

REPORT ON THE ASSESSMENT OF WATER QUALITY IN NORTHERN GUNUNG RARA (NGR) FOREST RESERVE 2019

by

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INTRODUCTION

An environmental baseline sampling was carried out by Hydrology Unit of Forest Research Centre to characterize the water quality of 4 rivers, which drained thru the Northern Gunung Rara (NGR) Sustainable Forest Management project area. These rivers are Sg.Lanap, Sg. Kasuyan, Sg. Kuamut and Sg. Imbok. This assessment is part of the study component required for the Forest Management Plan for NGR project area.

LOCATION OF STUDY AREA

A total of 4 sampling points represent the project watershed and its sub-catchment areas which predominantly drain through the project site (Figure 1). These sampling points are labelled W1 to W4 (Table 1). The chemical analyses and water quality classes for all parameters tested for the sampling points in the project area are listed in Table 2.

Table 1. The location of water quality sampling points in NGR FR (see Map, Figure 1).

Sampling Point	Location	GPS location		Date of Sampling	Surrounding Condition
		Latitude	Longitude		
W1	Sg. Lanap	04°59'28.7"	117°08'07.1"	December 2019	Secondary forest
W2	Sg. Kasuyan	04°55'19.3"	117°11'18.0"		Secondary forest
W3	Sg. Kuamut	04°53'45.8"	117°14'24.3"		Secondary forest
W4	Sg. Imbok	04°51'04.9"	117°22'18.7"		Secondary forest

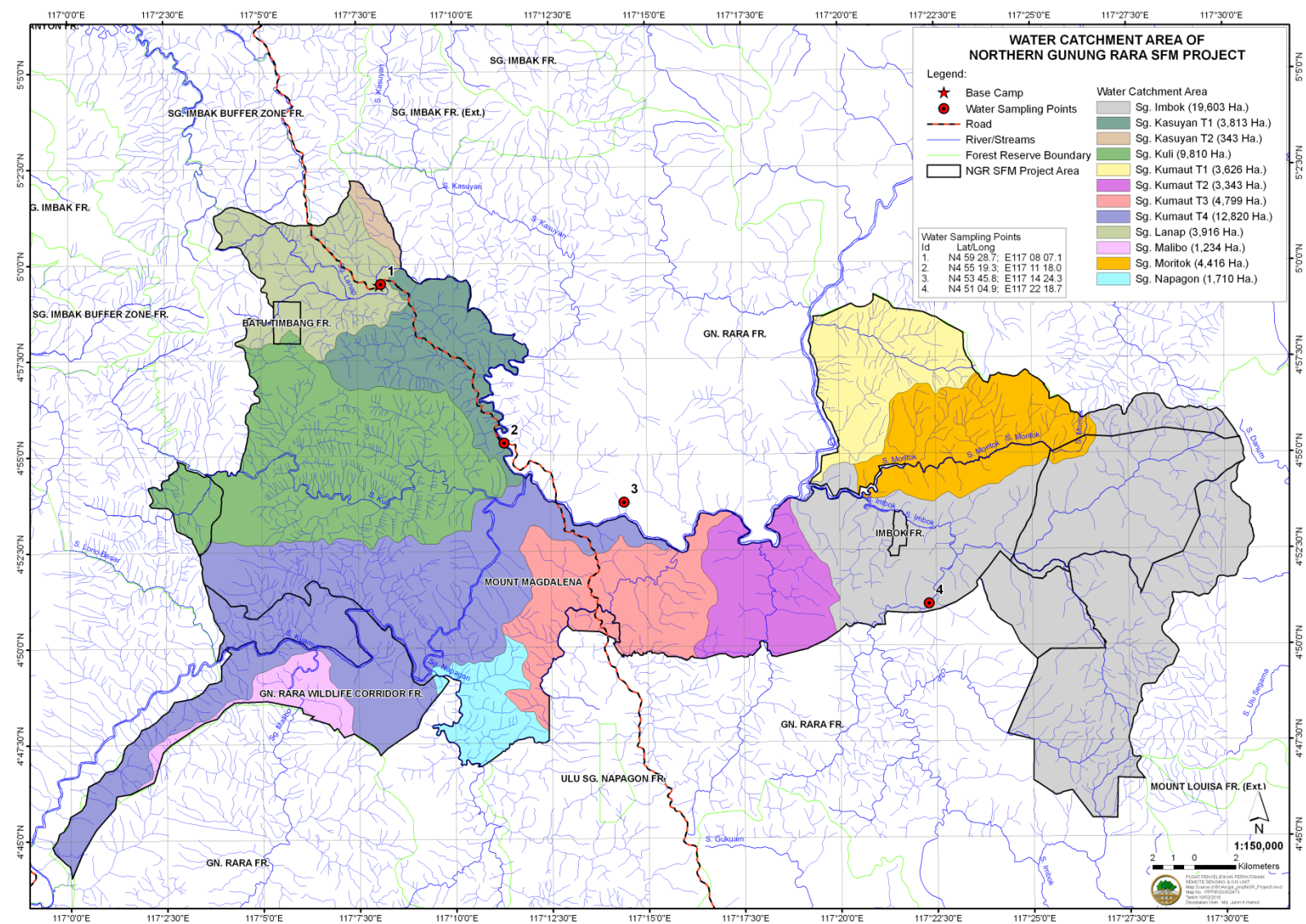


Figure 1. The location of water sampling points to assess river water quality in Northern Gunung Rara Forest Reserve

METHODOLOGY

Water quality sampling using Model Hanna Multiparameter with pH/EC/DO Water Quality Meter

Assessment of the water quality was taken by using Hanna Multiparameter Water Quality Meter. The water quality parameters assessed include pH value, dissolved oxygen, temperature, conductivity and total dissolved solid. The probe of the meter was put into the river water until it is fully immersed, for five minutes to allow the measurement of key parameters until they are stabilized.



Figure 2. Hanna Multiparameter Water Quality Meter

National Water Quality Standards for Malaysia (NWQSM)

National Water Quality Standards for Malaysia (NWQSM) is used to determine the water quality status and to classify the rivers. It also provides a convenient means of summarizing water quality data for sampled river water. DOE river water monitoring programme was practised in Malaysia since the year 1978. Water quality data were used to determine the water quality status whether it is in clean, slightly polluted or polluted category and to classify the rivers in Class I, II, III, IV or V based on NWQSM.

RESULTS

Water Quality

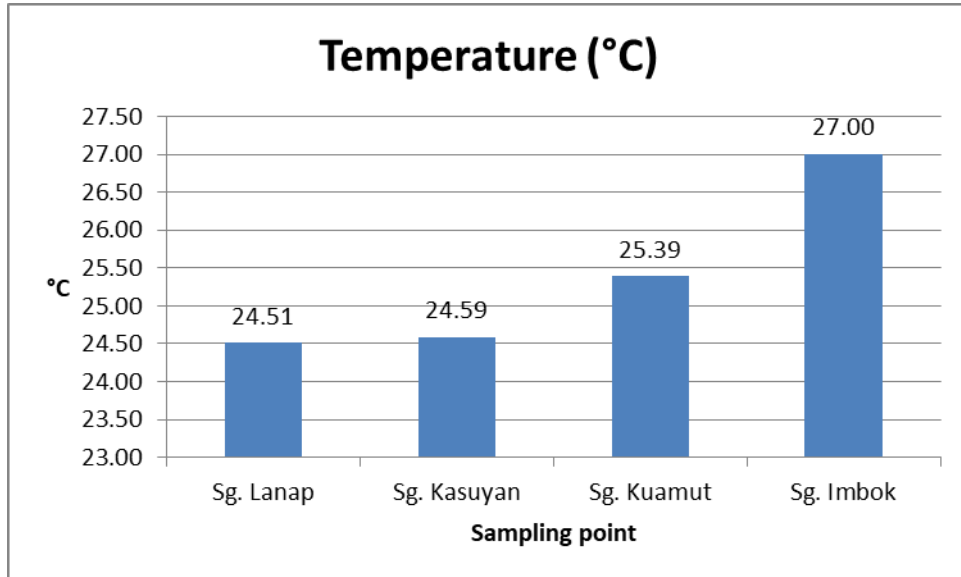
The chemical analyses and water quality classes for all parameters tested for four sampling points in the project area are listed in Table 2.

Table 2. The results of chemical analyses and water quality classes for all parameter tested for sampling location W1-W4 in NGR project area . Note: Dissolved Oxygen (DO in mg/l), Conductivity ($\mu\text{S/cm}$), Total Dissolved Solid (TDS in mg/l), and Temperature ($^{\circ}\text{C}$).

Sampling Location	Location	Temperature ($^{\circ}\text{C}$)	pH Value	Dissolved Oxygen, DO (mg/l)	Conductivity ($\mu\text{S/cm}$)	Total Dissolved Solid (mg/l)
W ₁	Sg. Lanap	24.51	7.23	7.16	31	16
W ₂	Sg. Kasuyan	24.59	7.12	7.08	28	14
W ₃	Sg. Kuamut	25.39	7.09	7.08	37	19
W ₄	Sg. Imbok	27.00	8.01	6.79	201	100
Minimum		24.51	7.09	6.79	28.00	14.00
Maximum		27.00	8.01	7.16	201.00	100.00
Mean		25.37	7.36	7.03	74.25	37.25
NWQSM*		Normal	Class I	Class I to Class II	Class I	Class I

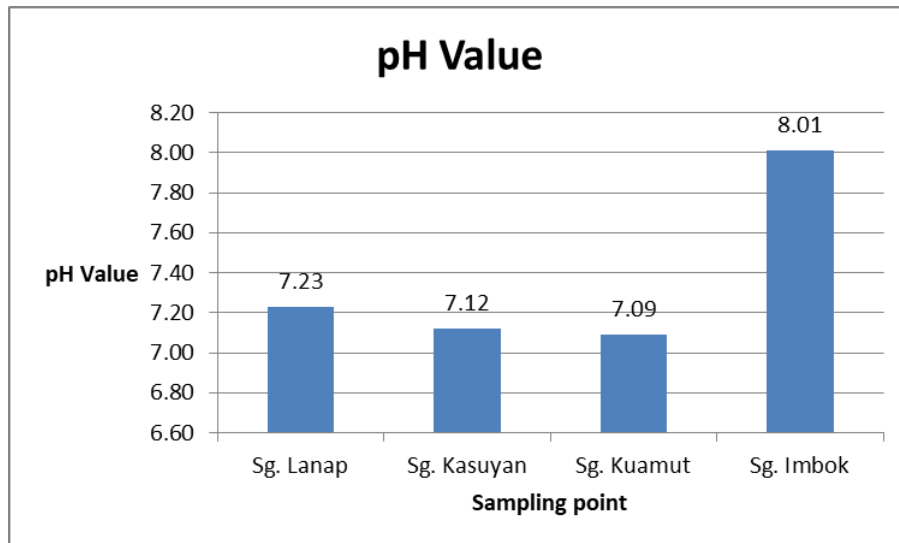
* National Water Quality Standards for Malaysia

DISCUSSION



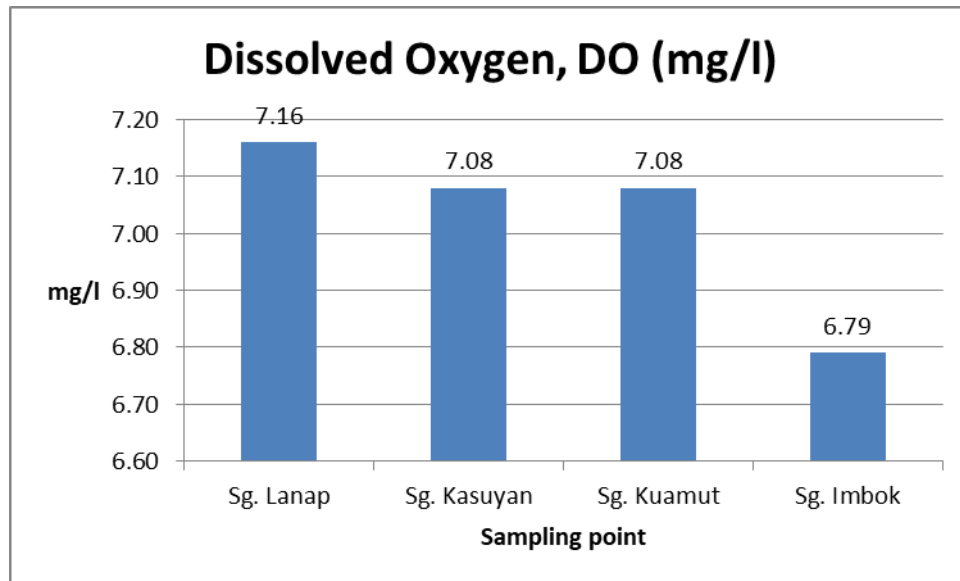
i. Temperature

The water temperature for all sampling points range from 24.51 to 27.00°C for the month of December 2019. The registered temperature levels are within the normal value for river water. Water temperature will vary according to seasonal changes, altitudes and with the changes from day to night. Warm during the day and cool during the night. An alteration of the water body temperature will affect the biological activity and growth of aquatic community.



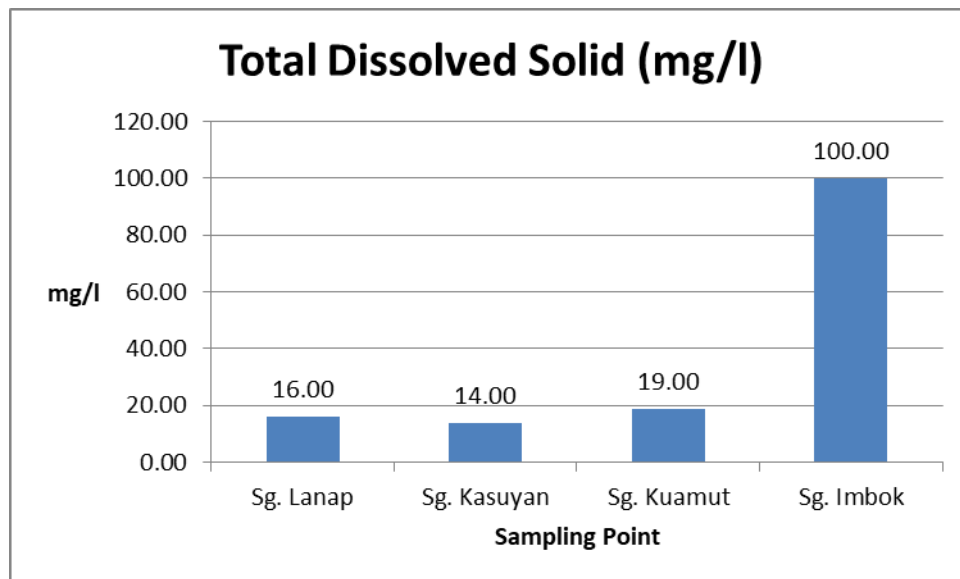
ii. pH Value

The narrow concentration of hydrogen ions between pH 6 to 9 indicates the typical suitability range for the existence of most biological life. The pH for all sampling points ranged from 7.09 to 8.01. All sampling points registered pH value under Class I water for the Interim National Water Quality Standards for Malaysia.



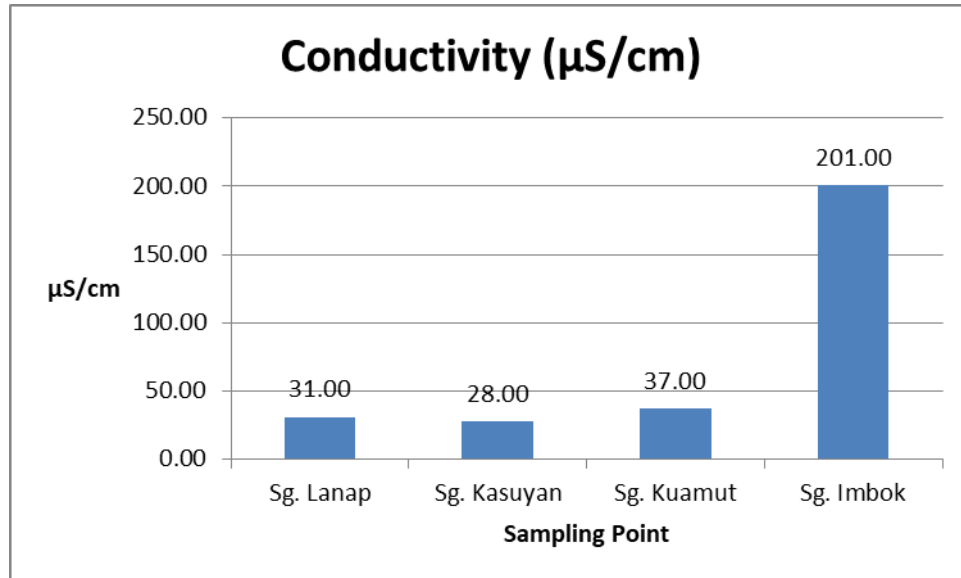
iii. Dissolved Oxygen (DO)

DO is an essential indicator in supporting aquatic life. It measures the amount of oxygen (O₂) that is dissolved in the water (Table 2). All sampling points ranged from 6.79 to 7.16 mg/L for the month of December 2019. Low DO level is considered a threat to aquatic organisms. All sampling points registered DO levels under Class I to Class II water for the Interim National Water Quality Standards for Malaysia.



iv. Total Dissolved Solid

TDS consists of the combined total of organic and inorganic substances in water. This refers to any minerals, salts, metals, cations or anions dissolved in water. All sampling points ranged from 14 to 100 mg/L for the month of December 2019. Based on the NWQSM, the TDS level for all sampling points is classified within the Class I water quality range.



v. Conductivity

Conductivity is the indicator of the presence of ions within the water, due to leaching from the ground or saline water intrusion. It is also the indicator of industrial discharges. The conductivity ranges from 28 to 201 µS/cm for the month of December 2019. All sampling points registered conductivity levels under Class I water for the Interim National Water Quality Standards for Malaysia.

Synthesis of assessment

According to the National Water Quality Standard (NWQS) the water quality of the rivers based on the physicochemical parameters (except for dissolved oxygen in certain sampling point) fall into Class 1. The pH for all rivers generally complied with the standards set for water under Class I of the NWQSM. The acceptable limit for river water pH is 6 to 9, thus the pH for all sampling points are in an acceptable limit.

For DO it is essential for the aquatic life within the river water. A low DO level would threaten the aquatic community whereas only DO level below 2 mg/l is considered harmful for aquatic life. The DO for all the sampling points are within the range of Class I and Class II of NWQSM. The temperatures for all sampling points vary as the sampling was done from early morning until in the afternoon and it is still in normal value of NWQSM.

The concentration of TDS (mg/L) and conductivity were low indicating that there is no leaching of organic or inorganic substances from the ground. Both parameter shows Class I of NWQSM.

It is recommended that the management team to always carry out periodic inspection and monitoring at all the sampling points to prevent deterioration of the water quality. The management team should install signage at all the sampling point to prevent visitors or passer by traversing the road from dumping waste into the watercourse. Nevertheless, the river water would require conventional treatment such as boiling before it can be used for domestic consumption.

REFERENCES

Department Of Environment Malaysia (DOE), 2011. Malaysia Environmental Quality Report 2011. <http://www.doe.gov.my/webportal/en/penerbitan-jas/>

http://www.wepa-db.net/policies/law/malaysia/eq_surface.htm

APPENDIX I

NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETER	UNIT	CLASS				
		I	IIA/IB	III*	IV	V
Al	mg/l	↑	-	(0.06)	0.5	↑
As	mg/l		0.05	0.4 (0.05)	0.1	
Ba	mg/l		1	-	-	
Cd	mg/l		0.01	0.01* (0.001)	0.01	
Cr (IV)	mg/l		0.05	1.4 (0.05)	0.1	
Cr (III)	mg/l		-	2.5	-	
Cu	mg/l		0.02	-	0.2	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l		-	-	3 SAR	
K	mg/l		-	-	-	
Fe	mg/l		1	1	1 (Leaf) 5 (Others)	
Pb	mg/l		0.05	0.02* (0.01)	5	
Mn	mg/l		0.1	0.1	0.2	
Hg	mg/l	N	0.001	0.004 (0.0001)	0.002	
Ni	mg/l	A	0.05	0.9*	0.2	
Se	mg/l	T	0.01	0.25 (0.04)	0.02	
Ag	mg/l	U	0.05	0.002	-	
Sn	mg/l	R	-	0.004	-	
U	mg/l	A	-	-	-	
Zn	mg/l	L	5	0.4*	2	
B	mg/l		1	(3.4)	0.8	
Cl	mg/l	L	200	-	80	
Cl ₂	mg/l	E	-	(0.02)	-	
CN	mg/l	V	0.02	0.06 (0.02)	-	
F	mg/l	L	1.5	10	1	
NO ₂	mg/l	S	0.4	0.4 (0.03)	-	
NO ₃	mg/l		7	-	5	
P	mg/l	O	0.2	0.1	-	
Silica	mg/l	R	50	-	-	
SO ₄	mg/l		250	-	-	
S	mg/l	A	0.05	(0.001)	-	
CO ₂	mg/l	B	-	-	-	
Gross-α	Bq/l	S	0.1	-	-	
Gross-β	Bq/l	E	1	-	-	
Ra-226	Bq/l	N	<0.1	-	-	
Sr-90	Bq/l	T	<1	-	-	
CCE	µg/l		500	-	-	
MBAS/BAS	µg/l		500	5000 (200)	-	
O & G (Mineral)	µg/l		40; N	N	-	
O & G (Emulsified Edible)	µg/l		7000; N	N	-	
PCB	µg/l		0.1	6 (0.05)	-	
Phenol	µg/l		10	-	-	
Aldrin/Dieldrin	µg/l		0.02	0.2 (0.01)	-	
BHC	µg/l		2	9 (0.1)	-	
Chlordane	µg/l		0.08	2 (0.02)	-	
t-DDT	µg/l		0.1	(1)	-	
Endosulfan	µg/l		10	-	-	
Heptachlor/Epoiside	µg/l		0.05	0.9 (0.06)	-	
Lindane	µg/l		2	3 (0.4)	-	
2,4-D	µg/l		70	450	-	
2,4,5-T	µg/l		10	160	-	
2,4,5-TP	µg/l		4	850	-	
Paraquat	µg/l	↓	10	1800	-	↓

National Water Quality Standards For Malaysia

PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	> 12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	> 100
Dissolved Oxygen	mg/l	7	5 - 7	5 - 7	3 - 5	< 3	< 1
pH	-	6.5 - 8.5	6 - 9	6 - 9	5 - 9	5 - 9	-
Colour	TCU	15	150	150	-	-	-
Electrical Conductivity*	$\mu\text{S/cm}$	1000	1000	-	-	6000	-
Floatables	-	N	N	N	-	-	-
Odour	-	N	N	N	-	-	-
Salinity	%	0.5	1	-	-	2	-
Taste	-	N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature	$^{\circ}\text{C}$	-	Normal + 2 $^{\circ}\text{C}$	-	Normal + 2 $^{\circ}\text{C}$	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	count/100 ml	10	100	400	5000 (20000) ^a	5000 (20000) ^a	-
Total Coliform	count/100 ml	100	5000	5000	50000	50000	> 50000

Notes :

- N : No visible floatable materials or debris, no objectional odour or no objectional taste
- * : Related parameters, only one recommended for use
- ** : Geometric mean
- a : Maximum not to be exceeded

DOE Water Quality Index Classification

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 – 0.3	0.3 – 0.9	0.9 – 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 – 3	3 – 6	6 – 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 – 25	25 – 50	50 – 100	> 100
Dissolved Oxygen	mg/l	> 7	5 – 7	3 – 5	1 – 3	< 1
pH	-	> 7	6 – 7	5 – 6	< 5	> 5
Total Suspended Solid	mg/l	< 25	25 – 50	50 – 150	150 – 300	> 300
Water Quality Index (WQI)		< 92.7	76.5 – 92.7	51.9 – 76.5	31.0 – 51.9	< 31.0

Water Classes And Uses

CLASS	USES
Class I	Conservation of natural environment. Water Supply I – Practically no treatment necessary. Fishery I – Very sensitive aquatic species.
Class IIA	Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species.
Class IIB	Recreational use with body contact.
Class III	Water Supply III – Extensive treatment required. Fishery III – Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

DOE Water Quality Classification Based On Water Quality Index

SUB INDEX & WATER QUALITY INDEX	INDEX RANGE		
	CLEAN	SLIGHTLY POLLUTED	POLLUTED
Biochemical Oxygen Demand (BOD)	91 - 100	80 - 90	0 - 79
Ammoniacal Nitrogen (NH ₃ -N)	92 - 100	71 - 91	0 - 70
Suspended Solids (SS)	76 - 100	70 - 75	0 - 69
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59