. Exposure to PCBs has been found to elicit a range of toxic responses in animal studies including reduced growth, reproductive impairment, and vertebral abnormalities. PCBs may also cause cancer in animals. A fish consumption advisory was put in place in Cocos Lagoon in 2006, following detection of PCBs in fish through USCG-funded research. In 2015, local resource managers asked NCCOS for help in assessing chemical contaminants in sediments and fish to understand the extent of the contamination throughout Cocos Lagoon.

("Assessment of Chemical Contaminants in Sediments and Biota from Cocos Lagoon, Guam") This National Oceanic and Atmospheric Administration (NOAA) National Centers for Coastal Ocean Science (NCCOS) research project, funded by the NOAA's Coral Reef Conservation Program (CRCP), began in May 2015 and is ongoing. The goal of this project is to quantify the extent of chemical contamination in sediments and fish in Cocos Lagoon, Guam. Significant chemical contaminant issues have been identified in the area of Cocos Island, as a result of past land use activities. The project is providing an assessment of the spatial distribution of a suite of both organic and inorganic chemical contaminants in sediments, as well as contaminant body burdens in fish.[62]

[62] EPA Fish and Shellfish Program Newsletter, May 2018. EPA 823-N-18-005

1.4.8.2. ***Recreational Waters (Beaches)***

Merizo Pier – Mamaon Channel 0.46 miles (Category 4b).
Potential sources of pollutants are wastewater sources such as sewer line blockages or breaks and sewer system overflows.

(b. ***<u>Manell-Geus Watershed Restoration Projects</u>***

(1) ***Manell-Geus Watershed as NOAA Habitat Focus Area***

In 2014, the National Oceanic and Atmospheric Administration (NOAA) announced its designation of Guam's Manell-Geus Watershed as a Habitat Focus Area under its Habitat Blueprint framework.[63]

While this site has amazing marine resources, the coastal ecosystem is impacted by poor water quality linked to erosion on the steep hillsides and along streambanks. Wildland fires, feral animals, and off-roading vehicles have accelerated the erosion. These conditions can lead to flooding in downstream areas, affecting the village and its adjacent reef.

Sedimentation can have serious impacts to coral health by increasing susceptibility to disease, decreasing growth rates, and affecting coral settlement. These problems are made worse by outbreaks of crown-of-thorns starfish (a carnivorous predator that preys on reef coral polyps) and overharvesting of key species such as large parrotfish.[64]

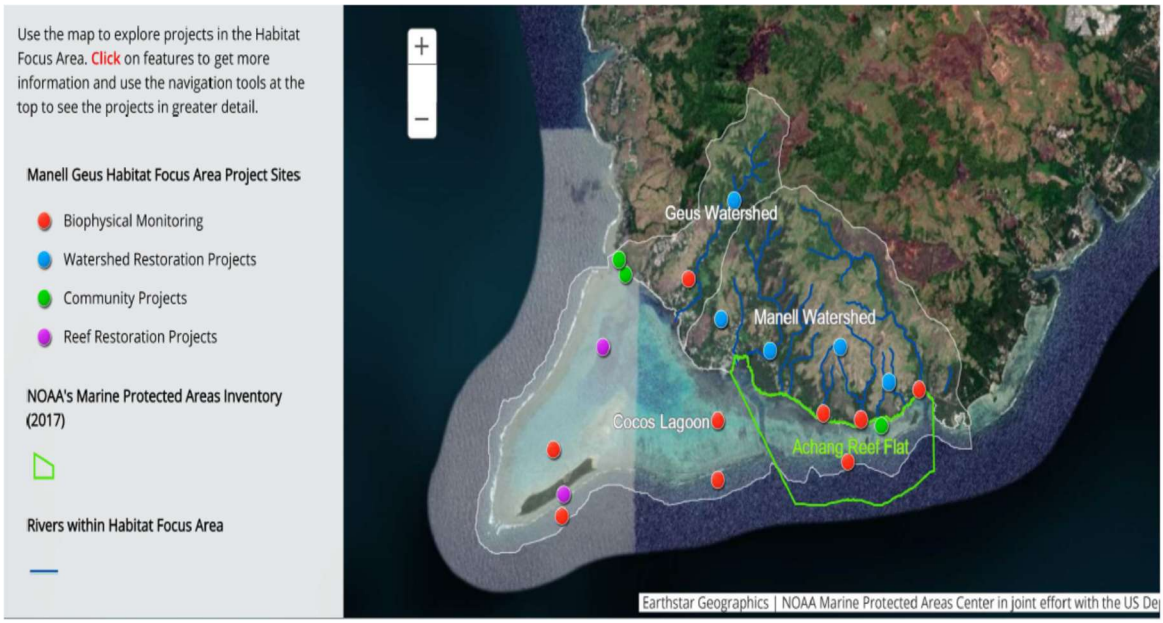

Figure 31. Manell Geus Habitat Focus Area Project Sites[65]

[63] https://www.habitatblueprint.noaa.gov/wp-content/uploads/2016/04/Habitat-Blueprint-1p-Fact-Sheet_19Nov2015.pdf
[64] https://www.habitatblueprint.noaa.gov/habitat-focus-areas/manell-geus-guam/
[65] Ibid. Story Map.

The story map site provides detailed information about the HFA:

- priority issues (upland erosion/wildland fires, stream erosion and flooding, water quality, algal growth, and coral bleaching);
- focus area objectives (to promote healthier reefs, to encourage healthier and safer coastal communities, to enhance community engagement);
- the projects (see Figure 30); and
- partners for the work undertaken in the watershed.

1.4.9. Toguan Watershed

The Toguan watershed is located between the villages of Umatac and Merizo. It has a drainage area of 1.41 sq. miles. The main rivers in the watershed include Toguan Creek, Pigua River and Bile River with approximate lengths of 1.38 miles, 1.09 miles and 0.73 mile respectively. Toguan Creek drains to Toguan Bay in the Philippine Sea, and Bile River and Pigua River discharge to Bile Bay((in the Philippine Sea. All these rivers flow from east to west.[66]

(a. ***Impaired Waters in the Toguan Watershed***

1.4.9.1 ***Recreational Waters (Beaches) Category 4a***

Toguan Bay Beach 0.46 miles

Table 9. Potential Pollutant Sources: Toguan Bay Beach (S-07).

Station	Wastewater: Septic systems	Wastewater: SSO	Wastewater: WWTP	Wastewater: Sewer line block/break	Wildlife	River discharge	Storm water runoff	Storm drains
Toguan Bay (S-07)			**X**		*	**X**	**X**	

*Suspected potential source not listed in the TMDL document.

(b. ***Watershed Project: GEPA Microbial Source Tracking (MST) for Toguan Bay Beach (S-07)***

The Agency developed a proposal in 2017 to collect and test water samples from four (4) beaches with bacteria TMDLs to determine whether the dominant source of Fecal Indicator Bacteria (FIB) is human[67] or non-human.[68] This sampling approach is considered a screening to help Guam EPA get a better understanding of the human fecal pollution contribution. A list of quantified and observed markers and FIB results are included in Appendix A.

In 2016, S-07 had 78% frequency of advisory where 19 advisories were released

[66] http://south.hydroguam.net/watersheds-toguan.php

[67] From sewage or septage.

[68] From cow, water buffalo, chicken/bird, deer, dog, and/or pig.

during the dry season and 21 were released during the wet season. [In 2016, n= 51, Min conc: ND, Max conc: >24,196 MPN].

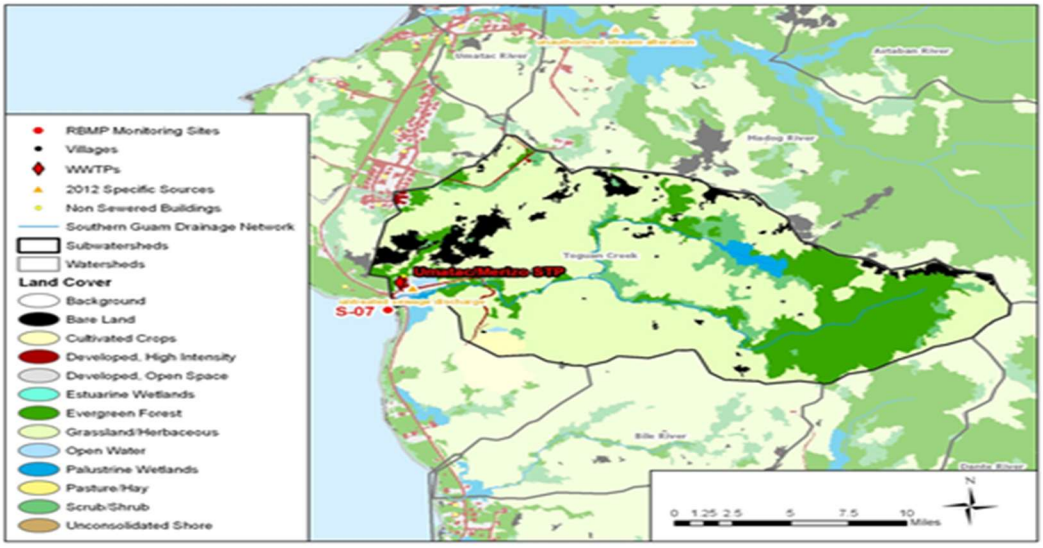

Figure 32. Location of Toguan Bay Beach to potential sources. (Guam Bacteria TMDL, 2013).

2.0 Point Source Pollution Control Program

The Agency implements the following specific programs designed to address known sources of pollution (point sources) including pipes, ditches, and sanitary or storm sewers.

(a) **Permit Compliance** – This program activity is implemented through site inspections and surveillance of conditions imposed via an approved Guam EPA Water Quality Certification (known as Section 401 Certification) and a National Pollutant Discharge Elimination System (NPDES) permit issued to industrial and non-industrial facilities.

Guam NPDES permits are administered by U.S. EPA, Region 9. The Guam EPA Environmental Monitoring and Analytical Services (EMAS) Division is responsible for reviewing Section 401 Water Quality Certification (WQC)[69] applications and processing them for action by the Agency Administrator. NPDES permits require 401 WQCs. The EMAS and Water Divisions review draft NPDES permits and develop the respective 401 WQC conditions and abatement schedules per the provisions of the NPDES permit and/or the 401 WQC application.

Table 10 identifies NPDES permits for the reporting period. The discharges from these permitted facilities included effluent from wastewater treatment plants, thermal effluent from the power plants, a number of discharges contained minor amounts of oil and other toxic materials, and storm water discharges. The guidelines for effluent limitations are based on the Revised 2017 Guam Water Quality Standards. Two permits were terminated by U.S. EPA during the reporting

[69] GWQS. 22 GAR Chapter 5, Section 5106. Section 401 Certifications.

period: the permit for GWA's Baza Gardens STP and the permit for the Guam Shipyard facility. *Pending issuance of a new permit, USEPA has administratively extended the permit terms for several listed facilities indicating an "expired" permit date.*

Table 10. Federal National Pollutant Discharge Elimination System (NPDES) Permits

Permit No.	Facility – Permit Expiration Date		Receiving Water(s)
GU0020087	GWA, Agana STP	12-31-2024	Philippine Sea
GU0020141	GWA, Northern District STP	12-31-2024	Philippine Sea
GU0020222	GWA, Agat/Santa Rita STP	12-31-2024	Philippine Sea
GU0020273	GWA, Umatac-Merizo STP	12-31-2024	Philippine Sea
GU0020371	GWA, Ugum Surface Water Treatment Plant	11-30-2026	Ugum River
GU0020001	GPA, Cabras Power Plant	01-31-2025	Apra Harbor
GU0110019	USN, Apra Harbor STP	04-30-2022	Philippine Sea
GU0020389	USN, Fena Water Treatment Plant	05-31-2027	Namo River
GUG000001[Δ] (BULK FUEL STORAGE)	Tristar Agat Terminal	03-31-2025	Big Guatali River
	Tristar, F-1 Pier		Apra Harbor
	Mobil Oil Guam, Inc.		Apra Harbor
	South Pacific Petroleum Corp.		Apra Harbor
	GPA, Piti Terminal		Piti Channel, Apra Harbor
GU00200397	Cabras Marine	07-30-2023	Apra Harbor
GU0020168	UOG, Marine Laboratory	AE*	Pacific Ocean
GU0020346	Unitek Environmental-Guam	08-31-2022	Apra Harbor
GUS040000	Department of the Navy, MS4•	01-31-2024	DON MS4 Permit Area
GUS040001	Guam DPW, MS4•	01-31-2024	DPW MS4 Permit Area[70]
GU0020095	GWA, Baza Gardens STP	08-31-2018	Permit terminated 1-31-2019
GU0020362	Guam Shipyard Dry Dock Facility		Permit terminated 12-06-2018

[Δ] Five existing permitted facilities consolidated by EPA under General Bulk Fuel Storage Facility Permit
AE* terms of existing permit "administratively extended" pending issuance of a new permit
• Municipal Separate Storm Sewer System NPDES Permit

GWA WWTP NPDES Permits

In late 2019, EPA reissued all four GWA WWTP permits jointly in a single document to promote consistent regulatory requirements across all facilities, including a joint set of general conditions applicable to all four facilities. The permits became effective in January 2020.

BULK FUEL STORAGE General NPDES Permit for Guam

The EPA Regional Administrator determined that bulk fuel storage facilities operating in the areas described in the proposed general NPDES permit are more appropriately and effectively controlled by a general permit than by individual permits. The subject general NPDES permit was issued January 31, 2019, effective April 1, 2019. It establishes effluent limitations, prohibitions, and other conditions on discharges from facilities in the general permit area. These

[70] The entire Island of Guam, except for areas under jurisdiction of military. DPW permit Appendix C.

conditions are based on the administrative record. EPA regulations and the permit contain a procedure which allows the owner or operator of a point source discharge to apply for an individual permit instead.

Guam MS4 Permits

Two Municipal Separate Storm Sewer (MS4) Permits were issued on Guam in December 2018, effective February 2019. The permittees were the Department of the Navy (DON) and the Guam Department of Public Works (DPW). The DON permit was modified in April 2020, effective May 2020. These permits can be reviewed at https://www.epa.gov/npdes-permits/guam-npdes-permits.

Figure 33. MS4 Permit Coverage Area (Source: EPA)

The Navy MS4 permit area includes the following facilities (Naval Base Guam, Apra Heights, Nimitz Hill, Naval Magazine and Naval Hospital and adjacent high school), located in any of the following watersheds: Agat, Apra, Cetti, Dandan, Fonte, Geus, Hagåtña, Inarajan, Manell, Pago, Piti-Asan, Taelayag, Talofofo, Toguan, Ugum, Umatac, and Ylig. In addition, the village limits of the village of Tamuning are included to the extent these limits extend northward beyond the boundaries of the Hagåtña watershed. The western tip of Navy Barrigada in the Hagåtña watershed is not covered.[71]

The Guam DPW permit covers the entire Island of Guam, except for the areas under the jurisdiction of the military.[72]

(b) **Enforcement**- Guam's Water Pollution Control Act and local Water Quality Standards authorize Guam EPA to take legal action against those who pollute the waters of Guam.

[71] DON MS4 NPDES Permit Appendix E, https://www.epa.gov/npdes-permits/guam-npdes-permits
[72] Guam DPW MS4 NPDES Permit Appendix C, https://www.epa.gov/npdes-permits/guam-npdes-permits

Enforcement is carried out through site inspections coupled with an assessment of respective water quality monitoring data. NPDES permittees submit quarterly DMRs or Discharge Monitoring Reports to EPA Region 9 for review and evaluation.

Appropriate enforcement action is applied for non-compliance to approved permit conditions.

3.0 Nonpoint Source (NPS) Pollution Control Program

In February l987 U.S. Congress passed the Water Quality Act which required states and territories to assess nonpoint source problems and develop management programs to control them. Nonpoint source pollution presents a serious threat to the quality of Guam's marine, surface and groundwater. And as the overall designated Agency responsible for protecting the quality of waters in Guam, Guam EPA oversees the following activities under its Water Pollution Control Program, NPS 319 program, and Guam's coastal NPS program, to prevent and control nonpoint source contamination.

3.1 Individual Wastewater Permits

Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam. The island's most extensive population development is occurring in the northern watershed above its federally designated sole source aquifer. Due to government funding constraints, such development is occurring without adequate public sewage infrastructure. As a result, occupants depend on septic tanks and leaching field systems for waste disposal.

Table 11. Wastewater Permitting Activities

Wastewater (Permit) Activity	2017	2018	2019
ST/LF* Permit Applications Reviewed & Processed	172	154	**N**
SC** Applications Reviewed & Processed	88	143	**N**
ST/LF Inspections	132	149	115
ST/LF Inspections (approved)	95	138	115
Occupancy Permits : ST/LF	64	130	115
Occupancy Permits : SC	39	9	**N**
Grease Trap Follow Up Inspections	142	173	160
Grease Trap inspected & Approved	17	7	26

Source: Guam EPA Water Pollution Control Program
***** Septic Tank/Leaching Field ** Sewer Connection
N – new reporting format only quantifies ***total numbers***, i.e. applications reviewed & processed; total inspections.

To control this nonpoint source of pollution, Section 48102, Chapter 48 of 10 Guam Code Annotated (GCA) requires that no building shall be occupied or used as a dwelling, school, public building, commercial building, industrial building or place of assembly without toilet or sewage

facilities of a type inspected and approved for the disposition of human excreta and other domestic wastes.

Furthermore, in the northern area of Guam, permitted housing density has been decreased to one residential dwelling unit per half acre of property in unsewered areas to protect the groundwater from contamination.

Permits are required for new and remodeled buildings. To ensure the installation of proper sewage disposal systems, the permitting process includes mandatory on-site inspection and building plan review, permit issuance and final inspection of the completed disposal system. Building occupancy permits are only issued upon approval of the structure's sewage disposal system.

During 2018, a total of two hundred ninety-seven (297) permit applications were reviewed and processed for septic tank/leaching fields (ST/LF) and connections to public sewer. Two hundred fifty-three (253) of two hundred sixty-four (264) ST/LFs met inspection criteria during the reporting period (2018-2019). Two hundred forty-five ST/LFs met occupancy permit requirements. The Agency conducted four hundred seventy-five grease trap follow-up compliance inspections. Thirty-three grease traps met approved inspection requirements

3.2 Soil Erosion and Sediment Control Program

Soil erosion is one of the island's most serious nonpoint source pollution problems especially in southern Guam. Increased local development has disturbed Guam's soils and greatly accelerated erosion that follows every rainfall. Erosion not only removes the productive topsoil and substrata, it leaves scars which regenerate growth with much difficulty. Eroded topsoils are transported to streams and rivers, reefs and beaches, where recreational sites and wildlife habitats are destroyed. The fragile, filter feeding organisms of the reef are smothered, light penetration into the water is drastically reduced and silt covers the bottom with a soft layer unsuitable for bottom-dwelling plants and animals. As pollution increases, productivity decreases, and the fish and other animals die or leave the area.

Guam EPA enforces the *Guam Soil Erosion and Sediment Control Regulations* (Public Law 25-152) to prevent, reduce, and control soil erosion or other environmental impacts to the community. Enforcement action is supported by an inspection program and an application review and approval process for all clearing, grading, or stockpiling permits. For most clearing and/or grading permits involving disturbed areas of one acre or more, there must be an accompanying Erosion Control Plan (ECP) which sets specific conditions to protect the quality and designated uses of the waters of Guam.

During 2018, a total of one hundred eleven (111) permits were issued and subject to compliance with the Guam Soil Erosion and Sedimentation Control Regulations. Of this total, forty-one (41) were permits for clearing; twenty-six (26) were permits for grading; and thirty-three (33) were permits for clearing and grading. A total of seventy-five (75) EPPs/ECPs were reviewed and

approved. The Water Pollution Control Program transitioned to a new reporting format in FY 2019. Some permitting activities and respective data reported in FYs 2016-2018 could not be similarly quantified for FY 2019.

Table 12. Soil Erosion & Sediment Control Permitting Activities

SE&SC (Permit) Activity	2017	2018	2019
Clearing	67	41	*New reporting format used. Some permit activity data merged and hard to quantify.*
Grading	54	26	
Clearing & Grading	21	33	
Stockpiling	20	4	
Clearing/Grading/ Stockpiling	22	7	
Enforcement Routine/Follow-up Inspection	119	76	
Site Ocular Inspections	90	75	
Reviewed & Approved EPP/ECP*	89	75	

Source: Guam EPA Water Pollution Control Program
* Environmental Protection Plan/Erosion Control Plan

3.3 Feedlot Waste Management Program

In 1986, the Guam EPA developed Feedlot Waste Management Regulations to control livestock operations which generate in excess of one hundred (100) pounds of waste per day. This volume constitutes a significant concentration of waste that would typically be generated by facilities housing approximately twenty (20) swine or five hundred (500) fowl. On-site visits to smaller livestock operations are undertaken when identified. Where improper handling of wastes exists, corrective action is recommended to the operator which is often handled through modifications in "housekeeping" procedures.

No feedlot operators were registered with Guam EPA during the reporting period. However, the Agency responds to reported complaints possibly connected to illegal livestock operations. A notice of violation may be issued to any person found in violation of the Feedlot Waste Management Regulations.

Improper handling, treatment and storage of waste from livestock operations are a concern because of the potential contamination of the island's water resources. In southern Guam, improper control of livestock wastes results in pollutants being transported to surface waters. Similarly in the north, such waste may be readily transported through the porous limestone to groundwater.

- *All proposed feedlot operations are required to obtain a permit from the Department of Public Works.*
- *The permitting process involves zoning assessment and site approval by the Department of Land Management and assessment for proper vector control measures by the Department of Public Health and Social Services.*
- *Guam EPA reviews the feedlot operations permit application, and the facility plans and specifications to assess the adequacy of waste storage, disposal and treatment facilities. Once construction is completed and Guam EPA has inspected and approved the facility, an operating permit is issued to the proposed feedlot operator. Annually monitoring of permitted feedlot operations is required.*

3.4 Urban Runoff

Urban runoff is one of Guam's most voluminous nonpoint source problems which impacts both groundwater and coastal waters. Urbanization generally increases the sheer volume of stormwater runoff because of the large number of impermeable surfaces associated with construction or land development. As a result, rainwater is not naturally allowed to percolate into the ground.

Guam EPA continues to improve stormwater management via its permitting process regulating any construction, land development or earth-moving operations. Project applications are evaluated for stormwater run-off disposal and mandated to incorporate "Best Management Practices" (BMPs). Permitted projects must implement these BMPs to maximize on-site containment and/or treatment of stormwater prior to discharge, especially discharges into any near shore waters of Guam. In Tumon Bay, discharges to coastal waters have been decreased with the elimination of most existing storm drains near shore.

The Water Division continues its efforts to modernize review procedures or applicable regulations by incorporating provisions for stormwater management based on criteria in the Manual.[73] The Agency utilizes the expertise of its assigned legal counsel to support the modernization and adjudication of outdated statutes and regulations.

3.5 Clean Water and Drinking Water Grants to Guam

EPA allots a portion of the Drinking Water State Revolving Fund (DWSRF) and Clean Water State Revolving Fund (CWSRF) as grants to Washington, D.C., and the U.S. territories of U.S. Virgin Islands (USVI), Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI) for drinking water and wastewater infrastructure.

Congress exempted the District and the U.S. territories from establishing state revolving loan fund programs. The District and the U.S. territories listed above instead chose to continue receiving funds under the Construction Grants Program. EPA supports public health and

[73] 2006 CNMI and Guam Stormwater Management Manual

environmental protection in the U.S. territories and the District by helping communities develop and maintain their water infrastructure through funding, tools, training, and technical assistance. Under Section 201 and 601 of the Federal Clean Water Act as amended, Guam EPA administers the use of federal funds to control point and nonpoint source pollution, resulting from small communities that generate raw sewage discharges and/or have on-site disposal systems, which do not function properly due to poor soil characteristics and/or improper operation and maintenance. Guam receives its allotment of federal funds based on its construction needs, in accordance with a construction grants priority list and system established by the Guam EPA Board of Directors. The priority list is usually revised annually to reflect impacts of each individual project on public health and the Northern Aquifer, the island's designated sole source of drinking water.

Since 1968, over $59 million has been provided to Guam by the EPA for the planning, design, and construction of wastewater collector systems and treatment facilities, as mandated by Title II and VI of the Federal Clean Water Act as amended. In 2017, EPA awarded just over $9 million in Clean Water and Safe Drinking Water State Revolving Funds to Guam Waterworks Authority (GWA).

As an example of the work performed using DWSRF and CWSRF funding, from October 1, 2016, through September 30, 2017, through an in-kind technical services contract, EPA provided grant funding to increase the technical, financial, and managerial capacities at GWA. The project included the development and implementation of enterprise-wide standard operating procedures, an upgraded geographic information system, and the creation of an asset management program. Working closely with EPA's contractor on asset management, GWA completed an asset inventory, installed a new computerized maintenance and management system for the control and tracking of work orders, and implemented a condition and criticality assessment tool. GWA is beginning to see a significant increase in the ratio of preventative to corrective maintenance. The five-year project helped GWA improve operations and management of their water and wastewater systems and implement standardized procedures and tracking for a more effective and efficient capital improvement program.[74]

4.0 Guam Water Quality Standards (GWQS)

Guam's Water Quality Standards are provisions of law which establish both the water quality goals for specific waters, and the regulatory basis for treatment controls and strategies.

- GWQS were initially adopted in 1975 and revised in 1987 and 1992.
- These standards were revised in 2001 and received EPA Region 9 approval in 2002. The most notable revisions address 1) *Anti-degradation*. The existing policy was revised to meet federal requirements 2) *Groundwater*. Numeric water quality criteria for groundwater were included. The criteria helped clarify necessary water quality levels to retain our sole source aquifer as an acceptable drinking water resource. 3) *Numeric Criteria for surface waters.* Numeric criteria (e.g. microbiology, pH, nutrients, and toxic substances) were

[74] EPA Document 830R18002. July 2018

updated and newly adopted to reflect updated federal requirements. 4) *Effluent limitations.* Protection was included for threatened and endangered species, and for those organisms harvested for food. Sections were added which allow schedules of compliance for point source discharges that need time to comply with the new requirements, establish federally required low-flow requirements for permit limit calculations, and identify petroleum spill prevention requirements for those facilities having a capacity of 660 gallons or greater. 5) *Wetlands and water quality certifications.* Requirements related to these sections were clarified. Unnecessary or redundant language was removed. Application forms were eliminated from the body of these standards so that revisions to the forms can be made by Agency staff as necessary, without going through a regulatory revision process.

- Amendments to the GWQS were filed with the Guam Legislature in October 2017, (effective 90 days thereafter), and approved by USEPA in March 2018. These amendments appropriately adopted EPA's 2012 Recreational Water Quality Criteria for protecting human health in recreational waters. The amendments include updated recreational water criteria; revised categories of waterbodies to which the recreational water criteria apply; and Statistical Threshold Values (STVs).
- A Triennial Review of GWQS was conducted in 2018 with a public hearing held on January 15, 2019, in accordance with CWA Section 303(c)(1) and EPA's implementing regulations at 40CFR 131.20. The next Triennial Review is planned in 2021.

Future revisions to the 2017 WQS could include additions of and changes to water quality criteria, adopted implementation procedures, or other general policies.

Other priority WQS issues under evaluation include but are not limited to:

- development of biological indices for water quality in all waters
- development of local wetland water quality standards
- re-assessment of marine water classifications: M-1, M-2, M-3
- new parameters for sediment quality criteria for selected contaminants
- changes to WQS for Cu, Ni, Al and/or clarification of mixing zone standards

5.0 Total Maximum Daily Loads (TMDLs)

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and allocates pollutant loading among point and nonpoint pollutant sources. A TMDL also includes a margin of safety to ensure protection of the water.

EPA has approved forty-three TMDLs for Guam: a *Sediment TMDL for the Ugum Watershed* prepared by Tetra Tech, Inc. and EPA for Guam EPA in October 2006; the *Northern Watershed Bacteria TMDLs* (Tetra Tech, Inc., March 2010) for seventeen recreational beaches; and twenty-five (25) additional Bacteria TMDLs were developed (Tetra Tech, Inc., December 2013) for recreational beach sites in central and southern Guam. Another TMDL for Tumon Bay is under development.

5.1 The Clean Water Act and the 303(d) List

Under section 303(d) of the 1972 Clean Water Act, Guam is required to develop its list of impaired waters. These impaired waters do not meet water quality standards that Guam has set, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that Guam establish priority ranking for waters on the list and develop TMDLs for these waters.

Section 303(d) of the CWA requires each state to submit an updated 303(d) list of impaired waters to EPA every two years. The 303(d) list provides a way for Guam EPA to identify and prioritize water quality problems. The list also serves as a guide for developing and implementing watershed recovery plans to protect beneficial uses while achieving federal and state water quality standards. The list is meant only as a means of identifying water quality problems-not the cause of water quality problems.

Causes of water quality problems are determined when water quality management plans are developed for the watersheds in which the listed segments are located. These plans contain controls referred to as the TDML.

5.2 Guam's Methodology for Developing the 303(d) List

Existing scientific data and best professional judgment are used to assess water quality and to determine which waterbodies should be listed. Guam EPA develops a draft list and presents the list for public comment. All public comments are reviewed and evaluated in the development of the final 303(d) list which is forwarded to the EPA for approval.

Guam EPA seeks all available information to determine if Guam's surface water is violating water quality standards. The assessment of impaired waters for 303(d) listing considers data submitted/generated by individuals, organizations and government agencies, as well as Guam EPA monitoring data.

Guam EPA follows federal criteria, GWQS, and scientific protocols in developing the list. It reviews all available data to ensure conformance with specified minimum quality assurance requirements:

- Sampling and analysis must be conducted under a written Quality Assurance/Quality Control Plan or by established and approved protocols
- Data must demonstrate that field instruments were operated according to accepted methods
- Data must demonstrate that biological monitoring followed standardized protocols
- Data must demonstrate that certain other testing methods complied with accepted practices

EPA listing guidelines require that Guam demonstrate good cause for not placing a waterbody on the list. If available data indicates a waterbody is not meeting water quality standards, and

the data meets listing guidelines, then Guam EPA must assume that the waterbody is water quality limited.

Guam EPA does not have information on all Guam waterbodies. Those without information, or information not compatible with the EPA guidelines, are not included on the 303(d) list. Streams and rivers with suspected problems are identified as "Waterbodies of Potential Concern." Streams and rivers will not be placed on the 303(d) list until sufficient data is available that indicates a violation of water quality standards. Guam EPA is mandated to protect water quality by establishing standards (GWQS) to protect beneficial uses. While there may be competing beneficial uses in a waterbody, federal law requires Guam EPA to protect the most sensitive of these beneficial uses. Guam EPA standards include parameters such as bacteria, pH (acidity level), turbidity, and dissolved gas, certain toxic and carcinogenic compounds, habitat and flow modification, and aquatic weeds or algae that affect aquatic life.

Appendix A contains the methodology narrative for developing Guam's 2022-2024 303(d) List.

5.3 Listed Waterbodies

Once a waterbody is placed on the 303(d) list Guam EPA must develop a TMDL for that waterbody. Guam EPA has committed to develop TMDLs on high priority listed waterbodies within 10 years. This time frame considers the urgency to protect public health, safeguard Guam drinking water sources, and the desire of landowners to begin working on restoration efforts.
Guam EPA's comprehensive watershed approach for protecting water quality includes developing TMDLs for both point and non-point sources. When establishing limits for pipes (point sources), Guam EPA monitors to determine what pollutant is causing water quality problems and in what amounts it is entering the water. The monitoring also attempts to determine how much of the pollution comes from non-point pollution, such as surface runoff, and how much is naturally occurring.

Guam EPA has received technical assistance from USEPA for all its TMDLs. Computer models determine what effect point source pollution is having on the waterbody, and how much of the pollutant can be discharged without exceeding water quality standards in the watershed. Computer modeling is also used to establish permit limits on the amount of pollutants each pipe can discharge.

When controlling pollution from non-point sources, several factors must combine to form a comprehensive approach to TMDL development.

5.4 Water Quality Management Plan Development

The Clean Water Act requires the state to develop a water quality management plan to reduce pollution on each waterbody on the 303(d) list. As much as possible, water quality management plans will be developed by government agencies in cooperation with landowners. If the land is agricultural, then the Guam Department of Agriculture and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture may be involved to work with the

landowners in the watershed to devise and implement a management plan. Federal agencies (such as the U.S. Navy and the Air Force) would be responsible for developing water quality management plans for federal lands, with Guam EPA oversight. The above plans should be sent to Guam EPA for inclusion in an overall watershed plan, which Guam EPA would then submit to EPA for approval.

5.5 Removing Waterbodies from the 303(d) list

A waterbody is removed from the list when there is evidence that:

- A TMDL has been approved;
- Water quality standards are met;
- Water quality standards are violated due only to natural conditions (meaning that there is no human-caused influence);
- The original listing was in error.

Guam EPA will continue to evaluate delisted waterbodies to ensure that management plans are being implemented, and water quality standards achieved.

6.0 Program Coordination with Other Agencies

One of the elements of Guam's strategy for effective water quality protection and restoration and pollution prevention is *"utilizing and developing our local expertise"*[75]. The information and collaborative partnerships established by working with others will help the island identify its resource problems and priorities and collectively develop and implement effective resource protection and restoration activities.

Key components of Guam's approach include:

- Interacting with other agencies and organizations and capitalizing on the best resources possible;
- Establishing executive and legislative support to sustain the long term commitment necessary for environmental work;
- Working closely with the military, a major island landowner, particularly regarding land use activities and impacts resulting from significant increases in military presence;
- Capacity building facilitated through technical assistance, workshops, and training activities; and,
- Promoting public involvement and environmental education.

6.1 Interacting With Other Agencies and Organizations

6.1.1 *Taking the lead on maintaining the Watershed Planning Committee (WPC)*[76]

The committee meetings and all documents prepared by the WPC are open to the public. However, staffing and funding constraints have affected the Agency's capacity to staff and

[75] Protecting and Restoring Guam's Waters, (Guam EPA September 1999)

[76] Executive Order 2004-04.

coordinate regular effective WPC meetings. Guam EPA continues to collaborate with WPC agency representatives on watershed issues and provides support to subject projects and activities as Guam EPA resources are available.

The WPC is made up of representatives from the following organizations and agencies:

(Mandatory)

Bureau of Statistics and Plans
Department of Agriculture
Department of Land Management
University of Guam Marine Lab
Department of Parks and Recreation
Port Authority of Guam
Department of Education
Department of Public Works
Guam Waterworks Authority
University of Guam Water and Environmental Research Institute
University of Guam College of Natural and Applied Sciences
Guam Environmental Protection Agency (Chair)

(Membership by Invitation)

U.S. Navy, U.S. Air Force, U.S. Coast Guard, U.S. Department of Agriculture, Natural Resources Conservation Service, U.S. Environmental Protection Agency, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Park Service, U.S. Fish & Wildlife Service, Northern and Southern Guam Soil and Water Conservation Districts

Past projects accomplished with a high level of WPC involvement include:

- Publication of *Guam's Unified Watershed Assessment (1998)*, which included the delineation, categorization and prioritization of watersheds on Guam;
- Development of restoration strategies for the two highest priority watersheds identified in the Unified Watershed Assessment (2000);
- Initiation of implementation of restoration strategies in Guam's priority watersheds (2001);
- Completion of a watershed executive order to promote the watershed approach; and
- Review and comment on documents and work products relative to strategies for managing water resources on Guam.

6.1.2 *Participating in External Forums to Improve Water Resources Coordination*

One of Guam EPA's priorities is to improve coordination between the highly overlapping areas of freshwater and coral reef protection activities, coastal zone and watershed programs, and water quality regulatory actions. This requires working with partner agencies (e.g.; GWA, Division of Aquatic Wildlife Resources, Division of Forestry, University of Guam Marine Lab, WERI, and Bureau of Planning's CZMP). Through collaborative work there are frequent opportunities for sharing expertise, ideas and perspectives, and resources. Specific examples of collaborative work include:

- Scheduled meetings between Guam EPA and GWA to discuss drinking water and wastewater management efforts;
- Participation in program development meetings for WERI, the Guam Soil & Water Conservation Districts, and the local Coral Reef Initiative Task Force;

- Relative to the anticipated military build-up, participation in Civilian-Military Task Force meetings;
- Meeting with government of Guam and non-governmental organizations to discuss, promote and develop program implementation mechanisms, i.e. Hotel and Restaurant Association (Pesticide Regulations), Rotary Club (Environmental issues), legislative oversight committee, Bureau of Planning (watershed planning), etc.

6.2 Establishing Executive and/or Legislative Support

All inter-organizational projects need external acknowledgment and support to be effective on a long-term basis. Executive and legislative support is particularly valuable.

Executive Orders (E.O.) developed by Guam EPA include E.O. 2004-04 which restructured the Watershed Planning Committee and its goals and E.O. 2014-07 which renamed the Environmental Education Sub-Committee as the "Guam Nature Alliance".

6.3 Working Closely With the Military

6.3.1 Environmental Restoration Program

The Department of Defense (DoD) and State/Territorial Memorandum of Agreement (DSMOA) Program works closely with DoD on environmental restoration and clean-up work in Guam. The program was created by the Superfund Amendment and Reauthorization Act of 1986.

Under the DSMOA Program, Guam EPA has regulatory oversight of the Navy and Air Force environmental restoration efforts to ensure compliance with local and federal laws and regulations. DSMOA oversees the following DoD programs:

- **Base Realignment and Closure** (BRAC): A clean-up program to ensure the environmental suitability of properties for transfer to GovGuam.
- **Installation Restoration Program**: The main DoD environmental restoration program which covers on-base actions, such as the Orote landfill at COMNAVMAR and CB landfill clean-up at Finegayan.
- **Formerly Used Defense Sites (FUDS):** U.S. Army Corps of Engineers program to clean up military sites that are no longer owned by the U.S. Government.
- **Superfund:** A clean-up program under the federal government to clean up the nation's uncontrolled hazardous waste sites listed under the National Priorities List (NPL). Anderson Air Force Base is under the NPL and listed as a Superfund site.

Restoration Advisory Board

Under the Defense Environmental Restoration Program, the Department of Defense has been conducting environmental restoration activities at its Navy and Air Force facilities on Guam. These activities focus on reducing the impact of present and past contamination from military operations.

In 1995, the United States Air Force (USAF) established a Restoration Advisory Board (RAB) to inform the local community of cleanup activities. The RAB is comprised of community members, USAF officials and representatives from regulatory agencies. The USAF RAB continues to meet on a quarterly basis to discuss program progress and to advise the community on the status and plans for the various Installation Restoration Program (IRP) sites. Most Air Force restoration projects are on long-term remedial alternative status and more recent meetings address DoD prioritized sites under the Military Munitions Response Program (MMRP).

The Navy Area-Wide RAB members are from the community and other entities such as the Navy, USEPA, and Guam EPA. Membership is unlimited and members remain active until they elect to resign. Meetings occur at least biannually, but meeting schedules are dictated by what projects are active, the status of these projects, decisions on cleanups, and/or the development of a sampling plan. RAB meetings are a platform in which the Navy can inform the community of the status of ongoing cleanup efforts. Such meetings provide an opportunity for participants to become familiar with the technical aspects of the cleanups, ask questions, and in turn the public may provide knowledge and expertise to the Navy.

Navy Environmental Restoration Program (ERP)
The purpose of the ERP is to determine if any past spills or releases of hazardous substances from Navy activities pose unsafe risks to human health and environment and to ascertain what type of cleanup is necessary for these sites. The ERP is divided into three sections:

- Installation Restoration (IR) – this program focuses on investigation and cleanup of hazardous substances at active Navy Bases;
- Munitions Response – this program concentrates on investigation cleanup of munitions, i.e., unexploded ordnances (UXO) and related compounds;
- BRAC – this program is similar to the IR and Munitions Response programs but highlights sites that are BRACs transferred from the Navy to another entity.

6.4 Capacity building through technical assistance, workshops and training

Given Guam's small local population, limited expertise, and geographical isolation, capacity building (building our expertise) is critical. Various forums for capacity building are utilized including on-the-ground assistance, training, and workshops.
On-the-ground technical assistance is an important component of capacity building. It is one of the areas that occupy the majority of Agency time. Guam EPA assistance is intended to promote water management objectives consistent with both coastal zone and nonpoint source management measures. Examples include inspections of drinking water systems, septic tank/leaching field systems, and erosion and sediment control projects. All involve extensive interaction with and training and education of "customers" as to the environmental or public health aspects of the particular situation, and the regulatory/programmatic considerations.

The Agency also provides technical assistance to architects, engineers, the public and Government of Guam agencies during the design stage and plan review process of projects. During these phases, Guam EPA recommends and/or requires the best management practices

and management measures suitable for the sites under evaluation. Non-regulatory groups, such as Bureau of Planning, NRCS, Conservation Districts, Extension Services, Division of Aquatic Wildlife Resources (DAWR), Division of Forestry, and WERI, are also engaged in capacity building, by promoting activities consistent with coastal zone management and nonpoint source pollution objectives in their work. Examples of a few of their relevant activities include:

- Environmental Quality Incentive Program (NRCS)
- Hosting Conservation Districts workshops
- Forest Stewardship programs (Division of Forestry)
- Publications of "Man, Land and Sea" (Bureau of Planning environmental newsletter)
- Education on appropriate use of fertilizers and pesticides through meetings with landscapers, 4-H programs, newspaper articles, and other forums (UOG - CALS)
- Educational presentations focusing on watersheds and marine conservation (DAWR, Guam EPA, WERI, Coast Zone Management Program, and NPS)

Workshops are also vitally important to local staff. They provide an option for training and for sharing expertise and ideas. With the shrinking economy, Guam EPA has increasingly looked to on-island workshops and on-line webcasts to fulfill this need.

6.5 Public Involvement and Environmental Education

The government of Guam is collectively responsible for the current and future state of water resources on Guam. Perhaps the most significant long-term impact the government can have in protecting and restoring these resources is to involve the public in this objective, and to support environmental education. Guam EPA is actively involved in this area in the following ways:

- The Agency solicits public review and comments on various plans and regulations it develops. Such action is undertaken in accordance with the local administrative adjudication law and guidance from its Guam EPA Board of Directors;
- Guam EPA leads, supports and participates in annual Earth Week/Month events. Typical events include tours of its lab for Guam's school children; public static displays; the distribution of educational information via newspaper, magazine, television and radio; Guam Nature Alliance community events featuring land, ocean, and river site-specific events like tree planting, river tours and monitoring activities, snorkeling/related ocean safety talks, and beach clean-ups;
- Guam EPA actively participates in numerous Island clean-up activities, i.e. Annual Guam International Coastal Clean-up;
- When possible, the Agency subject matter experts provide presentations at schools, to real estate groups, legislators and mayors, to members of the local Chamber of Commerce and other business groups, etc.;
- Agency representatives participate in public forums or public hearings especially as they relate to environmental issues;
- Agency representatives participate in Guam nature Alliance (GNA) meetings.

7.0 Water Pollution Control Programs and Improved Water Quality

Guam EPA's water pollution control programs continue the mission to maintain and/or improve surface water quality on island. During the reporting period, program efforts included:

- Permit compliance inspections as required.
- Continued enforcement and implementation of Guam's Soil Erosion and Sedimentation Control rules and regulations.
- Progress on watershed restoration activities via 1) Guam EPA collaboration with village mayors/partner government agencies to investigate water quality issues in nearby coastal waters and rivers/streams. 2) Efforts by partnering agencies and organizations to initiate and implement environmental awareness on Guam.
- Meeting the growing demand and challenges of permitting and enforcement under the Individual Wastewater Regulations, i.e. reviewing construction plans; inspecting completed and existing wastewater disposal systems; issuing occupancy permit clearances; initiating enforcement actions against illegally occupied buildings, etc.

7.1 Recommendations

7.1.1 Watershed Planning Committee Support

Guam EPA should maintain and support regular meetings of the WPC. CWA Section 319 funds should be budgeted to 1) sustain the WPC and to implement watershed planning and management processes 2) implement TMDL and watershed restoration projects which help waterbodies meet GWQS.

7.1.2. *Nonpoint Source (NPS) Pollution Monitoring*

The Water and EMAS Divisions should collaborate to complete the drafted strategy for a NPS Pollution Monitoring Plan. The Comprehensive Monitoring Strategy includes "Nonpoint Source Pollution Monitoring" as one of its ten monitoring programs. The goal of such assessment activity is to identify nonpoint source pollutants affecting water quality. In general, NPS Pollution Monitoring will involve:

a). Assessing water quality based on a variety of monitoring data contained in

- 305(b) and related plans
- permitting data
- enforcement records and existing GIS data
- Guam EPA quarterly reports
- available water quality reports
- compliance monitoring reports submitted to Guam EPA

b). Performing discrete sampling events for site specific activities, as well as sub-watershed areas encompassing several square miles, to evaluate stormwater runoff contaminants from a variety of land uses;

c). Evaluating nonpoint source Best Management Practices (BMPs) implementation to understand the most effective combination for reducing nonpoint source pollutants.

7.1.3 Develop enforceable regulations that implement the criteria contained in the *CNMI/Guam Stormwater Management Manual*

Guam EPA should complete the comprehensive review, approval, and adjudication process for modernized Erosion Control and Stormwater Management Regulations. When this is accomplished, the Manual and its accompanying regulations shall be the standard:

a) to protect the waters of Guam from the adverse impacts of urban stormwater runoff
b) to provide design guidance on effective best management practices (BMPs) for new development sites and redevelopment sites both during and post construction; and
c) to improve the quality of BMPs that are constructed in the CNMI and Guam, specifically in regard to their performance, longevity, safety, ease of maintenance, community acceptance and environmental benefit.

7.1.4 *Guam Nature Alliance*

The Agency should continue to support this active education committee which has implemented a diversity of creative and unique environmental awareness, outreach and information projects.

7.1.5 *Update Rules and Regulations to Support Compliance and Enforcement Action and Increase or Create Fees to Support Increasing Cost(s) of Service*

In order to strengthen enforcement and compliance action, Guam EPA should invest time and effort in revising and updating all its rules and regulations, incorporating reasonable fee schedules proportionate to the costs of services which the Agency provides and crafting respective legislation. Public education campaigns should be developed and implemented to build support from policy makers and other stakeholders and to educate the public in general.

C. Cost/Benefit Assessment

No report available.

D. Special State Concerns and Recommendations

Significant issues that affect Guam's Water Quality Programs include:

- *GWA Order for Preliminary Relief*
- *Consent Decree*
- *Military Buildup*

These key issues present increasing pressure on the Agency to oversee and/or undertake critical environmental regulatory and enforcement tasks. The Agency's dilemma becomes even more challenging because it is experiencing personnel losses due to (staff) retirement, and competition with other organizations offering improved employment. Lastly, the Agency is facing financial challenges in managing its resources in the wake of increasing employee costs, nation-wide competition for federal dollars, outdated fees for the cost of services Guam EPA provides, and the overall state of Guam's economy.

1.0 GWA Order for Preliminary Relief[77] and the 2011 Court Order

In fiscal year 2003 the of Government of Guam and the Guam Waterworks Authority (jointly "Defendants") and the United States of America ("Plaintiff) agreed and entered into a Stipulated Order for Preliminary Relief (Order) as the most appropriate way to require the immediate implementation of short-term projects and initial planning measures by the "Defendants" to begin to address issues of compliance at GWA's Publicly Owned Treatment Works and three public water systems. GWA and the Government of Guam were ordered to implement provisions under fourteen headings.

In October 2006, the parties, through their respective undersigned counsel, jointly requested the Court for stipulated changes in the Order.

"On October 10, 2011, the Stipulated Order was replaced by a District Court Order (CO) which recognizes GWA's progress in providing reliable and safe drinking water and which is focused more on environmental issues and the need to work through the projects identified in the Water Resources Master Plan. GWA is working closely with both USEPA and Guam EPA in order to achieve or exceed the goals of the CO and has completed over 98% of the required projects under the CO as of 2023."[78]

A copy of the updated "Water Resources Master Plan" and the Order for Preliminary Relief RE: Deadlines for Projects Under the Amended Stipulated Order, Civil Case No. 02-0035" are posted on the GWA website at: http://guamwaterworks.org/compliance-and -safety/.

2.0 ORDOT CONSENT DECREE

On February 11, 2004, the Government of Guam (Guam Department of Public Works and Guam Environmental Protection Agency) entered into a Consent Decree (Civil Case No. 02-00022) with the United States of America (U.S. Environmental Protection Agency with the U.S. Department of Justice) in U.S. District Court, Territory of Guam. The Consent Decree is a settlement agreement to resolve issues related to the unauthorized discharge of pollutants from the Ordot Dump to the Lonfit River. The historical and continuing discharge of pollutants to the Lonfit River is a violation of the Clean Water Act (CWA).

The Consent Decree outlined a timeline that the Government of Guam agreed to follow in completing specific tasks to correct the violation. These tasks included financing the closure of Ordot Dump, and the siting, design and construction of a new Municipal Solid Waste Landfill Facility (MSWLF) that is fully compliant with Subtitle D of the federal Resource Conservation and Recovery Act (RCRA).

"…On March 17, 2008, Gershman, Brickner & Bratton, Inc. (GBB), solid waste management consultants, was appointed as Receiver by the District Court of Guam to achieve the

[77] http://guamwaterworks.org/compliance-and-safety/2011-court-order/

[78] 2023 Consumer Confidence Water Quality Report, GWA

government's compliance with the Clean Water Act as set forth in the Consent Decree."[79] An update to the status of the Consent Decree, the closing of the Ordot Dump and the opening of a new Guam municipal landfill can be found at the following link: **http://guamsolidwastereceiver.org/updates-done.shtml**

As of April 2019, the Court issued an order partially ending the receivership. It also authorized the Receiver to continue its work to complete the post-closure plan for the Ordot Dump.

3.0 Military Buildup on Guam[80]

The Department of the Navy released the Record of Decision (ROD) for relocating U.S. Marine Corps forces to Guam on August 29, 2015.

The Department of the Navy selected the preferred alternatives as described in the Final Supplemental Environmental Impact Statement (SEIS). This includes:

- Cantonment and family housing Alternative E with the USMC cantonment to be located at Navy Computer and Telecommunications Station – Guam (Finegayan), and family housing to be located at Andersen Air Force Base.
- Live Fire Training Range Complex (LFTRC) option selected was Alternative 5 to be located at Andersen Air Force Base – Northwest Field. The LFTRC also includes a stand-alone hand grenade range at Andersen South. This action will ensure consistency with the new force posture adopted by the Department of Defense in accordance with the April 2012 Roadmap Adjustments' international agreement.

This ROD provides for a smaller force on Guam than originally was proposed in the 2010 Final EIS, while fulfilling U.S. national security interests in the Western Pacific. A copy of the ROD can be downloaded at http://guambuildupeis.us.

[79] Excerpt from GBB web site overview. *http://guamsolidwastereceiver.org/courtorder.html*

[80] http://www.guambuildupeis.us/