APPENDICES

APPENDIX 1

WORKING PROCEDURE FOR BIOCHEMICAL OXYGEN DEMAND (20° C, 5 DAYS)

REAGENTS AND APPARATUS

Phosphate Buffer Solution
Dissolve 8.5 g KH_2PO_4, 21.75 g K_2HPO_4, 33.4 g Na_2HPO_4 $7H_2O$, and 1.7 g NH_4Cl in about 500 ml deionised water and dilute to 1 L. The pH should be 7.2.

Magnesium Sulfate Solution

Dissolve 22.5 g $MgSO_4.7H_2O$ in deionised water and dilute to 1 L.

Calcium Chloride Solution
Dissolve 27.5 g $CaCl_2.2H_2O$ in deionised water and dilute to 1 L.

Ferric Chloride Solution
Dissolve 0.25 g of $FeCl_3.6H_2O$ in deionised water and dilute to 1 L.

Acid and alkali solution, for neutralization of caustic or acidic waste samples
i) Acid – Add 28 ml concentrated sulfuric acid to deionised water. Dilute to 1 L.
ii) Aklaki – Dissolve 40 g Sodium Hydroxide in deionised water. Dilute to 1 L.

Sodium Sulfite Solution
Dissolve 1.575 g Na_2SO_3 in 1000 ml deionised water.

Nitrification inhibitor – 2-Chloro-6-(trichloromethyl) pyridine.

Glucose-glutamic acod solution
Organic mixture of reagent-grade glucose and reagent grade glutamic acid at 103°C for 1 hour. Add 150 mg glucose and 150 mg glutamic acod to deionised water and dilute to 1 L.

Ammonium Chloride Solution
Dissolve 1.15 g NH_4Cl in about 500 ml deionised water, adjust the pH to 7.2 with NaOH solution, and dilute to 1 L. Solution contains 0.3 mg N ml^{-1}.

Seed – Commercial available
a) Seed control – Determine BOD of the seeding material as for any other sample.
b) To determine a sample DO uptake subtract seed DO uptake from total DO uptake. The DO uptake of seeded dilution water should be between 0.6 and 1.0 mg L^{-1}.

Dissolved oxygen meter is used.

Dissolved oxygen meter is used.

PROCEDURE

Preparation of dilution water

Placed desired volume of water in a suitable bottle and add 1 ml each of phosphate buffer, $MgSO_4$, $CaCl_2$ and $FeCl_3$ solutions/L of water.

Bring dilution water temperature to 20° C before use. Saturate with DO by aerating with organic free filtered air.

Glucose-glutamic Acid check

Determine the 5 days 20° C BOD of a 2% dilution of the glucose-glutamic acid standard.

Sample Pretreatment

Sample containing caustic alkalinity or acidic – neutralize samples to pH 6.5 to 7.5 with a solution of sulfuric acid (H_2SO_4) or Sodium hydroxide (NaOH).

Sample containing residual chlorine compounds – destroy the chlorine residue by adding Na_2SO_3 dilution. Check the sample for residue chlorine after 10 to 20 min.

Sample temperature adjustment – bring samples to 20 ± 1°C before making dilutions.

Dilution

Dilutions that result in a residual DO at least 1 mg L^{-1} and a DO uptake of at least 2 mg L^{-1} after 5 days incubation produce the more reliable results. Several dilutions of prepared sample was made to obtain DO uptake in this range.

Prepare dilutions in graduated cylinders and then transfer to BOD bottles.

Seeding is added directly to dilution water if needed.

Initial DO was determined immediately after filling BOD bottle with diluted sample. The bottle was closed tightly, water –seal and incubate for 5 days at 20°C.

Determination of final DO

After 5 days incubation, DO was determined in sample dilutions.

i. When dilution water is not seeded:

$$BOD_5 \text{ mg } L^{-1} = \frac{D1 - D2}{P}$$

Where:

D1 = DO of diluted sample immediately after preparation, mg L^{-1}
D2 = DO of diluted sample after 5 days incubation at 20°C, mg L^{-1}
P = decimal volumetric fraction of sample used.

ii. When dilution water is seeded (seed material is added directly to sample):

$$BOD_5 \text{ mg } L^{-1} = \frac{(D1 - D2) - (B1 - B2)\, f}{P}$$

Where:

F = (Volume of seed in diluted sample)/(Volume of seed in seed control)
B1 = DO of seed control before incubation, mg L^{-1}
B2 = DO of seed control after incubation, mg L^{-1}

BIBIOGRAPHY

Standard method For the Examination of Water and Waste Water (1998), 20th Edition APHA.

Method Ref. No: APHA-5210B.

WORKING PROCEDURE FOR DETERMINATION OF CHEMICAL OXYGEN DEMAND

REAGENT AND APPARATUS

Standard Potassium Dichromate Digestion Solution, 0.01667 M (0.1 N):
Add to about 500 ml distilled water 4.903 kg $K_2Cr_2O_7$, primary standard grade, previously dried at 150°C for 2 hours, 167 ml concentrated H_2SO_4 and 33.3 g $HgSO_4$. Dissolve the solution, cool to room temperature and dilute to 1000 ml.

Standard Potassium Dichromate Digestion Solution, 0.00833 M:
Add to about 500 ml distilled water 2.4515 g $K_2Cr_2O_7$, primary standard grade, previously dried at 150°C for 2 hours, 83.5 ml concentrated H_2SO_4 added $AgSO_4$ and 16.65 g of $HgSO_4$. Dissolved the solution, cool to room temperature and dilute to 1000 ml.

Sulphuric Acid Reagent:
Add $AgSO_4$ reagent or technical grade crystals or powder, to concentrated H_2SO_4 at the rate of 5.5 g Ag_2SO_4/kg H_2SO_4.

Ferroin Indicator Solution:
Dissolve 1.485 g 1,10-phenathroline monohydrate and 695 mg $FeSO_4.7H_2O$ in distilled water and dilute to 100 ml.

Standard Ferrous Ammonium Sulphate Titrant (FAS) 0.10 M:
Dissolve 39.2 g $Fe(NH_4)_2(SO_4)_2.6H_2O$ in distilled water. Add 20 ml concentrated H_2SO_4, cool and dilute to 1000 ml.

Digestion vessels the borosilicate culture tubes, 16 x 100 mm with TFE-lined screw caps are used.

PROCEDURE

Washed digestion vessels (Borosilicate culture tubes) and caps with 20% H_2SO_4 to prevent contamination.

Placed sample in culture tube and digestion solution was added.

Sulphuric acid reagent was added to the solution so an acid layer is formed under the sample digestion solution layer.

Cap tubes is closed tightly and inverted each several times to mix completely.

Culture tube was placed in oven, preheated to 150°C and reflux for 2 hours.
After that, the culture tubes was cool to room temperature.

Culture tube cap was removed and TFE-covered magnetic stirring bar was added.

0.5 to 0.10 ml (1 to 2 drops) of Ferroin indicator was added and the magnetic stirrer was used to stir rapidly.

The final result is a sharp color change from blue green to reddish brown.

A blank culture tube containing reagents and a volume of distilled water equal to that of the sample was prepared for reflux sand titrate.

Calculation:

$$\text{COD as mg } O_2\,L^{-1} = \frac{(A - B) \times M \times 8000}{\text{ML sample}}$$

Where:

A = mL FAS used for blank
B = mL FAS used for sample
M = Molarity of FAS

BIBIOGRAPHY

Standard method For the Examination of Water and Waste Water (1998), 20th Edition APHA.

Method Ref. No: APHA-5220C.

WORKING PROCEDURE FOR DETERMINATION OF AMMONIACAL NITROGEN

REAGENT AND APPARATUS

Distillation apparatus, the borosilicate glass flask of 800 to 2000 ml capacity are used where the flask is attached to a vertical condenser so that the outlet tip may be submerged below the surface of the receiving acid solution.

Phenol solution
Mix 11.1 ml liquefied phenol = 89% with 95% v/v ethyl alcohol to a final volume of 100 ml.

Sodium Nitroprosside = 0.5% w/v
Dissolved 0.5 g sodium nitroprosside in 100 ml deionised water. Store in a amber bottle for up to 1 month.

Alkaline citrate
Dissolve 200 g trisodium citrate and 10 g of Sodium Hydroxide. Dilute to 1000 ml

Sodium hypochlorite commercial solution, about 5%.

Oxidising solution
Mix 100 ml of alkaline citrate solution with 25 ml sodium hypochlorite.

Standard ammonium solution
Dissolve 3.819 g NH_4Cl (dry at 100°C) in 1 L deionsed water, 1000 ppm (A)
1 ml A = 1 mg N or 1.22 mg NH_3.

PROCEDURE

Preparation of equipment

Add 500 ml deionised water and 20 ml borate buffer. Adjust pH to 9.5 with 6N NaOH, and add to a distillation flask. Then Add a fes glass beads or boiling chips and use this mixture to steam out the distillation apparatus until distillate shows no traces of ammonia.

Sample preparation

Use 500 ml of water sample and add in 25 ml borate buffer. Then adjust the pH to 9.5 with 6N NaOH using a pH meter.

The alkaline sample was poured into a distillation flask and distill. Then collect distillate in a 250 mL Erlenmeyer flask containing 50 mL 0.05N H_2SO_4 solution.

Prepare a standard curve by plotting absorbance readings of standards against ammonia concentrations of standards. Compute sample concentration by comparing water absorbance with the standard curve. Treat blank and standards same as samples as procedure below.

Take 25 ml sample or less and made up to 25 ml with D1 water in a 50 ml standard flask. Add 1 ml phenol solution, 1 ml sodium nitroprusside solution and 2.5 ml oxidising solution. Mix thoroughly after each addition of solution.

Stopper flask and place in dark are to allow the blue colour of indophenol to develop at least 1 hour.

Read the absorbance at 640 nm and obtain the concentration from the standard graph with various concentration viz., 0, 0.1, 0.3, 0.5 and 0.7 mg L^{-1}.

CALCULATION

$$\text{Mg } NH_3\text{-N } L^{-1} = \text{Conc. In ppm} \times \frac{\text{Vol distillate}}{\text{Sample size}}$$

BIBIOGRAPHY

Standard method For the Examination of Water and Waste Water (1998), 20th Edition APHA.

Method Ref. No: APHA-4500 NH_3.

Appendix 2

List of flora and fauna before construction of wetland cells.

Flora	**Species**
Oil palm	*Nephrolepis*
Rubber	*Stenochlaena ferns*
Under-storey plants	*Clidemia hirta*
	Dillenia suffruticosa
	Borreria latifolia
	Alstonia angustiloba
	Ficus spp.
Shade tolerant species	*Paspalum conjugatun*
	Ottochloa nodosa
	Ischaemum muticum
	Centotheca lappacea
Leguminous cover crops	*Pueraria*
	Centrosema
Creepers	*Mikania scandens*
	Passiflora foetida
Scamblers	*Asystacia intrusa*
	Melastoma malabathricum
	Cyperus spp.
Aquatic flora	*Hydrilla verticillata*
	Ceratophyllum sp.
	Najas sp.
	Utricularia aurea
	Limnocharis flava
	Typha angustifolia
	Monochoria hastate
	Lugwigia hyssopifolia
	Lemna sp. (duckweed)
Fauna	**Species**
Rats	*Rattus rattus, R. tiomanicus, R. diardii*
Squirrels	*Callosciurus* spp.
Shrews	*Suncus* spp.
Porcupines	*Hystric brachyura*
Scaly ant-eaters	*Manis javanica*
Bats	*Cynopterus* spp., *Macroglossus* sp.
	Long-tail macaques (*Macaca fascicularis*), Short-tail macaques (*Macaca nemestrina*), Dusky leaf-monkeys (*Prebytis obscura*)
Others	Otters, Civet cats, Leopard cats
Wild pigs	*Sussrofa* sp.

Snakes	*Naja naja,* King cobra (*Ophiophagus hannah*), Python (*Python reticulates*)
Birds	Sparrow, mynah, swift, magpie, robin, weaver bird, sun-bird, Eagle, kite, pigeon, dove, parrot, cuckoo coucal (*Centropus sinensis*) Kingfisher, bee-eater, swallow, bulbul, night jar and jungle, moor hen (*Gallinula chloropus*) and fowl.
Reptiles	Monitor lizards, frogs, toads, tortoises
Fishes	Snake-head (ikan haruan), cultured carp (grass and big-head),Tilapia (*Oreochromis* spp), seluang (*Rasbora sumatrana*), sepat ronggeng (Trichogaster trichopterus), terbul (*Osteochilus hasseltii*), ikan putih (*Puntius binotatus*), pelampung jarring (*Puntius tetrazona*), keli (*Clarias* spp) and haruan (*Channa striatus*).
Insects	Butterflies, moths, bees, crickets, grass-hoppers, tettigonids, praying mantis, beetles, flies, rhinoceros beetle (Dryctes rhinoceros), palm weevil (*Rhynchophorus schach*), cockchafers) (*Apogonia* spp.)

Appendix 3

Appendix 3.1. Mean WQI as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_WQI (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 1.875551	(2) 1.928716	(3) 1.941839
1	....	....	(1)		0.000033*	0.000022*
2	....	....	(2)	0.000033*		0.297988
3	....	....	(3)	0.000022*	0.297988	

Appendix 3.2. Mean pH as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_pH (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 0.9161163	(2) 0.8853722	(3) 0.8607865
1	....	....	(1)		0.000009*	0.000022*
2	....	....	(2)	0.000009*		0.000009*
3	....	....	(3)	0.000022*	0.000009*	

Appendix 3.3. Mean pH as Influenced by Location

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_PH (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION		
PHASE	LOCATION	SEASON		(1) 0.8827738	(2) 0.8934732	(3) 0.8860281
....	UN	....	(1)		0.000268*	0.232135
....	PL	....	(2)	0.000268*		0.006278*
....	CW	....	(3)	0.232135	0.006278*	

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_PH (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION	
PHASE	LOCATION	SEASON		(1) 0.8886395	(2) 0.8862106
....	....	D	(1)		0.247357
....	....	W	(2)	0.247357	

Appendix 3.5. Mean pH as Influenced by the Interaction between Phases and Locations.

STAT GENERAL MANOVA				Newman-Keuls test; LOG_PH (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 2								
PHASE	LOCATION	SEASON		(1) 0.9211621	(2) 0.9132350	(3) 0.9139518	(4) 0.8821580	(5) 0.8930298	(6) 0.8809288	(7) 0.8450012	(8) 0.8741549	(9) 0.8632036
1	UN	....	(1)		0.243165	0.144147	0.000017*	0.000008*	0.000020*	0.000010*	0.000026*	0.000032*
1	PL	....	(2)	0.243165		0.884583	0.000022*	0.000050*	0.000008*	0.000026*	0.000017*	0.000020*
1	CW	....	(3)	0.144147	0.884583		0.000008*	0.000086*	0.000017*	0.000032*	0.000020*	0.000026*
2	UN	....	(4)	0.000017*	0.000022*	0.000008*		0.027656*	0.803388	0.000017*	0.236651	0.000731*
2	PL	....	(5)	0.000008*	0.000050*	0.000086*	0.027656*		0.037870*	0.000020*	0.000778*	0.000017*
2	CW	....	(6)	0.000020*	0.000008*	0.000017*	0.803388	0.037870*		0.000008*	0.170019	0.000974*
3	UN	....	(7)	0.000010*	0.000026*	0.000032*	0.000017*	0.000020*	0.000008*		0.000022*	0.000233*
3	PL	....	(8)	0.000026*	0.000017*	0.000020*	0.236651	0.000778*	0.170019	0.000022*		0.026539*
3	CW	....	(9)	0.000032*	0.000020*	0.000026*	0.000731*	0.000017*	0.000974*	0.000233*	0.026539*	

Appendix 3.6. Mean pH as Influenced by the Interaction between Phases and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_PH (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 3					
PHASE	LOCATION	SEASON		(1) 0.9227012	(2) 0.9095314	(3) 0.8873039	(4) 0.8834406	(5) 0.8559134	(6) 0.8656597
1	....	D	(1)		0.000618*	0.000022*	0.000008*	0.000020*	0.000017*
1	....	W	(2)	0.000618*		0.000009*	0.000022*	0.000017*	0.000008*
2	....	D	(3)	0.000022*	0.000009*		0.314907	0.000008*	0.000022*
2	....	W	(4)	0.000008*	0.000022*	0.314907		0.000022*	0.000012*
3	....	D	(5)	0.000020*	0.000017*	0.000008*	0.000022*		0.011245*
3	....	W	(6)	0.000017*	0.000008*	0.000022*	0.000012*	0.011245*	

Appendix 3.7. Mean pH as Influenced by the Interaction between Locations and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_PH (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 2 X 3					
PHASE	LOCATION	SEASON		(1) 0.8824520	(2) 0.8830955	(3) 0.8983871	(4) 0.8885594	(5) 0.8850794	(6) 0.8869767
....	UN	D	(1)		0.867330	0.000515*	0.506673	0.773942	0.642897
....	UN	W	(2)	0.867330		0.000696*	0.487697	0.606532	0.572048
....	PL	D	(3)	0.000515*	0.000696*		0.010741*	0.003101*	0.008585*
....	PL	W	(4)	0.506673	0.487697	0.010741*		0.638123	0.681161
....	CW	D	(5)	0.773942	0.606532	0.003101*	0.638123		0.622324
....	CW	W	(6)	0.642897	0.572048	0.008585*	0.681161	0.622324	

Appendix 3.8. Mean DO as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_DO (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 0.8250467	(2) 0.8470422	(3) 0.8430779
1	....	....	(1)		0.000083*	0.000506*
2	....	....	(2)	0.000083*		0.444139
3	....	....	(3)	0.000506*	0.444139	

Appendix 3.9. Mean DO as Influenced by Location

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_DO (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION		
PHASE	LOCATION	SEASON		(1) 0.8213162	(2) 0.8416659	(3) 0.8521848
....	UN	....	(1)		0.000114*	0.000022*
....	PL	....	(2)	0.000114*		0.045172*
....	CW	....	(3)	0.000022*	0.045172*	

Appendix 3.10. Mean DO as Influenced by Season

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_DO (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION	
PHASE	LOCATION	SEASON		(1) 0.8275105	(2) 0.8492673
....	....	D	(1)		0.000009*
....	....	W	(2)	0.000009*	

Appendix 3.11. Mean DO as Influenced by the Interaction between Phases and Locations.

STAT GENERAL MANOVA				Newman-Keuls test; LOG_DO (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 2								
PHASE	LOCATION	SEASON		(1) 0.8123156	(2) 0.8215396	(3) 0.8412850	(4) 0.8378238	(5) 0.8454974	(6) 0.8578054	(7) 0.8138092	(8) 0.8579607	(9) 0.8574638
1	UN	....	(1)		0.596493	0.019820*	0.037013*	0.006531*	0.000076*	0.875328	0.000065*	0.000065*
1	PL	....	(2)	0.596493		0.095182	0.087129	0.057335	0.001937*	0.416726	0.002498*	0.001518*
1	CW	....	(3)	0.019820*	0.095182		0.716154	0.658107	0.305158	0.020346*	0.402091	0.205285
2	UN	....	(4)	0.037013*	0.087129	0.716154		0.699211	0.220306	0.031255*	0.279088	0.165251
2	PL	....	(5)	0.006531*	0.057335	0.658107	0.699211		0.399082	0.007780*	0.556917	0.208703
2	CW	....	(6)	0.000076*	0.001937*	0.305158	0.220306	0.399082		0.000098*	0.986993	0.971377
3	UN	....	(7)	0.875328	0.416726	0.020346*	0.031255*	0.007780*	0.000098*		0.000121*	0.000083*
3	PL	....	(8)	0.000065*	0.002498*	0.402091	0.279088	0.556917	0.986993	0.000121*		0.998500
3	CW	....	(9)	0.000065*	0.001518*	0.205285	0.165251	0.208703	0.971377	0.000083*	0.998500	

Appendix 3.12. Mean DO as Influenced by the Interaction between Phases and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_DO (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 3					
PHASE	LOCATION	SEASON		(1) 0.8038986	(2) 0.8461948	(3) 0.8513938	(4) 0.8426906	(5) 0.8272393	(6) 0.8589165
1	....	D	(1)		0.000008*	0.000017*	0.000022*	0.001643*	0.000020*
1	....	W	(2)	0.000008*		0.483051	0.636378	0.028445*	0.199020
2	....	D	(3)	0.000017*	0.483051		0.468631	0.006163*	0.310146
2	....	W	(4)	0.000022*	0.636378	0.468631		0.037110*	0.126213
3	....	D	(5)	0.001643*	0.028445*	0.006163*	0.037110*		0.000199*
3	....	W	(6)	0.000020*	0.199020	0.310146	0.126213	0.000199*	

Appendix 3.13 Mean DO as Influenced by the Interaction between Locations and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_DO (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 2 X 3					
PHASE	LOCATION	SEASON		(1) 0.8028795	(2) 0.8397528	(3) 0.8349464	(4) 0.8483853	(5) 0.8447058	(6) 0.8596638
....	UN	D	(1)		0.000023*	0.000024*	0.000017*	0.000008*	0.000020*
....	UN	W	(2)	0.000023*		0.517542	0.475810	0.504854	0.036902*
....	PL	D	(3)	0.000024*	0.517542		0.268765	0.387303	0.007807*
....	PL	W	(4)	0.000017*	0.475810	0.268465		0.620295	0.128882
....	CW	D	(5)	0.000008*	0.504854	0.387303	0.620295		0.108827
....	CW	W	(6)	0.000020*	0.036902*	0.007807*	0.128882	0.108827	

Appendix 3.14. Mean BOD as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_BOD (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 0.6748069	(2) 0.5307915	(3) 0.4999321
1	....	....	(1)		0.000009*	0.000022*
2	....	....	(2)	0.000009*		0.010641*
3	....	....	(3)	0.000022*	0.010641*	

Appendix 3.15. Mean BOD as Influenced by Location

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_BOD (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION		
PHASE	LOCATION	SEASON		(1) 0.5743955	(2) 0.5699348	(3) 0.5612003
....	UN	....	(1)		0.715647	0.527984
....	PL	....	(2)	0.715647		0.475652
....	CW	....	(3)	0.527984	0.475652	

Appendix 3.16. Mean BOD as Influenced by Season

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_BOD (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION	
PHASE	LOCATION	SEASON		(1)	(2)
				0.5833248	0.5536955
....	....	D	(1)		0.001702*
....	....	W	(2)	0.001702*	

Appendix 3.17. Mean BOD as Influenced by the Interaction between Phases and Locations.

STAT GENERAL MANOVA				Newman-Keuls test; LOG_BOD (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 2								
PHASE	LOCATION	SEASON		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				0.7018112	0.6730714	0.6495381	0.5267897	0.5392157	0.5263692	0.4945858	0.4975171	0.5076935
1	UN	....	(1)		0.195376	0.048577*	0.000017*	0.000008*	0.000020*	0.000010*	0.000032*	0.000026*
1	PL	....	(2)	0.195376		0.289020	0.000008*	0.000022*	0.000017*	0.000032*	0.000026*	0.000020*
1	CW	....	(3)	0.048577*	0.289020		0.000022*	0.000009*	0.000008*	0.000026*	0.000020*	0.000017*
2	UN	....	(4)	0.000017*	0.000008*	0.000022*		0.575588	0.984894	0.594550	0.550839	0.665332
2	PL	....	(5)	0.000008*	0.000022*	0.000009*	0.575588		0.831466	0.336008	0.328823	0.486613
2	CW	....	(6)	0.000020*	0.000017*	0.000008*	0.984894	0.831466		0.479267	0.395208	0.400124
3	UN	....	(7)	0.000010*	0.000032*	0.000026*	0.594550	0.336008	0.479267		0.897938	0.825192
3	PL	....	(8)	0.000032*	0.000026*	0.000020*	0.550839	0.328823	0.395208	0.894938		0.646603
3	CW	....	(9)	0.000026*	0.000020*	0.000017*	0.665332	0.486613	0.400124	0.825192	0.646603	

Appendix 3.18. Mean BOD as Influenced by the Interaction between Phases and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_BOD (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 3					
PHASE	LOCATION	SEASON		(1) 0.7446508	(2) 0.6049630	(3) 0.5033790	(4) 0.5582041	(5) 0.5019448	(6) 0.4979195
1	....	D	(1)		0.000009*	0.000008*	0.000022*	0.000017*	0.000020*
1	....	W	(2)	0.000009*		0.000022*	0.006836*	0.000008*	0.000017*
2	....	D	(3)	0.000008*	0.000022*		0.001518*	0.933870	0.946485
2	....	W	(4)	0.000022*	0.006836*	0.001518*		0.003258*	0.002750*
3	....	D	(5)	0.000017*	0.000008*	0.933870	0.003258*		0.815859
3	....	W	(6)	0.000020*	0.000017*	0.946485	0.002750*	0.815859	

Appendix 3.19. Mean BOD as Influenced by the Interaction between Locations and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_BOD (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 2 X 3					
PHASE	LOCATION	SEASON		(1) 0.5848631	(2) 0.5639280	(3) 0.5931410	(4) 0.5467286	(5) 0.5719705	(6) 0.5504300
....	UN	D	(1)		0.447228	0.632660	0.178852	0.456605	0.192340
....	UN	W	(2)	0.447882		0.330594	0.581198	0.642365	0.435742
....	PL	D	(3)	0.632660	0.330594		0.079232	0.439844	0.098383
....	PL	W	(4)	0.178852	0.581198	0.079232		0.463410	0.830772
....	CW	D	(5)	0.456605	0.642365	0.439844	0.463410		0.427328
....	CW	W	(6)	0.192340	0.435742	0.098383	0.830772	0.427328	

Appendix 3.20. Mean COD as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_COD (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 0.9942785	(2) 0.8891100	(3) 0.7854031
1	....	....	(1)		0.002442*	0.000022*
2	....	....	(2)	0.002442*		0.002805*
3	....	....	(3)	0.000022*	0.002805*	

Appendix 3.21. Mean COD as Influenced by Location

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_COD (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION		
PHASE	LOCATION	SEASON		(1) 0.8948610	(2) 0.8943472	(3) 0.8795834
....	UN	....	(1)		0.988355	0.901253
....	PL	....	(2)	0.988355		0.674676
....	CW	....	(3)	0.901253	0.674676	

Appendix 3.22. Mean COD as Influenced by Season

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_COD (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION	
PHASE	LOCATION	SEASON		(1) 0.9525521	(2) 0.8266422
....	....	D	(1)		0.000012*
....	....	W	(2)	0.000012*	

Appendix 3.23. Mean COD as Influenced by the Interaction between Phases and Locations.

STAT GENERAL MANOVA				Newman-Keuls test; LOG_COD (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 2								
PHASE	LOCATION	SEASON		(1) 1.001938	(2) 0.9975570	(3) 0.9833401	(4) 0.8962464	(5) 0.9027330	(6) 0.8683505	(7) 0.7863982	(8) 0.7827516	(9) 0.7870594
1	UN	....	(1)		0.945221	0.954180	0.460404	0.404053	0.289628	0.016584*	0.017082*	0.013276*
1	PL	....	(2)	0.945221		0.823563	0.384866	0.297014	0.253160	0.016155*	0.017240*	0.012361*
1	CW	....	(3)	0.954180	0.823563		0.358864	0.206132	0.271571	0.024594*	0.027595*	0.017752*
2	UN	....	(4)	0.460404	0.384866	0.358864		0.918972	0.661725	0.311654	0.385197	0.200432
2	PL	....	(5)	0.404053	0.297014	0.206132	0.918972		0.851943	0.359195	0.413340	0.266485
2	CW	....	(6)	0.289628	0.253160	0.271571	0.661725	0.851943		0.403417	0.535696	0.202309
3	UN	....	(7)	0.016584*	0.016155*	0.024594*	0.311654	0.359195	0.103417		0.954394	0.991732
3	PL	....	(8)	0.017082*	0.017240*	0.027595*	0.385197	0.413340	0.535696	0.954394		0.997488
3	CW	....	(9)	0.013276*	0.012361*	0.017752*	0.200432	0.266485	0.202309	0.991732	0.997488	

Appendix 3.24. Mean COD as Influenced by the Interaction between Phases and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_COD (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 3					
PHASE	LOCATION	SEASON		(1) 1.090960	(2) 0.8975968	(3) 0.8953771	(4) 0.8828429	(5) 0.8713192	(6) 0.6994870
1	....	D	(1)		0.000105*	0.000257*	0.000167*	0.000109*	0.000020*
1	....	W	(2)	0.000105*		0.964343	0.952486	0.952003	0.000641*
2	....	D	(3)	0.000257*	0.964343		0.800698	0.878626	0.000484*
2	....	W	(4)	0.000167*	0.952486	0.800698		0.816467	0.000661*
3	....	D	(5)	0.000109*	0.952003	0.878626	0.816467		0.000544*
3	....	W	(6)	0.000020*	0.000641*	0.000484*	0.000661*	0.000544*	

Appendix 3.25. Mean COD as Influenced by the Interaction between Locations and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_COD (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 2 X 3					
PHASE	LOCATION	SEASON		(1) 0.9485769	(2) 0.8411451	(3) 0.9602247	(4) 0.8284697	(5) 0.9488579	(6) 0.8103119
....	UN	D	(1)		0.030811*	0.970242	0.041710*	0.995545	0.027914*
....	UN	W	(2)	0.030811*		0.078253	0.798897	0.077268	0.809270
....	PL	D	(3)	0.970242	0.078253		0.061933	0.819231	0.030992*
....	PL	W	(4)	0.041710*	0.798897	0.061933		0.073343	0.715120
....	CW	D	(5)	0.995545	0.077268	0.819231	0.073343		0.042661*
....	CW	W	(6)	0.027914*	0.809270	0.030992*	0.715120	0.042661*	

Appendix 3.26. Mean AN as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_AN (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 0.2923623	(2) 0.1145975	(3) 0.1111060
1	....	....	(1)		0.000009*	0.000022*
2	....	....	(2)	0.000009*		0.695257
3	....	....	(3)	0.000022*	0.695257	

Appendix 3.27. Mean AN as Influenced by Location

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_AN (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION		
PHASE	LOCATION	SEASON		(1) 0.1885002	(2) 0.1700994	(3) 0.1594661
....	UN	....	(1)		0.041686*	0.003757*
....	PL	....	(2)	0.041686*		0.239225
....	CW	....	(3)	0.003757*	0.239225	

Appendix 3.28. Mean AN as Influenced by Season

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_AN (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION	
PHASE	LOCATION	SEASON		(1)	(2)
				0.1927235	0.1526537
....	....	D	(1)		0.000009*
....	....	W	(2)	0.000009*	

Appendix 3.29. Mean AN as Influenced by the Interaction between Phases and Locations.

STAT GENERAL MANOVA				Newman-Keuls test; LOG_AN (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 2								
PHASE	LOCATION	SEASON		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				0.3262106	0.2800869	0.2707893	0.1155972	0.1274100	0.1007852	0.1236929	0.1028013	0.1068239
1	UN	....	(1)		0.004873*	0.002071*	0.000020*	0.000008*	0.000010*	0.000017*	0.000032*	0.000026*
1	PL	....	(2)	0.004873*		0.570218	0.000017*	0.000022*	0.000032*	0.000008*	0.000026*	0.000020*
1	CW	....	(3)	0.002071*	0.570218		0.000008*	0.000009*	0.000026*	0.000022*	0.000020*	0.000017*
2	UN	....	(4)	0.000020*	0.000017*	0.000008*		0.750858	0.802469	0.621065	0.714510	0.592152
2	PL	....	(5)	0.000008*	0.000022*	0.000009*	0.750858		0.581346	0.820462	0.560708	0.590411
2	CW	....	(6)	0.000010*	0.000032*	0.000026*	0.802469	0.581346		0.628438	0.902034	0.927801
3	UN	....	(7)	0.000017*	0.000008*	0.000022*	0.621065	0.820462	0.628438		0.578463	0.557838
3	PL	....	(8)	0.000032*	0.000026*	0.000020*	0.714510	0.560708	0.902034	0.578463		0.805987
3	CW	....	(9)	0.000026*	0.000020*	0.000017*	0.592152	0.590411	0.927801	0.557838	0.805987	

Appendix 3.30 Mean AN as Influenced by the Interaction between Phases and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_AN (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 3					
PHASE	LOCATION	SEASON		(1) 0.3543830	(2) 0.2303416	(3) 0.1099618	(4) 0.1192332	(5) 0.1138256	(6) 0.1083864
1	....	D	(1)		0.000009*	0.000017*	0.000022*	0.000008*	0.000020*
1	....	W	(2)	0.000009*		0.000008*	0.000009*	0.000022*	0.000017*
2	....	D	(3)	0.000017*	0.000008*		0.747442	0.761905	0.901694
2	....	W	(4)	0.000022*	0.000009*	0.747442		0.671533	0.830155
3	....	D	(5)	0.000008*	0.000022*	0.761905	0.671533		0.904602
3	....	W	(6)	0.000020*	0.000017*	0.901694	0.830155	0.904602	

Appendix 3.31. Mean AN as Influe ed by the Interaction between Locations and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_AN (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 2 X 3					
PHASE	LOCATION	SEASON		(1) 0.2245254	(2) 0.1524751	(3) 0.1736326	(4) 0.1665661	(5) 0.1800124	(6) 0.1389199
....	UN	D	(1)		0.000017*	0.000217*	0.000040*	0.000501*	0.000020*
....	UN	W	(2)	0.000017*		0.222447	0.270133	0.136011	0.288770
....	PL	D	(3)	0.000217*	0.222447		0.580251	0.617586	0.033389*
....	PL	W	(4)	0.000040*	0.270133	0.580251		0.543844	0.077553
....	CW	D	(5)	0.000501*	0.136011	0.617586	0.543844		0.011390*
.....	CW	W	(6)	0.000020*	0.288770	0.033389*	0.077553	0.011390*	

Appendix 3.32. Mean TSS as Influenced by Phases

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_TSS (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: PHASE		
PHASE	LOCATION	SEASON		(1) 2.133394	(2) 1.328534	(3) 1.043322
1	....	....	(1)		0.000009*	0.000022*
2	....	....	(2)	0.000009*		0.000009*
3	....	....	(3)	0.000022*	0.000009*	

Appendix 3.33. Mean TSS as Influenced by Location

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_TSS (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION		
PHASE	LOCATION	SEASON		(1) 1.499367	(2) 1.489344	(3) 1.516539
....	UN	....	(1)		0.813407	0.685896
....	PL	....	(2)	0.813407		0.797741
....	CW	....	(3)	0.685896	0.797741	

Appendix 3.34. Mean TSS as Influenced by Season

STAT. GENERAL MANOVA				Newman-Keuls test; LOG_TSS (anova2.sta) Probabilities for Post Hoc Tests MAIN EFFECT: LOCATION	
PHASE	LOCATION	SEASON		(1) 1.522958	(2) 1.480543
....	....	D	(1)		0.195078
....	....	W	(2)	0.195078	

Appendix 3.35. Mean TSS as Influenced by the Interaction between Phases and Locations.

STAT GENERAL MANOVA				Newman-Keuls test; LOG_TSS (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 2								
PHASE	LOCATION	SEASON		(1) 2.028722	(2) 2.068324	(3) 2.303136	(4) 1.219923	(5) 1.494447	(6) 1.271233	(7) 1.249456	(8) 0.9052611	(9) 0.9752489
1	UN	....	(1)		0.606872	0.001069*	0.000017*	0.000009*	0.000022*	0.000008*	0.000026*	0.000020*
1	PL	....	(2)	0.606872		0.002285*	0.000020*	0.000022*	0.000008*	0.000017*	0.000032*	0.000026*
1	CW	....	(3)	0.001069*	0.002285*		0.000026*	0.000008*	0.000017*	0.000020*	0.000010*	0.000032*
2	UN	....	(4)	0.000017*	0.000020*	0.000026*		0.002060*	0.782857	0.701202	0.000146*	0.001482*
2	PL	....	(5)	0.000009*	0.000022*	0.000008*	0.002060*		0.003733*	0.004166*	0.000020*	0.000017*
2	CW	....	(6)	0.000022*	0.000008*	0.000017*	0.782857	0.003733*		0.777221	0.000035*	0.000714*
3	UN	....	(7)	0.000008*	0.000017*	0.000020*	0.701202	0.004166*	0.777221		0.000052*	0.001080*
3	PL	....	(8)	0.000026*	0.000032*	0.000010*	0.000146*	0.000020*	0.000035*	0.000052*		0.363177
3	CW	....	(9)	0.000020*	0.000026*	0.000032*	0.001482*	0.000017*	0.000714*	0.001080*	0.363177	

Appendix 3.36 Mean TSS as Influenced by the Interaction between Phases and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_TSS (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 1 X 3						
PHASE	LOCATION	SEASON		(1) 2.120580	(2) 2.146208	(3) 1.364402	(4) 1.292667	(5) 1.083891	(6) 1.002753
1	....	D	(1)		0.668922	0.000009*	0.000022*	0.000008*	0.000017*
1	....	W	(2)	0.668922		0.000022*	0.000008*	0.000017*	0.000020*
2	....	D	(3)	0.000009*	0.000022*		0.231328	0.000029*	0.000008*
2	....	W	(4)	0.000022*	0.000008*	0.231328		0.000501*	0.000025*
3	....	D	(5)	0.000008*	0.000017*	0.000029*	0.000501*		0.175787
3	....	W	(6)	0.000017*	0.000020*	0.000008*	0.000025*	0.175787	

Appendix 3.37. Mean TSS as Influenced by the Interaction between Locations and Seasons

STAT GENERAL MANOVA				Newman-Keuls test; LOG_TSS (anova2.sta) Probabilities for Post Hoc Tests INTERACTION: 2 X 3					
PHASE	LOCATION	SEASON		(1) 1.482363	(2) 1.516371	(3) 1.504160	(4) 1.474528	(5) 1.582350	(6) 1.450728
....	UN	D	(1)		0.838036	0.716642	0.896210	0.342351	0.858212
....	UN	W	(2)	0.838036		0.838881	0.898361	0.271902	0.810219
....	PL	D	(3)	0.716642	0.838881		0.874448	0.394007	0.810201
....	PL	W	(4)	0.896210	0.898361	0.874448		0.376138	0.691869
....	CW	D	(5)	0.342351	0.271902	0.394007	0.376138		0.241446
....	CW	W	(6)	0.858212	0.810219	0.810201	0.691869	0.241446	