UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

EAD 512/4 – Urban Drainage Management

Duration: 3 hours

Please check that this examination paper consists of **EIGHT (8)** pages of printed material including appendix before you begin the examination.

Instructions: Answer **FOUR (4)** questions. All questions carry the same marks.

You may answer the question either in Bahasa Malaysia or English.

All questions **MUST BE** answered on a new sheet.

Write the answered question numbers on the cover sheet of the answer script.

1. (a) List down **SIX (6)** main objectives of the New Urban Stormwater Management Manual (MSMA) for Malaysia and discuss **TWO (2)** of them. Use diagrams and sketches in order to assist your explanations.

[10 marks]

(b) Discuss **THREE (3)** main problems associated with Stormwater Issues which has not been able to overcome by the government so far. In your opinion, how does the new manual (MSMA) can reduced the impact of the problems.

[10 marks]

(c) Explain the state of the art of Bio-Ecological Drainage System in solving stormwater issue in this country.

[5 marks]

2. Determine the size of an above-ground storage for the proposed residential development in Georgetown, Penang. The area of the site is $700m^2$, an above-ground storage will be provided in the lawn area at the front of the site. The storage will be excavated into the lawn and a brick retaining wall constructed along the front and side boundary of the site. The primary outlet will be an orifice and secondary outlet consists of broad crested weir slot in the retaining wall. The site condition before development was park lawn. The surface runoff flows into the OSD via perimeter drain within the site consists as follows:-

Dwelling	$= 200m^2$
Garage	$= 45m^2$
Driveway	$= 45m^2$
Surface Paving and paths	$= 55m^2$
Lawns and Garden	$= 355m^2$

Note: Based the OSD by assuming $t_c = 45$ minutes, $t_{cs} = 30$ minutes, $t_d = 30$ minute, $C_d = 0.62$ and $C_{BCW} = 1.70$.

[25 marks]

3. (a) Briefly discuss the factors that should be considered in the design of detention pond.

[5 marks]

(b) Discuss on the **THREE (3)** approaches of control at source and the related devices for each approach.

[10 marks]

(c) Determined the preliminary estimate of the detention pond for 50 year ARI. The allowable inflow rate is $12m^3/s$ and the pond inflow hydrographs for 50 year ARI are given in the Table 1. Note that the pond inflow hydrographs are given as triangular hydrograph.

$$V_S = 1.291\ V_i\left(1 - \frac{Q_o}{Q_i}\right)^{0.753}\left(\frac{t_i}{t_p}\right)^{-0.411}$$

Table 1

Time (mins)	Storm Duration (mins)			
	30	45	60	75
	Pond Inflow (m^3/s)			
0	0	0	0	0
30	30			
40		25	21	
50				17
70	0			
90		0		
100			0	
130				0

[10 marks]

4. (a) Name **FIVE (5)** groups of gross pollutant trap (GPT) that could be used in Malaysia, and briefly describe their function.

[10 marks]

(b) Given a small urban catchment at Sg. Rokam, Rapat Setia in Ipoh, and the following information. Calculate the size required for an SBTR type 1 GPT to be installed to trap 70% of sediment ≥ 0.04mm diameter.

Catchment Area	= 113.8ha
Urban area	= 80%
Soil type	= 'silty sand'
Trap area ratio, R	= 0.8 E-4
Average annual sediment load from upstream	= 117,000kg
Peak flow at GPT site for 3 month ARI rainfall, $Q_{0.25}$	= 11.5 m^3/sec
Trap length, L_t	= 14.0m
Trash rack length, L_r	= 10.0m

[15 marks]

5. Given a study area in Penang with **TWO (2)** perimeter swale and information as shown in Figure 1,

Catchment area, A	= 6,500m^2
Landscape area	= 4,600m^2 (category 7)
Pavement area	=1,900m^2 (Category 1)
Overland sheet flow path length	= 35m
Reach length of perimeter swale	= 130m
Expected flow velocity in swale	= 0.25m/s
Bottom width for swale	= 1.8m
Manning n for swale	= 0.035
Side slope	= 1:6 (batter); 1:50 (base)
Longitudinal slope	= 1:1000
Freeboard	= 50mm

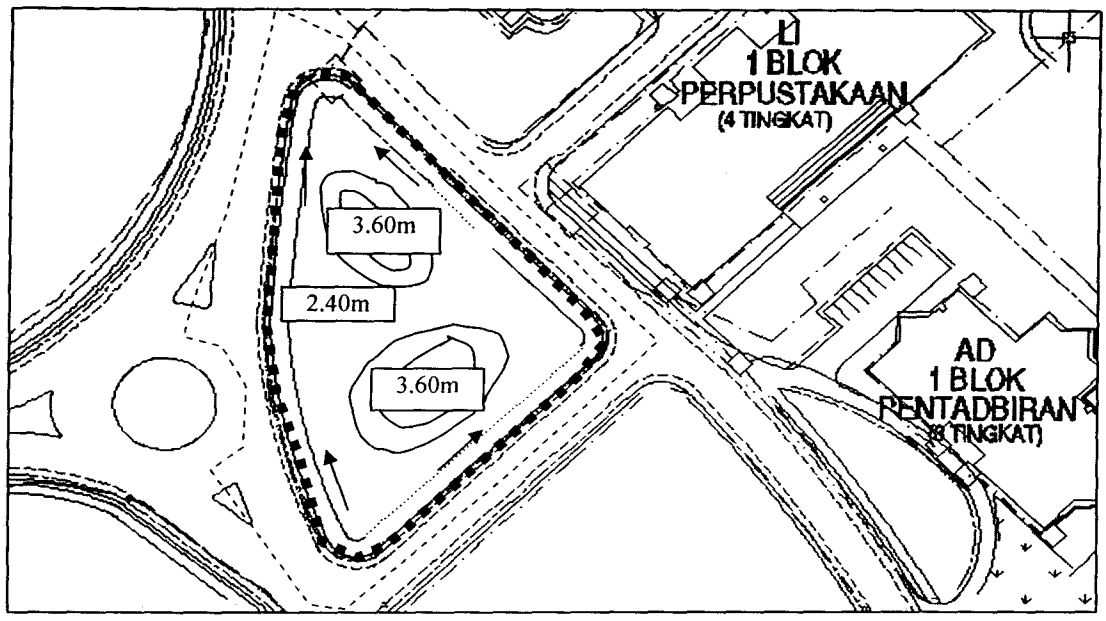

Figure 1

(a) Estimate the time of concentration for the study area.

[4 marks]

(b) Assume that the design is for a minor system with a design rainfall of 10 year ARI, Calculate the peak flow expected in the swales.

[14 marks]

(c) Calculate the size of the swales required to cater for the peak flow that might occur.

[7 marks]

APPENDIX

$$PSD = \frac{a - \sqrt{a^2 - 4b}}{2}$$

$$a = \left(4\frac{Q_a}{t_c}\right)\left(0.333t_c\frac{Q_p}{Qa} + 0.75t_c + 0.25t_{cs}\right)$$

$$b = 4Q_aQ_p$$

$$SSR = 0.06t_d(Q_d - c - d)$$

$$c = 0.875PSD\left(1 - 0.459\frac{PSD}{Q_d}\right)$$

$$d = 0.214\frac{PSD^2}{Q_d}$$

$$\ln({}^{R}I_t) = a + b\ln(t) + c(\ln(t))^2 + d(\ln(t))^3$$

$$D_t = 0.0065 \times P_{0.01^*} \times M / A_t$$

$$H_r = 1.22\left(\frac{Q_{0.25}}{L_r}\right)^{2/3}$$

$$V_{0.25} = \frac{Q_{0.25}}{(D_w + H_r)W_t}$$

Coefficients of the Fitted IDF Equation for Penang

ARI (years)	a	b	c	d
2	4.5140	0.6729	-0.2311	0.0118
5	3.9599	1.1284	-0.3240	0.0180
10	3.7277	1.4393	-0.4023	0.0241
20	3.3255	1.7689	-0.4703	0.0286
50	2.8429	2.1456	-0.5469	0.0335
100	2.7512	2.2417	-0.5610	0.0341

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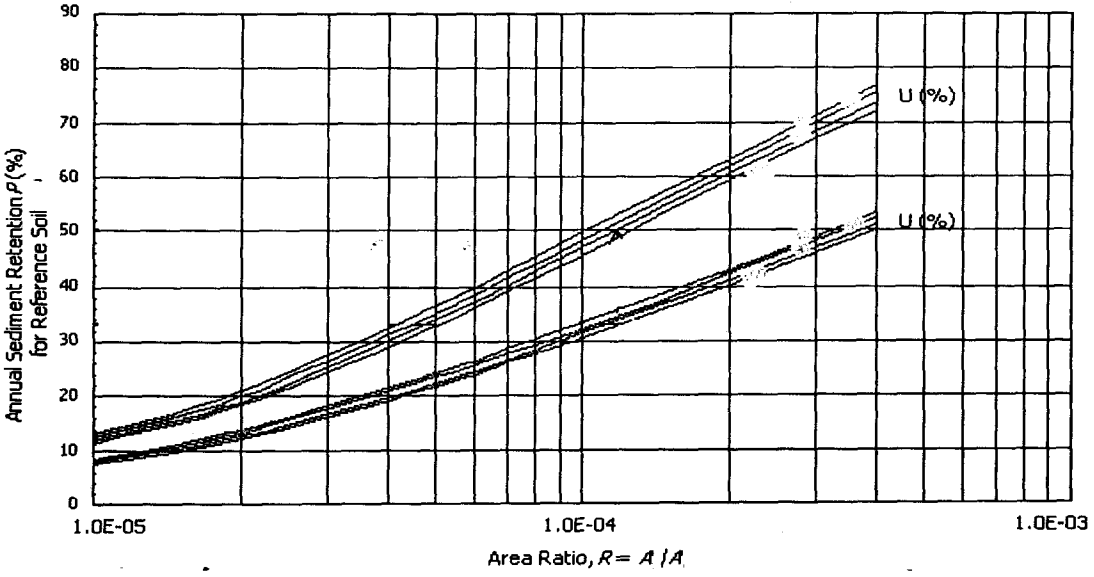
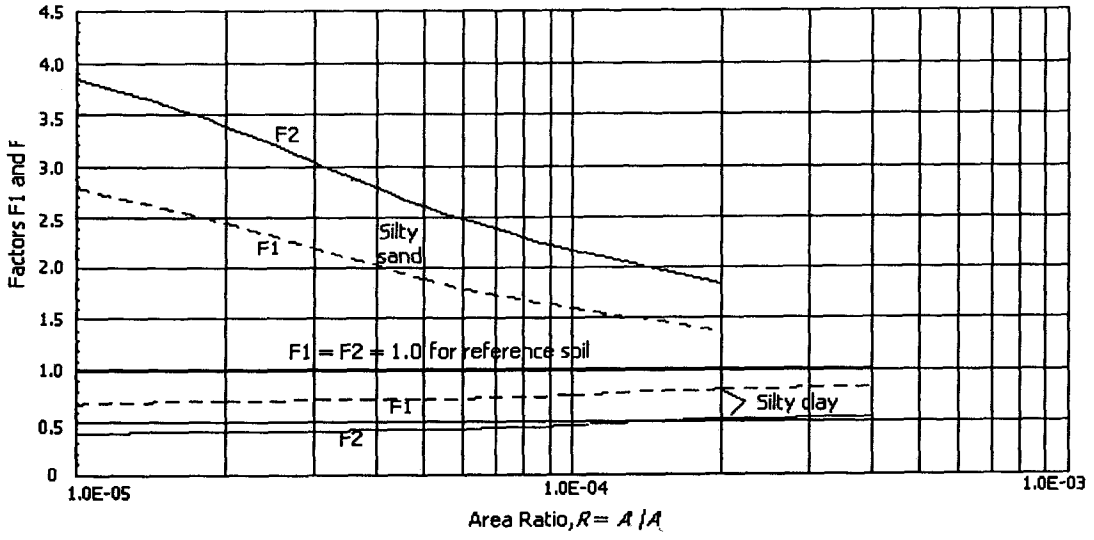
Duration (minutes)	$^2P_{24h}$ (mm)				
	West Coast				East Coast
	≤ 100	120	150	≥ 180	All
5	2.08	1.85	1.62	1.40	1.39
10	1.28	1.13	0.99	0.86	1.03
15	0.80	0.72	0.62	0.54	0.74
20	0.47	0.42	0.36	0.32	0.48
30	0.00	0.00	0.00	0.00	0.00





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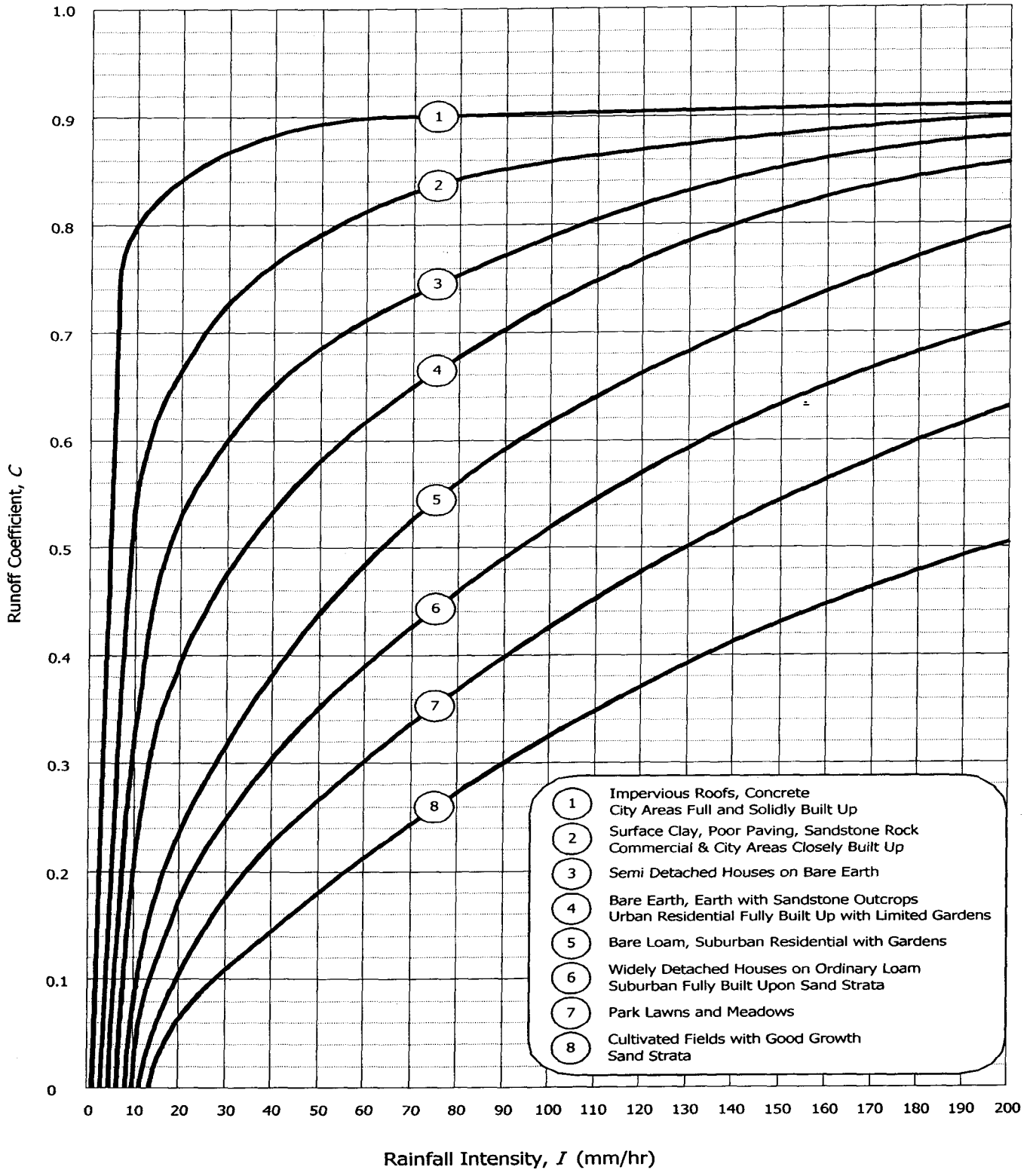

The Runoff Coefficient for Urban Catchment

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