UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	URBAN STORMWATER MANAGEMENT
COURSE CODE	:	BFW40503
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS AN **ONLINE ASSESSMENT** AND CONDUCTED VIA **CLOSE BOOK**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) With the aid of a sketch diagram, discuss on the principles water quantity control in Urban Stormwater Management Manual (MSMA).

(4 marks)

(b) Bio-retention system is being proposed at a new residential area. As an engineer, explain briefly the implementation and limitations of the system.

(6 marks)

(c) Design a Best Management Practices (BMPs) treatment train using swale, wetlands and water quality pond shown in **FIGURE Q1(c)**, to reduce TSS by 80% from a residential sub-catchment, with an area of 18 ha. The average contributing impervious of the residential area is 80%. State your assumptions in the calculation. Refer **FIGURE Q1(c)(i)** for calculations.

(15 marks)

Q2 (a) As an engineer, you are asked to facilitate a client in designing detention pond. Briefly explain the design consideration in terms of general requirements, inlet and outlet.

(4 marks)

(b) With the aid of sketch, propose a complete rainwater harvesting system (RWHS) with their functions and important design considerations for a new commercial building by using five basic components.

(8 marks)

(c) A new flood study has been proposed at Site 2321006 Ladang Lendu, Melaka. By referring to the Urban Stormwater Management Manual in Malaysia, you are required to construct the hyetograph of the temporal pattern for 24-hour duration design rainfall with the return period of 100 years.

(13 marks)

Q3 (a) Urban stormwater management consists of planning, design, construction, and operation functions. With your own words, elaborate each component in detail with appropriate examples.

(8 marks)

(b) A grassed swale is proposed for a new project in Batu Pahat, Johor to convey design flow for a 10-year ARI minor system from sub-catchment A. The details are given in **TABLE Q3(b)** and **TABLE Q3(b)(i)**. As a water engineer, you are required to :

(i) Estimate peak flow, Q_p.

(2 marks)

(ii) Propose size of the trapezoidal swale.

(8 marks)

(iii) Sketch the cross section of swale.

(2 marks)

(c) Onsite detention is to be built in a very limited space. Design a simple composite storage system that is practical and commonly used.

(5 marks)

Q4 (a) As a flood mitigation engineer, you are assigned to sizing and designing stormwater quality control facility at the downstream of Sg. Kerayong catchment as shown in **FIGURE Q4(a)**.

(i) Compute the Total Suspended Solid (TSS), Total Nitrogen (TN) and Total Phosphorus (TP) annual loading (in tonne/year) generated from a 753.28 ha mixed development area. The mean annual rainfall for the catchment is 2850 mm. Refer **TABLE Q4(a)(i)** for calculation.

(12 marks)

(ii) Propose the preliminary size of a water quality pond required to reduce the TSS, TN & TP by 80%, 35% and 40%, respectively from the residential area (114.54 ha). The average runoff coefficient of the area is 0.55.

(13 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2021/2022 PROGRAMME : BFF
COURSE NAME : URBAN STORMWATER MANAGEMENT COURSE CODE : BFW 40503

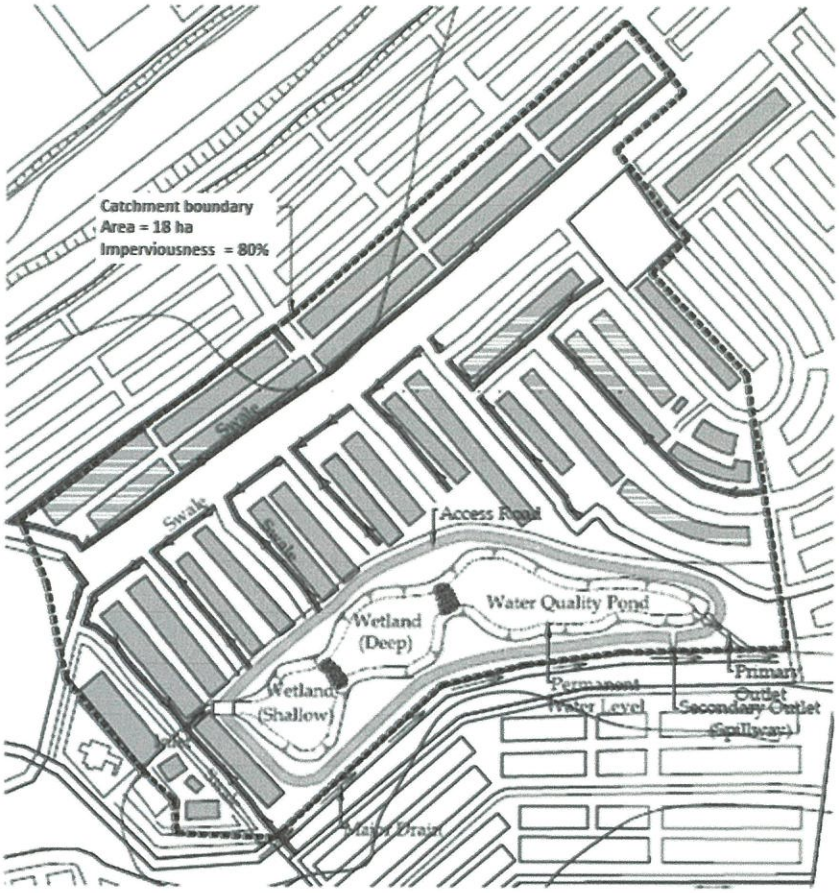

Figure Q1(c) Nomograph for Overland Flow Time

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2021/2022
COURSE NAME : URBAN STORMWATER MANAGEMENT
PROGRAMME : BFF
COURSE CODE : BFW 40503

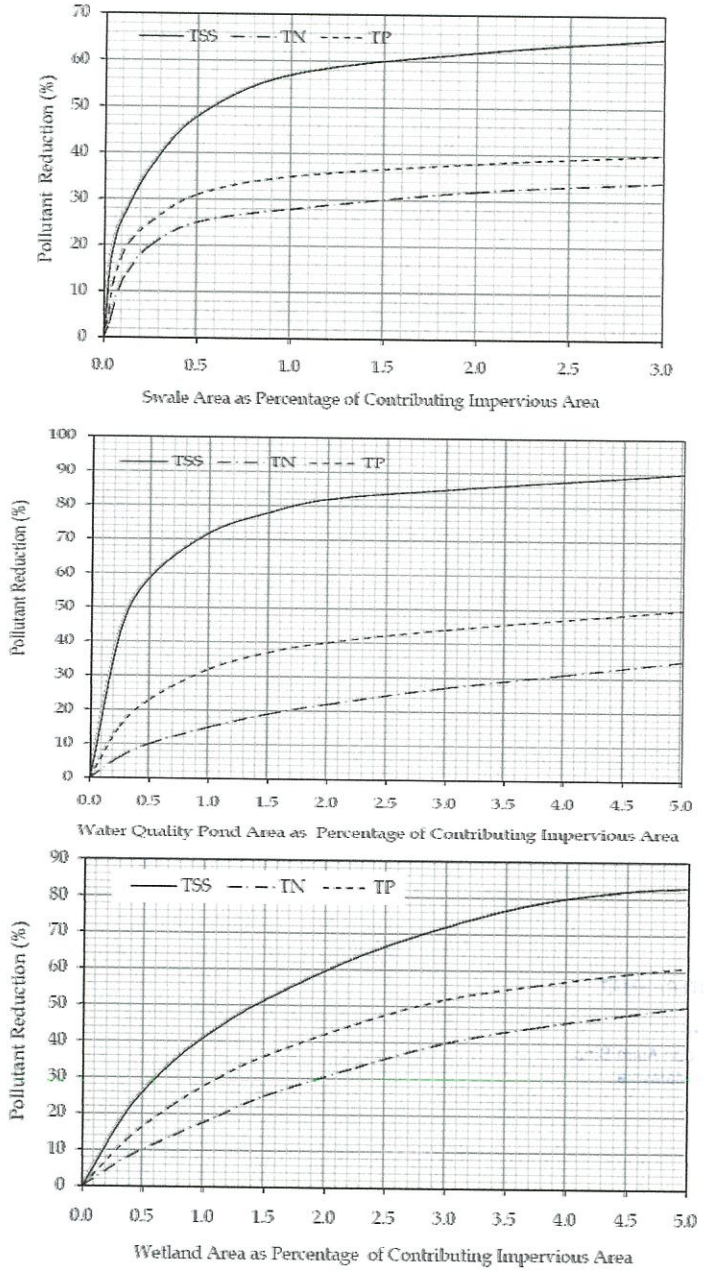

FIGURE Q1(c)(i)

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2021/2022 PROGRAMME : BFF
COURSE NAME : URBAN STORMWATER MANAGEMENT COURSE CODE : BFW 40503

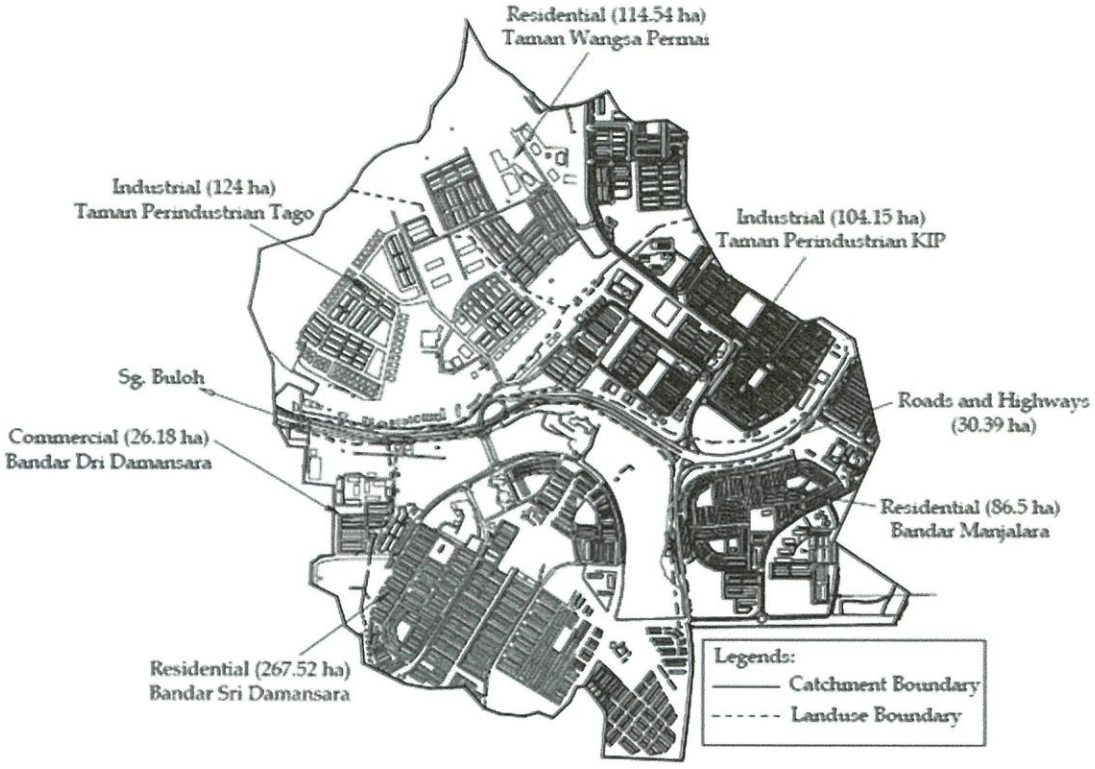

FIGURE Q4(a) Sg. Kerayong catchment area

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2021/2022 PROGRAMME : BFF
COURSE NAME : URBAN STORMWATER MANAGEMENT COURSE CODE : BFW 40503

TABLE Q4(a)(i) Mean EMC values and runoff coefficients for selected landuses

Pollutants		Landuses			
Parameter	Unit	Residential	Commercial	Industrial	Highway
TSS	mg/L	128.00	122.00	166.00	80.00
Turbidity	NTU	122.00	96.00	147.00	69.00
TDS	mg/L	131.00	43.00	137.00	38.00
pH	-	6.46	6.77	6.66	6.57
BOD	mg/L	17.90	22.90	19.30	14.90
COD	mg/L	97.00	134.00	140.00	81.00
AN	mg/L	0.73	0.85	1.00	0.44
TKN	mg/L	2.38	2.53	4.25	1.43
TN	mg/L	4.21	4.84	5.00	2.25
TP	mg/L	0.34	0.32	0.49	0.16
O&G	mg/L	2.00	4.00	NA	3.00
Zn	mg/L	0.19	0.34	0.43	0.21
Pb	µg/L	6.00	22.00	12.00	20.00
Cu	µg/L	28.00	37.00	42.00	28.00
Cr	µg/L	4.00	32.00	31.00	11.00
Ni	µg/L	10.00	17.00	30.00	15.00
Cd	µg/L	6.00	26.00	5.00	10.00

Source: Local stormwater studies conducted by DID in Malacca, Damansara, Penang and Kajang

Landuse	Runoff Coefficient (C)	
	For Minor System (≤10 year ARI)	For Major System (> 10 year ARI)
Residential		
Bungalow	0.65	0.70
Semi-detached Bungalow	0.70	0.75
Link and Terrace House	0.80	0.90
Flat and Apartment	0.80	0.85
Condominium	0.75	0.80
Commercial and Business Centres	0.90	0.95
Industrial	0.90	0.95
Sport Fields, Park and Agriculture	0.30	0.40
Open Spaces		
Bare Soil (No Cover)	0.50	0.60
Grass Cover	0.40	0.50
Bush Cover	0.35	0.45
Forest Cover	0.30	0.40
Roads and Highways	0.95	0.95
Water Body (Pond)		
Detention Pond (with outlet)	0.95	0.95
Retention Pond (no outlet)	0.00	0.00

Note: The runoff coefficients in this table are given as a guide for designers. The near-field runoff coefficient for any single or mixed landuse should be determined based on the imperviousness of the area.

EQUATIONS

$$Annual\ pollutant\ load = Mean\ annual\ rainfall \times EMC \times A \times C_v/100$$