



Republic of the Philippines
Department of Environment and Natural Resources
PROVINCIAL ENVIRONMENT AND NATURAL RESOURCES OFFICE
MIMAROPA Region

AUG 12 2022



MEMORANDUM

FOR : The Regional Executive Director
DENR MIMAROPA Region
1515 L&S Bldg. Roxas Blvd. Ermita, Manila

THRU : The ARD for Technical Services

FROM : The OIC, PENR Officer

SUBJECT : SUBMISSION OF THE WATER QUALITY MONITORING
PRELIMINARY REPORT OF APO REEF NATURAL
PARK FOR THE FIRST SEMESTER OF CY 2022

Respectfully forwarded is memorandum dated August 8, 2022 of CENRO Sablayan regarding Submission of the Water Quality Monitoring Preliminary Report of Apo Reef Natural Park for the 1st Semester of CY 2022. The Water Quality Monitoring Preliminary Report of Apo Reef Natural Park-Protected Area Management Office (ARNP-PAMO) includes the results of the laboratory analyses of samples collected and transported to the EMB Calapan Satellite Laboratory on May 23, 2022. The Class SA standard for most of the parameters measured were met except for oil and grease and fecal coliform count. Particularly, three of the seven stations failed the Class SA standard for fecal coliform count and all stations failed the set standard for oil and grease.

Attached herewith is the narrative report with corresponding appendices.

For information and record.


ERNESTO E. TAÑADA

TSD-CDS8/11/2022

Copy furnished:

1. Planning Section
2. File

So. Pag-asa, Brgy. Payompon, Mamburao, Occidental Mindoro
Email: penroccemin@denr.gov.ph



Republic of the Philippines
Department of Environment and Natural Resources
MIMAROPA Region
COMMUNITY ENVIRONMENT AND NATURAL RESOURCES OFFICE
National Road, Brgy. Sto. Niño, Sablayan, Occidental Mindoro
E-mail: cenrosablayan@denr.gov.ph

August 8, 2022

MEMORANDUM

FOR : The Regional Executive Director
DENR MIMAROPA Region
Ermita, Manila

THRU : The PENR Officer
Mamburao, Occidental Mindoro

FROM : The CENR Officer

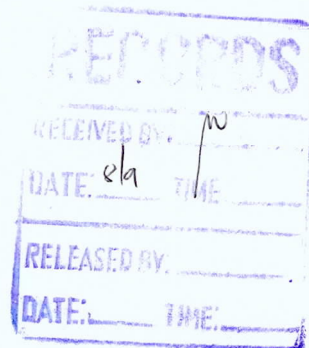
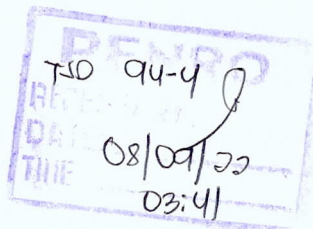
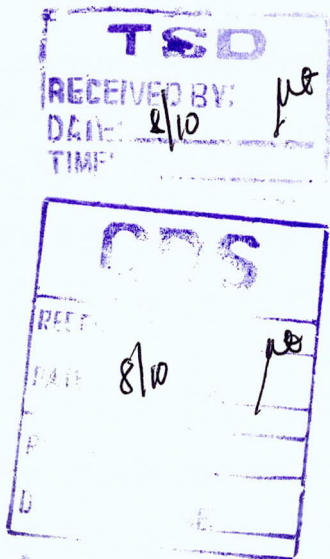
SUBJECT : **SUBMISSION OF THE WATER QUALITY MONITORING
PRELIMINARY REPORT OF APO REEF NATURAL PARK
FOR THE FIRST SEMESTER OF CY 2022**

Respectfully forwarded is the Water Quality Monitoring Preliminary Report of Apo Reef Natural Park – Protected Area Management Office (ARNP-PAMO) for the 1st Semester of CY 2022. The report includes the results of the laboratory analyses of samples collected and transported to the EMB Calapan Satellite Laboratory on May 23, 2022. The Class SA standard for most of the parameters measured were met except for oil and grease and fecal coliform count. Particularly, three of the seven stations failed the Class SA standard for fecal coliform count and all stations failed the set standard for oil and grease

Attached herewith is the narrative report with corresponding appendices.

For information and record.


FOR. ANASTACIO A. SANTOS, MPA





Department of Environment and Natural Resources
MIMAROPA Region
APO REEF NATURAL PARK
Protected Area Management Office



August 8, 2022

MEMORANDUM

FOR : The Regional Executive Director
DENR-Region 4B – MIMAROPA
1515 L&S Bldg., Roxas Blvd., Ermita, Manila

THRU : The OIC, PENR Officer
Mamburao, Occidental Mindoro

The CENR Officer

FROM : The Protected Area Superintendent

SUBJECT : **SUBMISSION OF THE WATER QUALITY MONITORING REPORT OF APO REEF NATURAL PARK FOR THE FIRST SEMESTER OF CY 2022**

Respectfully submitted is the Water Quality Monitoring Report of Apo Reef Natural Park for the 1st Semester of CY 2022. The results of the laboratory analyses performed by EMB Calapan Satellite Laboratory on the water samples collected on May 23, 2022 are presented in the table below. We would like to note that ARNP-PAMO has already submitted a separate Milestone Accomplishment Report for this activity last June.

Parameters	Measurements						
	Lighthouse	Rangers' Kiosk	Picnic Grounds	Ego Wall	San Antonio 1	San Antonio 2	Groundwater Well
Color	5	5	5	5	5	5	5
DO	10.2	9.5	9.7	8.5	9.5	7.7	9
FCC	2	4	<1.8	>1600	240	540	<1.8
Phosphate	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
pH (Range)	7.78	7.9	7.91	8.06	8.05	8.04	7.46
Temperature	29	29	29	29	29	29	29
TSS	95	9	9	13	12	14	10
Oil and grease	13	7	11	14	4	7	7

Attached herewith are the narrative report and its corresponding appendices.

For your information and record.


KRYSTAL DAYNE T. VILLANADA

National Highway, Brgy. Sto. Niño, Sablayan, Occidental Mindoro
E-mail: aporeefnaturalpark@gmail.com



Water Quality Monitoring Report

1st Semester of 2022

I. INTRODUCTION

Water quality is an important factor in coastal and marine ecosystems. It impacts the species richness or the number of species present in a community within an ecosystem (Johnston & Roberts, 2009). However, human activities have continuously caused a decrease in water quality, driving the degradation of coastal and marine ecosystems worldwide. For instance, harmful algal blooms (HABs), likely caused by anthropogenic nutrient enrichment, has led to large fish kills in Asia (Furuya et al., 2018). Outbreaks of Crown-of-Thorns Starfish (CoTS), which has resulted to large-scale coral declines, are also widely hypothesized to be linked to anthropogenic nutrient enrichment (Wooldridge & Brodie, 2015; Brodie et al., 2017). This is why the monitoring and improvement of water quality is critical to the management of coastal and marine resources.

Water quality monitoring is vital in developing policies and management decisions for water bodies, especially those that are delegated as Protected Areas (PAs) like Apo Reef Natural Park (ARNP). In the Philippines, the implementation of the Coastal and Marine Ecosystems Management Program (CMEMP) under the supervision of the DENR Biodiversity Management Bureau, includes Water Quality Monitoring within legislated NIPAS PAs as a subcomponent. This aims to quantify the pollution load and other water parameters that indicate pollution in PAs. Water quality monitoring in government-managed PAs has only commenced last 2020, but ARNP was only included last year. Thus, this is the second year of implementation of this subcomponent of CMEMP in ARNP.

The water quality in Apo Reef Natural Park will be monitored twice this year. The following are the specific objectives of the WQM in ARNP:

1. To establish two additional permanent monitoring stations within the Protected Area;
2. To collect data on water quality parameters in the seven monitoring stations; and,
3. To implement necessary management actions.

II. METHODOLOGY

Monitoring stations

A total of seven monitoring stations were sampled this year. Five of which were established last year as per PAMB Resolution No. 2021-01. All stations were within the Multiple-Use Zone (MUZ) of Apo Reef Natural Park. This year, two additional stations were established by virtue of PAMB Resolution No. 2022-02. These two stations lie within the Strict Protection Zone (SPZ) of the PA, specifically at a stretch known as San Antonio. These were selected because they are a.) permanent coral reef monitoring stations, and b.) close to the navigational shipping route.

Six of the seven stations were sampled for surface water. Three of which were located along the bathing beach in Apo Island (Lighthouse, Picnic Ground, and Ranger's Kiosk). These stations were less than 1 m in depth and at least 300 meters away from each other (EMB, 2008). The depth in the remaining stations sampled for surface water were approximately 10 m (Ego Wall, San Antonio 1, and San Antonio 2). The three stations along the bathing beach and Ego Wall were selected because of high tourist traffic. Thus, the safety of these stations for human recreation may be assessed. The water quality in these stations may also be compared with San Antonio 1 and San Antonio 2, which are within the SPZ where no recreational activities are allowed, to evaluate the possible impacts of tourism on water quality.

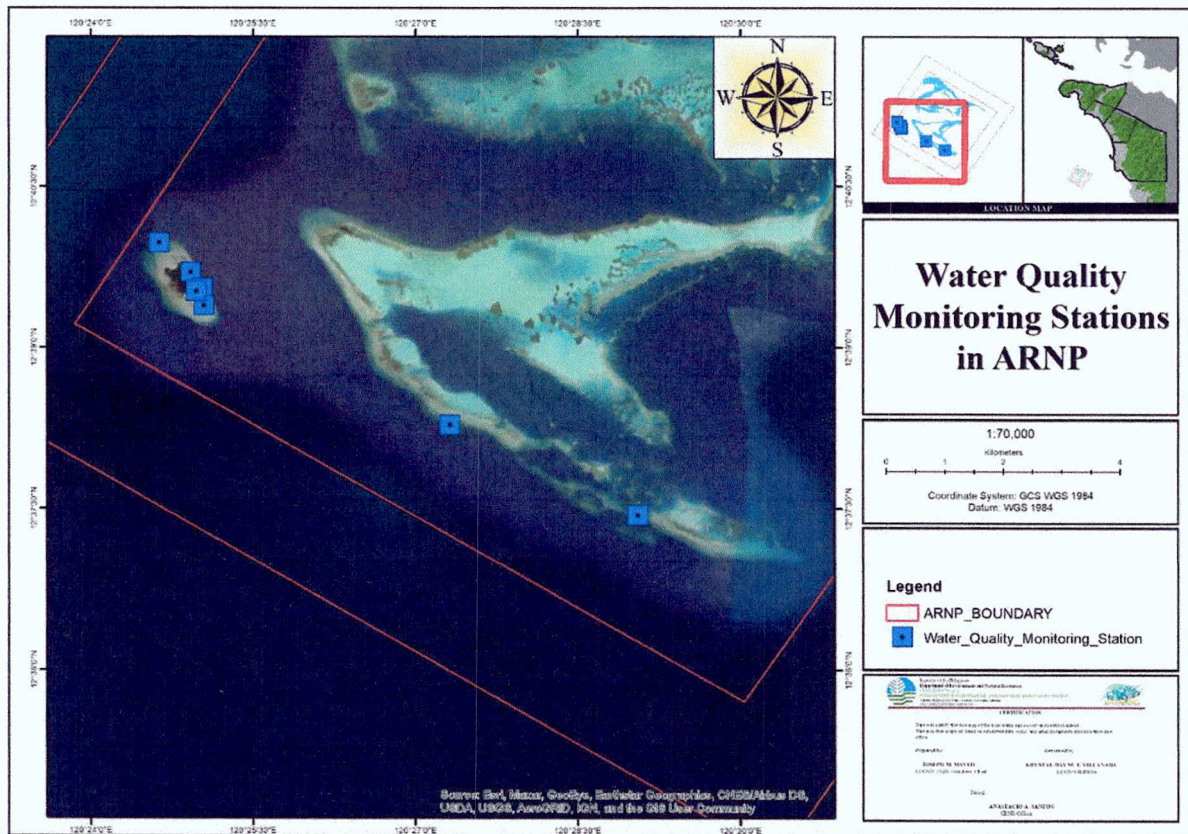


Figure 1. Map of the seven water quality monitoring stations sampled on 2022.

One station was sampled for groundwater: the groundwater well proximal to the Ranger's Station. Water from this groundwater well is accessed for domestic use using a galvanized iron hand pump and an electric water pump. This station was included in the assessment because it was adjacent to a septic tank system on the island which can impact groundwater quality.

Field Collection and Laboratory Analysis

The water samples were collected on May 23, 2022 by personnel from PEMU Occidental Mindoro, ARNP-PAMO, and MENRO Sablayan. The sampling time was within 5:27 AM to 6:41 AM. Prior to the collection of every sample, a field data sheet was accomplished and the sampling containers were washed once with the sample water. The sample containers used were namely, 1 L wide-mouthed jar, 270 mL sterile glass container, and 2 L polyethylene containers.

Discrete sampling was the method used in collecting water samples from the groundwater well and monitoring stations along the bathing beach. This was also used in collecting samples for oil and grease analysis in Ego Wall and the two stations in San Antonio. Depth-integrated sampling was the method used in collecting the other water samples in these deeper monitoring stations. For this sampling method, separate water samples were collected at the surface (0.10-0.50 m), middle layer (~5 m), and near-bottom depth (9.5-10 m) using an improvised PVC sampling device (Figure 2). The sampling device used was designed to work like a Van Dorn sampler. However, two divers manually close the stoppers unlike the Van Dorn which features a messenger. The water samples from the three different depths were then mixed before transferring to the sample containers.

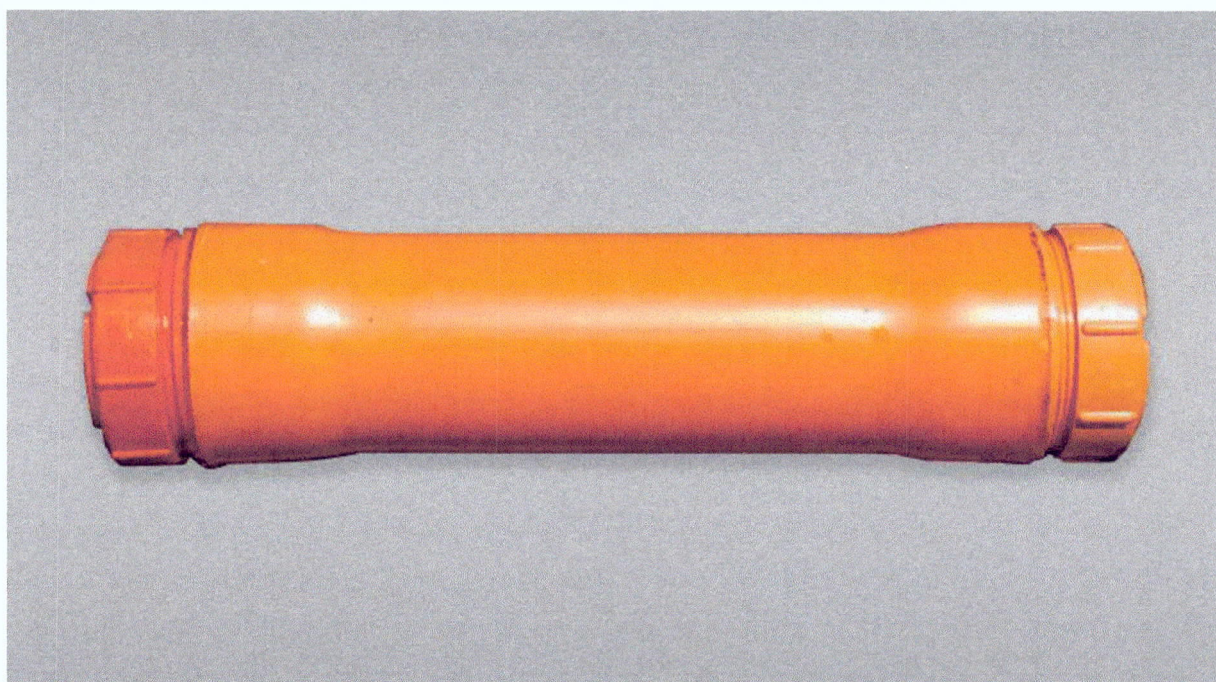


Figure 2. PVC sampling device used in collecting samples from different depths (surface, middle-layer, and near-bottom) at Ego Wall.

In sampling the groundwater well, at least 68 gallons of water were purged from the well before sampling. This was done to eliminate the stagnant water in the well and acquire a water sample that is representative of the characteristics of the groundwater. After purging, sample containers were filled with water from a PVC pipe connected to the electrical pump and nearest to the well.

All samples were immediately stored in two coolers double-lined with heavy-duty plastic bags and filled with ice to maintain the temperature at approximately 4 °C. The samples were then transported to the EMB Calapan Satellite Lab and received by Mary Ann B. Lontoc (Environmental Management Specialist II). It is important to note that several parameters measured last year were not included this year and the analytical method used for phosphate measurement was different from last year (Table 1).

Table 1. Laboratory methodologies conducted by Optimal Laboratories, Inc. and EMB Calapan Satellite Laboratory to measure the selected water quality parameters in 2021 and 2022, respectively.

Water Quality Parameters	Optimal Laboratories Inc.	EMB Calapan Satellite Laboratory
Color	Visual Comparison	Visual Comparison
pH	Electrometric	Electrometric
Total Suspended Solids	Gravimetric Dried at 103-105	Gravimetric Dried at 103-105
Dissolved Oxygen	Azide Modification	Azide Modification
Biochemical Oxygen Demand	5-day BOD Test	-
Fecal Coliform Count	Multiple Tube Fermentation	Multiple Tube Fermentation
Nitrate	Brucine Colorimetric	-
Phosphate	Stannous Chloride	Ascorbic Acid
Surfactants	Anionic Surfactants as MBAS	-

Water Quality Parameters	Optimal Laboratories Inc.	EMB Calapan Satellite Laboratory
Oil & Grease	LLP-Gravimetric (PET)	LLP-Gravimetric (PET)

Data Analysis

The results were then compared to standards based on intended beneficial use. To date, ARNP has not yet been classified based on the guidelines for classification of water bodies provided in the Water Quality Monitoring Manual published by DENR EMB. For this assessment, the results for the surface water were compared to the standards for Class SA (Protected Waters and Fishery Class I), which is the highest classification for marine waters. Meanwhile, the standards used for groundwater is for Class B (Bathing and Other Primary Contact Recreation) water bodies in accordance to the DENR Department Administrative Order (DAO) No. 2016-08 as amended by DAO No. 2021-19. The preliminary data were also compared to the results of the water quality monitoring last year.

III. RESULTS AND DISCUSSION

Almost all stations passed the water quality standards set by the DENR Environmental Management Bureau for the physical parameters measured (Color, Temperature, and Total Suspended Solids). The lone exception is Lighthouse (LH) which did not pass the Class SA standard for TSS. The TSS recorded in the area is 95 mg/L which is well above the set standard for protected waters and even recreational waters (Class SB). This may be due to coastal runoff from the heavy rainfall prior to sampling or recurrent sediment resuspension from strong waves (Otaño-Cruz et al., 2014). Despite which, it is important that TSS in stations directly situated in coral reef areas, Ego Wall (EW) and San Antonio 1 & 2 (SA1 & SA2), were low (12 mg/L to 14 mg/L) because high sediment loads may cause coral mortality or reduce settlement and growth rates of corals (Tuttle & Donahue, 2022).

Table 2. Color, temperature, and total suspended solids measurements in the seven water quality monitoring stations.

Parameters	Measurements						
	GW	LH	RK	PG	EW	SA1	SA2
Color (TCU)	5	5	5	5	5	5	5
Temperature (°C)	29	29	29	29	29	29	29
Total Suspended Solids (mg/L)	10	95	9	9	13	12	14

Values in red mark measurement that failed standards set by DENR-EMB.

All stations passed the set standards for the chemical parameters pH, phosphate, and dissolved oxygen (Table 3). The values for pH and dissolved oxygen ranged from 7.46 to 8.06 and 7.7 to 10.2 mg/L, respectively. Meanwhile, phosphate level in all stations were below the minimum detection limit which is 0.02 mg/L. These results indicate that eutrophication – the excessive growth plants and algae in a water body – and its effects are prevented or unlikely under the existing conditions. In the recent years, several publications have also linked Crown-of-Thorns Starfish (CoTS) outbreaks with nutrient enrichment (Wooldridge & Brodie, 2015; Brodie et al., 2017). Thus, it can be inferred that one of the triggers of CoTS outbreaks is being controlled.

Oil and grease is the only chemical parameter measured wherein all stations failed the Class SA and Class B standards, with measurements ranging from 4 to 14 mg/L. The amount

oil and grease increased in the five initial water quality monitoring stations (Figure 3). A possible cause for this increase may be the corresponding increase in tourism operations within the Protected Area. In Ego Wall, the increase may be artificial, although unlikely, due to the change in sampling method from depth-integrated sampling to discrete sampling. Petroleum hydrocarbons, for instance, are more likely to be transported horizontally from its source than vertically or deeper into the water column (National Research Council, 2003) therefore, higher concentrations will be available on top of the water column where the samples were taken.

Table 3. Dissolved oxygen, phosphate, pH, and oil and grease measurements in the seven water quality monitoring stations.

Parameters	Measurements						
	GW	LH	RK	PG	EW	SA1	SA2
Dissolved Oxygen (mg/L)	9	10.2	9.5	9.7	8.5	9.5	7.7
Phosphate (mg/L)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
pH (Range)	7.46	7.78	7.9	7.91	8.06	8.05	8.04
Oil and grease (mg/L)	7	13	7	11	14	4	7

Values in red mark measurement that failed standards set by DENR-EMB.

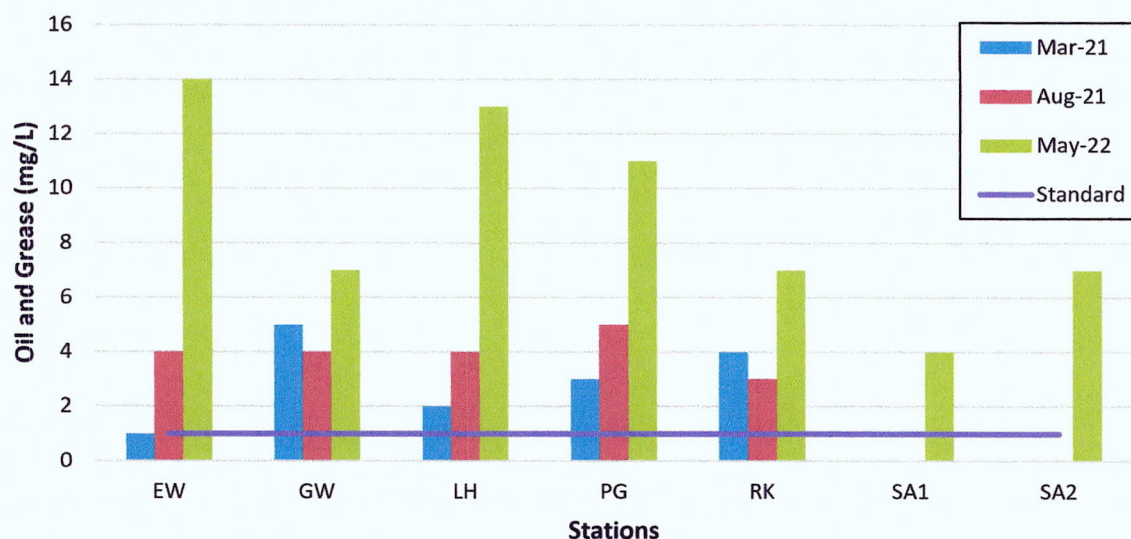


Figure 3. Oil and grease concentration across the monitoring stations from 2021 to 2022.

Marine transportation activities are suspected to be the main cause of the increased oil and grease in ARNP. This is because ARNP is proximal to domestic shipping routes, particularly long-distance primary routes which connect major ports in the country (MARINA, 2018). Ropax vessels (RoRo passenger-cargo vessels) and cargo vessels including container and tanker ships are serving mainly for these routes (JICA, 2005). These vessels are known to release oil, mainly petroleum oil, into the sea in their routine operations, and as a result of major accidents like collisions and groundings. Other vessels such as commercial and small-scale fishing boats and recreational boats may also be contributing to oil pollution in ARNP.

Apart from oil and grease, fecal coliform count is another parameter which showed notable results (Table 4). The groundwater well and bathing beach stations (LH, RK, and PG) all passed the Class SA and Class B standards for fecal coliform count. This is despite being closer to the potential point source which is the septic tank system at the Ranger's Station. Fecal coliform count in these stations also remained fairly the same from 2021 to 2022 (Figure

4). In contrary, all water quality monitoring stations with depths greater than 5 meters failed the standards for Class SA water bodies. There was a significant increase in fecal contamination in Ego Wall from 2021 (1.8 and 4.5 MPN/100 mL) to 2022 (>1600 MPN/100 mL). Sewage from Apo Island is unlikely to be the source of this fecal contamination given the results in nearby monitoring stations. Other possible sources will be sewage discharge from shipping, recreational, and fishing vessels and stormwater runoff from mainland Sablayan.

Table 4. Fecal coliform counts in the seven monitoring stations.

Parameters	Measurements						
	GW	LH	RK	PG	EW	SA1	SA2
Fecal Coliform Count (MPN/100mL)	1.8	2	4	1.8	1600	240	540

Values in red mark measurement that failed standards set by DENR-EMB.

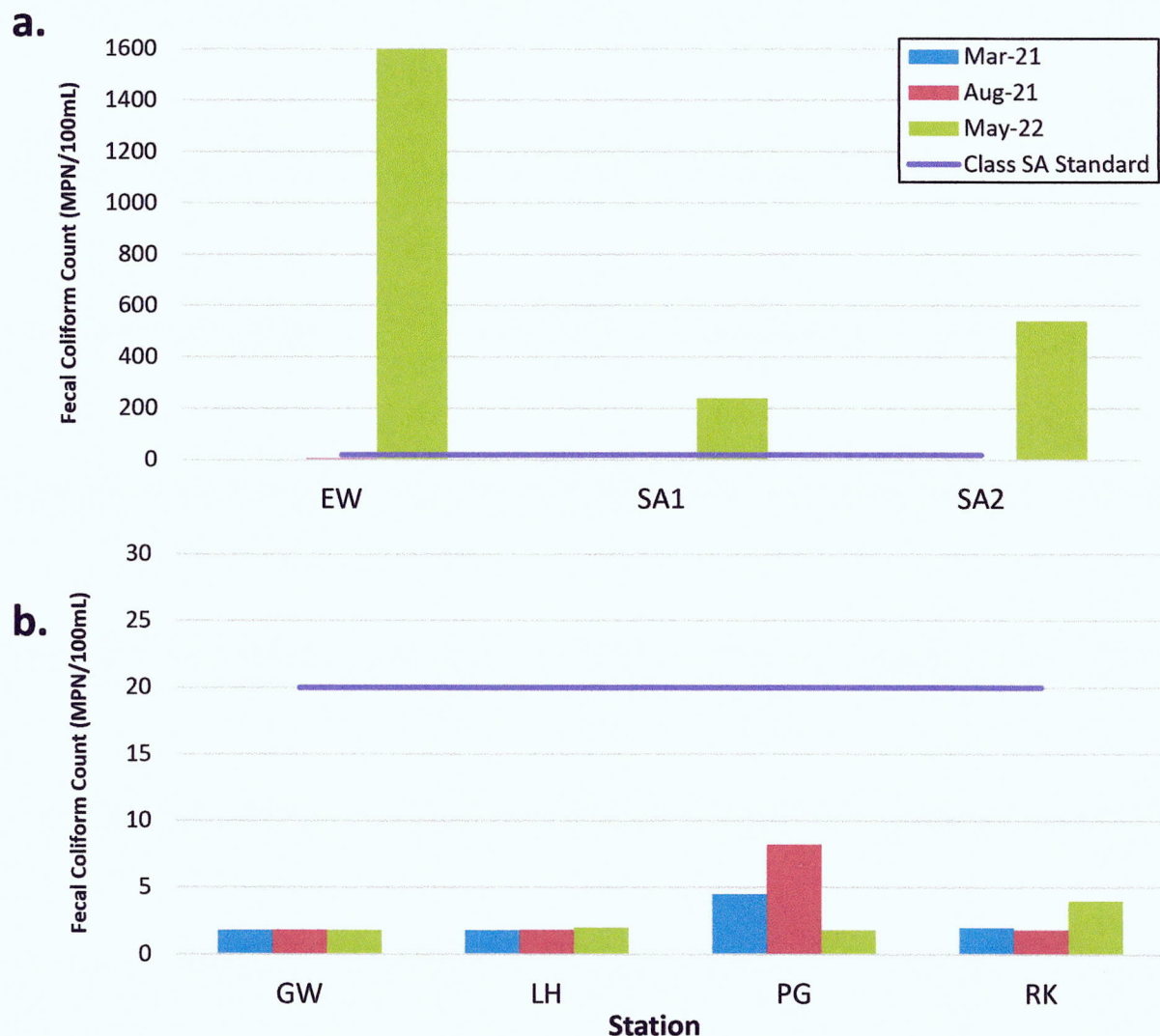


Figure 4. Fecal coliform count across the monitoring stations from 2021 to 2022. Monitoring stations with depth greater than 5 meters (a); monitoring stations proximal to the septic tank system (b).

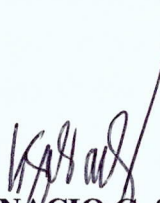
IV. CONCLUSIONS AND RECOMMENDATIONS

The monitoring stations sampled for surface water and groundwater passed the standard for Class SA and Class B water bodies for most of the physico-chemical parameters measured. It was found that low nutrient levels within the MPA are maintained and the effects of eutrophication such as HABs and depleted oxygen levels are prevented. Meanwhile, oil and grease levels remain to fail the standard set by DENR-EMB (1 mg/L). The values acquired for this parameter ranged from 4-13mg/L. Marine transport activities are the most likely sources of the oil and grease recorded in the Protected Area. Being proximal to navigational shipping lanes, the Protected Area is exposed to oil discharge from Ropax and cargo vessels. Additionally, commercial and small-scale fishing boats and recreational boats operating inside or outside the Protected Area may also contribute to oil pollution in the area to a lesser extent.

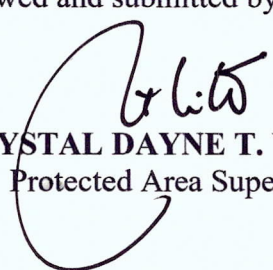
For fecal coliform count, the sole bacteriological parameter measured, four of the seven monitoring stations passed the standard for Class SA and Class B water bodies. These include the groundwater well and the monitoring stations along the bathing beach indicating that the water from these areas is safe for human contact, particularly for bathing, and other domestic uses. On the other hand, measurements acquired in Ego Wall and San Antonio were high and well above the accepted levels. This is especially alarming for Ego Wall which is a popular dive site for tourists. A possible cause for the sudden increase of fecal contamination in this site is sewage discharge from vessels including recreational boats which increased their operation within the Protected Area this year. The fecal coliform count in this area should be closely monitored in the next sampling period and the necessary management actions shall be taken if it sustains high levels of fecal contamination.

Generally, it is recommended that sampling stations within the Protected Area be increased to improve the generality of the findings. Should this pose challenges in complying with the advised holding time for the samples, replicate samples for each monitoring station may be collected instead as an initial effort to improve the reliability of inferences drawn from the data. Aside from these, the Maritime Industry Authority (MARINA) should be consulted for feasible actions addressing the increased oil and grease levels within the MPA, and response plans for major accidents which may lead to oil spills should be developed.

Prepared by:


HUGO IGNACIO G. SALVADOR
CMEMP Extension Officer

Reviewed and submitted by:


KRYSTAL DAYNE T. VILLANADA
Protected Area Superintendent

V. REFERENCES

- Brodie, J., Devlin, M. & Lewis, S. (2017). Potential enhanced survivorship of Crown of Thorns Starfish larvae due to near-annual nutrient enrichment during secondary outbreaks on the central mid-shelf of the Great Barrier Reef, Australia. *Diversity*, 9(1): 1-14. <https://doi.org/10.3390/d9010017>
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VI. APPENDICES

Appendix A. Participants of the water sampling in Apo Reef Natural Park on May 23, 2022.

Name	Position	Office
Josephine Lovella M. Cruz	Environment Management Specialist II	PEMU Occidental Mindoro
Fenly M. Galindez	Environmental Monitoring Officer	PEMU Occidental Mindoro
Hugo Ignacio G. Salvador	CMEMP Extension Officer	ARNP-PAMO
Anna Ritchelle D. Nicanor	Administrative Aide IV	ARNP-PAMO
Roberto P. Beringuela	Park Maintenance Foreman	ARNP-PAMO
Efraim Z. Pagador	Forest Ranger	ARNP-PAMO
Romel M. Pacaul	Boat Captain	ARNP-PAMO
Mark Dennis M. Barretto	Boat Captain	ARNP-PAMO
Salvador M. Ciasico	Support Staff	ARNP-PAMO
Temart E. Rebito	Park Ranger	ARNP-PAMO
Kelvin U. Zubiri	Park Ranger	ARNP-PAMO
Federico A. de Jesus	Park Ranger	ARNP-PAMO
Melvin Cariño	Park Ranger	MENRO Sablayan
Joel A. Pagador, Jr.	Park Ranger	MENRO Sablayan

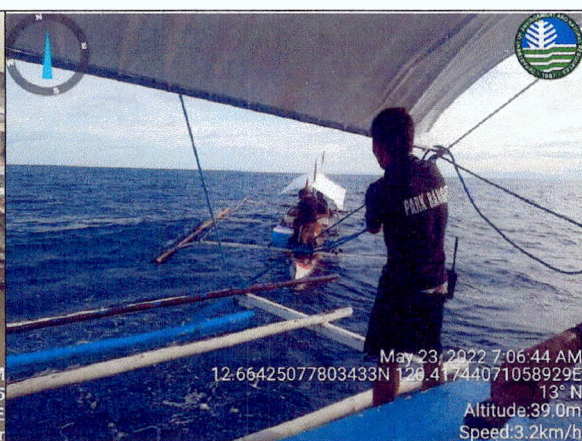
Appendix B. Photodocumentation of the water sampling in the seven monitoring stations in Apo Reef Natural Park on May 23, 2022.

	
<p>EMS II Josephine Lovella M. Cruz collecting water samples in front of Picnic Ground.</p>	<p>Forest Ranger Efraim Z. Pagador closing the sampling equipment in San Antonio at 5-meter mark.</p>
	
<p>Environment Monitoring Officer Fenly M. Galindez collecting water sample for oil and grease using a 1L wide mouth bottle.</p>	<p>CMEMP Extension Officer and Support Staff Salvador M. Ciasico transferring water from the sampling equipment.</p>
	
<p>Josephine Lovella M. Cruz collecting water samples in front of the Rangers' Kiosk.</p>	<p>Park Rangers Kelvin U. Zubiri and Joel A. Pagador, Jr. sealing the water samples collected in front of the lighthouse.</p>

Appendix B. (Continuation)



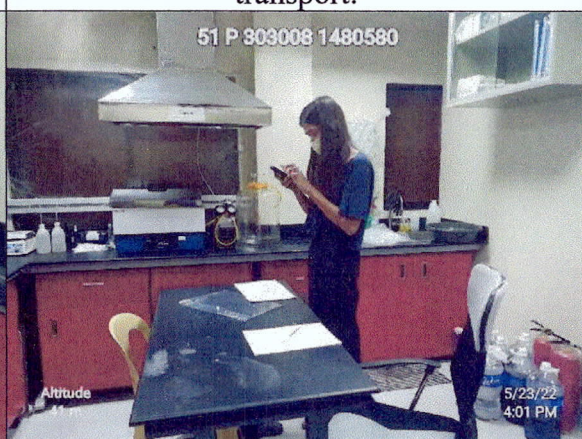
Collection of water samples from the groundwater well beside the Rangers' Station.



Park Rangers transferring samples collected from Apo Island to MBca Jerlyn for transport.


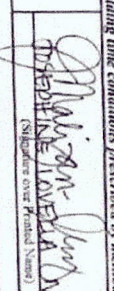



SCDO Anna Ritchelle D. Nicanor ensuring the correctness of the chain-of-custody forms submitted.



CMEMP Extension Officer Hugo Salvador taking photographs of the forms duly signed by laboratory staff.



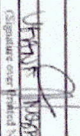
Appendix C. Analysis Request/Sample Submittal Form.

 Department of Environment and Natural Resources ENVIRONMENTAL MANAGEMENT BUREAU Regional Office No. IV - B MIMAROPA Environmental Monitoring and Enforcement Division - Laboratory 6th Floor, Bay Bldg., 1515 Keesee Blvd., Ermita, Manila Tel. and Fax No. 02-421-8804									
ANALYSIS REQUEST/SAMPLE SUBMITTAL FORM									
Client	NO REF. PROJECTED AREA		Contact Address	Subic Bay, Occ. Ndo.					
Contact	9506791176		Program						
Sampling Source	H2O KEEP		Submission Date	5-28-22		Submission Time	AM		
<input type="checkbox"/> Some analysis may not satisfy holding time conditions prescribed by method. <input type="checkbox"/> Do NOT test if holding time conditions prescribed by method is NOT satisfied.									
Submitted By	 JOSEPHINE NOVELLA M. CRUZ (Signature over Printed Name)		Submission Date	5-28-22		Submission Time	PM		
No. of Sample(s)	Sample Identification	Lab. Sample	Sample Type	Container Type	Sampling Date/Time	Analysis Requested*			
1.)	PICNIC Ground	SW	SW	plastic bottle	5-28-22 5:27AM	<input checked="" type="checkbox"/> pH by Electronic Method <input checked="" type="checkbox"/> DO by Electronic Method <input type="checkbox"/> Temperature by <input type="checkbox"/> BOD-5 Day Aqueous Modified Method <input type="checkbox"/> TSS by Gravimetric Method <input type="checkbox"/> Oil and Grease by Gravimetric Method <input type="checkbox"/> Chloride by Argentometric Method <input type="checkbox"/> Ammonia by ISE Method <input type="checkbox"/> Nitrate by ISE Method <input type="checkbox"/> Phosphate by Colorimetric Method <input type="checkbox"/> Fecal Coliform by MTT Method <input type="checkbox"/> Fecal Coliform by Eosine Methylene Blue <input type="checkbox"/> Total Coliform by MTT Method <input type="checkbox"/> Particulate Matter <input checked="" type="checkbox"/> Bacteriological			
2	Kanigay's Kiosk	SW	SW	plastic bottle	5-28-22 5:41AM	<input checked="" type="checkbox"/> pH by Electronic Method <input checked="" type="checkbox"/> DO by Electronic Method <input type="checkbox"/> Temperature by <input type="checkbox"/> BOD-5 Day Aqueous Modified Method <input type="checkbox"/> TSS by Gravimetric Method <input type="checkbox"/> Oil and Grease by Gravimetric Method <input type="checkbox"/> Chloride by Argentometric Method <input type="checkbox"/> Ammonia by ISE Method <input type="checkbox"/> Nitrate by ISE Method <input type="checkbox"/> Phosphate by Colorimetric Method <input type="checkbox"/> Fecal Coliform by MTT Method <input type="checkbox"/> Fecal Coliform by Eosine Methylene Blue <input type="checkbox"/> Total Coliform by MTT Method <input type="checkbox"/> Particulate Matter <input checked="" type="checkbox"/> Bacteriological			
3	Light House	SW	SW	plastic bottle	5-28-22 5:50AM	<input checked="" type="checkbox"/> pH by Electronic Method <input checked="" type="checkbox"/> DO by Electronic Method <input type="checkbox"/> Temperature by <input type="checkbox"/> BOD-5 Day Aqueous Modified Method <input type="checkbox"/> TSS by Gravimetric Method <input type="checkbox"/> Oil and Grease by Gravimetric Method <input type="checkbox"/> Chloride by Argentometric Method <input type="checkbox"/> Ammonia by ISE Method <input type="checkbox"/> Nitrate by ISE Method <input type="checkbox"/> Phosphate by Colorimetric Method <input type="checkbox"/> Fecal Coliform by MTT Method <input type="checkbox"/> Fecal Coliform by Eosine Methylene Blue <input type="checkbox"/> Total Coliform by MTT Method <input type="checkbox"/> Particulate Matter <input checked="" type="checkbox"/> Bacteriological			
4	Groundwater	SW	SW	plastic bottle	5-28-22 6:24AM	<input checked="" type="checkbox"/> pH by Electronic Method <input checked="" type="checkbox"/> DO by Electronic Method <input type="checkbox"/> Temperature by <input type="checkbox"/> BOD-5 Day Aqueous Modified Method <input type="checkbox"/> TSS by Gravimetric Method <input type="checkbox"/> Oil and Grease by Gravimetric Method <input type="checkbox"/> Chloride by Argentometric Method <input type="checkbox"/> Ammonia by ISE Method <input type="checkbox"/> Nitrate by ISE Method <input type="checkbox"/> Phosphate by Colorimetric Method <input type="checkbox"/> Fecal Coliform by MTT Method <input type="checkbox"/> Fecal Coliform by Eosine Methylene Blue <input type="checkbox"/> Total Coliform by MTT Method <input type="checkbox"/> Particulate Matter <input checked="" type="checkbox"/> Bacteriological			
Received by	 JOSEPHINE NOVELLA M. CRUZ (Signature over Printed Name)		Date	5-28-22		Time	PM		

*Sample submission to EMB-MANMORPA Regional Environmental Laboratory requires approval from the client that results generated from the analysis of such samples for use by the EMB-MANMORPA Laboratory.

*Results relate only to the sample as received and analyzed by this laboratory.

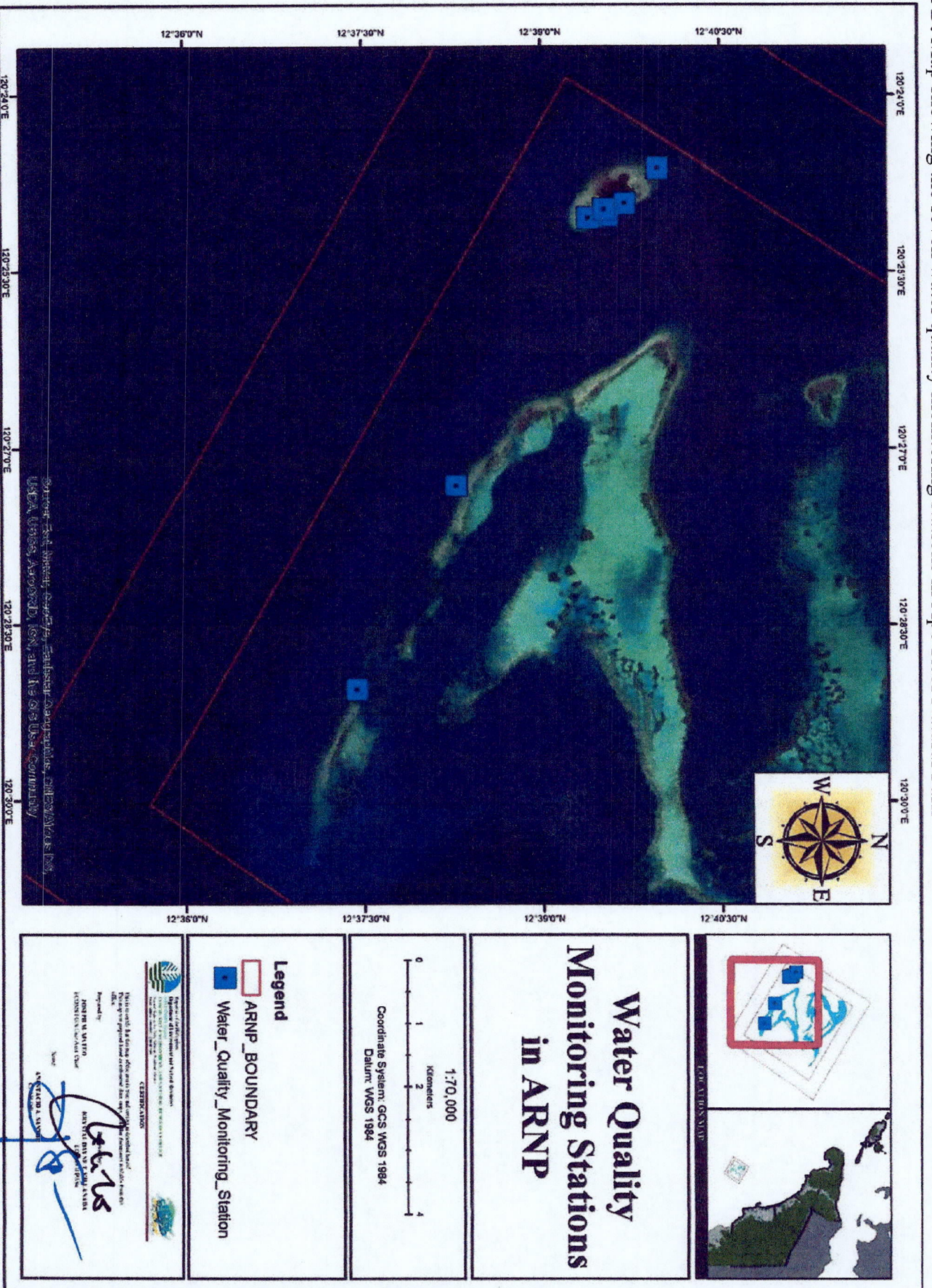
Appendix C. (Continuation)

 Department of Environment and Natural Resources ENVIRONMENTAL MANAGEMENT BUREAU Regional Office No. IV - BANGALUPA Environmental Monitoring and Enforcement Division - Laboratory 400 EDSA by the Bay Bridge, 1115 Roman Road, Ermita, Manila 1201 Tel. and Fax No. (2) 221-8904 AR 5557 No. _____									
ANALYSIS REQUEST/SAMPLE SUBMITTAL FORM									
Client		AFO KEEF		Contact Address		Sabayan, Occ. Mdo.			
Contract		9906791176		Program					
<input checked="" type="checkbox"/> Some analysis may not satisfy holding time conditions prescribed by method. <input checked="" type="checkbox"/> Do NOT test if holding time conditions prescribed by method is NOT satisfied.									
Submitted By		 J. M. Crave <small>(Signature over Printed Name)</small>		Submission Date		5-23-22		Submission Time	
								AM	
								PM	
No. of Sample(s)	Sample Identification	Laboratory Sample	Sample Type	Container Type	Sampling	Analysis Requested*			
5	ECO Wk11	501	plastic bottle	5-23-22	211h1	<input checked="" type="checkbox"/> DO by Electrode Method <input checked="" type="checkbox"/> DO by Winkler Method <input checked="" type="checkbox"/> Temperature by <input checked="" type="checkbox"/> BOD by BOD-5 Day, Acid Modified Method <input checked="" type="checkbox"/> TSS by Gravimetric Method <input checked="" type="checkbox"/> Oil and Grease by Gravimetric Method <input checked="" type="checkbox"/> Chloride by Argentometric Method <input checked="" type="checkbox"/> Ammonia by ISE Method <input checked="" type="checkbox"/> Nitrate by ISE Method <input checked="" type="checkbox"/> Phosphate by Colorimetric Method <input checked="" type="checkbox"/> Fecal Coliform by MTT Method <input checked="" type="checkbox"/> Total Coliform by Euxens Substrate Method <input checked="" type="checkbox"/> Penicillin Matter <input checked="" type="checkbox"/> 7-17-20-25			
6	San. hazard 3	501	plastic bottle	5-23-22	211h1	<input checked="" type="checkbox"/> DO by Electrode Method <input checked="" type="checkbox"/> DO by Winkler Method <input checked="" type="checkbox"/> Temperature by <input checked="" type="checkbox"/> BOD by BOD-5 Day, Acid Modified Method <input checked="" type="checkbox"/> TSS by Gravimetric Method <input checked="" type="checkbox"/> Oil and Grease by Gravimetric Method <input checked="" type="checkbox"/> Chloride by Argentometric Method <input checked="" type="checkbox"/> Ammonia by ISE Method <input checked="" type="checkbox"/> Nitrate by ISE Method <input checked="" type="checkbox"/> Phosphate by Colorimetric Method <input checked="" type="checkbox"/> Fecal Coliform by MTT Method <input checked="" type="checkbox"/> Total Coliform by Euxens Substrate Method <input checked="" type="checkbox"/> Penicillin Matter <input checked="" type="checkbox"/> 7-17-20-25			
7	San. hazard 11	501	plastic bottle	5-23-22	211h1	<input checked="" type="checkbox"/> DO by Electrode Method <input checked="" type="checkbox"/> DO by Winkler Method <input checked="" type="checkbox"/> Temperature by <input checked="" type="checkbox"/> BOD by BOD-5 Day, Acid Modified Method <input checked="" type="checkbox"/> TSS by Gravimetric Method <input checked="" type="checkbox"/> Oil and Grease by Gravimetric Method <input checked="" type="checkbox"/> Chloride by Argentometric Method <input checked="" type="checkbox"/> Ammonia by ISE Method <input checked="" type="checkbox"/> Nitrate by ISE Method <input checked="" type="checkbox"/> Phosphate by Colorimetric Method <input checked="" type="checkbox"/> Fecal Coliform by MTT Method <input checked="" type="checkbox"/> Total Coliform by Euxens Substrate Method <input checked="" type="checkbox"/> Penicillin Matter <input checked="" type="checkbox"/> 7-17-20-25			
Received by:		 J. M. Crave <small>(Signature over Printed Name)</small>		Date		5-23-22		Time	
								AM	
								PM	

*Sample submission to MTR-MITM-ENR Regional Environmental Laboratory requires agreement from the client that results generated from the analysis of same samples be used by the MTR-MITM-ENR Laboratory.

*Results relate only to the sample as received and analyzed by this Laboratory.

Appendix D. Map showing the seven water quality monitoring stations in Apo Reef Natural Park



Appendix E. Results of the laboratory analyses of samples collected on May 23, 2022.



Department of Environment and Natural Resources
Environmental Management Bureau
MIMAROPA Region

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RESULTS OF ANALYSIS

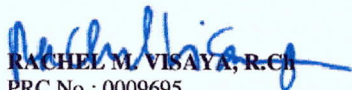
SOURCE : **APO REEF NATURAL PARK**
ADDRESS : Sablayan, Occidental Mindoro
SAMPLED BY : **JMCruz and FMGalindez (PEMU Occi)**
DATE SAMPLED : 23 May 2022 DATE REPORTED : 15 June 2022
DATE RECEIVED : 23 May 2022 ARF/SS CODE : CAL-22-149

Laboratory Sample Code	Station Number	Time of Collection	Station Identification
22-0360C	1	0527H	Picnic Ground
22-0361C	2	0544H	Ranger's Kiosk
22-0362C	3	0559H	Light House

CHARACTERISTIC	Method of Analysis	Environmental Condition	Date Analyzed	LABORATORY SAMPLE CODE		
				22-0360C	22-0361C	22-0362C
Color, TCU	Visual Comparison; SMEWW 2120 B	58-70 %RH, 23.4-24.5 °C	23 May 22	5	5	5
Dissolved Oxygen (DO), mg/L	Azide Modification Method; 4500-O C	54-78 %RH, 21.9-22.1 °C	23-24 May 22	9.70	9.50	10.20
Fecal Coliforms, MPN/100ml	Multiple Tube Fermentation Technique; SMEWW 9221 B-C	29.5-88.1 %RH, 20.5-34.6 °C	24 May 22	<1.8	4.0	2.0
Oil and Grease, mg/L	Liquid-Liquid, Partition-Gravimetric Method; SMEWW 5520-B	41 %RH, 23.8 °C	30 May 22	11	7	13
Phosphate (P-PO ₄), mg/L	Ascorbic Acid Method; SMEWW 4500 E	66-72 %RH, 20.5-22.9 °C	26 May 22	<0.02	0.02	<0.02
pH (Laboratory @ 25°C)	Electrometric Method; SMEWW 4500-H-B	58-70 %RH, 23.4-24.5 °C	23 May 22	7.91	7.90	7.78
Total Suspended Solids, mg/L	Gravimetric Method- Dried at 103-105°C; SMEWW 2540 B	40 %RH, 25.5 °C	01 June 22	9	17	95

NOTE: Measurement Uncertainty (MU) is available upon request.
This report shall not be reproduced in part but in whole.
Results refer only to samples as received.

CERTIFIED BY:


RACHEL M. VISAYA, R. Ch

PRC No.: 0009695

Head, Regional Environmental Laboratory MIMAROPA

Regional Environmental Laboratory – Calapan (043) 288-1681
PENRO Compound, Brgy. Suqui, Calapan City, Oriental Mindoro
Office of the Regional Director: (02) 8536 9786; Administrative and Finance Division: (02) 8536 9786
Environmental Management and Enforcement Division: (02) 8633 2587; Clearance and Permitting Division: (02) 8633 2587
Records Management Unit: (02) 8633 8900
Website: www.mimaropa.emb.gov.ph

Appendix E. (Continuation)



Department of Environment and Natural Resources
Environmental Management Bureau
MIMAROPA Region

Page 2 of 3

RESULTS OF ANALYSIS

SOURCE : APO REEF NATURAL PARK
ADDRESS : Sablayan, Occidental Mindoro
SAMPLED BY : JMCruz and FMGalindez (PEMU Occi)
DATE SAMPLED : 23 May 2022 DATE REPORTED : 15 June 2022
DATE RECEIVED : 23 May 2022 ARF/SS CODE : CAL-22-149

Laboratory Sample Code	Station Number	Time of Collection	Station Identification
22-0363C	4	0637H	Ground Water
22-0364C	5	0641H	Ego Wali

CHARACTERISTIC	Method of Analysis	Environmental Condition	Date Analyzed	LABORATORY SAMPLE CODE	
				22-0363C	22-0364C
Color, TCU	Visual Comparison; SMEWW 2120 B	58-70 %RH, 23.4-24.5 °C	23 May 22	5	5
Dissolved Oxygen (DO), mg/L	Azide Modification Method; 4500-O C	54-78 %RH, 21.9-22.1 °C	23-24 May 22	9.00	8.50
Fecal Coliforms, MPN/100ml	Multiple Tube Fermentation Technique; SMEWW 9221 B-C	29.5-88.1 %RH, 20.5-34.6 °C	24 May 22	<1.8	>1,600
Oil and Grease, mg/L	Liquid-Liquid, Partition-Gravimetric Method; SMEWW 5520-B	41 %RH, 23.8 °C	30 May 22	7	14
Phosphate (P-PO ₄), mg/L	Ascorbic Acid Method; SMEWW 4500 E	66-72 %RH, 20.5-22.9 °C	26 May 22	<0.02	<0.02
pH (Laboratory @ 25°C)	Electrometric Method; SMEWW 4500-H-B	58-70 %RH, 23.4-24.5 °C	23 May 22	7.46	8.06
Total Suspended Solids, mg/L	Gravimetric Method-Dried at 103-105°C; SMEWW 2540 B	40 %RH, 25.5 °C	01 June 22	10	13

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Appendix E. (Continuation)



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MIMAROPA Region

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RESULTS OF ANALYSIS

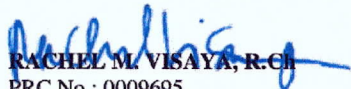
SOURCE : APO REEF NATURAL PARK
ADDRESS : Sablayan, Occidental Mindoro
SAMPLED BY : JMCruz and FMGalindez (PEMU Occi)
DATE SAMPLED : 23 May 2022 DATE REPORTED : 15 June 2022
DATE RECEIVED : 23 May 2022 ARF/SS CODE : CAL-22-149

Laboratory Sample Code	Station Number	Time of Collection	Station Identification
22-0363C	4	0637H	Ground Water
22-0364C	5	0641H	Ego Wali

CHARACTERISTIC	Method of Analysis	Environmental Condition	Date Analyzed	LABORATORY SAMPLE CODE	
				22-0363C	22-0364C
Color, TCU	Visual Comparison; SMEWW 2120 B	58-70 %RH, 23.4-24.5 °C	23 May 22	5	5
Dissolved Oxygen (DO), mg/L	Azide Modification Method; 4500-O C	54-78 %RH, 21.9-22.1 °C	23-24 May 22	9.00	8.50
Fecal Coliforms, MPN/100ml	Multiple Tube Fermentation Technique; SMEWW 9221 B-C	29.5-88.1 %RH, 20.5-34.6 °C	24 May 22	<1.8	>1,600
Oil and Grease, mg/L	Liquid-Liquid, Partition-Gravimetric Method; SMEWW 5520-B	41 %RH, 23.8 °C	30 May 22	7	14
Phosphate (P-PO ₄), mg/L	Ascorbic Acid Method; SMEWW 4500 E	66-72 %RH, 20.5-22.9 °C	26 May 22	<0.02	<0.02
pH (Laboratory @ 25°C)	Electrometric Method; SMEWW 4500-H-B	58-70 %RH, 23.4-24.5 °C	23 May 22	7.46	8.06
Total Suspended Solids, mg/L	Gravimetric Method-Dried at 103-105°C; SMEWW 2540 B	40 %RH, 25.5 °C	01 June 22	10	13

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Appendix E. (Continuation)



Department of Environment and Natural Resources
Environmental Management Bureau
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RESULTS OF ANALYSIS

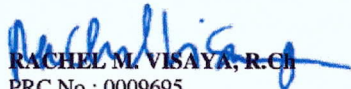
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ADDRESS : Sablayan, Occidental Mindoro
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DATE SAMPLED : 23 May 2022 DATE REPORTED : 15 June 2022
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Laboratory Sample Code	Station Number	Time of Collection	Station Identification
22-0363C	4	0637H	Ground Water
22-0364C	5	0641H	Ego Wali

CHARACTERISTIC	Method of Analysis	Environmental Condition	Date Analyzed	LABORATORY SAMPLE CODE	
				22-0363C	22-0364C
Color, TCU	Visual Comparison; SMEWW 2120 B	58-70 %RH, 23.4-24.5 °C	23 May 22	5	5
Dissolved Oxygen (DO), mg/L	Azide Modification Method; 4500-O C	54-78 %RH, 21.9-22.1 °C	23-24 May 22	9.00	8.50
Fecal Coliforms, MPN/100ml	Multiple Tube Fermentation Technique; SMEWW 9221 B-C	29.5-88.1 %RH, 20.5-34.6 °C	24 May 22	<1.8	>1,600
Oil and Grease, mg/L	Liquid-Liquid, Partition-Gravimetric Method; SMEWW 5520-B	41 %RH, 23.8 °C	30 May 22	7	14
Phosphate (P-PO ₄), mg/L	Ascorbic Acid Method; SMEWW 4500 E	66-72 %RH, 20.5-22.9 °C	26 May 22	<0.02	<0.02
pH (Laboratory @ 25°C)	Electrometric Method; SMEWW 4500-H-B	58-70 %RH, 23.4-24.5 °C	23 May 22	7.46	8.06
Total Suspended Solids, mg/L	Gravimetric Method-Dried at 103-105°C; SMEWW 2540 B	40 %RH, 25.5 °C	01 June 22	10	13

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Appendix F. Abridged water quality monitoring report based on the recommended format.

CMEMP Component 1: MPA/MPA Network Establishment and Strengthening

Performance Indicator: Number of WQM stations established and WQM stations monitored

WQM stations established:

The WQM stations established in Apo Reef Natural Park, Sablayan, Occidental Mindoro are shown in the table below. Five stations are within the Multiple-Use Zone, while two stations are within the Strict Protection Zone.

Site	Coordinates	
	Northing	Easting
Lighthouse	12.661739	120.415408
Rangers' Station	12.659286	120.417194
Picnic Grounds	12.656553	120.417456
Groundwater Well	12.658833	120.416239
Ego Wall	12.66633	120.410528
San Antonio 1	12.6381	120.4553
San Antonio 2	12.6239	120.4842

Summary:

The key observations and recommendations from the WQMA for the 1st Semester of CY 2021 are shown in the table below:

Monitoring Site	Class	Passed Parameters	Failed Parameters	Recommendations
Lighthouse	SA	Color, Phosphate, Dissolved Oxygen, Fecal Coliform Count, pH, Temperature,	Total Suspended Solids and Oil and Grease	<ul style="list-style-type: none"> • Increase number of sampling stations and or introduce replicates in each station • Regulation of discharge of oil and sewage from small motorized watercrafts (e.g. recreational boats) • Formulation of oil spill and ship grounding response protocols • Consultation with MARINA regarding shipping activities in Apo West and East Pass
Rangers' Kiosk	SA	Color, Phosphate, Dissolved Oxygen, Fecal Coliform Count, pH, Temperature, Total Suspended Solids	Oil and Grease	
Picnic Grounds	SA			
Ego Wall	SA			
San Antonio 1	SA	Color, Phosphate, Dissolved Oxygen, pH, Temperature, Total Suspended Solids	Fecal Coliform Count and Oil and Grease	
San Antonio 2	SA			
Groundwater Well	B	Color, Phosphate, Dissolved Oxygen, Fecal Coliform Count, pH, Temperature, Total Suspended Solids	Oil and Grease	

Appendix E. (Continuation)



Department of Environment and Natural Resources
Environmental Management Bureau
MIMAROPA Region

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RESULTS OF ANALYSIS

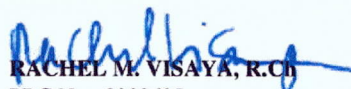
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ADDRESS : Sablayan, Occidental Mindoro
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DATE SAMPLED : 23 May 2022 DATE REPORTED : 15 June 2022
DATE RECEIVED : 23 May 2022 ARF/SS CODE : CAL-22-149

Laboratory Sample Code	Station Number	Time of Collection	Station Identification
22-0365C	6	0612H	San Antonio 1
22-0366C	7	0544H	San Antonio 2

CHARACTERISTIC	Method of Analysis	Environmental Condition	Date Analyzed	LABORATORY SAMPLE CODE	
				22-0365C	22-0366C
Color, TCU	Visual Comparison; SMEWW 2120 B	58-70 %RH, 23.4-24.5 °C	23 May 22	5	5
Dissolved Oxygen (DO), mg/L	Azide Modification Method; 4500-O C	54-78 %RH, 21.9-22.1 °C	23-24 May 22	9.50	7.70
Fecal Coliforms, MPN/100ml	Multiple Tube Fermentation Technique; SMEWW 9221 B-C	29.5-88.1 %RH, 20.5-34.6 °C	24 May 22	240	540
Oil and Grease, mg/L	Liquid-Liquid, Partition-Gravimetric Method; SMEWW 5520-B	41 %RH, 23.8 °C	30 May 22	4	7
Phosphate (P-PO ₄), mg/L	Ascorbic Acid Method; SMEWW 4500 E	66-72 %RH, 20.5-22.9 °C	26 May 22	<0.02	<0.02
pH (Laboratory @ 25°C)	Electrometric Method; SMEWW 4500-H-B	58-70 %RH, 23.4-24.5 °C	23 May 22	8.05	8.04
Total Suspended Solids, mg/L	Gravimetric Method-Dried at 103-105°C; SMEWW 2540 B	40 %RH, 25.5 °C	01 June 22	12	14

NOTE: Measurement Uncertainty (MU) is available upon request.
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PRC No.: 0009695

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R4B-2022-010728

Regional Environmental Laboratory – Calapan (043) 288-1681
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