2022-2024 INTEGRATED REPORT
GUAM EPA

APPENDIX A

Marine and Surface Water
Monitoring and Assessment Methodology

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The Guam Environmental Protection Agency (Guam EPA) is responsible for monitoring, assessing, and protecting the water quality for the Island of Guam. Guam laws and regulations that support this include the *Guam Environmental Protection Agency Act* (10 GCA[1], Chapter 45) Guam EPA's enabling legislation; the *Water Resources Conservation Act* (10 GCA, Chapter 46) which requires identification of Guam's significant water resources and the necessary planning, regulation and management of these resources for their protection, conservation and rational development; and the *Guam Water Pollution Control Act* (10 GCA, Chapter 47) which authorizes among other powers and duties, the Agency to study, investigate, and determine practical ways and means of eliminating from all ground and surface waters of the Territory, all substances and materials which pollute the same; determining practical methods of pollution prevention detrimental to public health or the health of animals.

The federal Clean Water Act (CWA) Section 305(b) requires that Guam submit a biennial water quality inventory report in April of even numbered years that reports the extent to which state waters provide for water resources that are swimmable, fishable, support aquatic life and contain organisms that are consumable. CWA Section 303(d) additionally requires that Guam list impaired waters (that are deemed not swimmable, fishable, not supporting of aquatic life and contain organisms that are not suitable for human health) and to provide a priority ranking for the development and implementation of management strategies (e.g., TMDLs) that will reduce the pollutant load(s) to the impaired waters. EPA specifies the process for development of both sections[2]. EPA Guidance recommends that Guam submit integrated reports to satisfy 303(d) and 305(b) requirements[3].

I. Monitoring Program

Guam EPA implements the *Comprehensive Monitoring Strategy for the Island of Guam* (CMS) (Guam EPA, 2006) to meet local and federal requirements. The Strategy is directed at the systematic monitoring and assessment of water resources for comparison to adopted Guam Water Quality Standards to determine prevailing conditions and water quality trends of that resource.

Existing Guam EPA Monitoring Projects

The CMS describes ten distinct monitoring projects intended to streamline monitoring and fulfill federal and local reporting requirements. **Table 1** (on the following page) shows the status of these ten proposed projects and describes what activities, if any, have been accomplished over the 2022 and 2024 reporting periods and what is planned for near future monitoring efforts. *Marine Debris removal efforts* were active over the 2022 reporting period and are included.[4]

[1] Guam Code Annotated

[2] EPA regulations 40 CFR 130.7 and 40 CFR 130.8).

[3] March 29, 2023, Memorandum from Brian Frazier, EPA Office of Wetlands, Oceans and Watershed, Re: Information Concerning 2024 Clean Water Act Sections 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions. https://www.epa.gov/tmdl/integrated-reporting-guidance-under-cwa-sections-303d-305b-and-314

[4] See Executive Order 2020-42 Establishing the Abandoned Derelict Vessels (ADV) Removal Group

Table 1. Guam EPA Monitoring Projects

Project	Status (Active or Suspended)	Status type	Information included in this report?
Status and Trends Monitoring Program	Suspended	Field work suspended due to lack of funding.	No
Guam Environmental Monitoring and Assessment Program (GEMAP) (aka US EPA's National Aquatic Resource Survey-NARS)	Active	● Conducted the 2020 National Coastal Condition Assessment (NCCA). ● Conducted the 2021 National Wetland Condition Assessment (NWCA). Continued during 2022. ● Conducted small survey of the 2023 National Rivers and Streams Assessment (NRSA) in 2023. To be continued in 2024.	No
Recreational Beach Monitoring Program	Active	Weekly beach surface water sampling for enterococci.	Yes
Marine Debris *removal efforts*: ● Abandoned and Derelict (ADV) vessels removal ● Cocos Lagoon tire reef removal and disposal	Active	Marine Debris removal has taken a front seat in the Agency's daily duties during 2020 and 2021.	Yes
Wetlands Monitoring Program	Suspended	Implemented *Wetlands* Monitoring project plan. Draft plan incorporates 2021-2022 NWCA survey findings.	No
Fish and Shellfish Consumption Monitoring Program	Suspended	Pending inclusion to CMS.	No
Groundwater Assessment Monitoring Program - Raw & Treated Groundwater	Active	Data collected by WERI/UOG: Water and Environmental Resources Institute Guam EPA Water Resources Program GEPA Safe Drinking Water (SDW) Program	No
Non-point Source Pollution Monitoring Program	Active	Pending completion of GEPA monitoring program plan	No
Underground Injection Control Monitoring Program	Active	GEPA's UIC program has permit-driven water quality monitoring requirements for UIC well/system owners.	No
Man-Made Impoundment Monitoring Program	Inactive	Pending implementation	No
Marine Preserve Water Quality Assessment Program	Active	Pending reporting data from 2015 *Reef flat* GEMAP/NCCA.	No

Future Guam EPA Monitoring Efforts

Guam NARS (National Aquatic Research Surveys)

Guam EPA has expanded NARS conducted in Guam to include probability-based surveys on wetlands resources. Furthermore, the Agency intends to streamline efforts to mirror USEPA's NARS schedule. The table below provides a proposed 4-year timeline that will accomplish implementation goals for each resource while mirroring national efforts.

NARS PROJECT: Timeline & Aquatic Resource Goals

Aquatic Resource	2021	2022	2023	2024
Wadeable Rivers & Streams	**Research**	**Design**	**Field**	**Field**
Coastal	**Lab**	**Report**	**Report**	**Design**
Wetlands	**Field**	**Field**	**Lab**	**Report**

NARS will follow the most current nationally adopted design, field, laboratory, data assessment methods and Quality Assurance Project Plans.

Impaired Waters Monitoring (IWM) of Conventional and Fecal Bacteria Project : 2024 -2025

Table 2 identifies waterbodies on Guam's proposed 2022-2024 303(d) List and the general information considered in all monitoring efforts. The project intends to support decision making relative to an impaired waterbody's sustained 303(d) listing or delisting.

Table 2. Targets: 2022-2024 303(d) Listed Waters

Waterbody Name/ Assessment ID	*Matrix*	*Pollutant*	*Rank*	*Project proposal*
Storm drain GUAGRD	Surface water/runoff	Bacteria (E. coli) Dissolved Oxygen, Nitrates, TSS, Turbidity, Salinity	Medium	Phase II TBD during 2024-2028 grant cycle
Tumon Bay (Faifai and Gun Beach) GUG-001C	*whole fish tissue (reef + pelagic)*	Dieldrin	High	** Draft Guam Tumon Bay TMDL*
Tumon Bay (Faifai and Gun Beach) GUG-001C	*whole fish tissue (reef + pelagic)*	Total Chlordane	High	
+ Impairment being assessed and mitigated by DOD ** Other contractor needed to assess waterbody Δ Future GEPA Monitoring Project				

Table 2. Targets: 2022-2024 303(d) Listed Waters

Waterbody Name/ Assessment ID	*Matrix*	*Pollutant*	*Rank*	*Project proposal*
Agana River 1 GUAGRA-3	*whole fish tissue and other orgs (freshwater)*	PCBs in fish tissue	Low +	
Agana River 2 GUAGRA-2-1A	*whole fish tissue and other orgs (freshwater)*	PCBs in fish tissue	Low +	
Agana Swamp GUG-1B	*whole fish tissue and other orgs (freshwater)*	PCBs in fish tissue	Low +	
Gabgab Beach GU-GB43 N. Orote Peninsula GUG-042 S. Orote Peninsula GUG-043 Tipalao Bay GUG-010A Cocos Lagoon 1 GUG-020A-1 Cocos Lagoon 2 GUG-020A-2	whole fish tissue (reef + pelagic)	PCBs in fish tissue	Low +	
Agat Bay 1 GUG-010B-1	whole fish tissue (reef + pelagic)	PCBs in fish tissue , Chlordane in fish tissue, Dioxin in fish tissue	Low +	
Apra Harbor 1 GUG-008A-2 Apra Harbor 2 GUG-008A-1	whole fish tissue (reef + pelagic)	PCBs in fish tissue	Low +	
Tanguisson Beach 2 GUG-001B-2 Further studies are needed to ascertain whether the toxin is being accumulated and concentrated in fish	Gracilaria tsudae + Epiphytic cyanobacteria (blue-green algae)	Toxic seaweed substance (http://guampedia.com/seaweed-gracilaria/)	Low**	
* Draft Tumon Bay TMDL under EPA R-9 Review				
Lonfit River 2 GUPGRL-2	Surface water	Iron	Low Δ	
West Surface Drainage GUSURW	Surface Water	Iron	Low Δ	
Waterbody Assessments targeted for IR 2026 Reporting Period (2024-2025) **GEPA Impaired Waters Monitoring Project**				
Storm drain GUAGRD	Surface water/runoff	E. coli, Dissolved Oxygen, Nitrates, TSS, Turbidity, Salinity	Medium	
Pago Bay GUG-003A	Marine water	Enterococci, Dissolved oxygen, Nitrate	Medium	

Table 2. Targets: 2022-2024 303(d) Listed Waters

Waterbody Name/ Assessment ID	*Matrix*	*Pollutant*	*Rank*	*Project proposal*
Pago River 1 GUPGRP-1-51A	Surface water	E. coli, Turbidity	Medium	
Pago River 2 GUPGRP-2	Surface water	E. coli, Dissolved Oxygen	Medium	
Pago River 4 GUPGMPW	Surface Water	Turbidity	Medium	
Agana River 1 GUAGRA-3	Surface water	Enterococcus, Dissolved oxygen	Low	
Ajayan River GUMZRAJ	Surface water	Dissolved Oxygen, Orthophosphates, Total Suspended solids	Medium	
Liyog River GUMZRL	Surface water	Dissolved Oxygen, Suspended solids, Orthophosphates, Nitrates	Medium	
Lonfit River 2 GUPGRL-2	Surface water	Salinity, Temperature, E. coli, Total Coliform, Enterococci, Turbidity	Low	
Lonfit River 3 GUPGRP-1-51B	Surface water	Salinity, Temperature, E. coli, Total Coliform, Enterococci	Low	
Sumay River GUMZRSY	Surface water	Dissolved Oxygen, Suspended solids, Orthophosphates, Nitrates	Medium	
Toguan River 1 GUMZRT-2	Surface water	Orthophosphates	Low	
Manell River GUMZRML	Surface Water	Nitrate, Orthophosphates	Medium	
Fonte River 1 GUAGRF-2	Surface Water	Nitrate	Medium	
Aslinget River 3 GUINRAP-46B	Surface Water	Orthophosphates	Low	
Togcha River 5 GUTURTG-1C	Surface Water	Nitrate	Low	
Tinago River	Surface Water	Orthophosphates	Low	
West Surface Drainage GUSURW	Surface Water	Nitrate, Total Suspended Solids	Low	

Spatial and temporal requirements for sampling and field, laboratory, Quality Assurance/Quality Control, and data assessment methods of proposed monitoring efforts will be presented in upcoming scopes of work and work plans during the 2024-2028 grant cycle. These requirements are critical in making decisions to continue listing or delisting impaired waterbodies.

Project Purpose. Guam EPA will monitor fresh and marine waters impaired or threatened by stressors directly or indirectly impacting aquatic life.

Stressors of impairment are those identified by Guam EPA's current biennial Integrated Report (IR). The IR uses data from internal and external organizations to identify Aquatic Life Use (ALUS) impairments. Impairments identified in this manner subsequently cause the listing of waters to the current *303(d) impaired water bodies list*.

Guam EPA uses data from its Status and Trends Monitoring Program (STMP) to identify stressors that threaten ALUS. Guam EPA defines such stressors as those that exceed ALUS parameter criteria specified in the Guam Water Quality Standards (GWQS) by a frequency of seventy-five percent or more.

Guam EPA will collect samples for the analysis of conventional physical and chemical stressors (i.e., dissolved oxygen, Salinity, Temperature, Turbidity, Total Suspended Solids, and nutrients) and fecal bacteria stressors (i.e., E. coli, Enterococci, and Total Coliform). Samples will be collected via sample bottle and probes within a bay or cross-section of the river in the water column.

Location. Guam EPA will monitor Assessment Units listed as 'impaired' for an ALUS conventional WQ parameter or have ALUS conventional WQ parameter data showing an exceedance of 75% or greater of GWQS ('threatened'). See the following **Table 3** of forty-three AUs targeted for monitoring.

Table 3. Target Sites and target parameters - IWM of Conventional and Fecal Bacteria Project

	Assessment Unit (AU)	Site ID	Watershed	Status ALUS	Parameter
Surface Water					
1	Achang River 2	MZRAC	Manell	Threatened	E. coli, orthophosphate
2	Agana River 1	AGRA-3	Agana	Impaired	DO, Enterococci
3	Agana River 1	A5	Agana	Threatened	DO
4	Agana River 2	AGRA-2	Agana	Threatened	DO
5	Agana Springs	AGRA-1	Agana	Threatened	DO, E. coli, Nitrate
6	Agfayan River MOUTH	INRAGB-3	Inarajan	Threatened	E. coli
7	Ajayan River	9Ajayan / MZRAJ	Manell	Impaired	DO, orthophosphate, TSS
8	Ajayan River	9Ajayan / MZRAJ	Manell	Threatened	E. coli
9	Asan River 1	ASRI-3	Piti & Asan	Threatened	E. coli
10	Aslinget River 3	5Aslinget / INRAP-46B	Dandan	Impaired	orthophosphate
11	Atantano River 3	BG4	Apra	Threatened	DO, E. coli
12	Fonte River 1	AGRF-2	Fonte	Impaired	Nitrate
13	Inarajan River 1	INRI1	Inarajan	Threatened	Nitrate
14	Liyog River	10Liyog / MZRL	Manell	Impaired	DO, orthophosphate, TSS, Nitrate
15	Liyog River	10Liyog / MZRL	Manell	Threatened	E. coli
16	Lonfit River 2	PGRL-2	Pago	Impaired	Salinity, Enterococci, E. coli, Total Coliform, Temperature, Turbidity,

	Assessment Unit (AU)	Site ID	Watershed	Status ALUS	Parameter
17	Lonfit River 3 (small section to confluence)	LR3 / PGRP-1-51B	Pago	Impaired	Salinity, Enterococci, E. coli, Total Coliform, Temperature,
18	Manell River	MZRML / 12Manell	Manell	Impaired	Nitrate, orthophosphate
19	Masso River 3	MA1	Piti & Asan	Threatened	E. coli
20	Matgue River	ASRM	Piti & Asan	Threatened	E. coli
21	Pago River 1	PGRP-1	Pago	Impaired	E. coli, Turbidity storm flows
22	Pago River 2	PGRP-2	Pago	Impaired	DO, E. coli
23	Pago River 3	PGEP	Pago	Threatened	DO
24	Pago River 4	PGMPW / 1Pago / P8 / P9	Pago	Impaired	Turbidity
25	Pago River 4	PGMPW / 1Pago / P8 / P9	Pago	Threatened	DO
26	Pigua River 2	MZRP-2	Toguan	Threatened	DO, E. coli
27	Storm Drain	AGRD	Northern	Impaired	DO, salinity, E. coli, Nitrate, TSS, turbidity (+ Enterococci)
28	Sumay River	11Sumay / MZRSY	Manell	Impaired	DO, orthophosphate, Nitrate, TSS
29	Tinago River	6TINAGO	Dandan	Impaired	orthophosphate
30	Togcha River 5 *incl. Togcha River 2, Togcha River 1*	3Togcha / TURTG-1C	Togcha	Impaired	Nitrate, *threatened: E. coli, orthophosphate*
31	Toguan River 1	MZRT-2 / 14Toguan	Toguan	Impaired	orthophosphate
32	Toguan River 2	MZRT-1	Toguan	Threatened	E. coli
33	unnamed creek G-3C	ASRI-2	Piti & Asan	Threatened	Nitrate
34	unnamed creek G-59	ASRI-1	Piti & Asan	Threatened	E. coli
35	West Surface Drainage	SURW (SurW-2)	Pago	Impaired	Nitrate, TSS
36	West Surface Drainage	SURW (SurW-2) / P2	Pago	Threatened	DO
Marine Water					
37	Pago Bay	S-19	Pago	Impaired	DO, Nitrate, Enterococci
38	Pago Bay	PGM15	Pago	Impaired	DO, Nitrate, Enterococci
39	Rocky Shorelines Northwest Coast (Double Reef)	DRM	Northern	Threatened	TSS
40	Rocky Shorelines Northwest Coast (Double Reef)	DRMI	Northern	Threatened	TSS

	Assessment Unit (AU)	Site ID	Watershed	Status ALUS	Parameter
41	Tanguisson Beach Area 2	TANG	Northern	Threatened	Enterococci
42	Taleyfac Bay 1	ATMA	Taelayag	Threatened	TSS
43	Talofofo Bay	TUM11	Talofofo	Threatened	Enterococci

Guam EPA will target thirteen watersheds monthly. See *Part VI. Figures* which show the AUs and target sites in each of the following watersheds: Agana, Apra, Dandan, Fonte, Inarajan, Manell, Northern, Pago, Piti & Asan, Taelayag, Talofofo, Togcha, and Toguan.

II. Assessment Methodology

As recommended in the IR Guidance[5], this section describes the method Guam uses to determine the water quality attainment status of all waters. Specifically, this section describes the following:

1. Changes in assessment methodology since the last reporting cycle.
2. What data were used to make attainment determinations (e.g., site specific and probability-based survey)
3. How the data and information were used to make attainment determinations and assigned the five-part categorization of surface waters.

Water quality attainment determinations are guided by the Revised *2017 Guam Water Quality Standards (GWQS)* which describe criteria and standards to be met by each water body of Guam. Narrative and numeric standards contained in the *2017 GWQS (Revised)* are applicable to specific "Categories of Waters" (S-1, S-2, S-3, M-1, M-2, and M-3 classification). These categories of waters have defined **designated-uses** as follows:

Guam Marine Waters: Categories of Water (GWQS 2017)

Designated-use	M-1 Excellent	M-2 Good	M-3 Fair
aesthetic enjoyment	X	X	X
aquatic life preservation	X		
aquatic life propagation		X	
aquatic life protection	X		X
aquatic life survival		X	
commercial and industrial use			X
consumption of organisms		X	
contact recreation: limited body			X
contact recreation: whole body	X	X	

[5] Guidance for 2006 Assessment, Listing and Reporting Requirement Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act: United States Environmental Protection Agency, (July 29, 2005) https://www.epa.gov/tmdl/integrated-reporting-guidance-under-cwa-sections-303d-305b-and-314

Guam Marine Waters: Categories of Water (GWQS 2017)

Designated-use	M-1 Excellent	M-2 Good	M-3 Fair
industrial cooling waters			X
mariculture activities		X	
marine scientific research	X		
shipping, boating, berthing, marinas			X

Typically, these designated uses are evaluated using the indicators in **Table 4**.

Table 4. Guam Designated-Uses and Indicators (GWQS 2017) for Use Support Determination

Designated Use (DU):	Body Contact	Aquatic Life (Preserve, Propagate, Protect, Survival, Maintenance)	Human Health Consumption (Toxics)	Aesthetic Enjoyment
GWQS Indicators:	E. coli Enterococci Fecal coliform - shellfish waters	Water Quality: pH Orthophosphates- OPO4 Nitrate- NO3 Ammonia- NH4 Dissolved Oxygen Salinity Chlorides Sulfates- SO4 Total Dissolved Solids Total Suspended Solids Turbidity Secchi Disc Visibility Water Temperature Radioactive Materials Conc. of Oil/Petroleum Product Biological/Benthic Assessment Toxicants (Water column and Sediment)	Drinking Water (S-1, S-2) Organisms (and S1 water)	Marine Debris

Each indicator listed above is subject to established criteria summarized in the next table (**Table 5**) taken from the 2017 GWQS (Revised). Further assessment of Use Support involves determining to what degree these indicators support designated uses.

Table 5. Criteria used to determine Degree of Use Support GWQS 2017 (Revised)

PARAMETERS		GWQS		
Marine Water	**Surface Water**	**M1/S1**	**M2/S2**	**M3/S3**
Enterococci		MARINE and FRESHWATER: Concentrations of enterococci bacteria shall not exceed 35cfu/100mL based upon the geometric mean of samples taken in a 30-day interval AND the Statistical Threshold Value (STV) of 130cfu/100mL should not be exceeded by more than 10 percent of the samples taken during the same 30-day interval.		
--	E. coli	FRESHWATER ONLY Concentrations of E. coli shall be no greater than 126cfu/100mL based upon the geometric mean of samples taken in a 30-day interval AND the Statistical Threshold Value (STV) of 410cfu/100mL should not be exceeded by more than 10 percent of the samples taken during the same 30-day interval.		
Fecal coliform (shellfish harvesting & growing areas)		Median of 14 fecal coliform/100mL and 10% of water samples taken from growing area should not exceed 43 fecal coliform/100mL.		
pH		Marine, Estuarine: 6.5 - 8.5 range (also, in deeper than euphotic zones, not >0.2pH from ambient) Freshwater: 6.5 - 9.0		
Orthophosphate (PO4-P)		not > 0.025 mg/L	not > 0.05 mg/L	not > 0.10 mg/L
Nitrate-nitrogen (NO3-N)		not > 0.10 mg/L	not > 0.20 mg/L	not > 0.50 mg/L
Ammonia-nitrogen		MARINE (M-1, M-2, M-3): 0.02 mg/L (table IV GWQS); FRESHWATER (S-1,S-2,S-3): 1hour average conc. not > CMC more than once every 3 years AND 30day average conc. not > CCC more than once every 3 years AND the average conc. over 30days not > CCC AND ambient conc. averaged over 4days not > 2xCCC.		
Dissolved Oxygen		Not decreased to < 75% saturation at any time [OR at 30degC Fresh water not < 5.6 mg/L; Marine and Wetlands Water not < 4.6 mg/L at 26degC Fresh water not < 6.2 mg/L; Marine and Wetlands Water not < 5.0 mg/L]		
Salinity	Salinity/Chlorides/Sulfates Total Dissolved Solids	Marine, estuarine, wetlands: not > +10% of ambient Freshwater only: max Cl and SO4 = 250 mg/L; TDS not > 500 mg/L or 133% of ambient; Salinity not > +20% of ambient.		
Residue (TSS)		TSS: not increased from ambient and not > 5 mg/L	TSS: not > +10% ambient and not > 20 mg/L	TSS: not > +25% ambient and not > 40 mg/L
Turbidity		not > 0.5 NTU over ambient (except when due to natural conditions)	not > 1.0 NTU over ambient (except when due to natural conditions)	
Secchi Visibility (Vertical or Horizontal)		not < 5m from ambient (except when due to natural conditions)		
Water Temperature		not changed more than 1.0^0C or 1.8^0F from ambient (Thermal effluent not meeting this standard shall be considered as having an adverse effect on aquatic life).		
Radioactive Materials		Discharges at any level into any waters are strictly prohibited.		
Oil or Petroleum Products		1) Shall not detect a visible film, sheen or result in visible discoloration of the surface with a corresponding oil or petroleum product odor, 2) Shall not cause damage to fish, inverts or objectionable degradation of drinking water quality, 3) shall not form an oil deposit on the shores or bottom of the receiving body of water.		
Toxic Substances (water column, sediment, drinking water consumption, organisms consumption)		General: 1) All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological, acute or chronic responses in human, plant, animal or aquatic life. 2) All waters shall be maintained free of toxic subs in conc. that produce contamination in harvestable aquatic life to the extent that it causes detrimental physiological, acute or chronic responses in humans or protected wildlife, when consumed. 3) The survival of aquatic life in marine and surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge. Numeric criteria: see Appendix A in 2017 GWQS.		

Data Assembly

Guam IR reporting relies on data sets from local academia, local government agencies and federal government agencies. This can include data solicitation from the Navy Environmental Office, the National Park Service Water Resources Division, Government of Guam programs, University of Guam research and grant awardees, and Guam Environmental Protection Agency projects listed in Table 1. Projects considered for reporting this assessment period are shown in **Table 6**.

Table 6. Project data for the Guam 2022-2024 IR assessment:

Organization	Project	Waterbody Type	Use Support	Year of data	Data Quality
Guam EPA	Recreational Beach Monitoring Project (RBMP) and Microbial Source Tracking (MST) Project	RBMP Marine Beaches; MST beaches and rivers	Body Contact	Jan – Dec 2020, 2021, 2022, 2023	For use support determination ; MST for Screening Data and TMDL development
Guam EPA	Marine Debris Removal: • ADV removal (see attached report *Guam ADV Removal Project_2021*) • Cocos Lagoon Tire Reef Removal (see attached report *Final Cocos Report.rev4.Final Submitted reduced*)	Marine Bay	Aesthetic enjoyment	2021, 2022	For use support determination
Brown and Caldwell; Gershman, Brickner & Bratton, Inc. Receiver for the Guam Solid Waste Authority.	Cessation of Point Source Leachate Discharges to Lonfit River	River	Aquatic Life and Human Health	*Pre-closure data 2012-13. Post-closure data 2017-2019 2022-2023*	2017-2019 data For use support determination 2022-2023 data for study development
Myeong-Ho Yeo (*Principal Investigator)*, Adriana Chang and James Pangelinan	Application of a SWAT Model for Supporting a Ridge-to-Reef Framework in the Pago Watershed, Guam	River	Aquatic Life	2021	For use support determination
Dr. P. Houk	Ridge to Reef Assessment for Southern Guam, USEPA Wetlands Program Development Grant	River	Aquatic Life	2020-2021	For use support determination (pH, phosphate, and nitrate)

Organization	Project	Waterbody Type	Use Support	Year of data	Data Quality
Department of the Navy	Radiological Environmental Monitoring Report for Calendar Years '20, '21, '22	Marine Bay	Body Contact, Aquatic Life and Human Health	2020, 2021, 2022	For use support determination
National Park Service, U.S. Department of the Interior	Pacific Island Network Water Quality Monitoring[6]	River and Marine Bays	Surface Water Trends	2007-2015 (published 2014, 2017, 2021)	For trends presentation
Prepared by Tom Schils, Marine Laboratory, University of Guam, for Naval Facilities Engineering Command Marianas	Water Quality Monitoring on Naval Base Guam, Submerged Lands	Marine Bays	Aquatic Life Trends	2018 - 2020	Continuous monitoring of WQ for baseline condition
David Burdick, M.S	A decade of change on Guam's coral reefs. A report of Guam Long-term Coral Reef Monitoring Program activities between 2010 and 2021. UOG Marine Lab Technical Report Aug 2023	Marine Bays	Aquatic Life Trends	2009 - 2022	Coral Reef health monitoring for trends

The quality of each data set and project was evaluated by reviewing project objectives, quality assurance and quality control requirements, laboratory method compatibility, analysis quality and method detection limits (MDLs). Data was identified as 'good quality' for direct use in Use Support Determinations as shown in the 'Data Quality' column in table above).

Project Indicators are listed in Table 7 (on the next page). These indicators were used to determine use-support. The associated number of samples collected throughout the duration of the project are also indicated in the table.

[6] https://irma.nps.gov/DataStore/Reference/Profile/2166407

Table 7. Compiled Project Indicators

Laboratory Parameter (WQ)	No. samples
Recreational Beach Monitoring Program (RBMP) Jan 2020 - Dec 2023	
Enterococci (MPN)	8,000
Marine Debris Removal	
Abandon and Derelict Vessel removal (2021 – 2022)	11 ADVs removed
Cocos Lagoon Tire Reef Removal	1,829 tires removed
Brown and Caldwell: *Cessation of Point Source Leachate Discharges to Lonfit River* (Oct 2021)	
Al, Cr, Cu, Fe, Mn, Ni, Zn	8
TSS, TDS, Chloride + Sulfates	8
Application of a SWAT Model for Supporting a Ridge-to-Reef Framework in the Pago Watershed in Guam (Nov 2021)	
Nitrate (NO3)	45
Turbidity	48
Ridge to Reef Assessment for Southern Guam, USEPA Wetlands Program Development Grant (2020-2021)	
pH	383
Phosphate(PO4)	383
Nitrate (NO3)	383
Radiological Environmental Monitoring Report for Calendar Year 2020, 2021, 2022	
Cobalt-60 & any radionuclide with gamma ray energies between 0.1 and 2.1 MeV.	~135 per year

Guam EPA's Recreational Beach Monitoring Program (RBMP)

Guam EPA's Recreational Beach Monitoring Program (RBMP) is included in this IR assessment and contributes data for use-support determination. Guam's subtropical climate allows for year-round recreation at all marine beaches, and fishing from both along the shoreline and offshore. Most of this type of recreational activity occurs along stretches of sandy beaches or limestone plateaus easily accessible from shore. To monitor for the designated use "Whole Body/Primary (body) Contact", weekly water grab samples are collected and tested for the approved EPA bacterial indicator. Bacteriological data has been collected by Guam EPA under the Recreational Beach Monitoring Program (RBMP) for over 25 years. Data collected weekly from fixed sampling sites along selected stretches of coastline is used to advise the public against swimming in waters exceeding bacterial standards. Weekly press releases identify those beaches where indicators in weekly water samples exceed water quality standards.

Data trends presented in the following tables and in the Assessment Results, Section III, are used to characterize risks of exposure to contaminated waters. Resulting trends allow for the ranking of beaches which enable managers to determine the need for further monitoring or the need to include additional unmonitored beaches.

RBMP Project Beaches and Stations

2020 and 2021 Beaches													
	Waterbody Name	**GEPA Beach Number**	**Water size**	**Coastal Water Class**	**2020 number advisories**	**2020 number closures***	**2021 number advisories**	**2021 number closures ****		**Monitoring Location ID**	**Monitoring Location Name**	**2020 number samples**	**2021 number samples**
1	Asan Memorial Beach, Head of Asan Bay	GB31	0.46	M-2	22	2	28	2	1	GUN-14	Asan Bay Beach	38	49
2	Asanite Point Beach aka First Beach	GB106	0.06	M-2	3	2	0	2	2	GUS-18	First Beach	38	49
3	Beach at Fonte River, West Hagatna Bay	GB27	0.13	M-2	18	2	11	2	3	GUN-21	Adelup Beach Park	38	49
4	Beach at Inarajan Bay	GB97	0.56	M-2	17	2	24	2	4	GUS-10	Inarajan Bay	38	49
5	Beach at Pago Bay	GB118	0.96	M-2	15	2	27	2	5	GUS-15	Pago Bay	38	49
6	Beach at Piti Bay	GB32	1.08	M-2	15	2	28	2	6	GUN-15	Piti Bay	38	49
									7	GUN-16	Santos Memorial	38	49
7	Beach North of Finile River	GB52	0.34	M-2	19	2	25	2	8	GUS-04	Bangi Beach	38	49
8	Beach north of Togcha River	GB113	0.27	M-2	0	2	0	0	9	GUS-13	Togcha Bay	16	0
9	Beach South of Finile River	GB53	1.17	M-2	13	0	34	2	10	GUS-30	North of Agat Marina, south of Chaligan Creek	13	48
10	Dungca's Beach, East Hagåtña Bay	GB22	0.99	M-2	6	2	9	2	11	GUN-06	Dungca's Beach - Sleepy Lagoon	38	49
									12	GUN-07	Dungca's Beach	38	49
									13	GUN-26	East Hagåtña Bay - Alupang Tower Beach	38	49
11	Family Beach	GB36	0.15	M-2	0	2	1	2	14	GUN-19	Family Beach	35	49

RBMP Project Beaches and Stations

2020 and 2021 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2020 number advisories	2020 number closures*	2021 number advisories	2021 number closures **		Monitoring Location ID	Monitoring Location Name	2020 number samples	2021 number samples
12	Gognga Beach, Tumon Bay	GB16	0.15	M-2	1	2	0	2	15	GUN-25	Gognga Beach - Okura Beach	38	49
13	Gun Beach, Tumon Bay	GB15	0.23	M-2	0	2	3	2	16	GUN-24	Gun Beach	38	49
14	Hagåtña Marina	GB25	0.43	M-2	12	2	16	2	17	GUN-10	Hagatna Channel	38	49
									18	GUN-11	Hagatna Channel - Outrigger Ramp	38	49
15	Head of Umatac Bay	GB67	0.14	M-2	13	2	11	2	19	GUS-06	Umatac Bay	38	49
16	Inarajan Pools	GB96	0.07	M-2	4	2	7	2	20	GUS-09	Inarajan Pool	38	48
17	Merizo Public Pier Park	GB75	0.46	M-2	15	2	25	2	21	GUS-08	Merizo Pier - Mamaon Channel	38	49
18	Naton Beach, Tumon Bay	GB17	1.10	M-2	3	2	1	2	22	GUN-02	Naton Beach - San Vitores	38	49
									23	GUN-03	Naton Beach - Matapang Beach Park	38	49
									24	GUN-04	Naton Beach - Guma Trankilidat	38	49
									25	GUN-23	Naton Beach - Fujita	38	49
19	NCS Beach/Tanguisson Beach	GB12	0.25	M-2	7	2	0	2	26	GUN-01	Tanguisson Beach	38	49
20	Nimitz Beach	GB55	0.49	M-2	17	2	27	2	27	GUS-05	Nimitz Beach	38	49
21	Outhouse Beach	GB35	0.46	M-3	2	2	0	2	28	GUN-18	Outhouse Beach	37	49
22	Port Authority Beach	GB37	0.46	M-3	4	2	2	2	29	GUN-20	Port Authority Beach	38	49
23	Tagachang Beach Park	GB117	0.18	M-2	0	2	4	2	30	GUS-14	Tagachang Beach	38	49

RBMP Project Beaches and Stations

2020 and 2021 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2020 number advisories	2020 number closures*	2021 number advisories	2021 number closures **		Monitoring Location ID	Monitoring Location Name	2020 number samples	2021 number samples
24	Talofofo Bay	GB105	0.21	M-2	26	2	41	2	31	GUS-11	Talofofo Bay	38	49
25	Togcha Beach aka Agat Beach	GB50	0.79	M-2	27	2	41	2	32	GUS-02	Togcha Beach - Namo	38	49
									33	GUS-03	Togcha Beach – Agat	38	49
									34	GUS-25	Togcha Beach – Cemetery	38	49
26	Toguan Bay	GB69	0.46	M-2	16	2	35	2	35	GUS-07	Toguan Bay	38	49
27	Trinchera Beach, East Hagåtña Bay	GB23	1.16	M-2	15	2	17	2	36	GUN-08	East Hagåtña Bay - Trinchera Beach	38	49
									37	GUN-09	Padre Palomo Park Beach	38	49
28	United Seamen's Service Beach (USO Beach)	GB34	0.52	M-2	4	2	8	2	38	GUN-17	United Seamen's Service	38	51
29	West Hagatna Beach	GB26	1.11	M-2	31	2	37	2	39	GUN-27	West Hagatna Bay - Park	38	49
									40	GUN-28	West Hagatna Bay - West Storm Drain	38	49
									41	GUN-13	Hagatna Bayside Park	38	49
30	West of Adelup Point, Asan Bay	GB28	0.41	M-2	13	2	10	2	42	GUN-22	Adelup Point Beach (West)	38	49
31	Ypan Beach Park Beach (Ipan Public Beach)	GB111	0.30	M-2	0	2	0	2	43	GUS-12	Ipan Public Beach	38	49
32	Ypao Beach, Tumon Bay	GB19	0.42	M-2	0	2	0	2	44	GUN-05	Ypao Beach	38	49
			15.97		**338**	**62**	**472**	**62**				**1621**	**2107**

RBMP Project Beaches and Stations

2020 and 2021 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2020 number advisories	2020 number closures*	2021 number advisories	2021 number closures **		Monitoring Location ID	Monitoring Location Name	2020 number samples	2021 number samples

*Preempt COVID-19 Closure (Precautionary due to Person-to-person transmission) from 3/24/2020-5/14/2020 and 8/21/2020-10/3/2020.

**Preempt Rainfall Advisory (Storm conditions) 9/23/2021-9/30/2021 and 10/6/2021-10/14/2021.

RBMP Project Beaches and Stations

2022 and 2023 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2022 number advisories ***	2022 number closures ***	2023 number advisories	2023 number closures****		Monitoring Location ID	Monitoring Location Name	2022 number samples	2023 number samples
1	Asan Memorial Beach, Head of Asan Bay	GB31	0.46	M-2	29	1	38	7	1	GUN-14	Asan Bay Beach	50	51
2	Asanite Point Beach aka First Beach	GB106	0.06	M-2	8	1	14	7	2	GUS-18	First Beach	50	51
3	Beach at Fonte River, West Hagatna Bay	GB27	0.13	M-2	15	1	43	7	3	GUN-21	Adelup Beach Park	50	51
4	Beach at Inarajan Bay	GB97	0.56	M-2	21	1	31	7	4	GUS-10	Inarajan Bay	50	51
5	Beach at Pago Bay	GB118	0.96	M-2	17	1	32	7	5	GUS-15	Pago Bay	50	51
6	Beach at Piti Bay	GB32	1.08	M-2	24	1	35	7	6	GUN-15	Piti Bay	50	51
									7	GUN-16	Santos Memorial	50	51
7	Beach North of Finile River	GB52	0.34	M-2	21	1	41	7	8	GUS-04	Bangi Beach	50	51
8	Beach north of Togcha River+	GB113	0.27	M-2	not applicable	not applicable	not applicable	not applicable	9	GUS-13	Togcha Bay	0	0

RBMP Project Beaches and Stations

2022 and 2023 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2022 number advisories ***	2022 number closures ***	2023 number advisories	2023 number closures****		Monitoring Location ID	Monitoring Location Name	2022 number samples	2023 number samples
9	Beach South of Finile River	GB53	1.17	M-2	35	1	42	7	10	GUS-30	North of Agat Marina, south of Chaligan Creek	50	51
10	Dungca's Beach, East Hagåtña Bay	GB22	0.99	M-2	9	1	21	7	11	GUN-06	Dungca's Beach - Sleepy Lagoon	50	51
									12	GUN-07	Dungca's Beach	50	51
									13	GUN-26	East Hagåtña Bay - Alupang Tower Beach	50	49
11	Family Beach	GB36	0.15	M-2	0	1	2	7	14	GUN-19	Family Beach	50	49
12	Gognga Beach, Tumon Bay	GB16	0.15	M-2	5	1	8	7	15	GUN-25	Gognga Beach - Okura Beach	50	51
13	Gun Beach, Tumon Bay	GB15	0.23	M-2	2	1	2	7	16	GUN-24	Gun Beach	50	51
14	Hagåtña Marina	GB25	0.43	M-2	2	1	20	7	17	GUN-10	Hagatna Channel	50	51
									18	GUN-11	Hagatna Channel - Outrigger Ramp	50	51
15	Head of Umatac Bay	GB67	0.14	M-2	16	1	32	7	19	GUS-06	Umatac Bay	50	50
16	Inarajan Pools++	GB96	0.07	M-2	0	1	18	7	20	GUS-09	Inarajan Pools++	6	40
17	Merizo Public Pier Park	GB75	0.46	M-2	29	1	41	7	21	GUS-08	Merizo Pier - Mamaon Channel	50	51
18	Naton Beach, Tumon Bay	GB17	1.10	M-2	3	1	19	7	22	GUN-02	Naton Beach - San Vitores	50	51
									23	GUN-03	Naton Beach - Matapang Beach Park	50	51

RBMP Project Beaches and Stations

2022 and 2023 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2022 number advisories ***	2022 number closures ***	2023 number advisories	2023 number closures****		Monitoring Location ID	Monitoring Location Name	2022 number samples	2023 number samples
									24	GUN-04	Naton Beach - Guma Trankilidat	50	51
									25	GUN-23	Naton Beach - Fujita	50	51
19	NCS Beach/Tanguisson Beach	GB12	0.25	M-2	9	1	1	7	26	GUN-01	Tanguisson Beach	50	51
20	Nimitz Beach	GB55	0.49	M-2	17	1	28	7	27	GUS-05	Nimitz Beach	50	51
21	Outhouse Beach	GB35	0.46	M-3	0	1	0	7	28	GUN-18	Outhouse Beach	50	51
22	Port Authority Beach	GB37	0.46	M-3	2	1	0	7	29	GUN-20	Port Authority Beach	50	51
23	Tagachang Beach Park	GB117	0.18	M-2	0	1	3	7	30	GUS-14	Tagachang Beach	50	51
24	Talofofo Bay	GB105	0.21	M-2	41	1	49	7	31	GUS-11	Talofofo Bay	50	51
25	Togcha Beach aka Agat Beach	GB50	0.79	M-2	25	1	44	7	32	GUS-02	Togcha Beach - Namo+++	50	0
									33	GUS-70	Togcha Beach - bridge	0	48
									34	GUS-03	Togcha Beach - Agat	50	51
									35	GUS-25	Togcha Beach - Cemetery	50	51
26	Toguan Bay	GB69	0.46	M-2	34	1	37	7	36	GUS-07	Toguan Bay	50	51
27	Trinchera Beach, East Hagåtña Bay	GB23	1.16	M-2	21	1	31	7	37	GUN-08	East Hagåtña Bay - Trinchera Beach	50	46
									38	GUN-09	Padre Palomo Park Beach	50	51

RBMP Project Beaches and Stations

2022 and 2023 Beaches

	Waterbody Name	GEPA Beach Number	Water size	Coastal Water Class	2022 number advisories ***	2022 number closures ***	2023 number advisories	2023 number closures****		Monitoring Location ID	Monitoring Location Name	2022 number samples	2023 number samples
28	United Seamen's Service Beach (USO Beach)	GB34	0.52	M-2	0	1	2	7	39	GUN-17	United Seamen's Service	50	51
29	West Hagatna Beach	GB26	1.11	M-2	36	1	36	7	40	GUN-27	West Hagatna Bay - Park	50	50
									41	GUN-28	West Hagatna Bay - West Storm Drain	50	50
									42	GUN-13	Hagatna Bayside Park	50	50
30	West of Adelup Point, Asan Bay	GB28	0.41	M-2	10	1	23	7	43	GUN-22	Adelup Point Beach (West)	50	51
31	Ypan Beach Park Beach (Ipan Public Beach)	GB111	0.30	M-2	0	1	0	7	44	GUS-12	Ipan Public Beach	50	51
32	Ypao Beach, Tumon Bay	GB19	0.42	M-2	0	1	8	7	45	GUN-05	Ypao Beach	50	51
			15.9										
	32		**7**		**431**	**31**	**701**	**217**			**45**	**2106**	**2166**

+ Beach north of Togcha River - Suspended sampling at this beach on Oct 7, 2020 due to access issues. Final sample collected on 7/30/20.

++ Inarajan Pools - Closed for park renovations from Feb 17, 2022 to Mar 15, 2023.

+++ Togcha Beach - Namo: Suspended sampling at this beach on Jan 27, 2023 because it became inaccessible. Established S-70 nearby.

***Preempt Rainfall Advisory (Storm conditions) 9/15/2022-9/22/2022.

****Preempt Rainfall Advisories released in 2023 on Jan 8-12, Jan 14-18, Feb 16-23, May 25-Jun 1, Aug 31-Sept 7, Oct 10-12, Oct 14-19.

In 2023, Guam EPA conducted a Microbial Source Tracking (MST) study intended to be used in TMDL development.

Microbial Source Tracking (MST) Screening at Nine Impaired Waters 2023

Project Purpose: Guam EPA is required to address its 303(d) listed impaired waters. According to the CWA, each state and territory must develop TMDLs for all the waters identified on their 303(d) listed waters. Two bacteria TMDLs for 42 beaches were developed in 2009 and 2013. Implementing these bacteria TMDLs involves managing nonpoint sources through grants, partnerships, and other programs, such as this study.

With the information gleaned from this study, the Guam EPA can reduce controllable sources of fecal indicator bacteria to decrease the total amount of bacteria load to impaired waterbodies.

Guam EPA hired LuminUltra (formerly Source Molecular) analytical services to perform real-time quantitative polymerase chain reaction (qPCR) DNA analysis on water samples. This technology provides a preliminary indicator of relative human and non-human pollution, allowing for the identification of fecal sources as the relative abundance of humans and select animals using the MST method, bacterial qPCR.

Project Location: Nine sites (five Guam Beach sites with bacteria TMDLs and three 303(d) impaired waters) are:

TMDL waters:

1. **Talofofo Bay (S-11)**
2. **Toguan Bay (S-7)**
3. **Hagatna Boat Basin (N-12) (marina)**
4. **Bangi Beach (S-4)**
5. **Adelup Beach Park (N-21)**
6. **Pago Bay (S-15)**

303(d) impaired waters (Pago Watershed):

7. **Pago River lower (PGRP-2)**
8. **Pago River upper (PGRP-1)**
9. **Lonfit River lower (PGRL-2)**

Water samples were collected during dry conditions and again during wet conditions. Dry season characteristics are 48 hours with less than 0.1 inches of rain and at least 24 hours without rain before sampling. *Dry season conditions* typically occur in Guam from January through June. The *wet season* target is during the first flush around July or August at the start of the wet season.

An adequate sample was collected and analyzed at LuminUltra Laboratory to identify human and non-human fecal pollution sources at Guam sites. Human- and Non-human sources of particular interest are:

- HF183 DNA marker specific to EPA Developed Assay of the Human-associated Bacteroides,
- HUMM2 Human-associated Bacteroides species (B. dorei)
- Rum2BAC assay for Ruminant species like cow/Water Buffalo (Karabao - *Bubalus bubalis*) and deer (Philippine deer - *Cervus mariannus*),

- Avian GFD for chicken and other birds,
- BacCan assay for dog/Canine,
- Pig2BAC fecal assay for pig (wild pig – *Sus scrofa*).

Fecal samples of the water buffalo *Bubalus bubalis* and the Philippine deer *Cervus mariannus* were validated for the *Rum2BAC* marker, demonstrating that this marker can detect these Guam species. However, in order to distinguish between *B. bubalis* and *C. mariannus* fecal contamination, validation of the water buffalo for the *CowM2* marker is necessary.

Pago River upper during wet conditions.

One hundred eight (108) samples were analyzed for human and non-human markers and twenty-two (22) samples were analyzed for FIB. Seventy-three (73) samples did not detect any marker (ND). Twenty-four (24) samples were quantifiable (ROQ or DNQ) for a marker, and eleven (11) samples yielded counts in one of two replicates but were not quantifiable.

Generally, the markers for birds, pigs, and dogs were observed at the Pago Watershed freshwater sites, while the markers for birds, pigs, dogs, humans, and ruminants were observed at coastal sites. No markers were observed during the wet condition sampling at Lonfit River LR3 and Pago River Upper sites in the upper Pago Watershed. Also, fecal indicator bacteria (FIB - E. coli or Enterococci) were detected at all sites during dry and wet conditions. FIB concentrations were higher during wet conditions than dry conditions at all nine sites.

The following table provides a list of quantified and observed markers and FIB results:

	Site name [* identified in one replicate]	Condition	Marker	Results: Marker Copies per 250 mL, FIB MPN/100mL
1	Lonfit River LR3	Dry	Bird_GFD	361.86
2	Lonfit River LR3*	Dry	Pig_Pig2Bac	observed
3	Lonfit River LR3	Dry	E. coli	31.00
4	Lonfit River LR3	Wet	E. coli	591.00
5	N12 Hagatna Boat Basin	Dry	Human_HF183	1220.00
6	N12 Hagatna Boat Basin	Dry	Human_HumM2	97.00
7	N12 Hagatna Boat Basin	Dry	Bird_GFD	464.05
8	N12 Hagatna Boat Basin	Dry	Enterococci	30.00
9	N12 Hagatna Boat Basin	Wet	Bird_GFD	515.52
10	N12 Hagatna Boat Basin	Wet	Dog_BacCan	1973.99
11	N12 Hagatna Boat Basin	Wet	Human_HF183	939.49
12	N12 Hagatna Boat Basin	Wet	Human_HumM2	133.01

	Site name [* identified in one replicate]	Condition	Marker	Results: Marker Copies per 250 mL, FIB MPN/100mL
13	N12 Hagatna Boat Basin	Wet	Enterococci	5172.00
14	N21 Adelup Beach Park	Dry	Bird_GFD	1881.86
15	N21 Adelup Beach Park	Dry	E. coli	ND
16	N21 Adelup Beach Park	Dry	Enterococci	20.00
17	N21 Adelup Beach Park	Wet	Bird_GFD	94.68
18	N21 Adelup Beach Park	Wet	Dog_BacCan	437.87
19	N21 Adelup Beach Park	Wet	Pig_Pig2Bac	49.32
20	N21 Adelup Beach Park*	Wet	Ruminant_Rum2Bac	observed
21	N21 Adelup Beach Park	Wet	Enterococci	19863.00
22	Pago River Lower*	Dry	Dog_BacCan-UCD	observed
23	Pago River Lower	Dry	Bird_GFD	1084.90
24	Pago River Lower	Dry	E. coli	414.00
25	Pago River Lower	Dry	Enterococci	717.00
26	Pago River Lower	Wet	Bird_GFD	129.49
27	Pago River Lower	Wet	E. coli	2247.00
28	Pago River Upper PGRP-1	Dry	Bird_GFD	321.82
29	Pago River Upper PGRP-1	Dry	Pig_Pig2Bac	408.00
30	Pago River Upper PGRP-1	Dry	E. coli	20.00
31	Pago River Upper PGRP-1	Dry	Enterococci	ND
32	Pago River Upper PGRP-1	Wet	E. coli	598.00
33	S04 Bangi Beach*	Dry	Human_HF183	observed
34	S04 Bangi Beach	Dry	Bird_GFD	1211.24
35	S04 Bangi Beach*	Dry	Ruminant_Rum2Bac	observed
36	S04 Bangi Beach	Dry	Enterococci	30.00
37	S04 Bangi Beach	Wet	Bird_GFD	96.96
38	S04 Bangi Beach	Wet	Dog_BacCan	3282.15
39	S04 Bangi Beach*	Wet	Human_HF183	observed
40	S04 Bangi Beach*	Wet	Pig_Pig2Bac	observed
41	S04 Bangi Beach*	Wet	Ruminant_Rum2Bac	observed
42	S04 Bangi Beach	Wet	Enterococci	10462.00
43	S07 Toguan Bay	Dry	Bird_GFD	715.87
44	S07 Toguan Bay	Dry	Enterococci	41.00
45	S07 Toguan Bay	Wet	Bird_GFD	380.00
46	S07 Toguan Bay*	Wet	Dog_BacCan	observed
47	S07 Toguan Bay	Wet	Enterococci	763.00
48	S11 Talofofo Bay*	Dry	Bird_GFD	observed
49	S11 Talofofo Bay	Dry	Enterococci	63.00
50	S11 Talofofo Bay	Wet	Bird_GFD	256.27
51	S11 Talofofo Bay*	Wet	Pig_Pig2Bac	observed

	Site name [* identified in one replicate]	Condition	Marker	Results: Marker Copies per 250 mL, FIB MPN/100mL
52	S11 Talofofo Bay	Wet	Enterococci	24197.00
53	S15 Pago Bay	Dry	Bird_GFD	260.95
54	S15 Pago Bay	Dry	E. coli	ND
55	S15 Pago Bay	Dry	Enterococci	41.00
56	S15 Pago Bay	Wet	Bird_GFD	174.59
57	S15 Pago Bay	Wet	Enterococci	161.00

Assessment of the Designated Use (DU) in these waters is presented in the Assessment Results, Section III.

Guam EPA's Marine Debris Removal

Guam EPA's marine debris efforts include the removal of eleven Abandoned and Derelict Vessels (ADV) from the Harbor of Refuge and the removal of a tire reef from Cocos Lagoon. In 2020, the Governor of Guam established the Guam Abandoned Derelict Vessel Removal Group (GADVRG) through Executive Order 2020-42. ADVs were addressed by the Government of Guam, the US EPA, and the US Navy Commander Task Force 73 (CTF73) Salvage Team of the US Pacific Fleet. The CTF73 successfully salvaged and removed eleven vessels in the Guam Harbor of Refuge between 2021 and 2022. The GADVRG also completed the proper disposal of all ADVs.

Guam EPA obtained NOAA funding for the removal of a tire reef placed into Cocos Lagoon by the Guam Department of Agriculture in the 1970s with the intention of increasing fish stocks through the creation of artificial habitats. One thousand eight hundred twenty-nine (1,829) tires were removed and disposed of in July 2021. Guam EPA will continue coral restoration efforts and marine debris outreach.

Marine Debris Project Stations:

Marine Debris Removal Projects 2021		
Marine Water	GWQS class	Completed
Piti Channel and Cabras Island	M-3	2022
Cocos Lagoon (M-1)	M-1	2021

Assessment of the ***Aesthetic Enjoyment*** Designated Use (DU) in these Marine waters is presented in the Assessment Results, Section III.

Brown and Caldwell: *Cessation of Point Source Leachate Discharges to Lonfit River* (October 2021)

The Technical Memorandum (TM) provides a comparison of the pre-closure and post-closure surface water data, which supports the conclusion that leachate point source discharges to the Lonfit River have ceased as the result of closure construction. Two hundred fifty-nine analytes[7] were analyzed in 2012-2013 (pre-closure) and in 2017-2019 (post-closure) to compare pollutant data from upstream, at the facility, and downstream. Project stations are:

Cessation of Point Source Leachate Discharges to Lonfit River. Post-closure data: 2017-2019		
Fresh Water	GWQS class	No. visits
SURW-5	S-1	10
SURW-8	S-1	2
SURW-7	S-1	5
SURW-4	S-2	4
SURW-1	S-2	6

Guam EPA received the raw data for 291 analytes from Lonfit sampling sites SURW-5, SURW-4, and SURW-1. Raw data for the Western Surface Drainage sampling was extracted from the TM document. We calculated one parameter- *Chloride + Sulfate* from the data set for Aquatic Life Use determination of applicable assessment units. The data is used for use support determination for Aquatic Life Use and Drinking Water Use of the following assessment units:

Assessment Unit Identifier	**Assessment Unit Name**	**Site ID**	**Uses assessed by provided dataset**
GUPGRL-1-51-B	Lonfit River 1	SURW-5	Aquatic Life, Drinking Water
GUPGRL-2	Lonfit River 2	SURW-4 and SURW-1	Aquatic Life, Drinking Water (With Treatment)
GUSURW	West Surface Drainage	SURW-8 and SURW-7	Aquatic Life, Drinking Water

The detected analytes were reviewed and classified into the following Categories of Designated Use:

category	**Designated Use**
1	consumption (tissue &/or water) criteria
2	no GWQS criteria listed
3	Aquatic Life Use
4	Aquatic Life Use and Consumption
5	Drinking water
6	Drinking Water and Aquatic Life Use

[7] Not including Salinity, Total Coliform, E. Coli, and Enterococcus

category	Designated Use
7	Drinking Water and Consumption
8	Aquatic Life Use, DW, Consumption

In the raw dataset, fifty-eight (58) analytes were detected in the Lonfit River 1 and Lonfit River 2 and are listed in the table below. Of the analytes detected, 28 apply to Aquatic Life Use (categories 3, 4, 6, 8) and 29 apply to Drinking Water Use (categories 5, 6, 7, 8). Seventeen (17) of the detected analytes either do not have associated criteria (Guam WQS or other) or are analytes used for determining Human Health Use for consumption of water and organisms or consumption of organisms only (category 1 and 2).

Detected analytes are:

	category	Lonfit Detected Analytes
1	5	1,4-Dioxane
2	1	3,3'-Dichlorobenzidine
3	1	4,4'-DDD
4	1	4,4'-DDE
5	4	4,4'-DDT
6	4	Aldrin
7	3	Alkalinity, Total (as CaCO3)
8	4	alpha Endosulfan (Endosulfan I)
9	6	Aluminum
10	3	Ammonia (as N)
11	6	Arsenic
12	6	Barium
13	1	Benzo(b)fluoranthene
14	4	beta Endosulfan (Endosulfan II)
15	1	BHC, alpha
16	1	BHC, beta
17	2	BHC, delta [.delta.-Hexachlorocyclohexane]
18	8	BHC, gamma (Lindane)
19	7	bis(2-Ethylhexyl)phthalate
20	2	Calcium
21	5	Caprolactam
22	8	Chlordane (technical)
23	2	Chlordane, alpha
24	2	Chlordane, beta
25	5	Chloride
52	3	Chloride + Sulfate (AqL) CALCULATED
26	5	Chromium
27	3	Chromium, Hexavalent
28	5	Cobalt
29	8	Copper

	category	Lonfit Detected Analytes
30	4	Dieldrin
31	1	Endosulfan sulfate
32	8	Endrin
33	1	Endrin aldehyde
34	5	Gross Beta
35	8	Heptachlor
36	8	Heptachlor epoxide
37	6	Iron
38	2	Magnesium
39	7	Manganese
40	8	Mercury
41	5	Methoxychlor
42	8	Nickel
43	2	Non-Volatile Organic Carbon
44	5	Perchlorate
45	6	pHd
46	2	Potassium
47	5	Radium-226
48	5	Radium-228
49	8	Selenium
50	2	Sodium
51	5	Sulfate
53	2	Tin
54	6	Total dissolved solids (TDS)
55	3	Total Phosphorus as P
56	3	Total Suspended Solids
57	3	Vanadium
58	8	Zinc

Lonfit River 1 and Lonfit River 2

Aquatic Life (AqL) use determination:

Twenty-eight (28) detected analytes are assessed for Aquatic Life Use support determination. Lonfit River 1 is the upstream (us) reach where up to ten samples of each parameter were analyzed at site SURW-5. Lonfit River 2 is the downstream (ds) reach where up to ten samples of each parameter were analyzed at SW-4 and at SURW-1. No exceedance of applicable criteria occurred above 10% at the upstream location (SURW-5 Lonfit River 1) or at the downstream locations (SW-4 and at SURW-1 Lonfit River 2).

			% Exceedance				
	AqL Analyte	Detected Unit	SURW-5(us) (S-1)	NO. samples	SW-4 & SURW-1 (ds) (S-2)	NO. samples	notes
1	4,4'-DDT	UG/L	0	10	0	10	

			% Exceedance				
	AqL Analyte	Detected Unit	SURW-5(us) (S-1)	NO. samples	SW-4 & SURW-1 (ds) (S-2)	NO. samples	notes
2	Aldrin	UG/L	0	10	0	10	
3	Alkalinity, Total (as CaCO3)	MG/L	0	2	0	2	CCC of 20mg/L is a minimum value
4	alpha Endosulfan (Endosulfan I)	UG/L	0	10	0	10	
5	Aluminum	MG/L	0	10	0	10	
6	Ammonia (as N) (pH~ 8.0)	MG/L	0	10	0	10	
7	Arsenic	UG/L	0	10	0	10	
8	Barium	UG/L	0	10	0	10	
9	beta Endosulfan (Endosulfan II)	UG/L	0	10	0	10	
10	BHC Gamma- = Lindane	UG/L	0	10	0	10	
11	Chlordane	UG/L	0	10	0	10	
12	Chloride + Sulfate (AqL)	MG/L	0	10	0	10	
13	Chromium, Hexavalent	UG/L	0	10	0	10	
14	Copper	UG/L	0	10	0	10	
15	Dieldrin	UG/L	0	10	0	10	
16	Endrin	UG/L	0	10	0	10	
17	Heptachlor	UG/L	0	10	0	10	
18	Heptachlor epoxide	UG/L	0	10	0	10	
19	Iron	UG/L	10	10	0	10	
20	Mercury	MG/L	0	10	0	10	
21	Nickel	UG/L	0	10	0	10	
22	pH	s.u.	0	8	0	8	
23	Selenium	UG/L	0	6	0	6	
24	Total dissolved solids (TDS)	MG/L	0	10	0	10	
25	Total Phosphorus as P	MG/L	10	6	0	6	EPA (1986) recommended criteria for phosphorus: No more than 0.1 mg/L for streams that do not empty into reservoirs.
26	Total Suspended Solids	MG/L	10*	10	0	10	
27	Vanadium	UG/L	0	10	0	10	GWQS 0.05 mg/L (50ug/L)
28	Zinc	UG/L	0	10	0	10	

*ambient data

OTHER (proposed, screen or advisory)

detected

Total Suspended Solids (TSS) Analyte

		Total Suspended Solids MG/L	Location	GWQS class	
upstream	SW-5-WS-20171029	< 0.56	Lonfit River 1	S-1	ambient data 6.33mg/L AND TSS 5mg/L, 1 exceedance (10% exceeedance)
	SW-5-WS-20171217	3.2	Lonfit River 1	S-1	
	SW-5-WS-20180128	< 0.56	Lonfit River 1	S-1	
	SW-5-WS-20180313	< 0.62	Lonfit River 1	S-1	
	SURW-5_20181015	< 3.2	Lonfit River 1	S-1	
	SURW-5_20190107	4	Lonfit River 1	S-1	
	SURW-5_20190318	< 3.2	Lonfit River 1	S-1	
	SURW-5-20190506	9	Lonfit River 1	S-1	
	SURW-5-20190904	< 3.2	Lonfit River 1	S-1	
	SURW-5-20191111	< 3.2	Lonfit River 1	S-1	
	SW-4-WS-20171102	1.6	Lonfit River 2	S-2	no ambient data; no exceedances of TSS 20mg/L
	SW-4-WS-20171217	2.6	Lonfit River 2	S-2	
	SW-4-WS-20180128	< 0.56	Lonfit River 2	S-2	
	SW-4-WS-20180313	3.9	Lonfit River 2	S-2	
	SURW-1_20181022	< 3.2	Lonfit River 2	S-2	
	SURW-1_20190107	6	Lonfit River 2	S-2	
	SURW-1_20190318	< 3.2	Lonfit River 2	S-2	
	SURW-1-20190506	6	Lonfit River 2	S-2	
	SURW-1-20190904	< 3.2	Lonfit River 2	S-2	
downstream	SURW-1-20191111	7	Lonfit River 2	S-2	

For the TSS analyte, the GWQS incorporates an average ambient data threshold in addition to a numeric criteria.

- Total Suspended Solids – one exceedance in Lonfit River 1 (S-1) upstream of the facility (10% exceedance).
- No exceedance observed at downstream sites in Lonfit River 2 (S-2).
- Guam EPA uses eighteen records from Status and Trends site PGRL-1 as background data for TSS 'ambient conditions' at the upstream location(s).

Drinking Water (DW) with or without Treatment use determination:

Twenty-nine (29) detected analytes are assessed for Lonfit River 1's Drinking Water use support determination and for Lonfit River 2's Drinking Water with Treatment use support determination. Lonfit River 1 has no exceedances above 10%. Lonfit River 2 has three exceedances above 10% each for Aluminum, bis(2-Ethylhexyl)phthalate, and Iron.

			% Exceedance				
	Detected DW analyte	Unit	SURW-5 (us) (S-1)	NO. samples	SW-4 & SURW-1 (ds) (S-2)	NO. samples	notes
1	1,4-Dioxane	UG/L	0	10	0	10	EPA has a non-binding health advisory in **DW** of 0.35 - 35 µg/L.
2	Aluminum	UG/L	10	10	30	10	
3	Arsenic	MG/L	0	10	0	10	
4	Barium	UG/L	0	10	0	10	
5	BHC, gamma (Lindane)	UG/L	0	10	0	10	
6	bis(2-Ethylhexyl)phthalate	UG/L	10	10	30	10	primary drinking water standard: the MCL is 0.006 mg/L,
7	Caprolactam	UG/L	0	10	0	10	Interim specific ground water quality criterion of 3000 µg/L and PQL of 5000 µg/L (ppb) for New Jersey DEP.

			% Exceedance				
	Detected DW analyte	Unit	SURW-5 (us) (S-1)	NO. samples	SW-4 & SURW-1 (ds) (S-2)	NO. samples	notes
8	Chlordane	UG/L	0	10	0	10	
9	Chloride	MG/L	0	10	0	10	
10	Chromium	MG/L	0	10	0	10	
11	Cobalt	UG/L	0	10	0	10	
12	Copper	UG/L	0	10	0	10	
13	Endrin	UG/L	0	10	0	10	
14	Gross Beta	PCI/L	0	10	0	10	4 mrem/year
15	Heptachlor	UG/L	0	10	0	10	
16	Heptachlor epoxide	UG/L	0	10	0	10	
17	Iron	UG/L	10	10	30	10	
18	Manganese	MG/L	0	2	0	2	
19	Mercury	MG/L	0	10	0	10	
20	Methoxychlor	UG/L	0	10	0	10	
21	Nickel	UG/L	0	10	0	10	
22	Perchlorate	UG/L	0	10	0	10	EPA three alternative regulatory options of perchlorate in public drinking water systems: 18ug/L, 90 ug/L or w/drawal.
23	pHd	s.u.	0	8	0	8	
24	Radium-226	PCI/L	10	10	10	10	
25	Radium-228	PCI/L	0	10	0	10	
26	Selenium	UG/L	0	6	0	6	
27	Sulfate	MG/L	0	10	0	10	
28	Total dissolved solids (TDS)	MG/L	0	10	0	10	
29	Zinc	UG/L	0	10	0	10	

OTHER (proposed, screen or adv)	
units?	>10% exceedance
MDL?	detected

Western Surface Drainage

Raw data for the Western Surface Drainage sampling was extracted from the TM document. Authors presented an analyte list of which 28 analytes were detected in the Western Surface Drainage. Of those detected, sixteen (16) analytes apply to Aquatic Life Use (categories 3, 4, 6, 8) and nineteen (19) apply to Drinking Water Use (categories 5, 6, 7, 8). Four (4) of the detected analytes either do not have associated criteria (Guam WQS or other) or are analytes used for determining Human Health Use for consumption of water and organisms or consumption of organisms only (category 1 and 2).

Detected analytes are classified into the following Categories of Designated Use:

	category	Western Surface Drainage Detected Analytes
1	8	2,4,6-Trinitrotoluene (TNT)
2	6	Aluminum
3	3	Ammonia (as N)
4	6	Barium
5	7	Benzo(a)pyrene
6	1	Benzo(b)fluoranthene
7	1	Benzo(k)fluoranthene
8	1	bis(2-Ethylhexyl)phthalate
9	6	Chloride
10	6	Sulfate
11	3	Chloride + Sulfate (AqL)
12	3	Chromium, Hexavalent
13	5	Cobalt
14	5	Gross-Beta
15	5	Indeno(1,2,3-c,d)pyrene
16	6	Iron
17	8	Mercury
18	8	Nickel
19	6	Nitrate-nitrite (as N)
20	6	pHd
21	5	Radium-226
22	5	Radium-228
23	8	Selenium
24	2	Tin
25	6	Total Dissolved Solids (TDS)
26	3	Total Suspended Solids
27	6	Uranium
28	3	Vanadium

Aquatic Life use determination:

Sixteen (16) detected analytes are assessed for Aquatic Life Use support determination. Two sites are located on the Western Surface Drainage channel, upstream SW-8 and downstream SW-7. Up to two samples of each analyte were collected at the upstream site and up to five samples of each analyte were collected at the downstream site. No exceedance of applicable criteria occurred above 10% at the upstream location SW-8. The downstream location SW-7 has two exceedances greater than 10% each for Nitrate-nitrate (as N) and Total Suspended Solids (numeric criteria only).

	Detected AqL Analyte	Unit	% Exceedance SW-8 (us) (S-1)	No. samples	SW-7 (ds) (S-1)	No. samples	notes
1	2,4,6-Trinitrotoluene (TNT)	UG/L	0	2	0	5	PROPOSED: Consumption tissue and water: 135 ug/L. DW 140 ug/L. EPA- Tap water screening 2.5 ug/L, Surface water 100ug/L.
2	Aluminum	µg/L	0	2	0	5	
3	Ammonia (as N)	mg/L	0	2	0	5	
4	Barium	µg/L	0	2	0	5	
5	Chloride + Sulfate (AqL)	MG/L	0	2	0	5	
6	Chromium, Hexavalent	µg/L	0	2	0	5	
7	Iron	µg/L	0	2	0	5	
8	Mercury	µg/L	0	2	0	5	
9	Nickel	µg/L	0	2	0	5	
10	Nitrate-nitrite (as N)	mg/L	0	1	100	3	
11	pHd	s.u.	0	1	0	5	
12	Selenium	UG/L	0	2	0	5	
13	Total dissolved solids (TDS)	MG/L	0	2	0	5	
14	Total Suspended Solids	mg/L	0	2	25	5	
15	Uranium	PCI/L	0	2	0	5	
16	Vanadium	µg/L	0	2	0	5	

OTHER (proposed, screen or adv)

>10% exceedance

detected

Drinking Water use determination:

Nineteen (19) detected analytes are used to assess Drinking Water use support determination for the Western Surface Drainage. Four drinking water criteria exceedances greater than 10% occurred in the Western Surface Drainage. Radium 226 plus Radium 228, Iron, Nitrate-nitrite (as N), and Uranium. Uranium is in exceedance greater than 10% at both sites.

Opportunity to monitor transport:

The Western Surface Drainage channel discharges into the Lonfit River 1 - downstream from SURW-5 and upstream from Lonfit River 2. These results may also offer an opportunity to monitor the transport of specific analytes in the watershed.

Assessment of the Designated Uses (DU) in these waters is presented in the Assessment Results, Section III.

Myeong-Ho Yeo (Principal Investigator), Adriana Chang and James Pangelinan: Application of a SWAT Model for Supporting a Ridge-to-Reef Framework in the Pago Watershed in Guam (Nov 2021)

Sediment and dissolved inorganic nitrogen concentrations for sites in the Pago Watershed indicates that sediment and nitrogen loading increases seasonally. Also, using the SWAT model, it is possible to zero in on pollutant loading to specific sub-basins in the river complex.

Sites were established at Lonfit River (upstream and downstream of the Ordot Dump), upper Pago River after confluence, and lower Pago River near the bay mouth.

Application of a SWAT Model for Supporting a Ridge-to-Reef Framework in the Pago Watershed in Guam -2021		
Fresh Water	GWQS class	No. visits
Site 1 (upstream of Ordot Landfill) [Lonfit River 1]	S-1	9
Site 2 (downstream of Ordot Landfill) [Lonfit River 2]	S-2	9
Site 3 (at the USGS Pago River Station) [Pago River 1]	S-2	15
Site 4 (Lower Pago River) [Pago River 4]	S-3	15

Based on presented results, problematic sub-basins are located in the Pago River section. Furthermore, two approaches applied in this study provide evidence that Pago River yields more sediments and nutrients than the other two rivers (Lonfit River and Sigua River) in the same river flow system. The SWAT model's results would allow local government agencies and Guam Environmental Protection Agency (EPA) to advance coral reef conservation goals.

Turbidity and Nitrate data from this project are used to identify whether associated water bodies are meeting GWQS.

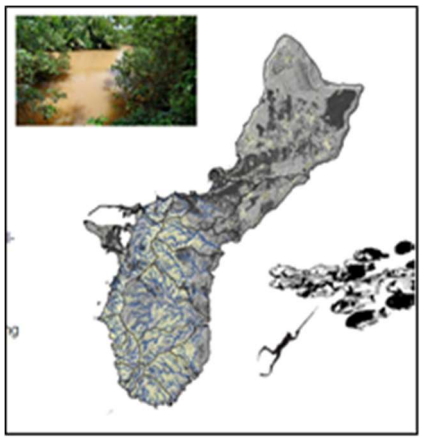
Turbidity – dry season concentrations (orange in table below) did not exceed GWQS at Site 1 or Site 2. One exceedance each (7% exceedance rate) occurred at Site 3 and Site 4. Wet season data indicate that turbidity concentrations are exceeding GWQS as exceedances were observed at Sites 2, 3 and 4. The table below shows exceedance rates of 14% occurred at Site 3 Pago River 1 and Site 4 Pago River 4 during the dry season. Exceedance rates of 50% at Site 2 Lonfit River 2 and Site 3 Pago River 1 occurred during the wet season. Exceedance rate of 38% at Site 4 Pago River 4 occurred during the wet season.

		Turbidity (NTU)				Remarks
	Date	Site 1	Site 2	Site 3	Site 4	
Sampling 1	6/9/2021	1.4	1.44	1.29	2.41	
Sampling 2	6/14/2021	0.411	0.437	0.729	1.06	
Sampling 3	6/16/2021	0.452	0.751	1.04	2.4	
Sampling 4	6/21/2021	0.454	0.554	0.998	2.01	
Sampling 5	6/23/2021			30	55.5	Tropical Depression 06W hit Guam Jen 21-22
Sampling 6	6/28/2021	0.591	0.65	1.08	2.05	
Sampling 7	6/30/2021			0.248	1.73	
Sampling 8	7/6/2021	0.445	0.423	0.971	1.99	
Sampling 9	7/7/2021	0.453	0.528	0.983	3.21	
Sampling 10	7/12/2021			0.957	1.53	
Sampling 11	7/14/2021	1.87	4.07	11.5	13.6	
Sampling 12	7/19/2021	0.792	1.04	0.938	2.58	
Sampling 13	7/22/2021			31	44	
Sampling 14	7/26/2021			28.3	53.4	
Sampling 15	7/28/2021			5.4	6.72	
	Dry avg:	0.66	0.77	5.06	9.59	
	Wet avg:	0.89	1.52	10.01	15.88	
	Classification:	S-1	S-2	S-2	S-3	
	ambient site:	PGRL-1, SURW-5(us)	SURW-1(ds), SW-4(ds)	R-2645-01D, PGRP-1	PGMPWbridge, PGMPW	
	GEPA waterbody:	Lonfit River 1	Lonfit River 2	Pago River 1	Pago River 4	
	ambient data source:	*GEPA, TM*	*TM*	*GEPA*	*GEPA*	
	ambient dry avg:	3.65	0.96	4.06	2.64	
	# dry samples:	67	4	65	82	
	ambient wet avg:	3.99	0.41	3.99	6.04	
	# wet samples:	60	4	52	57	
	Criteria:	not >0.5 NTU over ambient	not >0.5 NTU over ambient	not >1 NTU over ambient	not >1 NTU over ambient	
	ambient dry criteria:	4.15	1.46	5.06	3.64	
	# dry exceedance	0	0	1	1	
	# dry samples:	5	5	7	7	
	ambient wet criteria:	4.49	0.91	4.99	7.04	
	# wet exceedance	0	2	4	3	
	# wet samples:	4	4	8	8	
	% exceedance dry season:	0	0	14	14	Exceedance of Turbidity based on this data set
	% exceedance wet season:	0	50	50	38	

Nitrate – dry season concentrations did not exceed GWQS at Site 1, 2 or 3. One exceedance (7% exceedance rate) occurred at Site 4. Wet season data indicate that nitrate concentrations are meeting GWQS as no exceedances were observed at any of the sites located in the Lonfit River 1, Lonfit River 2, Pago River 1, and Pago River 4.

Assessment of the ***Aquatic Life*** Designated Use (DU) in these waters is presented in the Assessment Results, Section III.

Dr. P. Houk: Ridge to Reef Assessment for Southern Guam, USEPA Wetlands Program Development Grant (2020-2021)



The general objectives of the study were to identify nutrient discharge patterns and dynamics, relative contributions of local stressors on coral-reef condition (fishing vs. pollution) and provide standardized datasets to local stakeholder agencies alongside analytical training.

Specific objectives included classifying point versus non-point sources of pollution, separate nutrient dynamics associated with human and natural factors, and create DIN criteria or water quality standards.

Nitrogen, phosphorus, and a suite of conventional parameters were analyzed. Water samples were collected monthly at the following 27 rivers (near the mouth) for 1 year:

Ridge to Reef Assessment for Southern Guam – 2020-2021 (27 Rivers sampled monthly)				
Fresh Water		WaterBody	GWQS class	No. visits
1	10Liyog	Liyog River	S-2	14
2	9Ajayan	Ajayan River	S-2	14
3	11Sumay	Sumay River	S-2	14
4	12Manell	Manell River	S-2	14
5	16LaSaFua	La Sa Fua River	S-2	14
6	17Cetti	Cetti River	S-2	14
7	18Sella	Sella River	S-2	14
8	19Asmafines	Asmafines River	S-2	14
9	SOUTHNEW (discharges to Cetti Bay)	unnamed river 1	S-2	14
10	26 AGANA	Agana River 1	S-2	14
11	25Fonte	Fonte River 1	S-2	14
12	13Geus	Geus River 3	S-3	14
13	14Toguan	Toguan River 1	S-3	14
14	15Umatac	Umatac River 1	S-3	14
15	1Pago	Pago River 4	S-3	14
16	20Taleyfac	Taleyfac River	S-3	14
17	21Namo	Namo River 3	S-3	13
18	22Masso	Masso River 3	S-3	15
19	23FishEye	Matgue River	S-3	14
20	24Asan	Asan River 2	S-3	14
21	2Ylig	Ylig River 3	S-3	14
22	3Togcha	Togcha River 5 (Ipan)	S-3	14
23	4Talofofo	Talofofo River 2	S-3	14
24	5Aslinget	Aslinget River 3	S-3	14
25	6Tinago	Tinago River	S-3	14
26	7Inarajan	Inarajan River 3	S-3	14
27	8Agfayan	Agfayan River	S-3	14

The report concludes that if rainfall is the primary driver of DIN, the primary suspect of water pollution was classified as ***non-point source***. If there was a weak or no relationship with rainfall and high DIN, the primary suspect is classified as ***point-source pollution*** whereby regulatory agencies can investigate.

Guam EPA assesses the pH, Phosphate (PO4), and Nitrate (NO3) data to determine aquatic-life use support.

R2R S-2 waters		**%Exceedances**		
Project site	IR WaterBody	pH	Phosphate(PO4)	Nitrate (NO3)
10Liyog	Liyog River	0	71	21
9Ajayan	Ajayan River	0	29	7
11Sumay	Sumay River	0	86	93
12Manell	Manell River	0	86	14
16LaSaFua	La Sa Fua River	0	0	0
17Cetti	Cetti River	0	0	0
18Sella	Sella River	0	0	0
19Asmafines	Asmafines River	0	0	0
SOUTHNEW	Unnamed River 1 (GUULRCR)	0	0	0
26 AGANA	Agana River 1	0	0	7
25Fonte	Fonte River 1	0	0	100

R2R S-3 waters		%Exceedances		
Project site	IR WaterBody	pH	Phosphate(PO4)	Nitrate (NO3)
13Geus	Geus River 3	0	0	0
14Toguan	Toguan River 1	7	50	7
15Umatac	Umatac River (GUULRU-2)	0	0	0
1Pago	Pago River 4	0	0	0
20Taleyfac	Taleyfac River	0	0	0
21Namo	Namo River 3	0	0	0
22Masso	Masso River 3	0	0	0
23FishEye	Matgue River	0	0	7
24Asan	Asan River 2	0	0	0
2Ylig	Ylig River 3	0	0	0
3Togcha	Togcha River 5 (Ipan)	0	0	50
4Talofofo	Talofofo River 2	0	0	0
5Aslinget	Aslinget River 3	0	43	0
6Tinago	Tinago River	0	57	0
7Inarajan	Inarajan River 2	0	0	0
8Agfayan	Agfayan River	0	0	0

Data assessment summarized in the tables above indicate that five S-2 waterbodies are above the 10% exceedance threshold for Phosphate (PO4) and/or Nitrate (NO3). At S-3 waters, three sites are above the 10% exceedance threshold for Phosphate (PO4) and one site for Nitrate (NO3). All the nitrate samples at site 25Fonte (Fonte River 1) were in exceedance of nitrate GWQS. All pH results except one sample at 14Toguan were within GWQS. One pH exceedance is below the 10% exceedance threshold.

Assessment of the ***Aquatic Life*** Designated Use (DU) in these river surface waters is presented in the Assessment Results, Section III.

Department of the Navy Radiological Environmental Monitoring Report for Calendar *Year 2020, 2021 and 2022*

The US Navy assesses annually the efficacy of radiological controls associated with Naval nuclear-powered ships in protecting the health and safety of the public and aquatic life. The US Navy reports on sampled harbor water, sediment, marine life, exhaust stack discharges, shoreline surveys, and perimeter radiation levels.

Radiological environmental monitoring was performed concurrent with the presence of nuclear ships at Apra Harbor, Guam in the 1960s and has continued to the present. Monitoring of Cobalt-60 and any radionuclide with gamma ray energies between 0.1 and 2.1 MeV occurs at the following water bodies:

Department of the Navy Radiological Environmental Monitoring Report for CY '20, '21, '22		
Marine Water	GWQS class	No. visits
Apra Harbor 2	M-2	4/year
Apra Harbor 3	M-3	4/year
Sasa Bay	M-2	4/year
Apra Harbor 1	M-1	4/year

Harbor Water samples are collected during the first month of each calendar quarter resulting in six samples per quarter.

Harbor Sediment samples are collected during the first month of each calendar quarter resulting in thirty-three samples per quarter.

Marine Life samples are collected during July of each year resulting in three samples per year. Samples are Marine Plant, Mollusk, and crustacean.

Shoreline Surveys are conducted during the second and fourth quarter of each year during low tide and surveyed, 3ft above ground level, for radiation levels from bottom sediment that has been washed ashore.

Airborne Radioactivity monitoring form facilities is continuously sampled during the year. Particulate material from sampled air is collected on air sample filters.

Perimeter radiation levels/ accumulated radiation exposure are tested quarterly by thermoluminescent dosimeters (TLDs) that are posted at the perimeter locations (at test and control sites). Test locations are at Alpha/Bravo Piers, Romeo/Sierra Piers, and at Uniform/Victor Piers.

All samples are consistent with background levels or are non-detectable. Cobalt-60 was not detected. "There was no increase in the general background radioactivity of the environment that can be measured, and radiation exposure to the general public is not distinguishable from that resulting from nature background radiation."

Assessment of the ***Aquatic Life*** Designated Use (DU) in these waters is presented in the Assessment Results, Section III.

III. Assessment Results

Attainment Determinations

Attainment Determinations identify waterbody segments that meet or do not meet *designated-uses* using monitoring parameters and criteria described in the Guam Water Quality Standards.

Guam Waterbody segments: Guam's Marine and Surface Water Segments data set was developed using geospatial processing programs (Esri's ArcGIS) to obtain visual coverage of Guam's natural resources, georeferenced resource segments, and identified associated measurement attributes for data assessments. Guam EPA's River, Marine Waterbodies and Beaches data sets are used to develop monitoring plans and to facilitate reporting on the water quality condition in support of designated uses.

Guam Rivers and Streams (river segments) were assigned based on digitized USGS 7.5-minute, 1:24,000-scale quadrangle series topographic maps for Guam and cross checked with Guam Orthophotos updated by FEMA in 2003. The River shapefile attributes include watershed location, Guam River ID number, river/stream name and channel length (calculated using 'calculate geometry' tool).

The Guam marine waterbodies data set was created in 2010. The shapefile is based on existing information found in USGS quadrangle series topographic maps for Guam (7.5-minute, 1:24,000 scale), the Atlas of the Reefs and Beaches of Guam (Coastal Zone Management Section, and the Bureau of Planning document, R.H. Randall and L.G. Eldredge, 1976), and existing ArcGIS information from the Bureau of Statistics and Plans (i.e. coastal features, ecological reserve areas, Guam seashore reserve areas, Marine Preserve areas). During the design phase of the *2010 and*

2015 Guam Reef Flat Condition Assessments (2015 condition to be reported during the next reporting cycle), marine waterbodies were further delineated to include 21.3 square kilometers of 'Reef flat' zone of the NOAA Benthic Habitat Data shapefile. The Benthic Habitat Data is NOAA's National Ocean Service map production effort to digitally map biotic resources and coordinate a long-term monitoring program that can detect and predict change in U.S. coral reefs, and their associated habitats and biological communities.

The Guam Beaches data set was created in 2003 for use in the USEPA Beach Grant project. Beaches are identified based on public use/access and characteristics that allow for swimming/wading. The dataset was created using existing information in the Atlas of the Reefs and Beaches of Guam (Coastal Zone Management Section, Bureau of Planning, R.H. Randall and L.G. Eldredge, 1976) and existing shapefiles from the Bureau of Planning (i.e. coastal features). Guam Beach location (beach stretch locations and beach monitoring stations), monitoring and notification data is submitted to the U.S. Environmental Protection Agency (EPA)'s Water Quality Exchange (WQX)[8] and BEach Advisory and Closing Online Notification (BEACON) system annually. These systems were created by USEPA as mechanisms to publish monitoring and notification data as well as to provide to the public a database of state-specific pollution occurrences for coastal recreation waters. WQX can be viewed on-line at ***https://www.epa.gov/waterdata/water-quality-data-wqx***. BEACON can be viewed online at ***https://www.epa.gov/waterdata/beacon-20-beach-advisory-and-closing-online-notification***

This section presents the results of Guam's surface water assessments, including the five-part categorization of all surface water segments, probability-based survey results, the section 303(d) list and summaries of designated use support.

Five-Part Categorization of Surface Waters

The following categories are to be assigned to waterbody assessment units depending on the analysis of current data:

Category 1: All designated uses are supported (no use is threatened and no use is not supported)
Category 2: Some, but not all designated uses are supporting (no use is not supporting).
Category 3: Insufficient information/data to make use support rating (no use is not supporting);
Category 4: One or more uses is not supporting but a TMDL is not needed because either
Category 4a: A TMDL has been completed,
Category 4b: Impairment is being addressed by other regulatory requirements sufficient to achieve water quality standards;
Category 4c: A use is not supporting but the impairment is not caused by a pollutant.
Category 5: One or more uses is not supporting and a TMDL is needed.

[8] WQX has effectively replaced the STORET (short for STOrage and RETrieval) Data Warehouse which was decommissioned in June 2018.

Assessment results: Guam EPA's Recreational Beach Monitoring Program (RBMP)

All monitored beaches are assigned to *Category 4a* as Bacteria TMDLs were approved by EPA in 2010 and 2015, respectively. Individual recreational beach use-support assessments for 32 beaches are presented in the next table which shows the degree of use-support for the designated use of Whole Body Contact Recreation using the Enterococci (bacteria) parameter (exceedances of greater than 10% colored red indicate a *not supporting* designation). Thirty-two (32) beaches in 2020 and thirty – one (31) in 2021, 2022 and 2023 were assessed resulting in a categorization of 15.97 and 15.70 miles respectively of Guam's beaches.

	Waterbody Name	2020 percent exceedance	2021 percent exceedance
1	Beach north of Togcha River	0	no samples; site suspended
2	Asanite Point Beach aka First Beach	8	0
3	Gognga Beach, Tumon Bay	3	0
4	Outhouse Beach	5	0
5	Ypan Beach Park Beach (Ipan Public Beach)	0	0
6	Ypao Beach, Tumon Bay	0	0
7	Family Beach	0	2
8	Naton Beach, Tumon Bay	8	2
9	Gun Beach, Tumon Bay	0	6
10	Tagachang Beach Park	0	8
11	Port Authority Beach	11	4
12	NCS Beach/Tanguisson Beach	18	0
13	Inarajan Pools	11	15
14	United Seamen's Service Beach (USO Beach)	11	16
15	Dungca's Beach, East Hagåtña Bay	16	18
16	West of Adelup Point, Asan Bay	34	20
17	Beach at Fonte River, West Hagatna Bay	47	22
18	Head of Umatac Bay	34	22
19	Hagåtña Marina	32	33
20	Trinchera Beach, East Hagåtña Bay	39	35
21	Beach at Inarajan Bay	45	49
22	Beach North of Finile River	50	51
23	Merizo Public Pier Park	39	51
24	Beach at Pago Bay	39	55
25	Nimitz Beach	45	55
26	Asan Memorial Beach, Head of Asan Bay	58	57
27	Beach at Piti Bay	39	57
28	Beach South of Finile River *(added in 2020)*	100	71
29	Toguan Bay	42	71
30	West Hagatna Beach	82	76
31	Talofofo Bay	68	84
32	Togcha Beach aka Agat Beach	71	84

	Waterbody Name	2022 percent exceedance	2023 percent exceedance
1	Beach north of Togcha River	no samples; site suspended	no samples; site suspended
2	Asanite Point Beach aka First Beach	16	27
3	Gognga Beach, Tumon Bay	10	16
4	Outhouse Beach	0	0
5	Ypan Beach Park Beach (Ipan Public Beach)	0	0
6	Ypao Beach, Tumon Bay	0	16
7	Family Beach	0	4
8	Naton Beach, Tumon Bay	6	37
9	Gun Beach, Tumon Bay	4	4
10	Tagachang Beach Park	0	6
11	Port Authority Beach	4	0
12	NCS Beach/Tanguisson Beach	18	2
13	Inarajan Pools++	0	45
14	United Seamen's Service Beach (USO Beach)	0	4
15	Dungca's Beach, East Hagåtña Bay	18	41
16	West of Adelup Point, Asan Bay	20	45
17	Beach at Fonte River, West Hagatna Bay	30	84
18	Head of Umatac Bay	32	64
19	Hagåtña Marina	4	39
20	Trinchera Beach, East Hagåtña Bay	42	61
21	Beach at Inarajan Bay	42	61
22	Beach North of Finile River	42	80
23	Merizo Public Pier Park	58	80
24	Beach at Pago Bay	34	63
25	Nimitz Beach	34	55
26	Asan Memorial Beach, Head of Asan Bay	58	75
27	Beach at Piti Bay	48	69
28	Beach South of Finile River	70	82
29	Toguan Bay	68	73
30	West Hagatna Beach	72	72
31	Talofofo Bay	82	96
32	Togcha Beach aka Agat Beach	50	86

++ Inarajan Pools - Closed for park renovations from Feb 17, 2022 to Mar 15, 2023.

TMDL development: Microbial Source Tracking (MST) Screening at Nine Impaired Waters 2023

The MST study conducted by Guam EPA is considered a supportive effort toward TMDL development and a screening to help Guam EPA better understand the contributing sources of fecal pollution. With this information, Guam EPA can investigate what regulatory action can be taken to reduce controllable sources of FIB. Even at this screening level, identifying fecal source pollution is also helpful in obtaining stakeholder buy-in for supporting management activities in affected coastal areas and watersheds.

These fecal sources' bacteria have relatively short survival times in the environment, and the observation of these markers represents recent fecal contamination in 2023.

Non-human markers were successfully identified in this screening. Two additional markers can be investigated to refine the identification of target non-human fecal sources: 1) Apply the Poultry/Chicken marker to further identify avian sources found at all sites. 2) Distinguishing between water buffalo B. bubalis and deer C. mariannus fecal contamination may be valuable in future MST studies; therefore, validating the water buffalo for the CowM2 marker can benefit management.

Reducing controllable sources will decrease the total bacteria load to these waterbodies, bringing them closer to compliance with recreational water criteria.

Simple Example Management Exercise: N12 Hagatna Boat Basin
Source identification at N12 Hagatna Boat Basin is as follows:

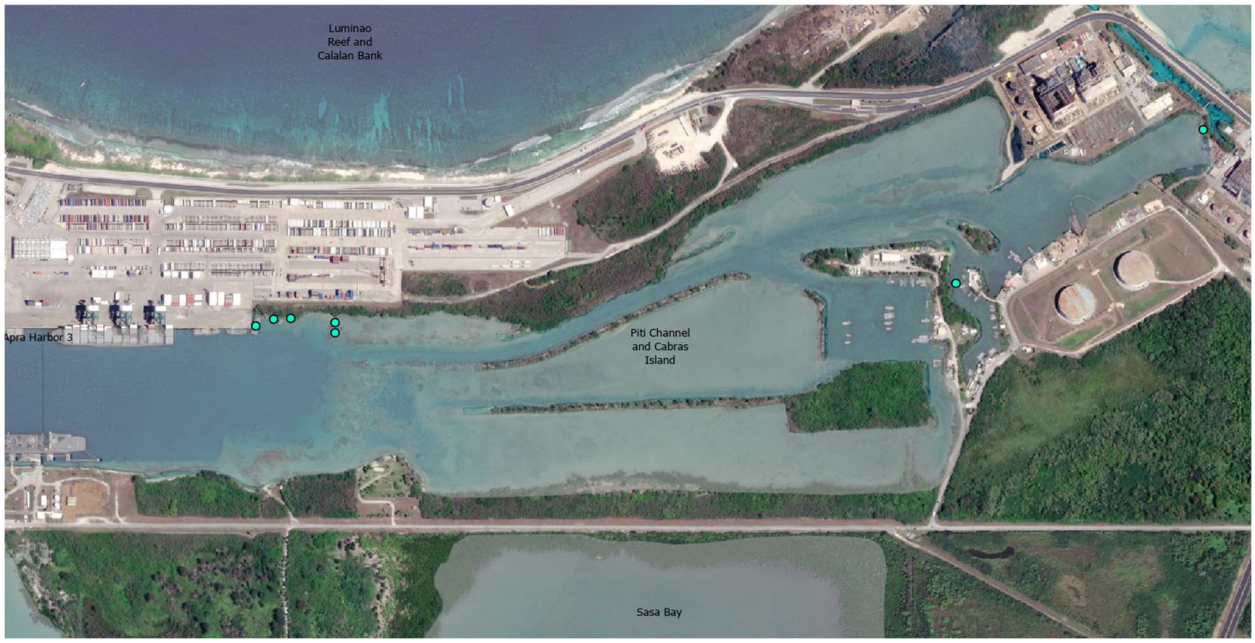
Site Name	Condition	Marker	Results
N12 Hagatna Boat Basin	Dry	Human_HF183	1220.00
N12 Hagatna Boat Basin	Dry	Human_HumM2	97.00
N12 Hagatna Boat Basin	Dry	Bird_GFD	464.05
N12 Hagatna Boat Basin	Dry	Enterococci	30.00
N12 Hagatna Boat Basin	Wet	Bird_GFD	515.52
N12 Hagatna Boat Basin	Wet	Dog_BacCan	1973.99
N12 Hagatna Boat Basin	Wet	Human_HF183	939.49
N12 Hagatna Boat Basin	Wet	Human_HumM2	133.01
N12 Hagatna Boat Basin	Wet	Enterococci	5172.00

Managing fecal sources at N12 Hagatna Boat Basin involves identifying and controlling human sources due to the absence of stormwater treatment systems for bird and dog sources. Dog fecal sources can also be controlled by removing feral dogs or educating owners to correctly collect and dispose of dog waste. Before controlling bird sources, more work should be done to identify the type of bird fecal source observed. Analysis using the poultry marker will indicate whether wild chickens or seabirds common to Hagatna are the source.

With funding, work should be done to expand the study area and adequately identify fecal sources by designing an MST study to support TMDL development and implementation. This MST study design goal should determine how the target source varies during all hydrologic and seasonal conditions; then, at least ten samples should be collected during each condition (e.g., dry and wet base and storm flow). Once sources are adequately identified, reduction strategies and activities, including considerations for a qualitative microbial risk assessment, for each waterbody can be identified and prioritized in an Agency implementation plan.

Assessment results: Guam EPA's Marine Debris Removal

Marine Waterbody	GWQS class	Status of removal
Piti Channel and Cabras Island	M-3	Removal of 11 ADVs completed in 2022 (see final report in Section VII). Removal of seven remaining ADVs is needed (ADV sites indicated in the figure below).
Cocos Lagoon (M-1)	M-1	Completed; Meets **Aesthetic Enjoyment** Designated Use (DU).



Assessment results: Brown and Caldwell: ***Cessation of Point Source Leachate Discharges to Lonfit River (Oct 2021)***

As described in the Data Assembly section (pp. 27-35), comparison and assessment of pre-closure and post-closure surface water data supports the conclusion that leachate point source discharges from the Ordot Dump Post-Closure Facility to the Lonfit River *have ceased*, as the result of closure construction. **Specific Lonfit River 2 and Lonfit River 3 parameters exceeding designated use criteria in the previous IR cycle were assessed as "meeting criteria" for respective designated use water quality parameters.**

The status of these specific parameters will be reported in ATTAINS as "Meeting Criteria" and delisted (i.e., no longer listed as a parameter not supporting its designated use). However, Lonfit River 2 and 3 remain impaired for other 303(d) unassessed pollutants. The Western Surface Drainage is added as an assessment unit, and impaired by exceedances to applicable water quality standards for two designated uses. As listed below, these parameters are Nitrate and TSS for ALUS; and Iron, Nitrate, and Uranium for drinking water use. Guam EPA will defer listing uranium pending further data and source assessment in the next IR reporting cycle.

2022-2024 Impaired Waters Assessment:

Assessment Unit	Designated use	Analyte (>10% exceedance of criteria)
Lonfit River 2	Drinking Water with Treatment	Aluminum*
Lonfit River 2	Drinking Water with Treatment	bis(2-Ethylhexyl)phthalate DEHP**
Lonfit River 2	Drinking Water with Treatment	Iron
Western Surface Drainage	Aquatic Life	Nitrate-nitrite (as N)
Western Surface Drainage	Aquatic Life	Total Suspended Solids
Western Surface Drainage	Drinking Water	Iron
Western Surface Drainage	Drinking Water	Nitrate-nitrite (as N)
Western Surface Drainage	Drinking Water	Radium-226 + Radium-228***
Western Surface Drainage	Drinking Water	Uranium****

***Aluminum is naturally occurring and typically at concentrations greater than current GWQS due to Guam's volcanic makeup. Furthermore, it is listed as part of the secondary drinking water regulations (those that may cause cosmetic effects or aesthetic effects in drinking water).**

****Suspected to be the result of laboratory contamination. DEHP is a common laboratory contaminant, and its presence is ubiquitous in materials used for environmental sampling and analysis (WI DNR, 2002) (TM doc)**

***One-time event - *considered unconfirmed* (TM doc)**
****Determination of uranium cannot be made due to insufficient information.**

Assessment results: Myeong-Ho Yeo (Primary Investigator), Adriana Chang and James Pangelinan: ***Application of a SWAT Model for Supporting a Ridge-to-Reef Framework in the Pago Watershed in Guam (Nov 2021)***

As discussed in the Data Assembly section above, Nitrate and Turbidity concentration data in the Lonfit River 1, Lonfit River 2, Pago River 1 and Pago River 4 during the wet and dry seasons are analyzed for aquatic life use support.

Nitrate at all sites were within the 10% exceedance threshold value (zero percent for sites in Lonfit River 1, Lonfit River 2, and Pago River 1 and 7% for Pago River 4).

Turbidity at Lonfit River 2, Pago River 1 and Pago River 4 were above the 10% exceedance threshold. These waterbodies are impaired for Turbidity.

The following table lists the impairments (>10% exceedance) identified from Yeo's data set.

Site	WaterBody	GWQS classification	Parameters > 10% exceedance threshold
Site 2	Lonfit River 2	S-2	Wet season Turbidity (NTU)
Site 3	Pago River 1	S-2	Dry season Turbidity (NTU), Wet season Turbidity (NTU)
Site 4	Pago River 4	S-3	Dry season Turbidity (NTU), Wet season Turbidity (NTU)

Assessment results: Dr. P. Houk: ***Ridge to Reef Assessment for Southern Guam, USEPA Wetlands Program Development Grant (2020-2021)***

pH, Phosphate PO4, and Nitrate NO3 concentrations presented in this project are assessed for ***Aquatic Life*** use-support.

The following table lists nine waterbodies with impairments (>10% exceedance) identified from Houk's data set.

Site	Waterbody	GWQS classification	Parameters > 10% exceedance threshold
10Liyog	Liyog River	S-2	Phosphate(PO4), Nitrate (NO3)
9Ajayan	Ajayan River	S-2	Phosphate(PO4)
11Sumay	Sumay River	S-2	Phosphate(PO4), Nitrate (NO3)
12Manell	Manell River	S-2	Phosphate(PO4), Nitrate (NO3)

Site	Waterbody	GWQS classification	Parameters > 10% exceedance threshold
25Fonte	Fonte River 1	S-2	Nitrate (NO3)
14Toguan	Toguan River 1	S-3	Phosphate(PO4)
3Togcha	Togcha River 5 (Ipan)	S-3	Nitrate (NO3)
5Aslinget	Aslinget River	S-3	Phosphate(PO4)
6Tinago	Tinago River	S-3	Phosphate(PO4)

Assessment results***: Department of the Navy Radiological Environmental Monitoring Report for Calendar Year 2020, 2021 and 2022***

All samples in 2020, 2021 and 2022 are consistent with background levels, or are non-detectable. Cobalt-60 was not detected. Aquatic Life Designated Use (DU) is met for Radioactive Materials at the following waterbodies:

Marine Water	GWQS class	Aquatic Life Designated Use (DU) for Radioactive Materials
Apra Harbor 2	M-2	Meets
Apra Harbor 3	M-3	Meets
Sasa Bay	M-2	Meets
Apra Harbor 1	M-1	Meets

IV. Trend Analysis for Surface Waters

Status and Trends Monitoring Program, Guam EPA

The Guam EPA Monitoring Program is continuing efforts to develop a water quality inventory document (entitled "STMP Surface and Marine Water Quality Assessment") based on data collected via its Status and Trends Monitoring Program and recorded in USEPA's STORET. A preview of the STMP 2013 assessment document featuring the Hagatna Watershed was included in Guam's 2014 IR.

The document presents information on:

- Guam's delineated watersheds and specific watershed links to river and marine waterbody segment information (e.g. known point and non-point pollution sources, advisory areas, water quality monitoring sites and biological monitoring sites);
- Watershed monitoring site information (e.g. site description, assigned Guam water quality classification, years sampled, total number of sampling events); and
- Watershed specific raw monitoring data and descriptive statistics of the data (e.g. number of samples, average concentration, minimum/maximum values, number of GWQS exceedances, percentage exceedance and box and whiskers charts showing yearly

data distribution, Observed Mobile Invertebrates, Percent Cover of major benthic Group Categories, and Species Observed).

The document is intended to be used by Agency managers for planning purposes; however, segments may be provided to the public.

The following table summarizes where exceedances occurred at 75% or more of samples taken. Continued investigation should be conducted at these sites in order to determine sources of these exceedances. Inclusion of these sites to the IWM program can be considered to further investigate.

STMP Sites with 75% or greater Exceedances:

Bacteria Concentration (MPN)		Orthophosphate (mg/L)		Nitrate (mg/L)		Oxygen (% Saturation)		Total Suspended Solids (mg/L)	
SITE	WATER SHED	SITE	WATER SHED	SITE	WATER SHED	SITE	WATER SHED	SITE	WATER SHED
AGMX	Hagatna	MZRAC	Manell	AGRA-1	Hagatna	A5	Hagatna	DRM	Northern
AGRA-1	Hagatna	MZRL	Manell	INRI1	Inarajan	AGRA-1	Hagatna	DRMI	Northern
INRAGB-3	Inarajan	TURTG-1B	Togcha	AGRD	Northern	AGRA-2	Hagatna	P2	Pago
MZRAC	Manell			P2	Pago	AGRA-3	Hagatna	ATMA	Taelaya g
MZRAJ	Manell			PGRLO	Pago	AGRD	Northern		
MZRL	Manell			ASRI-2	Piti / Asan	P2	Pago		
TANG	Northern			T3	Togcha	P8	Pago		
ASRI-1	Piti / Asan			TURTG -1B	Togcha	P9	Pago		
ASRI-3	Piti / Asan					PGEP	Pago		
ASRM	Piti / Asan					PGRLO	Pago		
MA1	Piti / Asan					MZRP-2	Toguan		
TUM11	Talofofo					FW site	Apra		
TURTG-C	Togcha								
MZRP-2	Toguan								
MZRT-1	Toguan								
FW site	Apra								

U.S. Department of the Interior National Park Service; Natural Resource Data Series (NRDS) Reports[9]

Report 1: Summary Report 2009 – 2014 for marine waters of the War in The Pacific National Historical Park in Asan and Agat, Guam. (October 2017, Natural Resource Data Series NPS/PACN/NRDS—2017/1122).- "The data presented in this report will be analyzed and interpreted for the establishment of expected parameter value ranges and long-term trends in future reports published in the National Park Service Natural Resource Report series. The purpose of collecting data on *Vital Signs* (an indicator of physical, chemical, biological elements or ecosystem processes selected to represent the overall health or condition of natural resources within parks) is to provide park managers information on current conditions and temporal trends in ecosystem health. Sampling methods employed here were not designed to match methods used to evaluate territory water quality criteria, and were therefore not directly comparable."

Project Data timeframe: This report presents data collected under the PACN water quality protocol (Jones et al. 2011) in the marine portion of War in the Pacific National Historical Park (WAPA) in Asan and Agat, Guam, USA, between 2008 and 2014.

Project Target Parameters (that are applicable to GWQS):

Parameter	Unit
pH	n/a
Orthophosphate (PO4)	mgP · L-1
Nitrates (NO3)	mgN · L-1
Oxygen Saturation	%
Salinity	%
Suspended solids	mg · L-1
Turbidity	NTU

Project Sites:

PACN site designation	Location	Decimal Degrees Latitude	Decimal Degrees Longitude	GWQS class
FWAPA02_mr	Asan	13.482261	144.723496	M-2
FWAPA05_mr	Asan	13.478204	144.711624	M-2
FWAPA10_mr	Agat	13.394444	144.654031	M-2
FWAPA15_mr	Agat	13.376842	144.644125	M-2

And numerous temporary sites in each bay in addition to these 4 fixed sites

Applicable GEPA Waterbodies:

Marine Bay Name	AU_ID	Size (sq mi)
Asan Bay	GUG-006A	0.58

[9] NRDS reports are annual or periodic data summary reports for long-term monitoring projects intended only for the release of basic data sets and summaries with minimal interpretation.

Marine Bay Name	AU_ID	Size (sq mi)
Agat Bay 2	GUG-010B-2	1.91

Project Results: "Results are presented as summaries by quarter because data from all sites were collected over a variable number of consecutive days, typically one to three". "Territory water quality standards were not violated".

Orthophosphate (PO4) [0.05mg/L M-2 criteria] – was not detected above GWQS during sampling events in Agat or Asan WAPA.

Nitrates (NO3) + Nitrate (NO2) [no GWQS available; 0.20mg/L for Nitrate (NO3)] – was not detected above GWQS during sampling events in Agat or Asan WAPA. "The highest measurements of NO2 + NO3 were usually taken near stream outputs in Asan and Agat". In Agat, the maximum concentration was observed during the 1st Quarter of 2010 at 0.021mg/L. In Asan, maximum concentration was observed during the 3rd quarter of 2009 at 0.015mg/L.

Dissolved Oxygen (concentration mg/L and % saturation) – all samples were above the 5.0mg/L threshold and the 75% DO Sat threshold.

pH [6.5 – 8.5 pH units] – all samples were within the threshold range.

Water temperature [not changed more than 1.0 deg C from ambient] – temperature values can be used as 'ambient' for future criteria assessments.

Turbidity [not > 1.0 NTU over ambient] – turbidity concentrations were generally low/ non-detect. Data collected can be used as 'ambient' for future criteria assessments.

Report 2: Marine Water Quality in Pacific Island National Parks Temporal, Spatial and Chemical patterns 2008 – 2015. (January 2021, Natural Resource Report NPS/PACN/NRR—2021/2220)[10].

"The National Park Service (NPS) designate(s) water quality as a "vital sign," or an indicator of physical, chemical, biological elements or ecosystem processes that represents the overall health and condition of natural resources within parks".

"The primary objectives of this program include determining the range, spatial patterns, and temporal trends of water quality parameters in the coastal marine waters of four parks".

[10] Citation: Raikow, D. F., S. Kichman, A. L. McCutcheon, and A. Farahi. 2021. Marine water quality in Pacific Island national parks: Temporal, spatial, and chemical patterns 2008–2015. Natural Resource Report NPS/PACN/NRR—2021/2220. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/nrr-2284328.

"Secondary objectives included determining particulate and dissolved nutrient fractions, and correlation of parameters in surface and near-bottom samples."

Furthermore, "Park managers can use this information to evaluate resource conditions and potential impacts and mitigation measures for their park and watersheds."

Project Target Parameters (that are applicable to GWQS):

Parameter	Unit
pH	n/a
Orthophosphate (PO4)	mgP · L-1
Nitrates (NO3)	mgN · L-1
Oxygen Saturation	%
Salinity	%
Suspended solids	mg · L-1
Turbidity	NTU

Project Sites:

For Guam, same as Report 1.

Project Results: Generally, "Waters measured in the near shore environments of all parks were oligotrophic, or having low nutrient concentrations, high oxygenation, and low turbidity."

Trends: At War in the Pacific NHP Agat unit, relatively high concentrations of chlorophyll were observed at the beginning of the observation period and a downward trend was observed. At War in the Pacific NHP Asan, a downward trend of salinity concentrations was observed.

Seasonality: Temperature showed strong evidence for seasonality, with significant results in most tests. Chlorophyll showed evidence of seasonality at War in the Pacific NHP.

Surface and Near-bottom Sample Correlation: Oxygen, pH, Salinity, temperature were highly correlated at Asan and Agat WAPA. Total Dissolved Phosphorus was perfectly positively correlated at the Asan WAPA (R=1.00). TDP at the Agat WAPA was obscured by high data censoring.

Summary of results by park:
War in the Pacific National Historical Park (Asan and Agat)

- Nutrient concentrations were unremarkable and consistent with previous studies of pacific islands.
- Nutrients were dominated by dissolved fractions.
- Salinity at Asan showed a decreasing trend.

- Chlorophyll at Agat showed a decreasing trend.
- Temperature and chlorophyll showed strong evidence of seasonality.
- Surface measurements were highly correlated with bottom measurements.
- Data censoring rates were very high for TDP and turbidity.
- No submarine groundwater discharge (SGD) plumes were detected.
- The salinity trend can be explained by the timing of rain events.

Project Discussion: Overall water quality in the marine portions of PACN parks was good, with low nutrient concentrations, predominance of dissolved nutrient species, high oxygenation, high clarity, and thus oligotrophic. Nutrient concentrations were generally consistent with previous studies.

Note that because the sampling regime differed from methods employed by state agencies, results of the current study were not directly comparable to state water quality standards. Water quality parameter values representing outliers were uncommon and attributable to identifiable non-repeating causes.

Report 3: Water Quality in the Asan River, War in the Pacific National Historical Park. Summary Report 2007 - 2012. (May 2014, Natural Resource Data Series NPS/PACN/NRDS—2014/662)[11]. – "This report is restricted to data presentation and limited description. The data presented in this report will be analyzed for the establishment of expected parameter value ranges and long-term trends in future reports published in the NPS Natural Resource Technical Report (NRTR) series. The purpose of collecting data on Vital Signs is to provide park managers information on current conditions and temporal trends in ecosystem health."

The report identifies that "Several parameters were found to be outside published water quality criteria values over the monitoring period. Slightly high pH, relative to water quality criteria (Guam 1997), may have been the result of autotrophic (plant) activity, i.e. macrophytes and/or algae. Supersaturation of oxygen was measured when high pH was measured, indicating the high autotrophic activity. Because autotrophs consume CO2, they can alter the carbonic acid balance in the water column resulting in higher pH (Wetzel 2001). Elevated turbidity may have been the result of siltation caused by the construction of homes just outside the park border in the upper reaches of the Asan River."

The GWQS classification of S-1 was used for data evaluation while all their projects sites are in fact classified as S-3.

Project Data timeframe: Data were collected from May 2007 - April 2012

[11] Citation: Raikow, D. F., and A. Farahi. 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.

Project Target Parameters (that are applicable to GWQS):

Parameter	Unit
pH	n/a
Orthophosphate (PO4)	mgP · L-1
Nitrates (NO3)	mgN · L-1
Oxygen Saturation	%
Turbidity	NTU

Project Sites: Eight (8) fixed sites and forty-nine (49) temporary sites in **Asan River 1** (AU_ID GUASRI-3, Size 1.320815 miles). All sites are classified as S-3. **Project Results:** "Thirteen sampling trips were conducted in the Asan River from 2007 to 2012. No data was collected in 2008. Results are presented in **summaries** by year".

GWQS	*6.5-9.0*	*0.100 mg/L*	*0.500 mg/L*	*Not < 75% [5.6mg/L]*	*Not >1.0 over ambient*
YEAR	**pH**	**PO4 mg/L**	**NO3 mg/L**	**DO Sat %**	**Turbidity NTU**
2007	Min 8.33 Max 8.97	Not sampled	Not sampled	Min 96.7 (median 112.9%)	Median 9.2
GWQS	*6.5-9.0*	*0.100 mg/L*	*0.500 mg/L*	*Not < 75% [5.6mg/L]*	*Not >1.0 over ambient*
YEAR	**pH**	**PO4 mg/L**	**NO3 mg/L**	**DO Sat %**	**Turbidity NTU**
2009	Min 7.7 Max 8.7	Min 0.015 Max 0.036	NO2+NO3: Min 0.001 Max 0.088	Min 69.4% (median 104.9%) [conc Min: 5.5 mg/L]	Median 10.4
2010	Min 8.0 Max 8.9	Min 0.015 Max 0.040	NO2+NO3: Min 0.001 Max 0.034	Min 73.4% (median 103.1%) [conc Min: 5.9 mg/L]	Median 0.4
2011	Min 8.1 Max 8.6	Min 0.015 Max 0.015	NO2+NO3: Min 0.001 Max 0.098	Min 88.4% (median 103.1%) [conc Min: 7.3 mg/L]	Median 1.7
2012	Min 7.8 Max 8.4	Min 0.015 Max 0.034	NO2+NO3: Min 0.001 Max 0.018	Min 80.5% (median 103.1%) [conc Min: 6.6 mg/L]	Median 0.2

The pH, nutrients and dissolved oxygen concentrations presented as summaries appear to be within GWQS. Reported turbidity concentration may be used to characterize ambient conditions. **GEPA will identify the raw data used to summarize their annual efforts to apply this data towards future Aquatic Life use-determination assessments.**

Baseline Water Quality Monitoring on Naval Base Guam, Submerged Lands (Schils, T., UOG ML for Naval Facilities Engineering Command Marianas)

The report states, "The main goal of this study was to build a better baseline of water quality data for NBG submerged lands and Guam. Such a baseline will be valuable for future impact assessments, monitoring studies, and reef health assessments."

NBG Submerged Lands study areas are found in four identified Guam EPA Marine Bays and are classified in the GWQS as M-1 and M-2 waters as follows:

Station Number	Study Area	Station Name	Latitude	Longitude	Reef Type	GEPA Marine Bay Name	GWQS classification
1	Naval Base Guam (NBG)	Inner Harbor	13.43181	144.67573	Patch Reef	Apra Harbor 2	M-2
2	Naval Base Guam (NBG)	Anchor Reef	13.44945	144.66715	Patch Reef	Apra Harbor 2	M-2
3	Naval Base Guam (NBG)	Middle Shoals	13.44959	144.65729	Patch Reef	Apra Harbor 2	M-2
4	Naval Base Guam (NBG)	Orote Point	13.44947	144.62466	Fringing Reef	Apra Harbor 2	M-2
5	Naval Base Guam (NBG)	Blue Hole (Orote Peninsula ERA)	13.43627	144.62741	Fringing Reef	Orote Peninsula Sea Cliffs (North)	M-1
6	Naval Support Activity Andersen Air Force Base (NSAA)	Double Reef (Haputo ERA)	13.59930	144.83145	Fringing Reef	Rocky Shorelines Northwest Coast (Double Reef)	M-1
7	Naval Support Activity Andersen Air Force Base (NSAA)	Lafac Bay (Pati Point MPA)	13.56697	144.94108	Fringing Reef	Rocky Shorelines Northeast Coast (Pati Point)	M-1

The study areas were monitored for conventional water quality parameters using continuous monitoring systems, *Sea-Bird Electronics (SBE) 19plus V2 SeaCAT Profilers*, and *First generation SAtlantic SeaFET multiprobes*, left in place at the study areas for the following duration:

Station	Variable	Interval (Duration)
Inner Apra Harbor (Station 1)	Temperature (°C), Depth (m), Salinity (‰),Diss. Ox. (mg/L), Turbidity (NTU)	09/25/2019 - 01/05/2020

Station	Variable	Interval (Duration)
	pH	09/25/2019 - 10/12/2019
Anchor Reef (Station 2)	Temperature (°C), pH	11/10/2018 - 11/25/2019
	Depth (m), Salinity (‰),Diss. Ox. (mg/L), Turbidity (NTU)	01/29/2019 - 09/19/2019
Middle Shoals (Station 3)	Temperature (°C), pH	11/08/2018 - 01/14/2020
	Depth (m), Salinity (‰),Diss. Ox. (mg/L), Turbidity (NTU)	01/29/2019-12/30/2019
Orote Point (Station 4)	Temperature (°C), pH	11/08/2018 - 10/16/2019
	Depth (m), Salinity (‰),Diss. Ox. (mg/L), Turbidity (NTU)	01/29/2019 - 09/20/2019
Blue Hole (Station 5)	Temperature (°C), Depth (m), Salinity (‰),Diss. Ox. (mg/L)	06/27/2019 - 10/03/2019
	Turbidity (NTU)	06/27/2019 - 09/10/2019
Double Reef (Station 6)	Temperature (°C), Depth (m), Salinity (‰),Diss. Ox. (mg/L), Turbidity (NTU)	06/27/2019 - 10/21/2019
Lafac Bay (Station 7)	Temperature (°C), Depth (m), Salinity (‰),Diss. Ox. (mg/L), Turbidity (NTU)	10/01/2019 - 01/01/2020

According to the report, sample intervals were set at 5 minutes, and data logging was programmed to start at midnight after each deployment. Parameters monitored are Temperature, Depth, Salinity, Dissolved Oxygen, Turbidity and pH.

The following table from the report indicates baseline conditions for study parameters. pH was monitored at the four stations in Apra Harbor 2 (Mean pH range 8.00 – 8.11). Reported Mean values for Dissolved Oxygen and pH meet GWQS.

	Station	Variable	Interval	N Obs	Mean ± SD	Median	Range	Skew	Kurt
1	Inner Apra Harbor (Station 1)	Temperature (°C)	09/25/19 - 01/05/20	29,224	29.41±0.87	29.77	3.61	-0.909	-0.258
2	Inner Apra Harbor (Station 1)	Depth (m)	09/25/19 - 01/05/20	29,126	4.63±0.24	4.67	1.53	-0.656	-0.100
3	Inner Apra Harbor (Station 1)	Salinity (‰)	09/25/19 - 01/05/20	28,979	34.04±0.18	34.10	1.84	-2.075	6.267
4	Inner Apra Harbor (Station 1)	Diss. Ox. (mg/L)	09/25/19 - 01/05/20	28,963	5.06±0.58	5.16	5.90	-0.565	0.527
5	Inner Apra Harbor (Station 1)	Turbidity (NTU)	09/25/19 - 01/05/20	29,229	1.77±1.20	1.45	12.71	2.796	12.67
6	Inner Apra Harbor (Station 1)	pH	09/25/19 - 10/12/19	790	8.00±0.07	7.99	0.28	0.155	-1.373

	Station	Variable	Interval	N Obs	Mean ± SD	Median	Range	Skew	Kurt
7	Anchor Reef (Station 2)	Temperature (°C)	11/10/18 - 11/25/19	50,847	28.68±1.11	28.56	4.16	-0.111	-1.506
8	Anchor Reef (Station 2)	Depth (m)	01/29/19 - 09/19/19	44,664	5.39±0.22	5.43	1.43	-0.497	-0.318
9	Anchor Reef (Station 2)	Salinity (‰)	01/29/19 - 09/19/19	44,947	34.27±0.21	34.30	2.03	-1.578	3.804
10	Anchor Reef (Station 2)	Diss. Ox. (mg/L)	01/29/19 - 09/19/19	42,649	5.81±0.61	5.85	4.07	-0.139	-0.762
11	Anchor Reef (Station 2)	Turbidity (NTU)	01/29/19 - 09/19/19	42,488	0.51±0.19	0.51	4.50	3.304	42.41
12	Anchor Reef (Station 2)	pH	11/10/18 - 11/25/19	6,419	8.08±0.03	8.08	0.34	-0.166	0.803
13	Middle Shoals (Station 3)	Temperature (°C)	11/08/18 - 01/14/20	63,930	28.65±0.98	28.63	4.05	-0.123	-1.331
14	Middle Shoals (Station 3)	Depth (m)	01/29/19 - 12/30/19	54,981	7.15±0.23	7.19	1.23	-0.559	-0.331
15	Middle Shoals (Station 3)	Salinity (‰)	01/29/19 - 12/30/19	55,197	34.33±0.18	34.35	1.49	-0.930	1.100
16	Middle Shoals (Station 3)	Diss. Ox. (mg/L)	01/29/19 - 12/30/19	53,125	5.79±0.45	5.83	3.43	-0.420	-0.266
17	Middle Shoals (Station 3)	Turbidity (NTU)	01/29/19 - 09/19/19	45,419	1.02±1.88	0.37	9.85	3.582	12.94
18	Middle Shoals (Station 3)	pH	11/08/18 - 01/14/20	17,412	8.11±0.15	8.15	0.80	-0.632	-0.613
19	Orote Point (Station 4)	Temperature (°C)	11/08/18 - 10/16/19	45,431	28.74±0.98	28.71	3.72	-0.124	-1.535
20	Orote Point (Station 4)	Depth (m)	01/29/19 - 09/20/19	38,422	8.70±0.24	8.74	1.86	-0.548	-0.050
21	Orote Point (Station 4)	Salinity (‰)	01/29/19 - 09/20/19	38,350	34.19±0.20	34.21	1.09	-0.537	-0.040
22	Orote Point (Station 4)	Diss. Ox. (mg/L)	01/29/19 - 09/20/19	36,188	6.12±0.44	6.18	3.16	-0.636	0.250
23	Orote Point (Station 4)	Turbidity (NTU)	01/29/19 - 09/20/19	38,342	2.50±3.86	1.13	24.31	2.774	8.990

	Station	Variable	Interval	N Obs	Mean ± SD	Median	Range	Skew	Kurt
24	Orote Point (Station 4)	pH	11/08/18 - 10/16/19	11,577	8.10±0.08	8.09	0.42	0.256	-0.887
25	Blue Hole (Station 5)	Temperature (°C)	06/27/19 - 10/03/19	21,642	29.71±0.25	29.72	2.25	-0.518	0.908
26	Blue Hole (Station 5)	Depth (m)	06/27/19 - 10/03/19	21,642	7.71±0.28	7.74	3.79	-0.385	2.106
27	Blue Hole (Station 5)	Salinity (‰)	06/27/19 - 10/03/19	21,642	34.34±0.11	34.34	0.69	-0.492	-0.798
28	Blue Hole (Station 5)	Diss. Ox. (mg/L)	06/27/19 - 10/03/19	20,994	6.26±0.09	6.26	0.71	0.132	-0.044
29	Blue Hole (Station 5)	Turbidity (NTU)	06/27/19 - 09/10/19	14,448	0.09±0.07	0.08	4.24	25.47	1,165
30	Double Reef (Station 6)	Temperature (°C)	06/27/19 - 10/21/19	14,064	29.65±0.21	29.65	1.26	0.210	-0.890
31	Double Reef (Station 6)	Depth (m)	06/27/19 - 10/21/19	14,064	7.70±0.29	7.73	3.64	-0.372	1.812
32	Double Reef (Station 6)	Salinity (‰)	06/27/19 - 10/21/19	14,064	34.24±0.10	34.27	0.64	-0.642	0.379
33	Double Reef (Station 6)	Diss. Ox. (mg/L)	06/27/19 - 10/21/19	14,064	6.23±0.34	6.22	2.57	-0.238	0.565
34	Double Reef (Station 6)	Turbidity (NTU)	06/27/19 - 10/21/19	14,064	2.96±3.55	1.70	23.61	3.560	14.22
35	Lafac Bay (Station 7)	Temperature (°C)	10/01/19 - 01/01/20	26,461	29.06±0.54	29.25	2.89	-0.720	-0.034
36	Lafac Bay (Station 7)	Depth (m)	10/01/19 - 01/01/20	26,461	8.15±0.34	8.18	4.47	-0.403	1.464
37	Lafac Bay (Station 7)	Salinity (‰)	10/01/19 - 01/01/20	26,461	34.24±0.18	34.27	0.83	-0.542	0.112
38	Lafac Bay (Station 7)	Diss. Ox. (mg/L)	10/01/19 - 01/01/20	26,461	6.22±0.28	6.22	1.76	-0.025	-0.545
39	Lafac Bay (Station 7)	Turbidity (NTU)	10/01/19 - 01/01/20	26,461	1.05±2.14	0.52	24.20	6.981	58.27

Notable excerpts for Variable / Parameter:

- **Temperature and dissolved oxygen**: A negative correlation between temperature and dissolved oxygen is observed at all stations. At high temperatures, dissolved oxygen can drop significantly.
- **Temperature and pH**: Positive correlations between temperature and pH have been well documented for reef systems over diel and seasonal time scales.
- **Temperature and Turbidity**: a moderate inverse relationship between temperature and turbidity could be largely attributed to tropical storm events causing terrestrial runoff of freshwater, which increases turbidity, lowers salinity, and decreases temperature. A weak negative correlation could also be explained by the effects of rough seas/rainfall/turbidity events.
- **Dissolved Oxygen**: Higher dissolved oxygen concentrations can be expected during periods of intense mixing, e.g., rough seas or tropical storm events.
- **Multivariate analyses of biological surveys** (benthic cover, fish populations, and mobile invertebrate communities) in NBG and NSAA waters also revealed a distinct difference between harbor sites and Guam's exposed fringing reefs.
- Overall, the **range in environmental variables** like temperature, dissolved oxygen, salinity, and turbidity is highest in the harbor. Communities in the harbor contain more stress-tolerant species, and species richness is lower. The higher negative skew in salinity for harbor sites shows that episodes of freshwater input regularly lower the salinity for harbor sites.
- Inner Apra Harbor is a singleton cluster, and the three Outer Apra Harbor stations (Anchor Reef, Middle Shoals, Orote Point) form the second cluster.

Notable excerpts for Sites:

- Inner Apra Harbor (Station 1): It is reasonable to expect that the marine habitats in the Inner Harbor are some of the most environmentally stressed marine habitats around the island, characterized by high temperatures, low dissolved oxygen concentrations, and episodes of high turbidity and low salinity. Also, it is safe to assume that Inner Harbor experiences larger fluctuations in salinity and dissolved oxygen.
- Anchor Reef (Station 2): The ranges in salinity and dissolved oxygen documented for Anchor Reef were the highest of the study. This station also showed the highest positive correlation between salinity and pH.
- Middle Shoals (Station 3): a minimal tidal range is observed at this station. Also, this station displayed the largest range in pH and the highest average pH. Furthermore, correlations indicate that this station could be situated near a mild halocline/thermocline.
- Orote Point (Station 4): turbidity levels at this site are very high for a marine environment and coincided with a steep drop in salinity. Temperature and turbidity had a moderate inverse relationship, which could be largely attributed to tropical storm events causing terrestrial runoff of freshwater, which increases turbidity, lowers salinity, and decreases temperature. Overall, the water quality data at Orote Point were the most similar to those of Middle Shoals.
- Blue Hole (Station 5): the high average concentration of dissolved oxygen (6.26±0.09 mg/L) because of the thorough mixing that occurs here. Correlations between water quality

variables are weak to non-existent. A moderate positive relationship was, however, found between temperature and salinity.

- Double Reef (Station 6): Dissolved oxygen concentrations at Double Reef are high (6.23±0.34 mg/L), comparable to those at Blue Hole and Lafac Bay. These are all forereef sites characterized by a well-mixed water column. Turbidity at Double Reef shows some pronounced spikes that might be **related to terrestrial runoff** from the neighboring coastal area.
- Lafac Bay (Station 7): has seen a sharp decline in scleractinian coral cover following recent bleaching events—the most exposed station of the study. Particularly rough seas were documented in the days around November 28, which were reflected in a salinity dip, dissolved oxygen spike, and multiple days of high turbidity. An unexpected strong negative correlation between salinity and temperature was documented for Lafac Bay - explained by a seasonality in seep or spring flow, with a net result of decreasing aquifer discharge of the Andersen sub-basin into Lafac Bay from the wet into the dry season.

A decade of change on Guam's coral reefs. A report of Guam's Long-term Coral Reef: A decade of change on Guam's coral reefs. A report of Guam Long-term Coral Reef Monitoring Program activities between 2010 and 2021. Prepared by David Burdick, M.S. August 2023 (University of Guam Marine Laboratory Technical Report 170)

This report provides trend information on coral reef health in four monitoring efforts conducted from 2009 through 2022 at Comprehensive Long-term Coral Reef Monitoring permanent sites on Guam, also known as the Guam Long-term Coral Reef Monitoring Program (GLTMP). These efforts involve reporting on four elements of the long-term monitoring program:

- Two coral bleaching and mortality observations from two island wide projects: *Island-wide Coral Bleaching Response and Recovery* and *Island-wide Staghorn Mortality Assessment*,
- Coral cover: *Reef Flat Monitoring*
- Comprehensive coral reef health indicators at high priority reef areas: *Reef Condition at the High Priority Reef Areas*. Indicators assessed are Coral cover, Coral community, Food fish biomass, Biomass of all food fish families, Total reef fish biomass, Small food fishes density, Invertebrate density (edible), and Vulnerability.

The following three tables provide a simple summary of the trends observed from each monitoring effort. For specific details, see the report.

The following table summarizes incidents and trends observed in three projects during the reported interval. (B = Bleaching event, R = recovery event)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
					B	B	B, extreme low tides	B, thermal anomalies	B, thermal anomalies	R	R	R	R	
Island-Wide Coral Bleaching Response and Recovery Sites					loss of 1/3 of corals, Eastern suffered 60% decline, little change along western					recovery detected at >1/2 of sites				
Island-Wide Staghorn Mortality Assessment					>1/2 mortality				↓29-100% of pre 2013			↓ further declines. Staghorn not observed at Sharks hole, Double Reef. No recovery at Tumon Bay, Cocos Lagoon, W. Hag Bay.		
Reef Flat Monitoring Sites: 2009–2022							white syndromes outbreaks		*Acropora sp.* white syndrome Tanguisson and Tumon	*Pocillopora damicornis* white syndrome outbreak	coral loss avg: 27% across 5 sites over 10 yr period		coral loss avg: 24% across 5 sites over 10 yr period (Tumon site increase) .	rapid mortality by an aggressive white syndrome or similar disease at Ypao Beach and Tepungan Channel.

The following table summarizes coral cover densities from the report at five *Reef Flat Monitoring* project study sites from 2009 through 2022.

		Piti reef flat coral cover	Tumon reef flat coral cover	Luminao reef flat coral cover	West Agana reef flat coral cover	Tanguisson reef flat coral cover		
2009		35%	~50–51%	~35%	~15–17%	24%	2009	
2010		↓			10%	↓	2010	
2011		~35%	38%		~15–17%	24%	2011	
2012			~50–51%				2012	
2013	B				~15–17%; bleaching in 2013	↓ (disease outbreak)	2013	B
2014	B	stable	27%	↓	28% new transects		2014	B
2015	B, extreme low tides	stable	38%		↓	~14%	2015	B, extreme low tides
2016	B, thermal anomalies	stable ~ ↑	25%		~16 - 18%		2016	B, thermal anomalies
2017	B, thermal anomalies	↓	24%			8%	2017	B, thermal anomalies
2018	R	35%				↑	2018	R
2019	R	33% - 38% (community composition Δ ?)		modest increase		↑	2019	R
2020	R		significant decrease	26%		↓	2020	R
2021	R		steady increase	~23-28%	21%	↑	2021	R
2022			44%	~23%	18%	12%	2022	

The next table summarizes indicator key points at six high priority reef area.

	Tumon Bay Marine Preserve	East Agana Bay	Piti Bomb Holes Marine Preserve (Piti Bay)	Fouha Bay	Achang Reef Flat Marine Preserve (Sumay Bay and Asgadao Bay)	Cocos – East (Cocos Lagoon 1)
Coral cover	~30% 2012 - 2020. Stable through bleaching events.	~45% 2010 - 2020. Stable through bleaching events.	16% 2010 and 2020. Stable.	18% 2-15-2019. ↓ at mouth of bay 2% cover to ~1%.	~5% 2014-2018	~5% 2014-2018
Coral community	dominated by bleaching-resistant coral species	dominated by bleaching-resistant coral species Porites rus	dominated by bleaching-resistant coral species mounding Porites spp.	Porites rus and mounding Porites spp	dominated by stress tolerant mounding Porites corals	mounding Porites spp.stable. ↓ Astreopora and Pocillopora.
Food fish biomass	↓ after 2012. ↑ 2019 - 2021	↓ after 2010. steady ↑ after 2019	food fish biomass remained low between 2012 and 2020	very low FFB but ↑ 2015-2019	low FFB persisted 2014 - 2018 and ↑ 2018 - 2021	low FFB persisted 2014 - 2021
Biomass of all food fish families	except groupers: ↑ 2019 -2021	Jacks and others: ↑ 2019 -2021	parrotfishes ↑ 2018 and 2020, while all others remained relatively stable	Surgeon fishes and "other families" ↑ 2019 and 2021	Surgeon fishes, wrasses, emperors, parrotfishes, and groupers ↑ 2014 - 2021	parrotfishes ↑ 2014 - 2021. Few or no emperors, groupers, or jacks were observed during any sampling year.
Total reef fish biomass	2019: moderate 21–41 g/m2, 39–77% of the potential	2019: low 12 g/m2, at 23% of the potential	2018: low 12–21 g·m-2, at 23–40% of the potential	2019: very low 3–8 g·m-2, at 6–15% of the potential	low 9–23 g·m-2, at 17–43% of the potential	2014: low 10–20 g·m-2, at 19–38% of the potential
Small food fishes density	↓ 2015 - 2019. ↑ 2019 - 2021	↓ 2015 - 2019. ↑ 2019 - 2021	↑ 2018 -2020	↓ 2015 - 2019. ↑ 2019 - 2021	↑ 2014 -2021 w/ low larger food fishes	↑ 2014 -2021 w/ no larger food fishes obs, and ↑ in moderate sizes.
Invertebrate density (edible)	2012: ↓ in sea cucumber, top shells and giant clams (heat stress)	2014-2016: ↓ 2021: Low sea cucumber, ↑ in edible shells	2012-2014: ↓ in sea cucumber, top shells (heat stress). Edible shells low through 2021, sea cucumber densities ↑ after 2017.	2015-2019 ↓ in giant clams, ↑ by 2021. (no sea cucumber obs).	2014-2018: ↓ sea cucumber, ↑ in edible shells	2014-2021: >50% ↓
Vulnerabilities	disease outbreaks, warming events.	disease outbreaks, Terpios, warming events.		sediment stress		heat stress, COTS

V. Other Issues

Reported spills

The Guam EPA receives reports of spill occurrences that reach or have the potential to reach surface water and/or marine water. Reports are submitted to the Guam EPA by the National Response Center, NPDES permittees, concerned citizens, and local government officials. The volume/quantity of these spills is not always reported. Therefore, the following table summarizes the number of spill occurrences by location (village) and type and an estimate of reported volume in gallons.

Wastewater/sewage and oil spills are the most numerous spill types and quantities in gallons reported in 2020-2021.

Wastewater/sewage and oil spills are the most numerous spill types in 2022-2023. Wastewater/sewage and bentonite (drilling fluid) had the highest spilled volumes in 2022-2023.

2020 and 2021 REPORTED SPILLS

Location (Village)	Ethylene glycol (engine coolant)	Diesel	Liquid Detergent	Oil (Bilge, Fuel: No. 1-D, Hydraulic, Jet Fuel: JP-1 (Kerosene), Jet Fuel: JP-5, Jet Fuel: JP-8, Lubricating, Motor, oily water, other, residual, waste oil, unknown oil)	Polyurethane coating	Soot	Unknown Material	Wastewater Spill (SSO)	White paint	TOTAL
Agana Heights	-	-	-	-	-	-	-	5	-	**5**
Agat	-	-	-	3	-	-	-	5	-	**8**
Asan	-	-	-	-	-	-	-	15	-	**15**
Barrigada	-	-	-	-	-	-	-	11	-	**11**
Chalan Pago - Ordot	-	-	-	-	-	-	-	5	-	**5**
Dededo	-	-	-	-	-	-	-	12	-	**12**
Hagatna	-	2	-	1	-	-	-	4	-	**7**
Harmon	-	-	-	-	-	-	-	3	-	**3**
Inarajan	-	-	-	-	-	-	-	11	-	**11**
Mangilao	-	-	-	-	-	-	-	6	-	**6**
Merizo	-	-	-	-	-	-	-	9	-	**9**
Mongmong-Toto-Maite	-	-	-	-	-	-	-	13	-	**13**
Piti	2	5	1	49	1	1	2	2	1	**63**
Santa Rita	-	2	-	17	-	-	1	11	-	**31**
Sinajana	-	-	-	-	-	-	-	1	-	**1**
Talofofo	-	-	-	-	-	-	-	1	-	**1**
Tamuning	-	-	-	1	-	-	-	28	-	**29**
Tumon	-	-	-	-	-	-	-	1	-	**1**
Yigo	-	-	-	1	-	-	-	3	-	**4**
Yona	-	-	-	-	-	-	-	3	-	**3**
TOTAL	**2**	**9**	**1**	**72**	**1**	**1**	**3**	**149**	**1**	**238**
reported amount (gallons):	3.25	>325	1	>2099	0.26	unknown	unknown	>1,103,032	0.5	

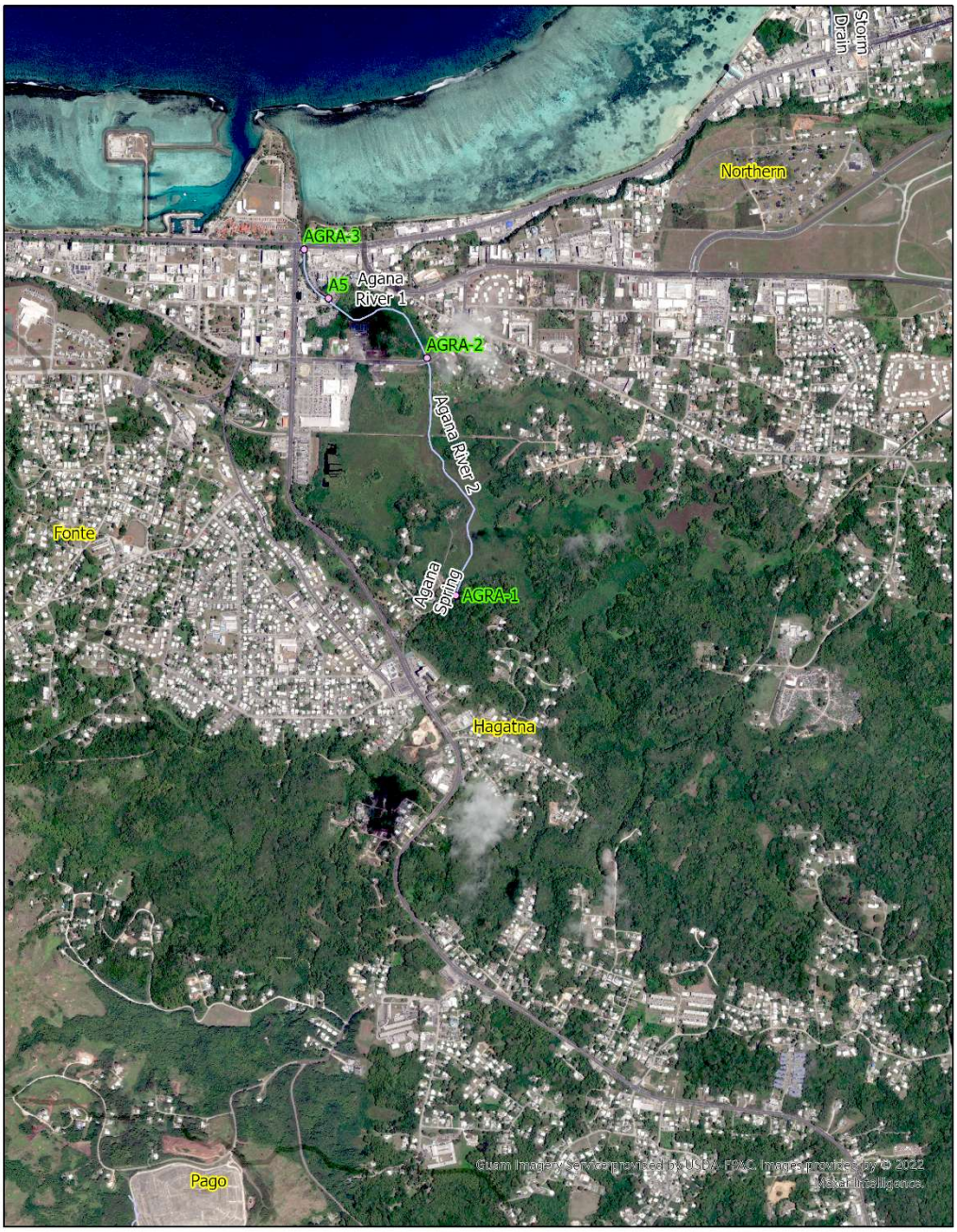
2022 and 2023 REPORTED SPILLS												
Location (Village)	**bentonite (drilling fluid)**	**Diesel**	**ethylene glycol, Radiator Fluid**	**Gasoline: Automotive (Unleaded)**	**Oil***	**Paint Chips**	**Silica Dust (Cement)**	**Unknown Material**	**Laundry Detergent**	**grey water**	**Wastewater Spill (SSO)**	**TOTAL**
Agana	--	1	--	1	1	--	--	--	--	--	4	**7**
Agana Heights	--	--	--	--	--	--	--	--	--	--	1	**1**
Agat	--	1	--	--	2	--	--	1	--	--	3	**7**
Anigua	--	--	1	1	--	--	--	--	--	--	--	**2**
Apra	--	--	--	--	1	--	--	--	--	--	--	**1**
Asan	--	--	--	--	--	--	--	--	--	--	1	**1**
Barrigada	--	--	--	--	--	--	--	--	--	--	2	**2**
Chalan Pago - Ordot	--	--	--	--	--	--	--	--	--	--	8	**8**
Dededo	--	--	--	--	--	--	--	--	--	--	14	**14**
Harmon	--	--	--	--	--	--	--	--	--	--	4	**4**
Maina	--	--	--	--	--	--	--	--	--	--	1	**1**
Malojloj	--	--	--	--	--	--	--	--	--	--	1	**1**
Mangilao	--	--	--	--	--	--	--	--	--	--	8	**8**
Merizo	--	--	--	--	--	--	--	--	--	--	5	**5**
Mongmong-Toto-Maite	--	--	--	--	--	--	--	--	--	--	9	**9**
Piti	--	11	3	--	38	1	1	3	1	--	--	**58**
Santa Rita	--	5	--	1	14	--	--	--	--	1	6	**27**
Sinajana	--	--	--	--	--	--	--	--	--	--	2	**2**
Tamuning	1	--	--	--	1	--	--	--	--	--	42	**44**
Barrigada (Tiyan)	--	--	--	--	--	--	--	--	--	--	2	**2**
Tumon	--	--	--	--	--	--	--	--	--	--	3	**3**
Umatac	--	--	--	--	--	--	--	--	--	--	1	**1**
Yigo	--	--	--	--	--	--	--	--	--	--	4	**4**
Yona	--	--	--	--	--	--	--	--	--	--	4	**4**
TOTAL	**1**	**18**	**4**	**3**	**57**	**1**	**1**	**4**	**1**	**1**	**125**	**216**
reported amount (gallons)	8,000	>4,765	>5	unknown	>220	unknown	unknown	>1	unknown	1	14,901,940	

Oil*: Fuel: No. 6, Lubricating, Other, jet fuel, Transmission Fluid, Power steering fluid, Jet-A-Fuel/Water Mixture, Marine Gasoil, Hydraulic Oil, unknown, vegetable oil, unknown sheen.

VI. FIGURES

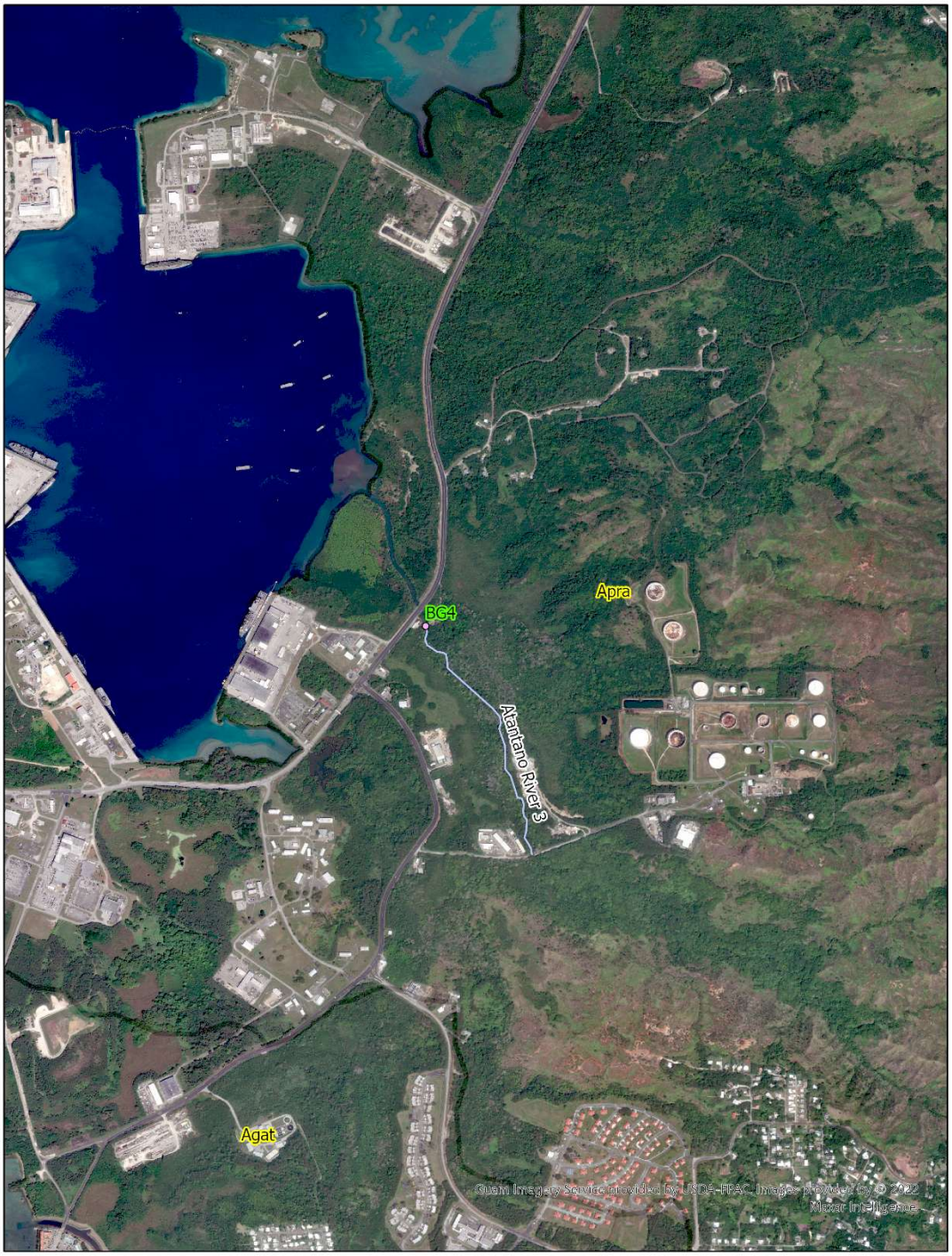
13 WATERSHEDS –Impaired Waters Monitoring

Agana



Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Agana River 1	AGRA-3	Agana	Impaired	DO, Enterococci
Agana River 1	A5	Agana	Threatened	DO
Agana River 2	AGRA-2	Agana	Threatened	DO
Agana Springs	AGRA-1	Agana	Threatened	DO, E. coli, Nitrate

Apra



Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Atantano River 3	BG4	Apra	Threatened	DO, E. coli

Dandan

Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Aslinget River 3	5Aslinget / INRAP-46B	Dandan	Impaired	orthophosphate
Tinago River	6TINAGO	Dandan	Impaired	orthophosphate

Fonte

Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Fonte River 1	AGRF-2	Fonte	Impaired	Nitrate

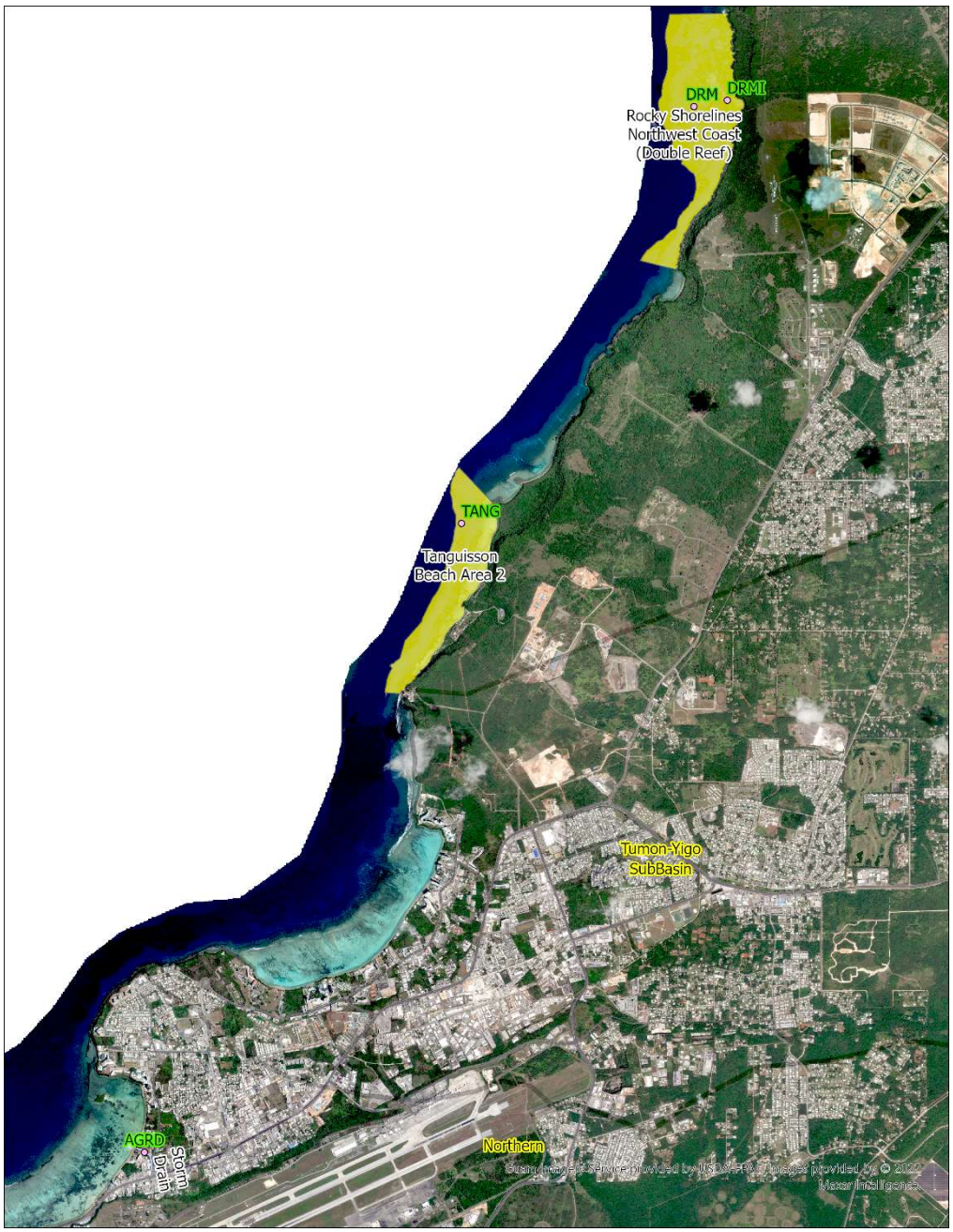
Inarajan

Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Agfayan River MOUTH	INRAGB-3	Inarajan	Threatened	E. coli
Inarajan River 1	INRI1	Inarajan	Threatened	Nitrate

Manell

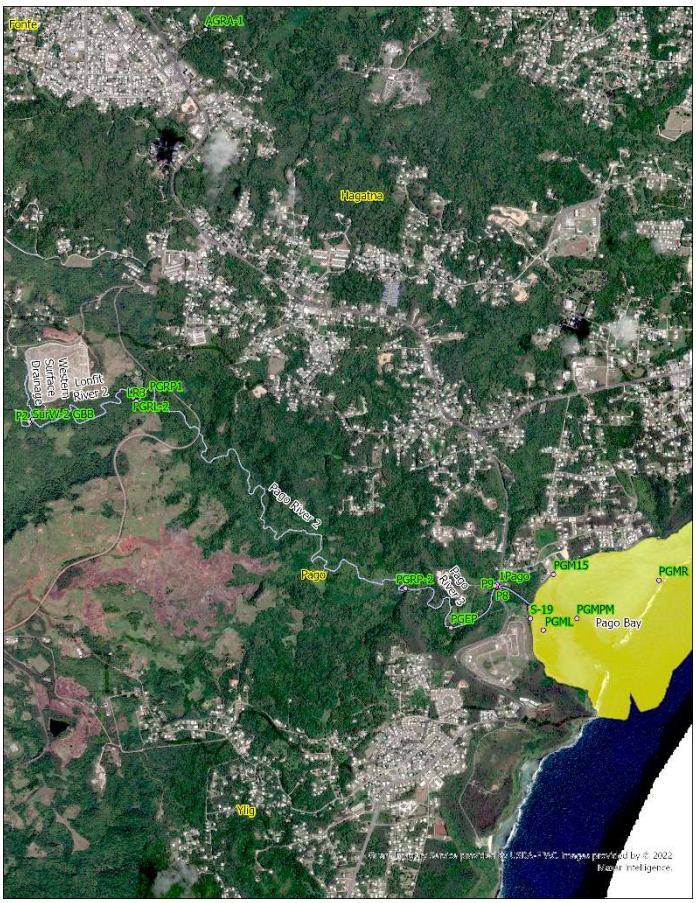
Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Achang River 2	MZRAC	Manell	Threatened	E. coli, orthophosphate
Ajayan River	9Ajayan / MZRAJ	Manell	Impaired	DO, orthophosphate, TSS
Ajayan River	9Ajayan / MZRAJ	Manell	Threatened	E. coli
Liyog River	10Liyog / MZRL	Manell	Impaired	DO, orthophosphate, TSS, Nitrate
Liyog River	10Liyog / MZRL	Manell	Threatened	E. coli
Manell River	MZRML / 12Manell	Manell	Impaired	Nitrate, orthophosphate
Sumay River	11Sumay / MZRSY	Manell	Impaired	DO, orthophosphate, Nitrate, TSS

Northern



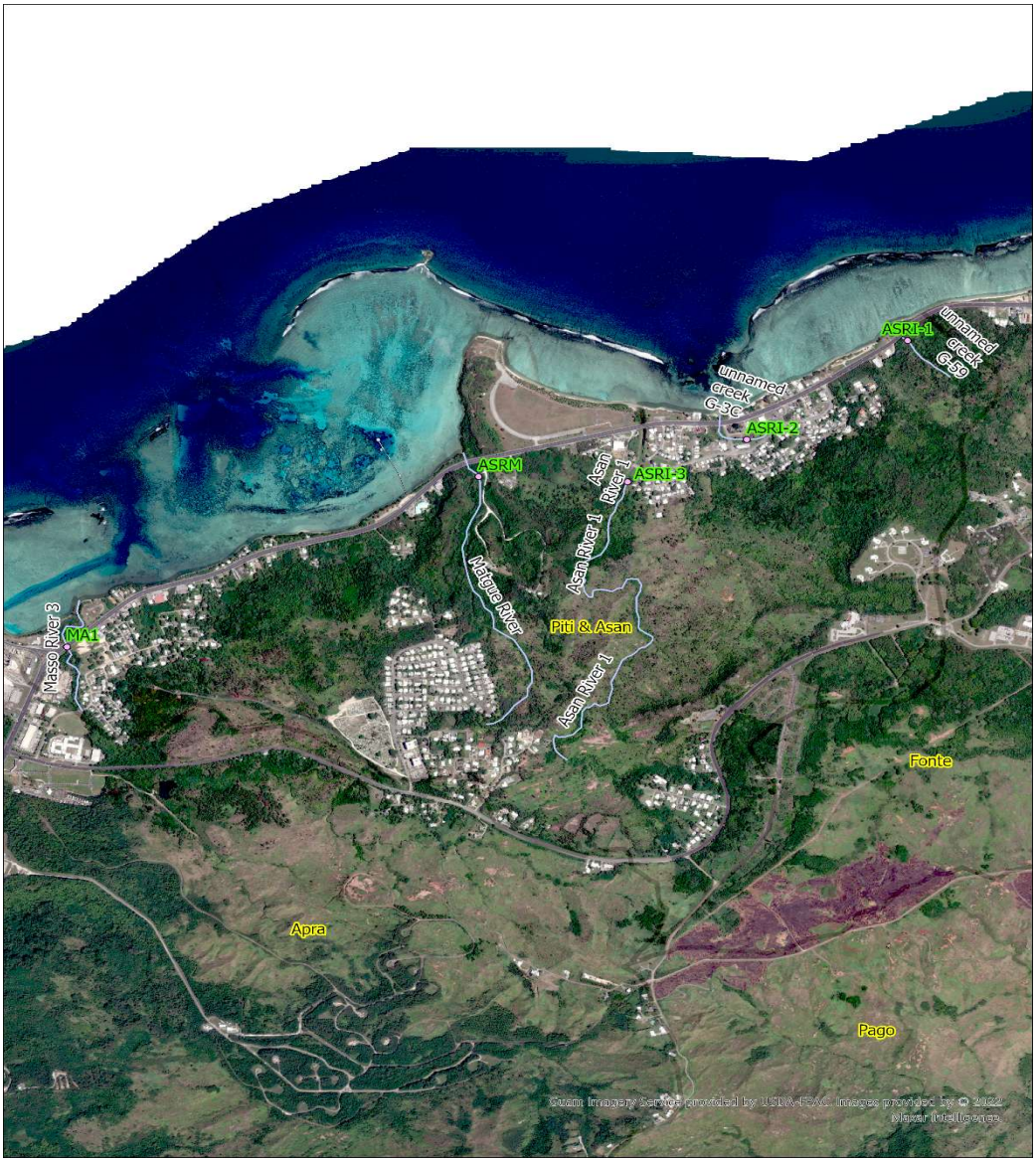
Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Storm Drain	AGRD	Northern	Impaired	DO, salinity, E. coli, Nitrate, TSS, turbidity (+ Enterococci)
Rocky Shorelines Northwest Coast (Double Reef)	DRM	Northern	Threatened	TSS
Rocky Shorelines Northwest Coast (Double Reef)	DRMI	Northern	Threatened	TSS
Tanguisson Beach Area 2	TANG	Northern	Threatened	Enterococci

Pago



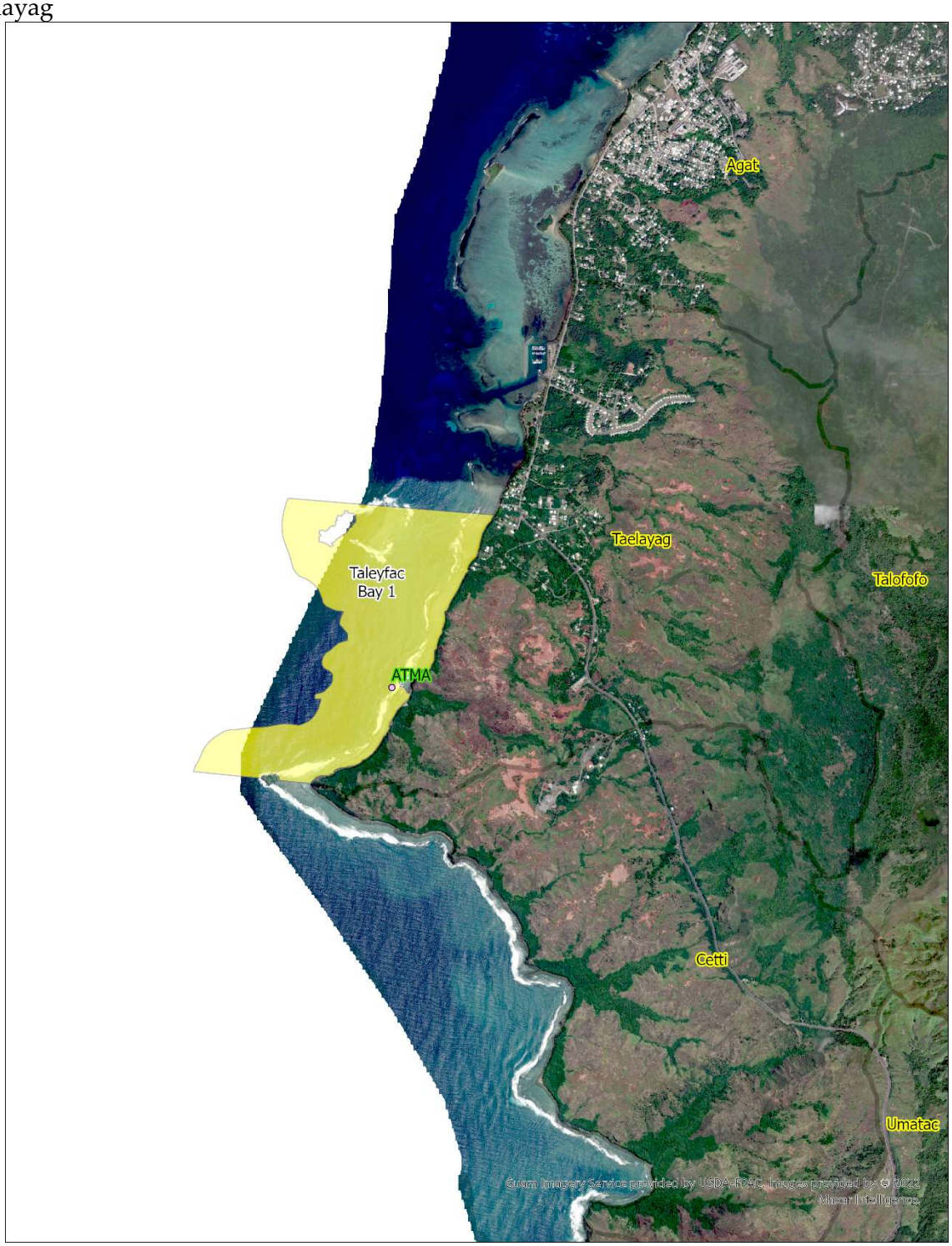
Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Lonfit River 2	PGRL-2	Pago	Impaired	Salinity, Enterococci, E. coli, Total Coliform, Temperature, Turbidity, (iron)
Lonfit River 3 (small section to confluence)	LR3 / PGRP-1-51B	Pago	Impaired	Salinity, Enterococci, E. coli, Total Coliform, Temperature, Turbidity
Pago River 1	PGRP-1	Pago	Impaired	DO, E. coli, Turbidity storm flows
Pago River 2	PGRP-2	Pago	Impaired	DO, E. coli
Pago River 3	PGEP	Pago	Threatened	DO
Pago River 4	PGMPW / 1Pago / P8 / P9	Pago	Impaired	Turbidity
Pago River 4	PGMPW / 1Pago / P8 / P9	Pago	Threatened	DO
West Surface Drainage	SURW (SurW-2)	Pago	Impaired	Nitrate, TSS
West Surface Drainage	SURW (SurW-2) / P2	Pago	Threatened	DO
Pago Bay	S-19, PGM15, PGML, PGMR, PGMPM	Pago	Impaired	DO, Nitrate, Enterococci

Piti & Asan



Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Asan River 1	ASRI-3	Piti & Asan	Threatened	E. coli
Masso River 3	MA1	Piti & Asan	Threatened	E. coli
Matgue River	ASRM	Piti & Asan	Threatened	E. coli
unnamed creek G-3C	ASRI-2	Piti & Asan	Threatened	Nitrate
unnamed creek G-59	ASRI-1	Piti & Asan	Threatened	E. coli

Taelayag

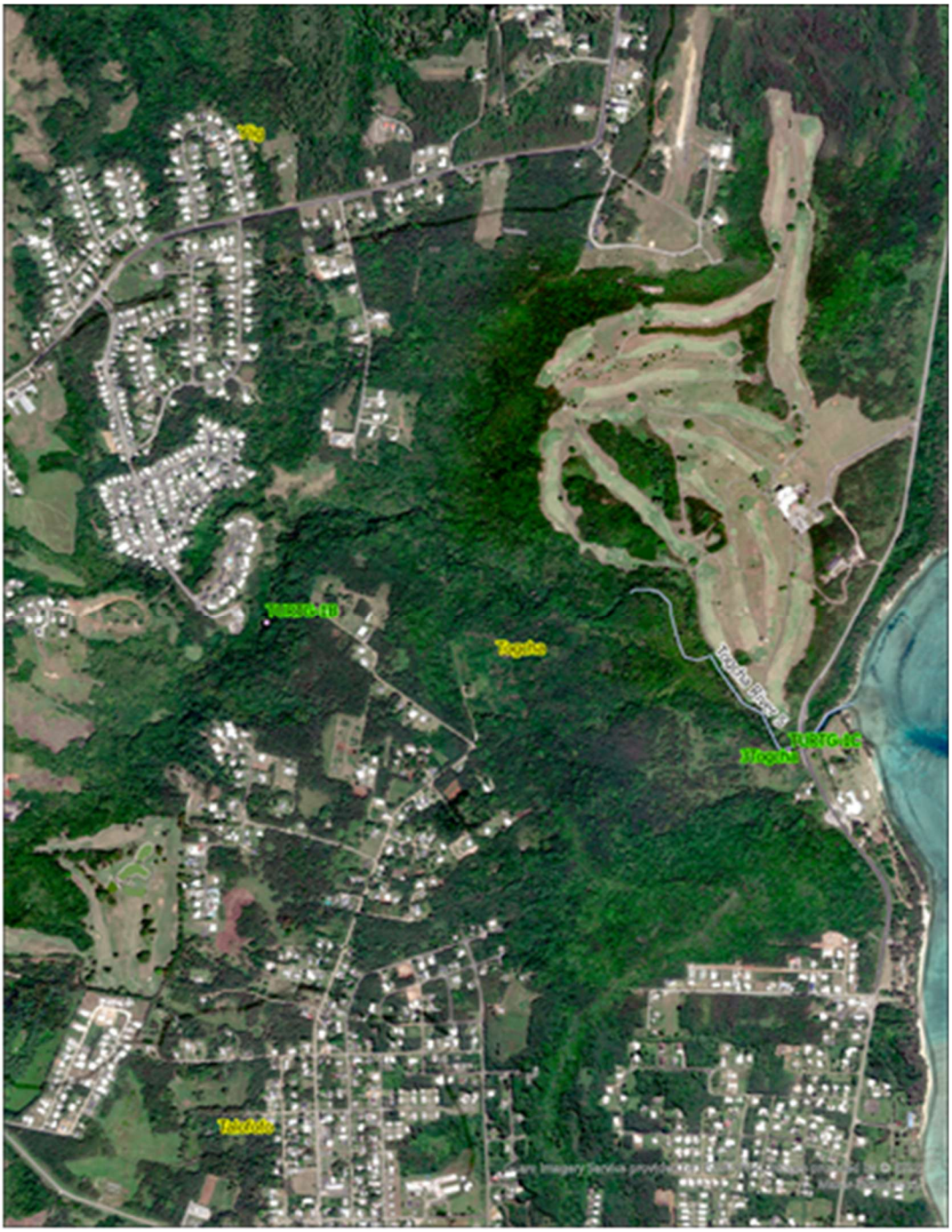


Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Taleyfac Bay 1	ATMA	Taelayag	Threatened	TSS

Talofofo

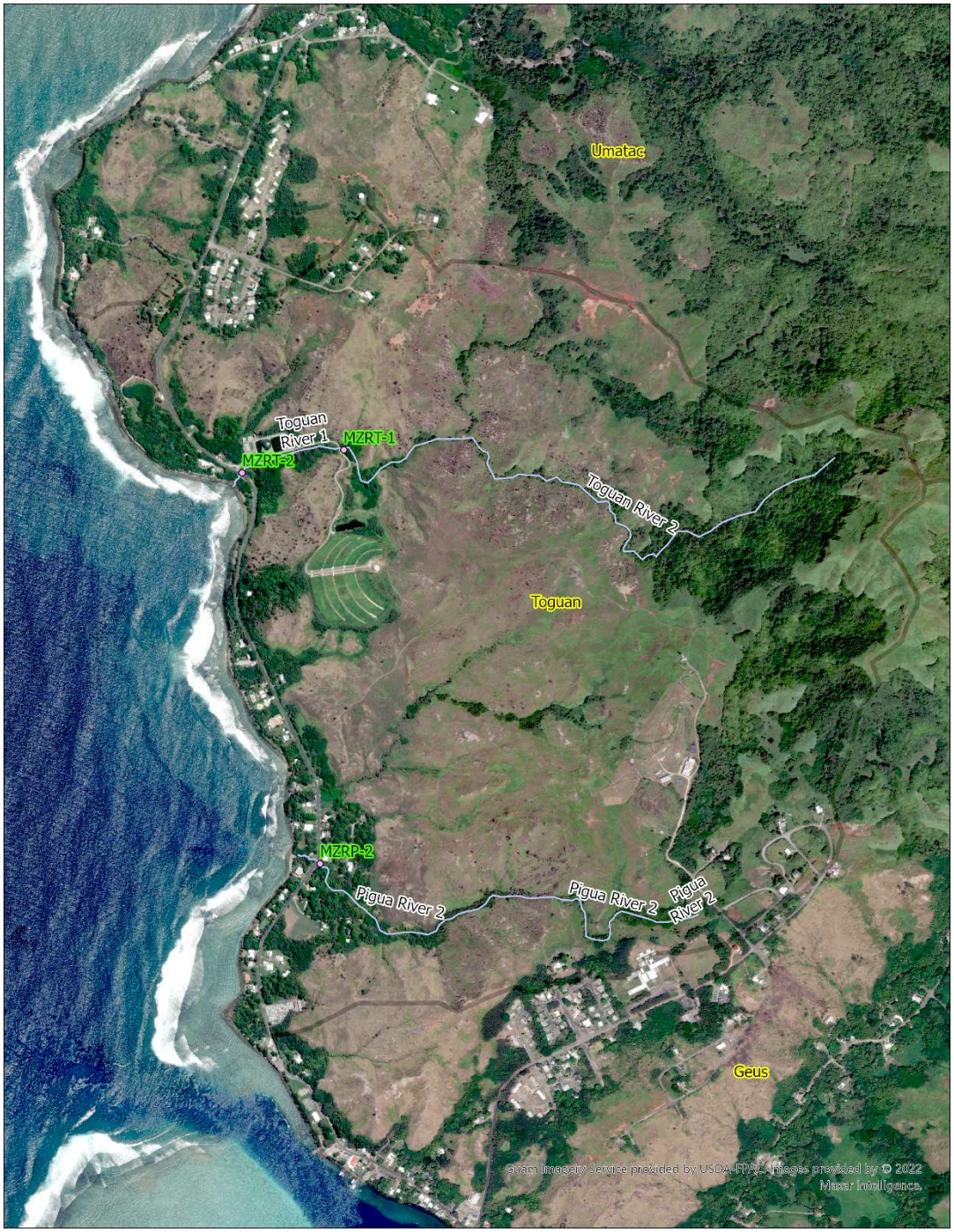
Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Talofofo Bay	TUM11	Talofofo	Threatened	Enterococci

Togcha



Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Togcha River 1	TURTG-C	Togcha	Threatened	E. coli
Togcha River 2	TURTG-1B	Togcha	Threatened	orthophosphate
Togcha River 5	3Togcha / TURTG-1C	Togcha	Impaired	Nitrate

Toguan

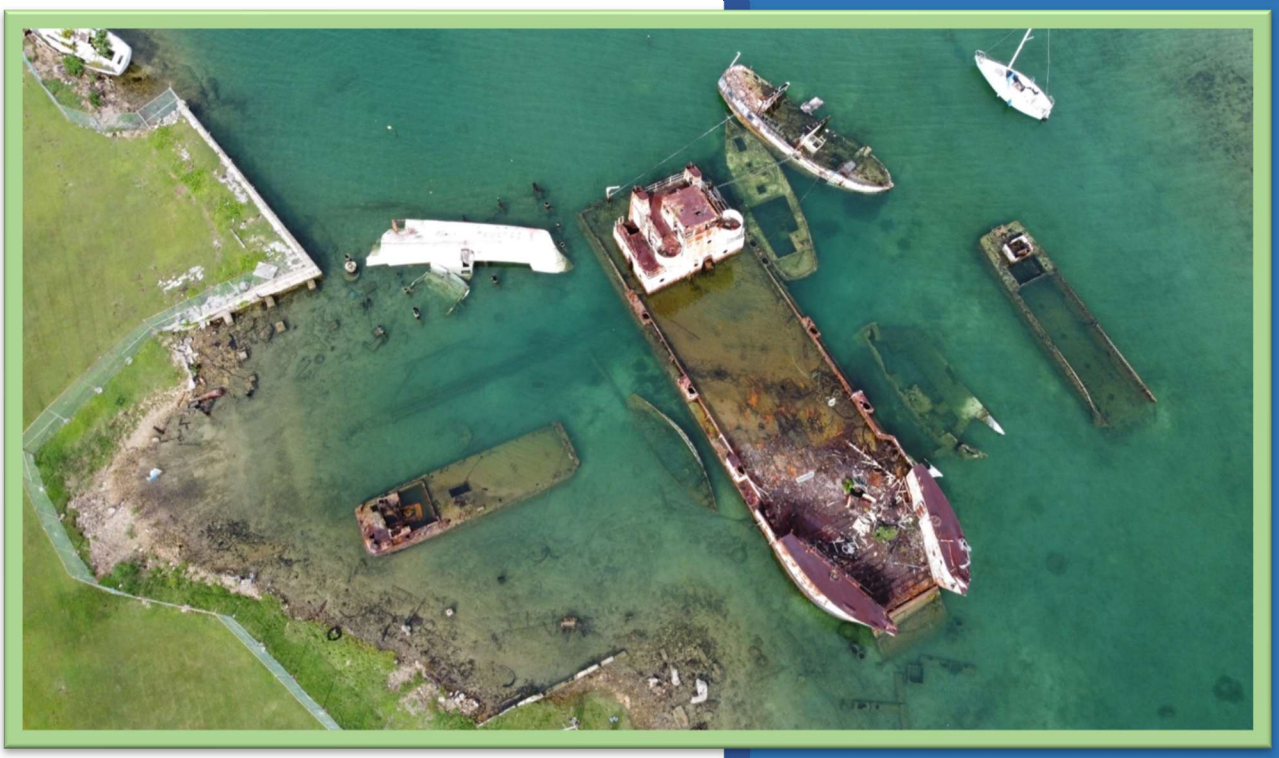


Assessment Unit	Site ID	Watershed	Status ALUS	Parameter
Pigua River 2	MZRP-2	Toguan	Threatened	DO, E. coli
Toguan River 1	MZRT-2 / 14Toguan	Toguan	Impaired	orthophosphate
Toguan River 2	MZRT-1	Toguan	Threatened	E. coli

VII. PROJECT REPORTS

2021

Guam ADV Removal Project



Guam Abandoned Derelict Vessel

Removal Group

US Navy Commander Task Force 73

Salvage Team

Guam Abandoned Derelict Vessel (ADV) Removal Project – Final Report

Abandoned derelict vessels (ADVs) endanger many of the waterways, shorelines and islands around the world. The physical presence of ADVs jeopardize these areas by damaging the environment, impeding navigational channels, posing a risk to human health and safety, and reducing commercial and recreational activities. The assessment, removal, and disposal of ADVs requires a significant amount of financial and technical resources that many places don't have and or are costly to obtain. These difficulties have led to many ADVs being unaddressed or untouched for decades. The island of Guam fell within this category.

To address this significant problem, the government of Guam in 2020 established the Guam Abandoned Derelict Vessel Removal Group (GADVRG), through Executive Order 2020-42. The GADVRG is composed of five (5) government of Guam agencies, four (4) United States federal government agencies and most importantly the United States Department of the Navy. The Navy contingent was specifically comprised of the Joint Region Marianas (JRM), Commander Task Force 73 (CTF-73), and the Naval Mobile Construction Battalion 133. Major job responsibilities were divided among partners, with the salvaging and demolition the responsibility of the Navy team and the disposal the responsibility of the GADVRG.

The primary objective of the group was to address the largest congregation of ADVs, eleven (11), within the Guam Harbor of Refuge (HoR). See Figure 1. The ADVs ranged in size and composition from fiberglass catamarans, to composite hull sail boats and long line fishing boats, to a large decommissioned military landing craft. See Figure 2 below. With the approval on September 24, 2021, of the United States Department of Defense's (DOD) Innovative Readiness Training (IRT) program application, to officially allow the Navy team to participate, and securing local and federal funds, the project officially started on October 1, 2021. The IRT is a DOD military training that authorizes military units to conduct training opportunities to increase deployment readiness related to their primary mission to assist the United States and its territories, exclusively, to tackle issues/projects locally that could not otherwise be addressed.

Figure 1. Proposed Temporay ADV Staging Area., PAG Lot 265-2.

Additional support was provided by USEPA Region 9 On-Scene Coordinators (OSCs) and their response teams and the US Coast Guard Sector Guam Marine Response team. In addition to onsite coordination, supervision and emergency spill response, both also provided hazardous material surveys, sampling, removal and disposal.

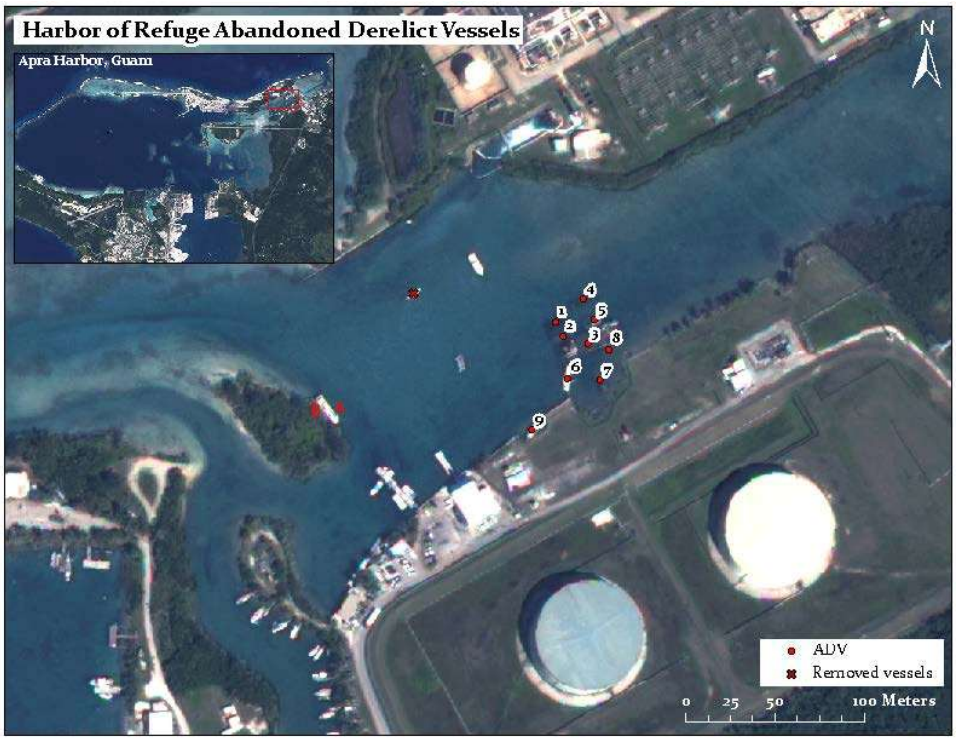


Figure 2. Location of ADVs to be removed within Harbor of Refuge, Piti Guam.

Commander Task Force 73 (CTF-73) salvage teams were quickly mobilized with the first targets, ADV #9 and ADV#B, brought to shore on October 4, 2021. ADV#3 was the last to be removed on March 7, 2022, with the demolition completed in June, 2022. The removal dates for all ADVs are listed in Table 1 below. The project lasted approximately 273 days with the site fully cleared and secured on June 30, 2022. See Appendix B for photographs of removal process.

Unexpected delays were experienced by the team which added additional days to the project. These included the transferring of specialized salvaging equipment, i.e. roller bags, from the east coast of the United States, to the testing and removal of asbestos containing material and lead based paint, to the on-island supply of cutting gases, and the rotation of the Navy salvage teams.

All eleven (11) identified ADVs were removed, demolished and disposed of. The final amount of material removed from the marine environment was over 80 metric tons of metallic waste, 40 metric tons of mixed solid waste, 158 kg of oily debris, 262 kg of asbestos containing material and ten marine batteries. All suspected hazardous materials were tested for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene and Xylene (BTEX), Polychlorinated biphenyls (PCBs) and the RCRA eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) and were non-detectable or below regulatory levels for toxicity. All waste materials were packaged and containerized to be shipped off-island to approved facilities or disposed of on-island within the certified landfill. All recoverable metallic debris were shipped to a recycling facility in Taiwan.

Air and water samples were collected and tested daily and weekly, respectively, by USEPA and Guam EPA with no notable detections or exceedances.

The GADVRG established a framework for success and featured a unified approach between local and federal governments to demonstrate a capacity to undertake steps towards identifying and addressing a longstanding environmental concern. The efforts undertaken by the GADVRG in October 2021 not only serves as a blueprint for future ADV removals along our coastlines, but for future discussions on maintaining intragovernmental partnerships to benefit the community and entity goals. This project has resulted in more than ridding decades old marine debris from Guam's environment. The work demonstrated at the Guam Harbor of Refuge can now usher in future results through developing policy for responsible watercraft ownership and the prevention of marine debris in the form of ADVs to affirm Guam's overarching goals in providing strategies which promote coral reef resiliency and restoration, climate change reversal and waste management.

Description of Harbor of Refuge ADVs removed

#	Removal Date	Vessel Name/Type of Vessel	Description
1	10/20/2021	Coronation - Longline fishing boat	Vessel laying on starboard side. Wooden superstructure appears to have collapsed. Engines and HAZMAT (batteries, compressor) present onboard. Dimensions of vessel: 17x5x5 m. Hull composition: fiberglass/metal composite.
2	10/22/2021	Vessel Name Unknown - Sailboat	Vessel partially submerged. No mast. Dimensions of vessel: 16x4.5x3.2 m. Hull composition: fiberglass/metal composite
3	03/07/2022	Guahan 2 - Large ex-military vessel	Vessel appears to be intact. Engines still onboard. Dimensions of vessel: 36x9.5x12 m. Hull composition: steel
4	11/052021	Vessel Name – Ex-military landing craft (YFU7)	Vessel appears to be intact. Engines still on board. Dimensions of vessel: 16.5x5x3.5 m. Hull composition: steel
5	03/07/2022	Vessel Name Unknown - Trimaran sailboat	Hull damaged. No superstructure. No engines on board. Observed as ADV in October 2003. Dimensions of vessel: 15x7.5x2 m. Hull composition: fiberglass
6	10/08/2021	Vessel Name Unknown - Longline fishing boat	Vessel inverted and resting against old wooden dock support. Superstructure damaged. No engines. Dimensions of vessel: 12x3.5x4 m. Hull composition: fiberglass/metal composite
7	10/12/2021	Vessel Name Unknown- Small tug boat	Vessel appears to be intact. Engines still on board. Dimensions of vessel: 15.5x4x2 m. Hull composition: steel
8	10/16/2021	Vessel Name Unknown - Sailboat hull	No mast. Deck missing. Fully submerged. Dimensions of vessel: 6x2.5x1.5 m. Hull composition: fiberglass/metal composite
9	10/04/2021	S/V Merlin - Sailboat	Vessel intact. Grounded along the shoreline. Dimensions of vessel: 11x3x3 m. Hull composition: fiberglass/metal composite
A	10/05/2021	Vessel Name Unknown – Longline Japanese boat	Part of the vessel appears to be submerged. No dimension and hull composition info available
B	10/04/2021	Vessel Name Unknown - Catamaran	Tied off to the ADV-A. No dimension and hull composition info available.

2021 COCOS LAGOON TIRE REEF REMOVAL PROJECT REPORT

COCOS LAGOON ABANDONED TIRE REEF REMOVAL PROJECT

PRINCIPAL INVESTIGATORS: GUAM ENVIRONMENTAL PROTECTION AGENCY
AND
GUAM DEPARTMENT OF AGRICULTURE

Funded by NOAA Marine Debris Grant (NA19NOS9990031)

Project Introduction

General view of CARB. (Photograph courtesy of GEPA).

The Government of Guam, through the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR) and the Guam Environmental Protection Agency (EPA), received a FY19 Marine Debris Removal Grant from the National Oceanic and Atmospheric Administration (NOAA) to expand the local government's abilities to address marine debris issues on island through community-driven and cost-effective removal projects. The project Award Number is NA19NOS9990031.

The awarded project was the removal of one of two artificial tire reef projects piloted by government of Guam fisheries scientists in the 1970's. The main objective of these artificial tire reefs were to increase fish populations through artificial fish shelters and to improve the habitat of inshore lagoon areas. This project was initiated in 1969 but was then discontinued in 1973, after fisheries scientist concluded that the artificial tire reefs were not recruiting enough fish populations to be effective. The tire reefs were abandoned in place and eventually forgotten.

The two tire reefs that were constructed were labeled Cocos Artificial Reef A (CARA) and Cocos Artificial Reef B (CARB). Both artificial tire reefs are located in the center of the Cocos Lagoon. The Cocos Lagoon is an atoll-like coral reef lagoon that borders the Manell-Geus watershed to the north-east and the Achang Reef Flat Marine Preserve to the east in the village of Merizo. The Manell-Geus watershed is a Habitat Focus Area for NOAA's Habitat Blueprint and Cocos Lagoon is a part of the NOAA Coral Reef Conservation Program Priority for Guam. Cocos Lagoon is a very rich and diverse marine habitat that supports cultural and subsistence harvests, as well as tourism operations. Cocos Lagoon is home to extensive seagrass beds, mangrove forests

and patch reefs, which provide important habitats for a variety of vertebrate and invertebrate species. Live coral cover in Cocos Lagoon has been documented at approximately 30% (Burdick et al., 2008). The lagoon also provides important habitat for sea turtles, including Endangered Species Act (ESA)-listed green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles (Hartwell *et al.*, 2017). Cocos Island is also being used as an introduction site for the Guam rail, *Ko'Ko'* bird, (*Gallirallus owstoni*), an ESA Listed species endemic to Guam

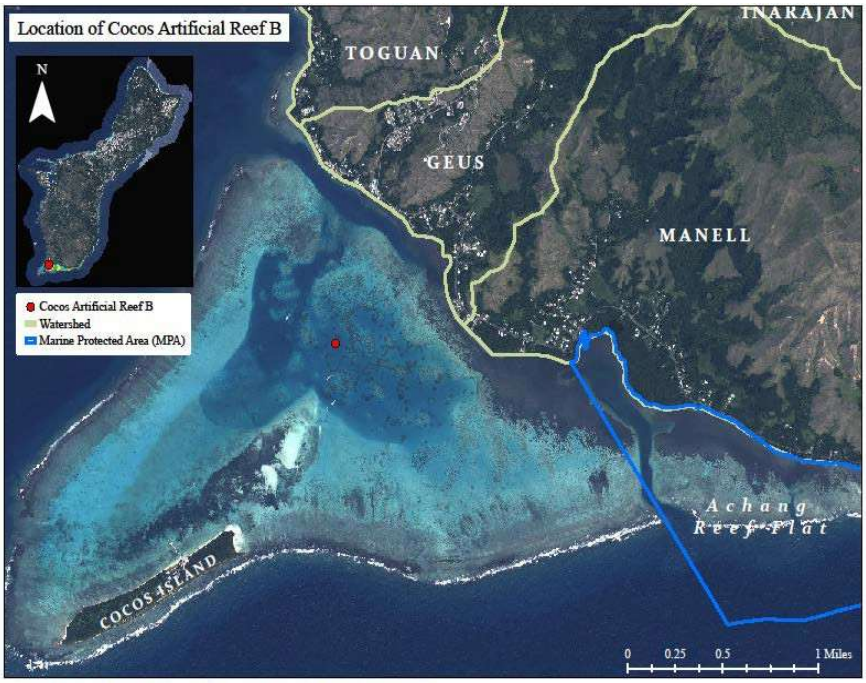


Figure 1. Location map of Cocos Artificial Reef B, the proposed project site.

CARA consisted of 351 tires that were tied together using nylon rope to form a "Y" shape, known as a "triad", and were placed flat on the sediment floor within a 75 foot by 75 foot grid at a depth of 25 feet. CARB consists of approximately 2,482 tires that sit atop a sandy, silty substrate at a depth of 20 feet, and is located at the coordinates 13.255248N, 144.665588E. CARB was constructed to test the vertical placement of the artificial fish shelters. At this site, tires were tied together in groupings of five using nylon rope to create tire tubes. The tire tubes were dumped randomly on top of each other

CARB (SIDE VIEW). (Photograph courtesy of GEPA).

Groups of tires buried under sediment at CARB. (Photograph courtesy of GEPA).

to achieve a 15 foot vertical tire reef mound. Recent assessments show that the current state of this site is about 5 feet shorter than its initial installation in the 1970's. Approximately one tire tube layer appears to be buried underneath the sediment surface.

In old project reports, CARA was described as being three different distances west of CARB. The Government of Guam attempted to locate CARA twice using the given information, but have not been successful. It is suspected that due to the high sedimentation rate within Cocos Lagoon, CARA may be buried. Search efforts of CARA continued throughout the duration of the removal project and was still not found. CARB is located within the central part of the Cocos Lagoon approximately 0.85 miles south of the Merizo Pier and public boat ramp.

Close-up of CARB. (Photograph courtesy of GEPA).

- **Reconnaissance Phase**

CARB sits atop a sandy, silty substrate at a depth of 20 feet, and is located at the coordinates 13.255248N, 144.665588E with a current estimated volume of 21,531 ft^3 (48.5 x 45.3 ft x 9.8 ft). Original documentation states that it was constructed with approximately 2,482 tires

After 45 plus years underwater, only minor coral recruitment was observed during site inspections of CARB. A total of sixty-nine (69) "coral features" were identified. Small coral heads of *Pocillopora damicornis, Porites cylindrica* and *Porites lutea* were observed, along with small encrusting colonies of *Porites rus, Pavona sp., Favia sp*. A coral transplanting plan was created to transplant/relocate as many features as possible. A small amount to no fish stock species was observed aggregating around the structure. Observed fish species were aggregating on the larger- sized coral features.

- **Coral Transplant Phase**

Guam EPA attempted a coral transplant of the sixty-nine (69) identified coral features to several suitable sites shoreward of CARB (Attachment B). A breakdown of those coral features are:

- 69 features observed
  - 35 features measuring <10cm
  - 33 features measuring >10cm
  - Total number of species ten (10)
  - No Guam or federally rare, threatened, or endangered (RTE) species were observed on or near the CARB.

horrescens, prior to transplantation. (Photograph courtesy of GEPA).

Coral heads and encrusting colonies suitable for transplant were identified, and removed from the tire substrate. Corals were removed by chipping off the living portion of the colony from the point of attachment on the tire using a chisel and hammer. All encrusting species (e.g. *Leptastrea purpurea, Pavona chiriquiensis, P. varians*) suffered damage (split and shattered) when removed from the tire substrate. Small non-encrusting species were relocated if all or a significant portion of the colony can be removed from the tire intact.

Example of encrusting coral feature, *Porites australiensis,* prior to transplantation (Photograph courtesy of GEPA).

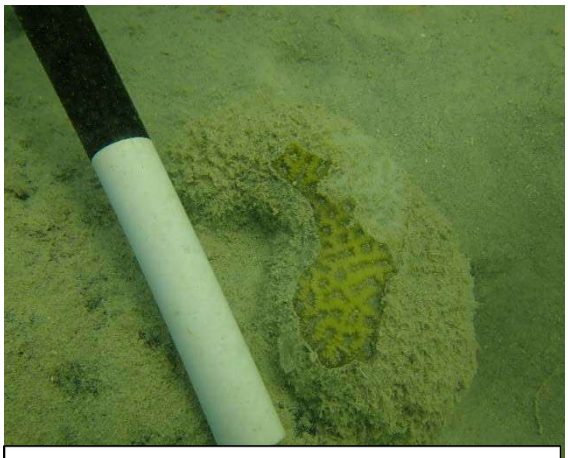
A coral transplant site was identified and prepped for the new coral colonies to be transplanted.

Largest Non-encrusting coral feature, *Porites cylindrica*, prior to transplantation (Photograph courtesy of GEPA).

The criteria developed for the transplant site were an:

- Area that is in close proximity to the tire reef;
- Area with an abundance of hard bottom substrate with enough space to accommodate transplants;
- Area that is protected or within an actively managed reef;
- Area with similar conditions as the transplants;
- Area that has low hydrodynamic condition, low turbidity and sedimentation.

The Transplant site 1 is located approximately 87 meters shoreward (13.25602N and 144.66573E) of CARB at a depth of 5 meters. Transplant site preparation entailed removing any type of sand, sediment, or biological growth with scrapers or wire brushes right before transplanting to ensure the maximum effectiveness of concrete or other adhesive materials. The adhesive mixture was prepared and mixed topside in a vessel. The adhesive mixture was then placed into large re-sealable bags, dispensed onto the cleaned substrate by divers and then the coral colony was placed into the adhesive mixture. Cable ties, concrete nails, or rebar was not needed as all transplanted corals were fragments. Transplanted coral fragments will be monitored as described below.



Example of coral feature, *Platygyra sp*, prior to transplantation (Photograph courtesy of GEPA).

Example of encrusting coral feature, *Leptoseris incrustans,* prior to transplantation (Photograph courtesy of GEPA).

Divers collecting Coral fragments for transplanting (Photograph courtesy of GEPA).

Coral fragments reattached at transplant site with concrete. (Photograph courtesy of GEPA).

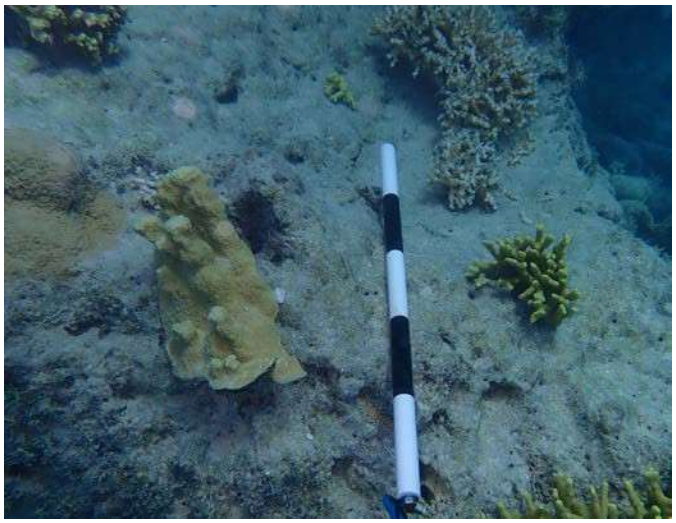
- **Coral Transplant Monitoring Phase**

The Government of Guam monitoring team will be monitoring the transplanted corals for a duration of 3 years. Transplanted corals will be monitored and documented for growth, diseases, bleaching or mortality rates. Monthly monitoring will occur for a duration of 6 months after the corals have been transplanted. After 6 months, coral monitoring will be performed quarterly for the remaining two and a half years of the project period. A total of sixteen coral transplant site visits will be performed for the post-transplant monitoring effort. Monitoring teams will survey the transplanted corals through the use of photo documentation and proper survey tools (i.e. meter sticks, scales). Monitoring teams will also collect the following data on the provided field sheets (found in the appendix): location, date, time, samplers, colony code/tag number, photo number, and health status (e.g. dead, alive, or bleached; see table below).

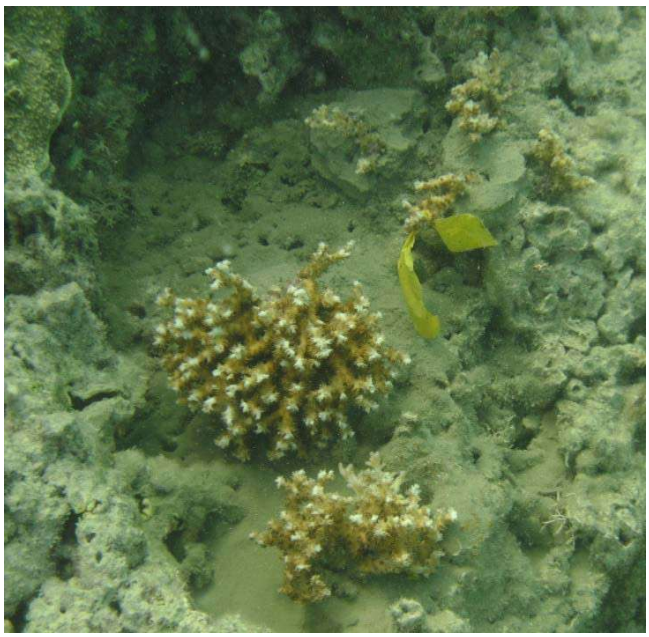
Survivorship monitoring will be performed on each individual colony.

Denotation	Description
Healthy	Living tissue on the fragment 100%
Dead % 50>	More than 50% living tissue left on the fragment
Dead % 50<	Less than 50% living tissue left on the fragment
Dead	No living tissue present on the fragment
Pale	Discoloration of the tissue towards pale
Bleached	Polyps still alive and fragment “looking” fluorescent white

A report documenting the transplant and monitoring phases will be produced separately at the conclusion of the monitoring and will be made available to the public.



Coral fragments reattached at transplant site with concrete. (Photograph courtesy of GEPA).



Coral fragments reattached at transplant site with concrete. (Photograph courtesy of GEPA).

- **Tire Reef Removal Phase**

Guam EPA conducted a Request for Proposal (RFP) for local environmental or salvage companies to conduct the tire removal and disposal work of CARB. The RFP process was initiated in January 2020 and finally concluded in December 2020 due to processing delays associated with the pandemic.

CARB Work site within Cocos Lagoon. (Photograph courtesy of Unitek).

The contract was awarded to Unitek Environmental Guam (Unitek), with the in-water work being performed by Trident, LLC, under contract number GEPA-2019-2200-001.

The primary objective of this project was to safely remove and properly dispose of the visible tires at Cocos Artificial Reef B (CARB). The secondary objective was to remove other waste that existed in CARB as well as waste produced from the removal effort. The field work for this project was completed between July 5, 2021 and July 28, 2021. Prior to the commencement of in water work, the contractor inspected and cleaned all equipment and materials on land prior to deploying and utilizing them, due to the sensitive nature of the Cocos Lagoon. The equipment consisted of two (2) support boats, two (2) 16' x 16' floating dive platforms (DPs), and all the necessary equipment for tire removal, diver support and turbidity and sedimentation control.

Tire retrieval. (Photograph courtesy of Guam EPA).

Dive platform (DP) 1 was utilized as the main working platform, with DP 2 as the collection and transport barge. Once DP -2 was loaded to capacity, with approximately 200 hundred tires, it was towed to the temporary staging area within the Cocos Resort parking lot/ramp within the village of Merizo. Tires were then offloaded utilizing a telescopic forklifts, transferred to the secondary containment area, and then finally loaded into standard dump trucks to be transported to the Unitek primary facility in the village of Agat. At this facility, all tires were cleaned with power washers prior to being hauled to the Guahan Waste Recycling Tire Shredding Facility for processing and final recycling/disposal at an off island facility.

First set of tire recovered (Photograph courtesy of Unitek).

Tires being transported to shore. (Photograph courtesy of Unitek).

Water quality samples for turbidity analyses were collected up-current, from within the turbidity curtain and down-current outside the turbidity curtain to ensure removal operations were within water quality standards. Samples were collected three times a day, once in the morning, afternoon and at the end of the working day. Only three (3) major exceedances occurred during the course of the project and coincided with heavy weather events.

Waste water collected during the cleaning and rinsing phase was treated and disposed of through the Unitek NPDES permitted water processing facility (NPDES No. GU0020346). Other solid waste, solids and dry sediment were disposed of at Guam Solid Waste Layon Landfill.

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Telescopic forklift offloading Tires. (Photograph courtesy of Unitek).

Removed Tires within temporary containment area. (Photograph courtesy of Unitek).

Recovered tires being cleaned and processed at the Unitek primary facility. (Photograph courtesy of Unitek).

Recovered tires being cleaned and processed at the Unitek primary facility. (Photograph courtesy of Unitek).

Stacked cleaned tires waiting to be shredded at the Tire Processing facility. (Photograph courtesy of Unitek).

Stock photograph of shredded tires containerized for shipping Tire Processing facility. (Photograph courtesy of Guahan Waste).

Close-up of Stock photograph of shredded tires. (Photograph courtesy of Guahan Waste).

A total of one thousand eight hundred twenty-nine (1,829) or 74% of the tires were removed from the CARB site out of a reported 2,482 tires, during the sixteen (16) days of in water work. Post inspections dives were conducted by Guam EPA divers on July 30, 2021, and verified that all project objectives were met and the project was completed. During this post dive inspection, a layer of tires could be made out just under the surface or partially exposed from the removal of upper tire layers. These remaining tires (approximately 653 or CCC, buried within the sediment were not part of the project objectives due to the high removal cost and the additional impacts from the potential resuspension of large volume of sediment. It is also anticipated that with the current sedimentation rate within Cocos lagoon that the remaining tires will be furthered buried and covered, reducing further exposure. The Government of Guam will continue to research alternative sources of funding and collaborations to remove the remaining tires at CARB and identify and locate CARA and remove those tires as well.

Partially exposed bottom layer of CARB not removed..
(Photograph courtesy of GEPA).

Partially exposed bottom layer of CARB not removed.
(Photograph courtesy of GEPA).

All recovered tires were shredded to two inch nominal size with an approximate volume of 75 cubic yards at the only tire recycling facility on Guam. All material was containerized and shipped off island to a recycled rubber company in Mumbai, India to be used either as tire-derived fuel (TDF) for the cement industry or as Crumb Rubber Granules for rubberized asphalt or in creating running tracks and other sports surfaces.

Conclusion

In recent years, the Cocos Lagoon has been surveyed for the presence of chemical contaminants due to the operation of a US Coast Guard (USCG) Long-Range Navigation (LORAN) station from 1944 to 1963 on Cocos Island. In studies conducted by USCG contractors, elevated levels of polychlorinated biphenyls (PCBs) were found in the soils on Cocos Island and within the fish in the lagoon (Environet, 2005; Element Environmental, 2008, 2013, 2014). After the results of the first study were released, a fish consumption advisory was put in place for Cocos Lagoon by the Government of Guam in 2006, as a response to the contamination of fish by high concentrations of the PCBs and other heavy metals. In 2015, NOAA's National Centers for Coastal Ocean Science (NCCOS) conducted a separate survey of the Cocos lagoon for chemical contaminants and they also found elevated levels of PCBs and DDT within fish tissues (Hartwell *et al.*, 2017).

A separate finding in this study was that elemental Zinc was the third highest metal concentrated within fish tissues. The government of Guam believes that the artificial tire reefs could have been a source of the zinc and the elevated levels found. As literature searches report that rubber tires are typically comprised of 1-2% Zinc by weight and Zinc is also the main heavy metal within its leachate (Collins *et al.,* 1994).

Removal of the 1,829 tires from CARB is anticipated to reduce and hopefully eliminate any further risk of contamination of heavy metals within the lagoon, specifically Zinc. This effort may also lead to the reduction of the Government of Guam fish consumption advisory for Cocos Lagoon, which will strengthen subsistence and cultural fishing practices. The government of Guam will be looking to conduct additional studies within Cocos Lagoon, regarding heavy metal contamination in the water column, sediment, and fish tissue to continue monitoring contaminant levels after the removal of the artificial reef has been completed.

Also, as part of this project, the principal investigators are planning to create an awareness campaign through the creation of posters, pamphlets, public service announcements, and other outreach tools to help educate the public on the negative effects of marine debris on our environment. The outreach campaign will focus on how to properly dispose of tires and other typical marine debris and the adverse effects of improperly disposed waste on our marine environment. This portion of the project is currently on hold due to the pandemic restrictions that are in place by the Government of Guam. The Government of Guam believes that cleaning up the artificial tire reef is an important step to ensure no additional harm to surrounding ecosystems Removal efforts of the artificial tire reef will help prevent any negative impact on the biological, economic, and cultural importance of Cocos Lagoon.

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VIII. 2022-2024 CWA 303(d) LIST

2022-2024 GUAM LIST OF IMPAIRED WATERBODIES
[Clean Water Act, Section 303(d)]

Waterbody Name	Assessment ID	Location	State	Water Type & Classification	Waterbody Size	Unit	Assessed Units	Pollutants	Basis for Listing	Priority Ranking
Agana River 1	GUAGRA-3	WATERSHED: Hagatna	GU	RIVER S2	0.52	MILES	0.52	Enterococcus, Dissolved Oxygen; PCBs in fish tissue	Exceeds WQS >10% of Samples; Fish Advisory (2001)	LOW
Agana River 2	GUAGRA-2-1A	WATERSHED: Hagatna	GU	RIVER S2	0.67	MILES	0.67	PCBs in fish tissue	Fish Advisory (2001)	LOW
Agana Swamp	GUG-1B	WATERSHED: Agana	GU	WETLAND	6.40	ACRES	6.40	PCBs in fish tissue	Fish Advisory (2001)	LOW
Agat Bay 1	GUG-010B-1	WATERSHED: Agat	GU	MARINE BAY M2	0.63	SQUARE MILES	0.63	PCBs in fish tissue, Chlordane in fish tissue, Dioxin in fish tissue	Fish Advisory (2001 & 2002)	LOW
Apra Harbor 1	GUG-008A-2	WATERSHED: Apra	GU	MARINE BAY M1	0.05	SQUARE MILES	0.05	PCBs in fish tissue	Fish Advisory (1999)	LOW
Apra Harbor 2	GUG-008A-1	WATERSHED: Apra	GU	MARINE BAY M2	4.61	SQUARE MILES	4.61	PCBs in fish tissue	Fish Advisory (1999)	LOW
Cocos Lagoon 1	GUG-020A-1	WATERSHED: Geus	GU	MARINE BAY M1	5.70	SQUARE MILES	5.70	PCBs in fish tissue	Fish Advisory (2006)	LOW
Cocos Lagoon 2	GUG-020A-2	WATERSHED: Geus	GU	MARINE BAY M2	0.34	SQUARE MILES	0.34	PCBs in fish tissue	Fish Advisory (2006)	LOW
North Orote Peninsula Sea Cliffs	GUG-042	WATERSHED: Apra	GU	MARINE BAY M1	0.23	SQUARE MILES	0.23	PCBs in fish tissue	Fish Advisory (1999)	LOW
South Orote Peninsula Sea Cliffs	GUG-043	WATERSHED: Apra	GU	MARINE BAY M2	0.02	SQUARE MILES	0.02	PCBs in fish tissue	Fish Advisory (1999)	LOW
Gabgab Beach	GU-GB43	WATERSHED: Apra	GU	COASTAL WATERS M2	0.65	MILES	0.65	PCBS in fish tissue	Fish Advisory (1999)	LOW

2022-2024 GUAM LIST OF IMPAIRED WATERBODIES

[Clean Water Act, Section 303(d)]

Waterbody Name	Assessment ID	Location	State	Water Type & Classification	Waterbody Size	Unit	Assessed Units	Pollutants	Basis for Listing	Priority Ranking
Lonfit River 2	GUPGRL-2	WATERSHED: PAGO	GU	RIVER-S2	1.07	MILES	1.07	Salinity, Total Coliform, E. Coli, Enterococcus, Iron,Temperature, Turbidity	Consent Decree; Exceeds WQS>10% of Samples	LOW
Lonfit River 3	GUPGRP-1-51B	WATERSHED: PAGO	GU	RIVER - S1	0.04	MILES	0.04	Salinity, Total Coliform, E. Coli, Enterococcus, Temperature	Consent Decree	LOW
Pago Bay	GUG-003A	WATERSHED: Pago	GU	MARINE BAY M2	0.70	SQUARE MILES	0.70	Enterococcus, Dissolved Oxygen, Nitrate	Exceeds WQS >10%of Samples	MEDIUM
Pago River 1	GUPGRP-1-51A	WATERSHED: Pago	GU	RIVER- S2	0.06	MILES	0.06	E. coli Turbidity	Exceeds WQS >10%of Samples	MEDIUM
Pago River 2	GUPGRP-2	WATERSHED: Pago	GU	RIVER - S3	4.74	MILES	4.74	E. coli, Dissolved Oxygen	Exceeds WQS >10%of Samples	MEDIUM
Storm Drain	GUAGRD	WATERSHED: Northern	GU	RIVER -S2	0.21	MILES	0.21	E. Coli, Dissolved Oxygen, Nitrates, Total Suspended Solids, Turbidity, Salinity	Exceeds WQS >10%of Samples	MEDIUM
Tanguisson Beach 2	GUG-001B-2	WATERSHED: Northern	GU	MARINE BAY M2	0.40	SQUARE MILES	0.40	Toxic substance in seaweed	Seafood Consumption Advisory	LOW
Tipalao Bay	GUG-010A	WATERSHED: Agat	GU	MARINE BAY M2	0.10	SQUARE MILES	0.10	PCBs in fish tissue	Fish Advisory (1999)	LOW
Tumon Bay	GUG-001C	WATERSHED: Northern	GU	MARINE BAY M2	1.98	SQUARE MILES	1.98	Dieldrin, Total Chlordane	Waters Not Attaining Designated Uses	HIGH
Ajayan River	GUMZRAJ	WATERSHED: Manell	GU	RIVER -S2	3.95	MILES	3.86	Dissolved Oxygen, Orthophosphates, Suspended Solids	Exceeds WQS >10% of Samples	MEDIUM
Liyog River	GUMZRL	WATERSHED: Manell	GU	RIVER -S2	1.83	MILES	1,81	Dissolved Oxygen, Orthophosphates, Suspended Solids, Nitrate (NO3)	Exceeds WQS >10% of Samples	MEDIUM

2022-2024 GUAM LIST OF IMPAIRED WATERBODIES

[Clean Water Act, Section 303(d)]

Waterbody Name	Assessment ID	Location	State	Water Type & Classification	Waterbody Size	Unit	Assessed Units	Pollutants	Basis for Listing	Priority Ranking
Sumay River	GUMZRSY	WATERSHED: Manell	GU	RIVER -S2	1.06	MILES	1.02	Dissolved Oxygen, Orthophosphates, Nitrates, Suspended Solids	Exceeds WQS >10% of Samples	MEDIUM
Toguan River 1	GUMZRT-2	WATERSHED: Toguan	GU	RIVER-S3	0.20	MILES	0.20	Orthophosphate	Exceeds WQS >10% of Samples	LOW
Pago River 4	GUPGMPW	WATERSHED: Pago	GU	RIVER-S3	0.52	MILES	0.52	Turbidity	Exceeds WQS >10% of Samples	MEDIUM
Manell River	GUMZRML	WATERSHED: Manell	GU	RIVER-S2	2.77	MILES	2.65	Nitrate (NO3), Orthophosphate	Exceeds WQS >10% of Samples	MEDIUM
Fonte River 1	GUAGRF-2	WATERSHED: Fonte		RIVER-S2	1.16	MILES	1.16	Nitrate (NO3)	Exceeds WQS >10% of Samples	MEDIUM
Aslinget River 3	GUINRAP-46B	WATERSHED: Dandan	GU	RIVER-S3	0.18	MILES	0.18	Orthophosphate	Exceeds WQS >10% of Samples	LOW
Togcha River 5	GUTURTG-1C	WATERSHED: Togcha	GU	RIVER-S3	0.50	MILES	0.50	Nitrate (NO3)	Exceeds WQS >10% of Samples	LOW
Tinago River	GU6TINAGO	WATERSHED: Dandan	GU	RIVER-S3	2.93	MILES	2.93	Orthophosphates	Exceeds WQS >10% of Samples	LOW
West Surface Drainage	GUSURW	WATERSHED: Dandan	GU	RIVER-S1	0.36	MILES	0.36	Iron, Nitrate, Total Suspended Solids, Uranium	Consent Decree; Exceeds WQS>10% of Samples	LOW

IX. 2022-2024 GUAM ASSESSMENT DATA FOR WATERBODIES

2022 2024 GUAM ASSESSMENT DATA : COASTAL/RECREATIONAL WATERS

Waterbody Name	Assessment Unit ID	Watershed /Bay Name	Coastal Water Classification (Designated Use)	Water Size in Miles	Reporting Category
Tarague Beach (Scout Beach)	GU-GB1	Northern Watershed / Tarague Beach (Scout Beach Area)	M1	3.42	3
Jinapsan Beach	GU-GB3	Northern Watershed / Jinapsan Beach Area	M1	1.28	3
Ritidian Beach	GU-GB4	Northern Watershed / Ritidian Point Beach Area	M1	2.21	3
Uruno Beach	GU-GB5	Northern Watershed / Uruno Beach Area	M1	1.74	3
Falcona Beach	GU-GB6	Northern Watershed / Falcona Beach Area	M1	0.37	3
South of Falcona Beach (Urunao)	GU-GB7	Northern Watershed / Falcona Beach Area	M1	0.24	3
Haputo Beach	GU-GB8	Northern Watershed / Haputo Beach Area	M1	0.19	3
Intermittent Beach - Shark's Hole	GU-GB9	Northern Watershed/ Tanguisson Beach Area 1	M1	0.19	3
Intermittent Beach - Tanguisson Pt.	GU-GB10	Northern Watershed / Tanguisson Beach Area 2	M2	0.26	3
Intermittent Beach - North Tanguisson	GU-GB11	Northern Watershed / Tanguisson Beach Area 2	M2	0.26	3
Fafai Beach	GU-GB13	Northern Watershed/ Tumon Bay	M2	0.37	3
Alupang Island Beach	GU-GB21	Northern Watershed / East Hagatna Bay	M2	0.02	3
West of volcanic headland	GU-GB29	Piti-Asan Watershed / Asan Bay	M2	0.37	3
Ski Beach	GU-GB38	Apra Watershed / Sasa Bay	M3	0.40	3
SRF Beach	GU-GB40	Apra Watershed / Apra Harbor 2	M3	0.40	3
Marianas Yacht Club Beach	GU-GB41	Apra Watershed / Sasa Bay	M2	0.18	3
Polaris Beach	GU-GB42	Apra Watershed / Apra Harbor 2	M2	0.19	3
Gabgab Beach	GU-GB43	Apra Watershed / Apra Harbor 2	M2	0.65	5
Orote Point Beaches	GU-GB44	Apra Watershed / Apra Harbor 1 and 2	M1	0.21	3

2022 2024 GUAM ASSESSMENT DATA : COASTAL/RECREATIONAL WATERS

Waterbody Name	Assessment Unit ID	Watershed /Bay Name	Coastal Water Classification (Designated Use)	Water Size in Miles	Reporting Category
Tipalao Beach	GU-GB45	Apra Watershed / Tipalao Bay	M2	0.15	3
Dadi Beach	GU-GB46	Agat Watershed / Agat Bay 1	M2	0.57	3
Apaca Park Beach	GU-GB48	Agat Watershed / Agat Bay 2	M2	0.14	3
Salinas Beach	GU-GB51	Agat Watershed / Agat Bay 2	M2	0.49	3
Taelayag Beach	GU-GB56	Taelayag Watershed / Taleyfac Bay 1	M1	0.87	3
Sagua Beach	GU-GB57	Taelayag Watershed / Taleyfac Bay 1	M1	0.62	3
Facpi Point Beaches	GU-GB58	Cetti Watershed / South Facpi Point beaches and rocky shorelines	M1	0.66	3
Beach south of Achugao	GU-GB59	Cetti Watershed / South Facpi Point beaches and rocky shorelines	M1	0.29	3
Beach south of Agaga River	GU-GB60	Cetti Watershed / South Facpi Point beaches and rocky shorelines	M1	0.25	3
Beach north of Asmafines River	GU-GB62	Cetti Watershed / Sella Bay	M1	0.12	3
Beach south of Sella River	GU-GB63	Cetti Watershed / Sella Bay	M1	0.12	3
Abong Beach	GU-GB64	Cetti Watershed / Sella Bay and Cetti Bay	M1	0.62	3
Mouth of Cetti Bay	GU-GB65	Cetti Watershed / Cetti Bay	M1	0.50	3
Head of Fouha Bay	GU-GB66	Umatac Watershed / Fouha Bay	M1	0.06	3
South of Machadgan Point	GU-GB68	Umatac Watershed / Umatac Bay 2	M2	0.25	3
Ajmo Beach	GU-GB70	Toguan Watershed / Toguan Bay and Bile Bay	M2	0.16	3
Bile Bay Beach	GU-GB71	Toguan Watershed / Bile Bay	M2	0.03	3
Pigua River Beach	GU-GB72	Toguan Watershed/ Bile Bay	M2	0.08	3

2022 2024 GUAM ASSESSMENT DATA : COASTAL/RECREATIONAL WATERS

Waterbody Name	Assessment Unit ID	Watershed /Bay Name	Coastal Water Classification (Designated Use)	Water Size in Miles	Reporting Category
Cocos Island	GU-GB73	Manell-Geus Watershed Cocos Lagoon 1	M1	1.16	3
Islet	GU-GB74	Manell-Geus Watershed Cocos Lagoon 1	M1	0.07	3
Piga Beach (Talona Beach)	GU-GB76	Geus Watershed / Cocos Lagoon 2	M2	0.42	3
Aba Beach	GU-GB78	Geus Watershed / Cocos Lagoon 2	M1	0.19	3
Aang Beach	GU-GB79	Manell Watershed / Cocos Lagoon 1	M1	0.12	3
Achang Bay	GU-GB80	Manell Watershed / Cocos Lagoon 1	M1	0.55	3
Beach to Liyog River Mouth	GU-GB81	Manell Watershed / Sumay Bay and Asgado Bay	M1	0.77	3
Liyog river Mouth	GU-GB82	Manell Watershed / Asgado Bay	M1	0.18	3
Beach to Asgadao Bay	GU-GB83	Manell Watershed / Asgado Bay	M1	0.04	3
Intermittent Beach, Asgadao Bay	GU-GB84	Manell Watershed / Asgado Bay	M1	0.12	3
Intermittent Beach 1, Ajayan Bay	GU-GB85	Manell Watershed / Asgado Bay	M1	0.12	3
Intermittent Beach 2, Ajayan Bay	GU-GB86	Manell Watershed / Asgado Bay and Ajayan Bay	M1	0.09	3
Ajayan River Mouth 1	GU-GB87	Manell Watershed / Ajayan Bay	M1	0.03	3
Intermittent Beach 3, Ajayan Bay	GU-GB88	Manell Watershed / Ajayan Bay	M1	0.09	3
Ajayan River Mouth 2	GU-GB89	Manell Watershed / Ajayan Bay	M1	0.06	3
Intermittent Beach 4, Ajayan Bay	GU-GB90	Manell Watershed / Ajayan Bay	M1	0.09	3
Aga Beach	GU-GB91	Inarajan Watershed / Aga Bay	M1	0.08	3
Guijen Rock area	GU-GB92	Inarajan Watershed / Inarajan Reef Flat	M1	0.44	3
Atao Beach	GU-GB93	Inarajan Watershed / Inarajan Reef Flat	M1	0.38	3
Beach north of Acho Point	GU-GB94	Inarajan Watershed / Inarajan Reef Flat	M1	0.27	3

2022 2024 GUAM ASSESSMENT DATA : COASTAL/RECREATIONAL WATERS

Waterbody Name	Assessment Unit ID	Watershed /Bay Name	Coastal Water Classification (Designated Use)	Water Size in Miles	Reporting Category
Agfayan River Beach	GU-GB95	Inarajan Watershed / Agfayan Bay	M2	0.07	3
Beach at Pauliluc Bay	GU-GB98	Dandan Watershed / Pauliluc Bay	M2	0.28	3
Ulomai Beach	GU-GB99	Dandan Watershed / Ulomai Beach Area	M2	0.11	3
Perez Beach	GU-GB101	Dandan Watershed / Nomna Bay	M2	0.26	3
Asiga Beach Area (Inarajan)	GU-GB102	Asalonso Watershed / Asiga Point Beach Area	M1	0.22	3
Head of Paicpouc Cove	GU-GB103	Asalonso Watershed / Talofofo Bay	M2	0.09	3
Calvos Beach	GU-GB108	Togcha Watershed / Talofofo Beaches	M2	0.51	3
Jones Beach	GU-GB110	Togcha Watershed / Talofofo Beaches	M2	0.09	3
North of Togcha Point	GU-GB114	Togcha Watershed / Togcha Bay and Beach North of Togcha Point	M2	1.03	3
Head of Ylig Bay	GU-GB115	Ylig Watershed / Ylig Bay	M2	0.18	3
Beach North of Ylig Bay	GU-GB116	Ylig Watershed / Ylig Bay	M2	0.07	3
North Pago Bay Beach	GU-GB119	Pago Watershed / Pago Bay	M2	0.24	3
Asan Memorial Beach	GUN-14	Piti-Asan Watershed / Asan Bay	M2	0.46	4a
Beach at Fonte River	GUN-21	Fonte Watershed / West Hagatna Bay	M2	0.13	4a
Beach at Inarajan Bay	GUS-10	Inarajan Watershed / Inarajan Bay	M2	0.56	4a
Beach at Pago Bay	GUS-15	Pago Watershed / Pago Bay	M2	0.96	4a
United Seamen's Service Beach 1	GUN-16	Piti-Asan Watershed / Piti Bay	M2	0.26	4a
United Seamen's Service Beach 2	GUN-17		M2	0.26	4a
Beach at Piti Bay/ Tepungan Beach	GUN-15	Piti-Asan Watershed / Piti Bay	M2	1.16	4a
Beach North of Togcha River	GUS-13	Togcha Watershed / Togcha Bay	M2	0.27	4a

2022 2024 GUAM ASSESSMENT DATA : COASTAL/RECREATIONAL WATERS

Waterbody Name	Assessment Unit ID	Watershed /Bay Name	Coastal Water Classification (Designated Use)	Water Size in Miles	Reporting Category
Dungca's Beach - Sleepy Lagoon	GUN-06	Northern Watershed / East Hagatna Bay	M2	0.34	4a
Dungca's Beach	GUN-07		M2	0.65	4a
Family Beach	GUN-19	Apra Watershed / Apra Harbor 2	M2	0.15	4a
Asanite Point Beach / First Beach	GUS-18	Togcha Watershed / Talofofo Beaches	M2	0.06	4a
Gognga Beach	GUN-25	Northern Watershed (Tumon Subbasin) / Tumon Bay	M2	0.15	4a
Gun Beach	GUN-24	Northern Watershed (Tumon Subbasin) / Tumon Bay	M2	0.23	4a
Hagatna Channel -Outrigger Ramp	GUN-11	Northern Watershed / (Hagatna Subwatershed) West Hagatna Bay	M2	0.15	4a
Hagatna Boat Basin	(GUN-12)		M2	0.13	4a
Hagatna Channel	GUN-10		M2	0.15	4a
Head of Talofofo Bay	GUS-11	Talofofo Watershed / Talofofo Bay	M2	0.21	4a
Head of Umatac Bay	GUS-06	Umatac Watershed / Umatac Bay 2	M2	0.14	4a
Inarajan Pools	GUS-09	Inarajan Watershed / Agfayan Bay	M2	0.08	4a
Merizo Pier - Mamaon Channel	GUS-08	Geus Watershed / Cocos Lagoon 2	M2	0.46	4a
NCS Beach/ Tanguisson Beach	GUN-01	Northern Watershed / Tanguisson Beach Area 2	M2	0.25	4a
Naton Beach- Guma Trankilidat	GUN-04	Northern Watershed (Tumon Subbasin) / Tumon Bay	M2	0.18	4a
Naton Beach - San Vitores	GUN-02		M2	0.23	4a
Naton Beach - Fujita	GUN-23		M2	0.36	4a
Naton Beach - Matapang Beach Park	GUN-03		M2	0.33	4a
Beach North of Finile River	GU-GB52	Agat Watershed / Agat Bay 2	M2	0.35	4a
Beach South of Finile River (Bangi Beach)	GUS-04	Agat & Taelayag Watersheds / Agat Bay 2 & Taleyfac Bay 2	M2	.0.88	4a

2022 2024 GUAM ASSESSMENT DATA : COASTAL/RECREATIONAL WATERS

Waterbody Name	Assessment Unit ID	Watershed /Bay Name	Coastal Water Classification (Designated Use)	Water Size in Miles	Reporting Category
Nimitz Beach	GUS-05	Taelayag Watershed / Taleyfac Bay 2	M2	0.56	4a
Outhouse Beach	GUN-18	Apra Watershed / Apra Harbor 3	M3	0.46	4a
Port Authority Beach	GUN-20	Apra Watershed / Piti Channel and Cabras Island	M3	0.46	4a
Tagachang Beach Park	GUS-14	Ylig Watershed / Tagachang Beach Park Area	M2	0.18	4a
Toguan Bay	GUS-07	Toguan Watershed / Toguan Bay	M2	0.46	4a
Togcha Beach (small cemetery)	GUS-25	Agat Watershed / Agat Bay 2	M2	0.31	4a **
Togcha Beach Namo Bay	GUS-02		M2	0.33	4a
Togcha Bay Agat Beach	GUS-03		M2	0.15	4a
Trinchera Beach, East Hagatna Bay	GUN-08	Northern Watershed / East Hagatna Bay	M2	0.48	4a
Trinchera Beach, Alupang Beach Towers	GUN-26		M2	0.26	4a
Padre Palomo	GUN-09		M2	0.42	4a
West Hagatna Beach Bayside Park	GUN-13	Northern Watershed (Hagatna Subwatershed) West Hagatna Bay	M2	0.37	4a
West Hagatna Beach 2 Bayside Park	GUN-27		M2	0.37	4a
West Hagatna Beach 3 (Stormdrain)	GUN-28		M2	0.37	4a
West of Adelup Point, Asan Bay	GUN-22	Fonte Watershed / Asan Bay	M2	0.41	4a
Ypan Beach Park Beach (Ipan Public Beach)	GUS-12	Togcha Watershed / Togcha Bay	M2	0.30	4a
Ypao Beach, Tumon Bay	GUN-05	Northern Watershed (Tumon Subbasin) / Tumon Bay	M2	0.42	4a

2022 2024 GUAM ASSESSMENT DATA: MARINE BAYS

Waterbody Name	Assessment Unit ID	WATERSHED Location	Water Classification	Water Size (Sq. Mi.)	Square Miles Assessed	Water Status	Reporting Category
AGAT BAY 1	GUG-010B-1	AGAT	M2	0.63	0.63	IMPAIRED	5
AGAT BAY 2	GUG-010B-2	AGAT	M2	1.91	1.91	ASSESSED	2
TIPALAO BAY	GUG-010A	AGAT	M2	0.10	0.10	IMPAIRED	5
APRA HARBOR 2	GUG-008A-2	APRA	M2	4.61	4.61	IMPAIRED	5
APRA HARBOR 3	GUG-008A-3	APRA	M3	0.42	0.42	ASSESSED	2
APRA HARBOR 1	GUG-008A-1	APRA	M1	0.05	0.05	IMPAIRED	5
COCOS LAGOON 1	GUG-020A-1	GEUS	M1	5.70	5.70	IMPAIRED	5
COCOS LAGOON 2	GUG-020A-2		M2	0.34	0.34	IMPAIRED	5
CETTI BAY	GUG-014A	CETTI	M1	0.65	0.00	NOT ASSESSED	3
PAGO BAY	GUG-003A	PAGO	M2	0.70	0.70	IMPAIRED	5
WEST HAGATNA BAY	GUG-002A	HAGATNA & FONTE	M2	1.56	1.56	ASSESSED	2
EAST HAGATNA BAY	GUG-001D	NORTHERN	M2	0.93	0.93	ASSESSED	2
AGFAYAN BAY: INARAJAN POOLS	GUG-017A	INARAJAN	M2	0.08	0.08	ASSESSED	3
AGFAYAN BAY	GUG-017C	INARAJAN	M2	0.08	0.00	NOT ASSESSED	3
DOUBLE REEF	GUG-001A	NORTHERN	M1	0.64	0.00	NOT ASSESSED	3
TANGUISSON BEACH 2	GUG-001B-2	NORTHERN	M2	0.40	0.40	IMPAIRED	5
TANGUISSON BEACH 1	GUG-001B-1	NORTHERN	M1	0.29	0.00	NOT ASSESSED	3
TALEYFAC BAY 1	GUG-012A-1	TAELAYAG	M1	0.71	0.00	NOT ASSESSED	3
TALEYFAC BAY 2	GUG-012A-2	TAELAYAG	M2	0.37	0.37	ASSESSED	3
TALOFOFO BAY	GUG-011A	TALOFOFO	M2	0.15	0.15	ASSESSED	2
TOGCHA BAY	GUG-007A	TOGCHA	M2	0.41	0.41	ASSESSED	2
TUMON BAY	GUG-001C	NORTHERN	M2	1.98	1.98	IMPAIRED	5
FOUHA BAY	GUG-016A	UMATAC	M1	0.26	0.00	NOT ASSESSED	3

2022 2024 GUAM ASSESSMENT DATA: MARINE BAYS

Waterbody Name	Assessment Unit ID	WATERSHED Location	Water Classification	Water Size (Sq. Mi.)	Square Miles Assessed	Water Status	Reporting Category
UMATAC BAY 1	GUG-016B-1	UMATAC	M1	0.06	0.00	NOT ASSESSED	3
UMATAC BAY 2	GUG-016B-2	UMATAC	M2	0.34	0.34	ASSESSED	3
YLIG BAY	GUG-005A	YLIG	M2	0.45	0.00	NOT ASSESSED	3
RITIDIAN POINT BEACH AREA	GUG-047	NORTHERN	M1	1.42	0.00	NOT ASSESSED	3
URUNO BEACH AREA	GUG-058	NORTHERN	M1	0.58	0.00	NOT ASSESSED	3
FALCONA BEACH AREA	GUG-031	NORTHERN	M1	0.19	0.00	NOT ASSESSED	3
HAPUTO BEACH AREA	GUG-033	NORTHERN	M1	0.07	0.00	NOT ASSESSED	3
SOUTH HAPUTO BEACH AREA	GUG-051	NORTHERN	M1	0.20	0.00	NOT ASSESSED	3
OKA POINT	GUG-041	NORTHERN	M2	0.20	0.00	NOT ASSESSED	3
ASAN BAY	GUG-006A	PITI/ASAN	M2	0.58	0.58	ASSESSED	2
PITI BAY	GUG-006B	PITI/ASAN	M2	1.35	1.35	ASSESSED	2
LUMINAO REEF/CALALA BANK	GUG-037	PITI/ASAN	M2	1.17	0.00	NOT ASSESSED	3
PITI CHANNEL/ CABRAS ISLAND	GUG-045	PITI/ASAN	M3	0.24	0.24	ASSESSED	3
SASA BAY	GUG-052	APRA	M2	0.74	0.00	NOT ASSESSED	3
NORTH OROTE PENINSULA SEA CLIFFS	GUG-042	APRA	M1	0.23	0.23	IMPAIRED	5
SOUTH OROTE PENINSULA SEA CLIFFS	GUG-043	APRA	M2	0.02	0.02	IMPAIRED	5
SOUTH FACPI POINT BEACHES/ROCKY SHORELINES	GUG-054	TAELAYAG	M1	0.66	0.00	NOT ASSESSED	3
SELLA BAY	GUG-053	CETTI	M1	0.27	0.00	NOT ASSESSED	3
TOGUAN BAY	GUG-018A	TOGUAN	M2	0.26	0	NOT ASSESSED	3
BILE BAY	GUG-030	TOGUAN	M2	0.17	0	NOT ASSESSED	3
SUMAY BAY	GUG-055	MANELL	M1	0.79	0.00	NOT ASSESSED	3
ASGADAO BAY	GUG-027	MANELL	M1	0.56	0.00	NOT ASSESSED	3
AJAYAN BAY	GUG-026	MANELL	M1	0.24	0.00	NOT ASSESSED	3

2022 2024 GUAM ASSESSMENT DATA: MARINE BAYS

Waterbody Name	Assessment Unit ID	WATERSHED Location	Water Classification	Water Size (Sq. Mi.)	Square Miles Assessed	Water Status	Reporting Category
AGA BAY	GUG-025	MANELL	M1	0.10	0.00	NOT ASSESSED	3
INARAJAN REEF FLAT	GUG-034	INARAJAN	M1	0.82	0.00	NOT ASSESSED	3
INARAJAN BAY	GUG-017B	INARAJAN	M2	0.17	0.17	ASSESSED	3
GUAIFAN POINT REEF FLAT	GUG-032	DANDAN	M2	0.08	0.00	NOT ASSESSED	3
PAULILUC BAY	GUG-044	DANDAN	M2	0.08	0.00	NOT ASSESSED	3
ULOMAI BEACH AREA	GUG-057	DANDAN	M2	0.09	0.00	NOT ASSESSED	3
NOMNA BAY	GUG-039	DANDAN	M2	0.17	0.00	NOT ASSESSED	3
NOMNA POINT REEF FLAT	GUG-040	DANDAN	M1	0.32	0.00	NOT ASSESSED	3
ASIGA POINT BEACH AREA	GUG-028	DANDAN	M1	0.16	0.00	NOT ASSESSED	3
MATALA POINT REEF FLAT	GUG-038	DANDAN	M1	0.25	0.00	NOT ASSESSED	3
TALOFOFO BEACHES	GUG-007B	TALOFOFO	M2	0.61	0.61	ASSESSED	3
BEACH NORTH OF TOGCHA POINT	GUG-029	YLIG	M2	0.53	0.00	NOT ASSESSED	3
TAGACHANG BEACH PARK	GUG-005B	YLIG	M2	0.24	0.24	ASSESSED	3
S. FADIAN POINT	GUG-049	NORTHERN	M2	0.58	0.00	NOT ASSESSED	3
N. FADIAN POINT	GUG-046	NORTHERN	M1	0.56	0.00	NOT ASSESSED	3
S. JANUM POINT	GUG-050	NORTHERN	M1	2.29	0.00	NOT ASSESSED	3
JANUM POINT REEF FLAT	GUG-035	NORTHERN	M1	0.09	0.00	NOT ASSESSED	3
PATI POINT	GUG-048	NORTHERN	M1	5.35	0.00	NOT ASSESSED	3
TARAGUE BEACH	GUG-056	NORTHERN	M1	3.09	0.00	NOT ASSESSED	3
JINAPSAN BEACH	GUG-036	NORTHERN	M1	0.75	0.00	NOT ASSESSED	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Achang River 1	GUMZRAC-2	WATERSHED: Manell	RIVER-S2	0.50	0.50	0.00	3
Achang River 2	GUMZRAC	WATERSHED: Manell	RIVER-S2	0.30	0.30	0.00	3
Agaga River	GUULRAG	WATERSHED: Cetti	RIVER-S2	0.78	0.72	0.00	3
Agana River 1	GUAGRA-3	WATERSHED: Hagatna	RIVER-S2	0.52	0.52	0.52	5
Agana River 2	GUAGRA-2-1A	WATERSHED: Hagatna	RIVER-S2	0.67	0.67	0.67	5
Agana Springs	GUAGRA-1	WATERSHED: Hagatna	RIVER-S2	0.04	0.04	0.00	3
Aguada River	GUAPRAG	WATERSHED: Apra	RIVER-S3	2.15	1.95	0.00	2
Ajayan River	GUMZRAJ	WATERSHED: Manell	RIVER-S2	3.95	3.86	3.86	5
Almagosa Spring	GUFLRA-1	WATERSHED: Talofofo	RIVER-S1	0.09	0.09	0.00	3
Asalonso River / unnamed tributary	GUINRAS	WATERSHED: Asalonso	RIVER-S3	2.84	2.10	0.00	3
Asan River 1	GUASRI-3	WATERSHED: Piti/Asan	RIVER-S3	1.32	1.32	1.32	3
Asan River 2	GUASRI-4	WATERSHED: Piti/Asan	RIVER-S3	0.79	0.71	0.00	3
Aslinget River 1	GUINRAL-1-46B	WATERSHED: Dandan	RIVER-S3	0.71	0.71	0.00	3
Aslinget River 2	GUINRAL-2	WATERSHED: Dandan	RIVER-S3	1.33	1.33	1.33	5
Aslinget River 3	GUINRAP-46B	WATERSHED: Dandan	RIVER-S3	0.18	0.18	0.00	3
Assupian River	INRAL-1-46F	WATERSHED: Dandan	RIVER-S3	0.52	0.52	0.00	3
Asmafines River	GUULRAS	WATERSHED: Cetti	RIVER-S2	0.83	0.78	0.00	3
Atantano River 1	GUAPRA-2	WATERSHED: Apra	RIVER-S3	3.30	3.30	0.00	3
Atantano River 2	GUAPEA	WATERSHED: Apra	RIVER-S3	6.38	6.23	0.00	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Big Guatali River	GUAPRA-1	WATERSHED: Apra	RIVER-S3	2.15	2.15	0.00	2
Bonya River	GUMLRB	WATERSHED: Talofofo	RIVER-S1	4.03	1.79	0.00	3
Cetti River	GUULRCL	WATERSHED: Cetti	RIVER-S2	1.92	1.89	0.00	3
Chagame River/ La Sa Fua River	GUULRL-1	WATERSHED: Umatac	RIVER-S2	2.50	2.46	0.00	3
Chaligan Creek 1	GUATRC-2	WATERSHED: Taelayag	RIVER-S3	0.92	0.92	0.00	3
Chaligan Creek 2	GUATRC	WATERSHED: Taelayag	RIVER-S3	0.06	0.06	0.00	3
Chaot River	GUAGRA-2	WATERSHED: Hagatna	RIVER S2	2.22	2.22	0.00	3
Finile Creek	GUATRF	WATERSHED: Agat	RIVER-S3	1.04	0.36	0.36	2
Fonte River 1	GUAGRF-2	WATERSHED: Fonte	RIVER-S2	1.16	1.16	1.16	5
Fonte River 2	GUAGRF-1	WATERSHED: Fonte	RIVER-S2	2.02	1.93	1.93	3
Gaan River 1	GUATRG-2	WATERSHED: Agat	RIVER-S3	0.56	0.56	0.00	3
Gaan River 2	GUATRG	WATERSHED: Agat	RIVER-S3	0.63	0.63	0.00	3
Geus River 1	GUMZRG-1	WATERSHED: Geus	RIVER-S1	0.99	0.99	0.00	3
Geus River 2	GUMZRG	WATERSHED: Geus	RIVER-S2	0.52	0.52	0.00	3
Geus River 3	GUMZRG-2	WATERSHED: Geus	RIVER-S3	0.78	0.78	0.78	5
Imong River 1	GUFLRI-2	WATERSHED: Talofofo	RIVER-S1	2.54	2.54	0.00	3
Imong River 2	GUFLRI-1	WATERSHED: Talofofo	RIVER-S1	1.93	1.93	0.00	3
Inarajan River 1	GUINRI-1-45A	WATERSHED: Inarajan	RIVER-S3	1.37	1.37	0.00	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Inarajan River 2	GUINRI-2	WATERSHED: Inarajan	RIVER-S3	0.86	0.86	0.00	3
Ylediagao River	INRI-1-45E	WATERSHED: Inarajan	RIVER-S3	0.59	0.59	0.00	3
Topony River	INRI-1-45F	WATERSHED: Inarajan	RIVER-S3	1.04	1.04	0.00	3
Nelansa River	INRI-1-45G	WATERSHED: Inarajan	RIVER-S3	0.93	0.93	0.00	3
Pasmano River	INRI-1-45H	WATERSHED: Inarajan	RIVER-S3	2.25	2.25	0.00	3
Dante River	INRI-1-45I	WATERSHED: Inarajan	RIVER-S3	1.52	1.52	0.00	3
Unnamed Tributary 10	INRI-1-45J	WATERSHED: Inarajan	RIVER-S3	0.43	0.43	0.00	3
Unnamed Tributary 11	INRI-1-45K	WATERSHED: Inarajan	RIVER-S3	0.43	0.43	0.00	3
La Sa Fua River	GUULRL-2	WATERSHED: Umatac	RIVER-S2	2.02	2.02	0.00	3
Laelae River	GUULRU-1	WATERSHED: Umatac	RIVER-S1	1.94	1.94	0.00	3
Laguas River	GUAPRL	WATERSHED: Apra	RIVER-S3	0.85	0.81	0.00	3
Laolao River 1	GUINRL-45B	WATERSHED: Inarajan	RIVER-S2	0.13	0.13	0.00	3
Laolao River 2	INRI-1-45B	WATERSHED: Inarajan	RIVER-S3	0.27	0.27	0.00	3
Fensol River	INRL-45C	WATERSHED: Inarajan	RIVER-S2	1.20	1.20	0.00	3
Fintasa River	INRL-45D	WATERSHED: Inarajan	RIVER-S2	2.12	2.12	0.00	3
Unamed Tributary 9	INRL-45L	WATERSHED: Inarajan	RIVER-S2	0.80	0.80	0.00	3
Liyog River	GUMZRL	WATERSHED: Manell	RIVER-S2	1.83	1.81	1.81	5
Lonfit River 1	GUPGRL-1-51 -B	WATERSHED: Pago	RIVER-S1	3.79	3.79	3.79	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Lonfit River 2	GUPGRL-2	WATERSHED: Pago	RIVER-S2	1.07	1.07	1.07	5
Lonfit River 3	GUPGRP-1-51B	WATERSHED: Pago	RIVER-S1	0.04	0.04	0.04	5
Maagas River 1	GUTURM-1	WATERSHED: Talofofo	RIVER-S2	0.39	0.39	0.00	3
Maagas River 2	GUTURT-2-48F	WATERSHED: Talofofo	RIVER-S2	1.68	1.68	0.00	3
Madofan River	GUULRMF	WATERSHED: Cetti	RIVER-S2	0.77	0.73	0.00	3
Madog River	GUULRM	WATERSHED: Umatac	RIVER-S3	2.11	2.11	0.00	3
Mahlac River	GUTURMA-1	WATERSHED: Talofofo	RIVER-S1	4.86	4.86	0.00	3
Manell River	GUMZRML	WATERSHED: Manell	RIVER-S2	2.77	2.65	2.65	5
Masso River 1	GUAPRM-1B	WATERSHED: Piti/Asan	RIVER-S3	0.31	0.31	0.31	2
Masso River 2	GUAPRM-1A	WATERSHED: Piti/Asan	RIVER-S3	2.58	2.58	2.58	3
Masso River 3	GU22MASSO	WATERSHED: Piti/Asan	RIVER-S3	0.41	0.41	0.41	2
Matgue River	GUASRM	WATERSHED: Piti/Asan	RIVER-S3	1.20	1.20	1.20	2
Maulap River 1	GUFLRM-1	WATERSHED: Talofofo	RIVER-S1	0.44	0.44	0.00	3
Maulap River 2	GUFLRM-2	WATERSHED: Talofofo	RIVER-S1	2.43	2.43	0.00	3
Namo River 1	GUATRN-1A-11	WATERSHED: Agat	RIVER-S3	1.65	1.65	1.65	2
Namo River 2	GUATRN-2	WATERSHED: Agat	RIVER-S3	0.36	0.36	0.36	2
Namo River 3	GU21NAMO	WATERSHED: Agat	RIVER-S3	0.39	0.39	0.39	
Namo River/ unnamed tributary 2	GUATRN-1	WATERSHED: Agat	RIVER-S3	0.11	0.11	0.00	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Namo River/ unnamed tributary 1	GUATRN-1A	WATERSHED: Agat	RIVER-S3	0.89	0.89	0.89	
Ascola Sito Creek	GUATRT-1	WATERSHED: Taelayag	RIVER-S3	0.97	0.97	0.00	3
Pago River 1	GUPGRP-1-51A	WATERSHED: Pago	RIVER-S2	0.06	0.06	0.06	5
Pago River 2	GUPGRP-2	WATERSHED: Pago	RIVER-S3	4.74	4.74	4.74	5
Pago River 3	GUPGEP	WATERSHED: Pago	RIVER-S3	0.54	0.54	0.00	3
Pago River 4	GUPGMPW	WATERSHED: Pago	RIVER-S3	0.52	0.52	0.52	5
Pauliluc River	GUINRAP-46A	WATERSHED: Dandan	RIVER-S3	4.93	4.55	0.00	3
Pigua River 1	GUMZRP	WATERSHED: Toguan	RIVER-S3	0.18	0.18	0.00	3
Pigua River 2	GUMZRP-2	WATERSHED: Toguan	RIVER-S3	1.50	1.50	0.00	3
Sadog Gago River	GUFLRSG-1	WATERSHED: Talofofo	RIVER-S1	0.52	0.52	0.00	3
Sagua River	GUATRSG	WATERSHED: Taelayag	RIVER-S3	0.58	0.53	0.00	3
Salinas River	GUATRS	WATERSHED: Agat	RIVER-S3	0.78	0.47	0.00	3
Sarasa River 1	GUTURS-1	WATERSHED: Talofofo	RIVER-S2	0.05	0.05	0.00	3
Sarasa River 2	GUTURT-2-48B	WATERSHED: Talofofo	RIVER-S2	2.25	2.25	0.00	3
Malaja/Sagge Tinechong River	GUTURT-2	WATERSHED: Talofofo	RIVER-S2	7.59	7.59	0.00	3
Sasa River 1	GUAPRS-1	WATERSHED: Apra	RIVER-S3	0.85	0.85	0.00	3
Sasa River 2	GUAPRS-2	WATERSHED: Apra	RIVER-S3	1.36	1.15	0.00	3
Sella River	GUULRS	WATERSHED: Cetti	RIVER-S2	2.55	2.49	0.00	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Sigua River	GUPGRS	WATERSHED: Pago	RIVER-S1	6.15	6.13	0.00	3
Sumay River	GUMZRSY	WATERSHED: Manell	RIVER-S2	1.06	1.02	1.02	5
Storm Drain	GUAGRD	WATERSHED: Northern	RIVER-S2	0.21	0.21	0.21	5
Taelayag Creek	GUATRTA	WATERSHED: Taelayag	RIVER-S3	1.37	1.34	0.00	3
Taleyfac River	GUATRT-2	WATERSHED: Taelayag	RIVER-S3	3.85	3.79	3.79	2
Talofofo River 2	GUTUETO	WATERSHED: Talofofo	RIVER-S3	0.46	0.46	0.46	2
Talofofo River 3	GUTUETU-48A	WATERSHED: Talofofo	RIVER-S2	0.96	0.96	0.00	3
Talofofo River 1	GUTURT-2-48A	WATERSHED: Talofofo	RIVER-S2	2.09	2.09	0.00	3
Togcha River 1	GUTURTG-C	WATERSHED: Togcha	RIVER-S3	0.99	0.99	0.00	3
Togcha River 2	GUTURTG-1A	WATERSHED: Togcha	RIVER-S3	0.95	0.93	0.00	3
Togcha River 3	GUTURTG-2	WATERSHED: Togcha	RIVER-S3	0.06	0.06	0.00	3
Togcha River 4	GUTURTG-X	WATERSHED: Togcha	RIVER-S3	0.04	0.04	0.00	3
Togcha River 5	GUTURTG-1C	WATERSHED: Togcha	RIVER-S3	0.50	0.50	0.50	5
Togcha River 6	GUTURTG-1B	WATERSHED: Togcha	RIVER-S3	0.08	0.08	0.00	3
Togcha River (Agat)	GUATRTO	WATERSHED: Agat	RIVER-S3	1.10	0.87	0.00	3
Toguan River 1	GUMZRT-2	WATERSHED: Toguan	RIVER-S3	0.20	0.20	0.20	5
Toguan River 2	GUMZRT-1	WATERSHED: Toguan	RIVER-S3	1.21	1.21	0.00	3
Unnamed Creek 1	GUASRI-2	WATERSHED: Piti/Asan	RIVER-S3	0.19	0.06	0.06	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Unnamed Creek 2	GUASRI-1	WATERSHED: Piti/Asan	RIVER-S3	0.17	0.17	0.00	3
Ugum River 1	GUTURU2	WATERSHED: Ugum	RIVER-S2	1.05	1.05	1.05	4a
Ugum River 3	GUTURU-1B	WATERSHED: Ugum	RIVER-S2	0.18	0.18	0.18	4a
Ugum River 4	GUTUETU-48H	WATERSHED: Talofofo	RIVER-S3	0.39	0.39	0.39	4a
Ugum River 5	GUTURU-1C	WATERSHED: Ugum	RIVER-S2	2.96	2.96	2.96	4a
Ugum River 6	GUTURU-1A-48H	WATERSHED: Ugum	RIVER-S2	4.43	4.43	4.43	4a
Umatac River	GUULRU-2	WATERSHED: Umatac	RIVER-S3	0.92	0.74	0.74	2
Ylig River 1	GUYNRY-1	WATERSHED: Ylig	RIVER-S3	23.57	23.47	0.00	3
Ylig River 2	GUYNRY-2	WATERSHED: Ylig	RIVER-S3	3.33	3.33	0.00	3
Ylig River 3	GUYNRY-3	WATERSHED: Ylig	RIVER-S3	0.41	0.41	0.41	5
Unnamed River 1	GUULRCR	WATERSHED: Cetti	RIVER-S2	0.36	0.30	0.00	3
Unnamed River 2	GUINRAGB	WATERSHED: Inarajan	RIVER-S3	0.95	0.06	0.06	3
Almagosa River	GUFLRA-2	WATERSHED: Talofofo	RIVER-S1	2.23	2.18	0.00	3
Unnamed River 3	GUG-35	WATERSHED: Manell	RIVER-S2	1.06	0.00	0.00	3
Unnamed Tributary 2	GUG-43A	WATERSHED: Inarajan	RIVER-S3	0.58	0.00	0.00	3
Unnamed Tributary 3	GUG-43B	WATERSHED: Inarajan	RIVER-S3	0.58	0.00	0.00	3
Unnamed Stream 1	GUG-55	WATERSHED: Talofofo	RIVER-S1	0.38	0.00	0.00	3
Intermittent Tributary 1	GUG-43C	WATERSHED: Inarajan	RIVER-S3	1.17	0.00	0.00	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Intermittent Tributary 2	GUG-43D	WATERSHED: Inarajan	RIVER-S3	0.37	0.00	0.00	3
Intermittent Tributary 3	GUG-43E	WATERSHED: Inarajan	RIVER-S3	0.24	0.00	0.00	3
Intermittent Tributary 4	GUG-43F	WATERSHED: Inarajan	RIVER-S3	0.58	0.00	0.00	3
Taguag River	GUG-5	WATERSHED: Piti/Asan	RIVER-S3	0.62	0.00	0.00	3
Auau Creek	GUG-16	WATERSHED: Agat	RIVER-S3	0.86	0.00	0.00	3
Bile River	GUG-30	WATERSHED: Toguan	RIVER-S3	0.64	0.00	0.00	3
Suyafe River	GUG-36	WATERSHED: Manell	RIVER-S2	0.88	0.00	0.00	3
Asgado Creek	GUG-39	WATERSHED: Manell	RIVER-S2	0.59	0.00	0.00	3
Asmaile River	GUG-40	WATERSHED: Manell	RIVER-S2	0.77	0.00	0.00	3
Tongan Creek	GUG-42	WATERSHED: Inarajan	RIVER-S3	0.86	0.00	0.00	3
Agfayan River	GUG-43	WATERSHED: Inarajan	RIVER-S3	3.15	0.00	0.00	3
Unnamed Tributary 4	GUG-57B	WATERSHED: Talofofo	RIVER-S3	0.82	0.00	0.00	3
Tolaeyuus River	GUG-60	WATERSHED: Talofofo	RIVER-S1	0.39	0.00	0.00	3
Talisay River	GUG-61	WATERSHED: Talofofo	RIVER-S1	3.72	0.00	0.00	3
Unnamed Tributary 5	GUG-62	WATERSHED: Talofofo	RIVER-S1	0.28	0.00	0.00	3
Unnamed Tributary 6	GUG-63	WATERSHED: Talofofo	RIVER-S1	0.22	0.00	0.00	3
Maemong River	GUG-64	WATERSHED: Talofofo	RIVER-S1	2.71	0.00	0.00	3
Unnamed Tributary 7	GUG-65	WATERSHED: Talofofo	RIVER-S1	0.57	0.00	0.00	3

2022-2024 GUAM ASSESSMENT DATA: RIVERS-STREAMS

Waterbody Name	Assessment Unit ID	Guam Location	Water Type & Classification	Channel length in Miles	Assessable Mles	ASSESSED MILES	Reporting Category
Unnamed Tributary 8	GUG-66	WATERSHED: Talofofo	RIVER-S1	0.66	0.00	0.00	3
Intermittent Tributary 5	PGRL-1	WATERSHED: Pago	RIVER-S3	3.07	3.07	0.00	3
Tinago River	GU6TINAGO	WATERSHED: Dandan	RIVER-S3	2.93	2.93	2.93	5
Unamed Tributary 12	GUINRAP-46D	WATERSHED: Dandan	RIVER-S3	0.85	0.85	0.00	3
Unamed Tributary 13	GUINRAP-46E	WATERSHED: Dandan	RIVER-S3	0.55	0.55	0	3
West Surface Drainage	GUSURW	WATERSHED: Dandan	RIVER-S1	0.36	0.36	0.36	5

2022 2024 GUAM ASSESSMENT DATA: WETLANDS

Waterbody Name	Assessment Unit ID	WATERSHED Location	Water *Type & Classification*	Water *Size (Acres)*	Acres Assessed	Water Status	Reporting Category
Agana Swamp	GUG-1B	HAGATNA	Wetlands - S2	175.44	6.40	IMPAIRED	5
Barrigada Ponding Basin	GUW-001	NORTHERN	Wetlands - S2	0.74	0.00	Not Assessed	3
Masso Reservoir	GUW-002	PITI/ASAN	Wetlands - S3	4.94	0.00	Not Assessed	3
Sasa Bay Wetlands	GUW-003	APRA	Wetlands - S3	252.05	0.00	Not Assessed	3
Atantano Wetlands	GUW-004	APRA	Wetlands - S3	321.24	0.00	Not Assessed	3
Shell Oil Wetlands	GUW-005	APRA	Wetlands - S3	5.68	0.00	Not Assessed	3
Naval Station Marsh	GUW-006	APRA	Wetlands - S3	98.84	0.00	Not Assessed	3
San Luis Ponds	GUW-007	APRA	Wetlands - S3	18.53	0.00	Not Assessed	3
Namo River Marsh	GUW-008	AGAT	Wetlands - S3	81.54	0.00	Not Assessed	3
Pulantat Marshes	GUW-009	YLIG	Wetlands - S3	4.94	0.00	Not Assessed	3
Naval Magazine Pond	GUW-010	YLIG	Wetlands - S3	1.24	0.00	Not Assessed	3
Fena Valley Reservoir	GUW-011	TALOFOFO	Wetlands - S1	200.16	0.00	Not Assessed	3
Naval Magazine Marshes	GUW-012	TALOFOFO	Wetlands -S1	5.93	0.00	Not Assessed	3
Talofofo River Valley	GUW-013	TALOFOFO	Wetlands - S1	689.42	0.00	Not Assessed	3
Sarasa Marsh	GUW-014	TALOFOFO	Wetlands - S1	6.18	0.00	Not Assessed	3
Assupian Marsh	GUW-015	INARAJAN	Wetlands - S3	1.24	0.00	Not Assessed	3
Yabai Wetland	GUW-016	INARAJAN	Wetlands - S3	2.47	0.00	Not Assessed	3
Agfayan River Valley	GUW-017	INARAJAN	Wetlands - S3	69.19	0.00	Not Assessed	3
Achang Bay Mangroves	GUW-018	GEUS	Wetlands - M1	24.71	0.00	Not Assessed	3