



ANNEX

NATIONAL WATER QUALITY STANDARDS

PARAMETER	UNIT	CLASS				
		I	IIA/IIIB	III#	IV	V
Al	mg/l	↑ N A T U R A L L E V E L S O R A B S E N T ↓	-	(0.06)	0.5	↑ L E V E L S A B O V E I V ↓
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		0.001	0.004 (0.0001)	0.002	
Ni	mg/l		0.05	0.9*	0.2	
Se	mg/l		0.01	0.25 (0.04)	0.02	
Ag	mg/l		0.05	0.0002	-	
Sn	mg/l		-	0.004	-	
U	mg/l	-	-	-		
Zn	mg/l	5	0.4*	2		
B	mg/l	1	(3.4)	0.8		
Cl	mg/l	200	-	80		
Cl ₂	mg/l	-	(0.02)	-		
CN	mg/l	0.02	0.06 (0.02)	-		
F	mg/l	1.5	10	1		
NO ₂	mg/l	0.4	0.4 (0.03)	-		
NO ₃	mg/l	7	-	5		
P	mg/l	0.2	0.1	-		
Silica	mg/l	50	-	-		
SO ₄	mg/l	250	-	-		
S	mg/l	0.05	(0.001)	-		
CO ₂	mg/l	-	-	-		
Gross-α	Bq/l	0.1	-	-		
Gross-β	Bq/l	1	-	-		
Ra-226	Bq/l	< 0.1	-	-		
Sr-90	Bq/l	< 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)	-		
†-DDT	µg/l	0.1	(1)	-		
Endosulfan	µg/l	10	-	-		
Heptachlor/Epoxide	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	-		

Notes :

* = At hardness 50 mg/l CaCO₃

= Maximum (unbracketed) and 24-hour average (bracketed) concentrations

N = Free from visible film sheen, discoloration and deposits

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*	µS/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	oC	-	Normal + 2 °C	-	Normal + 2 °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

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
Ammoniacal Nitrogen	91 - 100	80 - 90	0 - 79
Biochemical Oxygen Demand	92 - 100	71 - 91	0 - 70
Chemical Oxygen Demand	76 - 100	70 - 75	0 - 69
Dissolved Oxygen	81 - 100	60 - 80	0 - 59

DOE WATER QUALITY INDEX CLASSIFICATION

PARAMETER	UNIT	CLASS				
		I	IIA	IIB	III	IV
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	-	> 7.0	6.0 – 7.0	5.0 – 6.0	< 5.0	> 5.0
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

WQI FORMULA AND CALCULATION

FORMULA

WQI = (0.22 * SIDO) + (0.19 * SIBOD) + (0.16 * SICOD) + (0.15 * SIAN) + (0.16 * SISS) + (0.12 * SlpH)
where;

SIDO = Subindex DO (% saturation)

SIBOD = Subindex BOD

SICOD = Subindex COD

SIAN = Subindex NH₃-N

SISS = Subindex SS

SlpH = Subindex pH

0 ≤ WQI ≤ 100

BEST FIT EQUATIONS FOR THE ESTIMATION OF VARIOUS SUBINDEX VALUES

Subindex for DO (in % saturation)

SIDO = 0 for x ≤ 8
 SIDO = 100 for x ≥ 92
 SIDO = -0.395 + 0.030x² - 0.00020x³ for 8 < x < 92

Subindex for BOD

SIBOD = 100.4 - 4.23x for x ≤ 5
 SIBOD = 108 * exp(-0.055x) - 0.1x for x > 5

Subindex for COD

SICOD = -1.33x + 99.1 for x ≤ 20
 SICOD = 103 * exp(-0.0157x) - 0.04x for x > 20

Subindex for NH₃-N

SIAN = 100.5 - 105x for x ≤ 0.3
 SIAN = 94 * exp(-0.573x) - 5 * | x - 2 | for 0.3 < x < 4
 SIAN = 0 for x ≥ 4

Subindex for SS

SISS = 97.5 * exp(-0.00676x) + 0.05x for x ≤ 100
 SISS = 71 * exp(-0.0061x) - 0.015x for 100 < x < 1000
 SISS = 0 for x ≥ 1000

Subindex for pH

SlpH = 17.2 - 17.2x + 5.02x² for x < 5.5
 SlpH = -242 + 95.5x - 6.67x² for 5.5 ≤ x < 7
 SlpH = -181 + 82.4x - 6.05x² for 7 ≤ x < 8.75
 SlpH = 536 - 77.0x + 2.76x² for x ≥ 8.75

Note:

* means multiply with

MWQI FORMULA AND CALCULATION

MWQI = SI DO^{0.2} x SI NH₃^{0.16} x SI FC^{0.14} x SI TSS^{0.14} x SI O&G^{0.13} x SI NO₃^{0.12} x SI PO₄^{0.11}

where;

SIDO = Subindex Dissolved Oxygen
 SINH₃ = Subindex Unionized Ammonia
 SIFC = Subindex Faecal Coliform
 SITSS = Subindex Total Suspended Solids
 SIO&G = Subindex Oil and Grease
 SINO₃ = Subindex Nitrate
 SIPO₄ = Subindex Phosphate

0 ≤ MWQI ≥ 100

BEST FIT EQUATIONS FOR THE ESTIMATION OF VARIOUS SUBINDEX VALUES

Dissolved Oxygen (DO) in mg/L

For DO between 3 and 7

$$SI(DO) = -85.816 + 55.476(DO) - 4.142(DO)^2$$

If DO is less than 3, or more than 10, SI = 10%

Ammonia (Unionized) (NH₃) in mg-N/L*

$$SI(NH_3) = 100 \exp^{-4.6(NH_3)}$$

* If Ammoniacal Nitrogen (NH₃+N) is measured, convert the value into unionized ammonia.

Faecal Coliform (FC) in MPN/100ml

$$SI(FC) = 100 \exp^{-0.005(FC)}$$

If FC ≥ 500 MPN, SI = 8%

Total Suspended Solids (TSS) in mg/L

$$SI(TSS) = 95.8 \exp^{-0.0043(TSS)}$$

If TSS > 100 mg/L, SI = 20%

Oil & Grease (OG) in mg/L

$$SI(OG) = 98 \exp^{-0.21(OG)}$$

Nitrate (NO₃) in mg-N/L

$$SI(NO_3) = 94.83 \exp^{-0.35(NO_3)}$$

Phosphate (PO₄) in mg-P/L

$$SI(PO_4) = 95.2 \exp^{-0.002(PO_4^{1000})}$$

UNIONIZED AMMONIA CALCULATION

In order to convert the concentration of total ammoniacal nitrogen into unionized ammonia, calculate (a), (b), (c) and (d). Substitute the results into equation 1.

a. Calculation of Ionic Strength (IS)

$$IS = \frac{19.9273 * Salinity}{(1000 - 1.005109 * Salinity)}$$

Salinity in part per thousand (ppt)

b. Calculation of PKa

$$PKa = (0.0901821 + \frac{2729.92}{(Temp + 273.15)}) + IS(0.1552 - 0.000314 * Temp)$$

Temperature in °C

c. Calculation of working pH

$$pH_{sw} = pH - (0.0007 * IS) - 0.131$$

d. Calculation of mole fraction for unionized ammonia

$$\text{Mole Fraction} = \frac{1}{1 + 10^{(PKa - pH_{sw})}}$$

Equation:

$$\text{Unionized ammonia} = \text{Total ammoniacal nitrogen} \times \text{mole fraction}$$

Total ammoniacal nitrogen should be measured in µg/l

