Akademika, No. 10, January 1977, 37–48.

CURRENT STATE OF THE ENVIRONMENT WITHIN AND AROUND KUALA LUMPUR—PETALING JAYA: A REVIEW

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SINOPSIS

Perkembangan urbanisasi yang pesat di Kuala Lumpur–Petaling Jaya dan kawasan Lembah Kelang amnya telah menimbulkan beberapa masalah. Makalah ini memberikan sedikit gambaran tentang keadaan sekarang berhubung dengan kualiti alam-sekitar di kawasan Kuala Lumpur–Petaling Jaya. Ulasan mengenai kerja-kerja yang telah dijalankan dalam bidang pencemaran udara dan air, pembuangan sisa, dan hakisan dan banjir juga diberikan.

SYNOPSIS

Rapid urbanization within Kuala Lumpur–Petaling Jaya and the Kelang Valley generally has given rise to many problems. This paper outlines the current situation with regard to environmental quality in Kuala Lumpur–Petaling Jaya and reviews some of the work done in air and water pollution, waste disposal, and erosion and flooding.

In the mid-nineteenth century, Kuala Lumpur was only a tin mining site at the confluence of the Kelang and Gombak rivers. One hundred years later and especially after independence, it has expanded rapidly as the capital of Malaysia. In 1970, metropolitan Kuala Lumpur contained 43 percent of the population of Selangor, and 8 percent of the populaton of Peninsular Malaysia[1]. Today, Kuala Lumpur is the most important urban centre in the Kelang Valley and forms a major part of the 'Superlinear City' within the Kuala Lumpur–Port Kelang conurbation (Figure 1). The ever increasing demand for suburban housing close to Kuala Lumpur has resulted in the growth of Petaling Jaya, Sg. Way–Subang, Subang Jaya and the Ampang–Ulu Kelang New Town, all of which are connected to Kuala Lumpur in one way or the other.

The rapid growth of Kuala Lumpur and the other emerging urban centres around it has generated a number of problems. Some are common to cities the world over, but others are more typical of cities in tropical or

1 R.J. Pryor, 1973. 'The changing settlement system of West Malaysia' *Journal of Tropical Geography*, v. 37, p. 53–67.

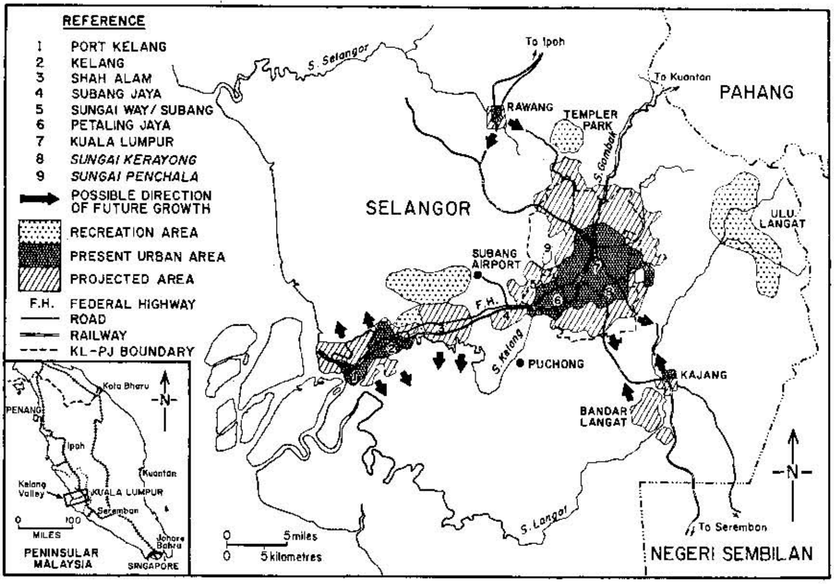

Figure 1: Kuala Lumpur–Petaling Jaya and its relation to other urban centres within the Kelang Valley (after Aiken & Leigh, 1975).

developing countries, or reflect specifically the local physical setting. This paper examines some of the major impacts of this growth as they relate to environmental quality particularly air and water pollution, waste disposal, and erosion and flooding.

AIR POLLUTION

One consequence of the expansion of Kuala Lumpur and the other urban centres within the Kelang Valley is the increase in the number of road vehicles. Aiken & Leigh[2] reported that between 1965 and 1973, the number of vehicles registered in the State of Selangor was more than doubled. In eastern Petaling Jaya, five miles from the centre of Kuala Lumpur, the average daily flow of vehicles along the Federal Highway increased from approximately 67,000 in 1969 to 80,000 in 1972, and to more than 90,000 in early 1974[3]. This route will probably become more congested with the development of Subang Jaya and Shah Alam, and the continued expansion of Kelang and Port Kelang. Indeed, massive traffic jams have now become a common feature within the city particularly during rush hours.

2 S.R. Aiken & C.H. Leigh, 1975. 'Malaysia's emerging conurbation' *Annals of the Association of American Geographers*, v. 65, n. 4, p. 546–563.
3 *The Sunday Mail*, April 7,1974.

The near total dependence on the automobile results in high level emissions of carbon monoxide (CO), sulphur dioxide (SO_2), hydrocarbon (HC) and oxides of nitrogen (NOx). Hydrocarbon and nitrogen oxides are particularly important in that they form the primary pollutants involved in what is known as 'photochemical smog'. When these primary pollutants are together in the presence of sunlight, a partially understood complex series of reactions takes place which results in the formation of various harmful secondary pollutants, including nitrogen dioxide (NO_2), ozone (O_3), and peroxyacetyl nitrate ('PAN'; $CH_3CO_3NO_2$). Ozone and PAN are usually referred to as 'photochemical oxidants'. The reactions which take place during the formation of photochemical smog have been summarized by Masters[4] and shown in Figure 2.

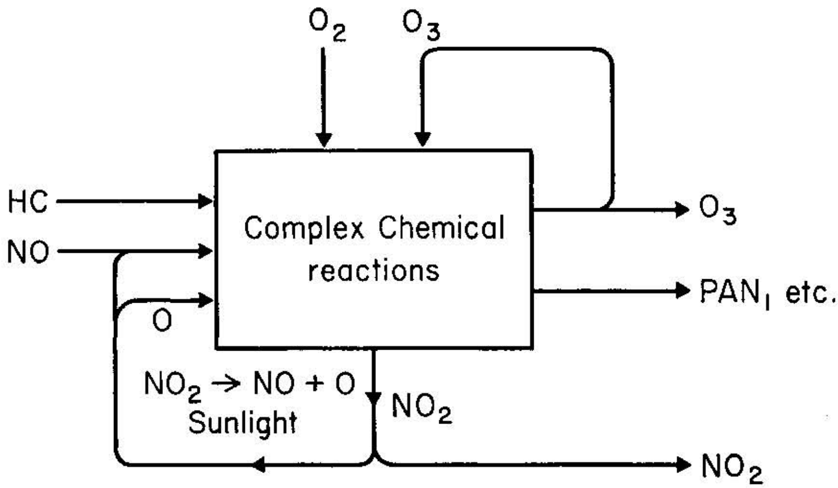

Figure 2: Summary of the photochemical reactions (source: Masters, G.M. 1974, p. 178)

One of the effects of photochemical air pollution is eye irritation. Ozone itself is not an eye irritant, but when it reacts with hydrocarbons, irritating substances such as formaldehyde, peroxybenzoyl nitrate, PAN, and acrolein can result. Ozone can cause chest constriction, irritation of the mucous membranes, headache, coughing, and exhaustion. It also causes damage to organic materials such as rubber, cotton, acetate, nylon, and polyester. Oxidants have been associated with increases in asthma attacks and can also cause serious damage to plants, resulting in such symptoms as leaf lesions and reduced plant growth.

4 G.M. Masters, 1974. *Introduction to Environmental Science and Technology*, John Wiley & Sons, p. 178.

Industries also form a major source of air pollution although very little is known about their specific contribution to the total pollutants. Sham[5], based on data collected using the candle peroxide method, however, has shown that the sulphur dioxide concentration within a one-mile radius from the Malayan Acid Works in Petaling Jaya is generally below the levels which are known to be adverse to human health. Nevertheless, certain adverse levels affecting health and vegetation have already been reached particularly near the Acid Works: a monthly concentration of 0.06 p.p.m. had been recorded at the Works during 1972–74.

Fallout from quarry and cement works represent somewhat bigger problem particularly to those living within a half-mile radius of Batu Caves. An analysis of the 1972–74 data indicates that the mean monthly dustfall within approximately two-mile radius from the Batu Caves was 34 tons/mile^2/month; the Hindu Temple which is nearest the source recorded a fallout concentration exceeding 92 tons/mile^2/month[6]. This is well above the proposed figures for the Malaysian ambient air quality standards which are 8.0–10.0 tons/mile^2/month for residential zone; 15.0 tons/mile^2/month for common zone; and 30.0 tons/mile^2/month for industrial zone[7]. Sham[8] further observes that a tongue of relatively high concentration occurs WSW of the source area along the railway line and the main north road to Ipoh. He attributes this to the physical barrier as well as to the deflection of the prevailing westerly winds by the limestone hills at the source area.

Aspects of the morning mixing depths, wind speeds and air pollution potential in the Kuala Lumpur area have been discussed by Sham[9]. He indicates that the ventilation volume (mixing depth X wind speed) at Kuala Lumpur is on the average much lower compared to that of either Pittsburgh, New York or Los Angeles. This suggests that from the meteorological point of view, at least, the community air pollution problems in Kuala Lumpur can be much more difficult than even those of Los Angeles. This is significant especially when the condition for high air pollution potential coincides with the morning traffic rush.

Pollution does not however stop with the atmosphere. When it rains the contaminants are normally brought down to the ground and these, along with the other effluents, create yet another form of pollution: the water pollution.

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5 S. Sham, 1976 (a). 'Sulphur dioxide concentration patterns in and around an industrial section of Petaling Jaya, Selangor' *Sains Malaysiana*, v. 5, n. 1, p. 15–26.
6 S.Sham, 1976 (b). 'Spatial distribution of dustfall concentration around Batu Caves, Selangor' *Sains Malaysiana*, v. 5, n. 1, p. 39–48.
7 Aziz Ahmad, the Director-General Factory and Machinery Department Malaysia, *Personal Communication*.
8 S.Sham, 1976 (b,) see footnote 6.
9 S.Sham, 1976. 'Morning mixing depths, wind speeds and air pollution potential in the Kuala Lumpur area' *Sains Malaysiana*, v. 5, n. 1, p. 27–38.

WATER POLLUTION

Certain water courses in Kuala Lumpur–Petaling Jaya and in the Kelang Valley had been known to be chemically polluted even before the recent urban expansion[10]. Water samples taken during 1958 and 1959 from Gombak River showed moderate to severe organic pollution. Biochemical Oxygen Demand (BOD) reached levels as high as 9.6 p.p.m., and Dissolved Oxygen content (DO) values as low as 3.9 p.p.m. In contrast, the upper Gombak River consistently gave DO values exceeding 4.8 p.p.m., and BOD values of less than 1.3 p.p.m.[11]. Klein[12] suggests that water with BOD of less than 5.0 p.p.m. is relatively unpolluted, from 5.0 to 10.0 p.p.m. doubtedful, and above 10.0 p.p.m. badly polluted. In relatively unpolluted waters the DO content will not fall below 4.0 p.p.m.

Nearly all industrial waste waters in Kuala Lumpur–Petaling Jaya are disposed of by one of two methods: (a) discharge to a watercourse, with or without pretreatment; (b) discharge to a municipal sewerage system, with or without pretreatment. Of the other industrial wastes, those that are particularly strong may be evaporated prior to burning or dumping on land[13]. However, by and large, most industrial waste waters are discharged untreated into surface drains or directly into the river system. In Petaling Jaya alone, 90 percent of the factories discharge wastes directly to the Kelang River system[14]. Studies carried out by the Selangor Environmental Protection Society[15] indicate that the BOD of the water in Sg. Kelang increases from below 4.0 p.p.m. at its source to 11.3 p.p.m. at the centre of Kuala Lumpur just before its confluence with Sg. Gombak. The value increases to 20.0 p.p.m. as it flows through Kuala Lumpur and Petaling Jaya. The DO value decreases from 2.8 p.p.m. at the centre of Kuala Lumpur to 0.5 p.p.m. at Puchong. Results obtained from Sg. Kerayong, a tributary of Sg. Kelang, suggest that the river is very polluted; at times no oxygen was detected in the river. The corresponding BOD was high reaching a value of 65.0 p.p.m. Samples taken from Sg. Pencala indicate that there was no dissolved oxygen at any time. The BOD was high with an average value of 106.0 p.p.m. This river drains the whole of Petaling Jaya and carries considerable quantities of industrial wastes together with septic tank effluent.

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10 S.R. Aiken & C.H. Leigh, 1975. see footnote 2, p. 557.
11 R.C. Norris & J.I. Charlton, 1962. *A Chemical and Biological Survey of the Sg. Gombak*, Government Printer, Kuala Lumpur.
12 L.Klein, 1966. *River Pollution III: Control*, Butterworth, London, p. 383–386.
13 D.Balfour & Sons, 1974. *Draft Final Report of A Master Plan for Sewerage and Sewage Disposal for Kuala Lumpur and Environs*, 3 volumes (unpublished).
14 *The Straits Times*, March 13,1973.
15 Selangor Environmental Protection Society, 1976. 'A study of the extent of pollution of the Sg. Kelang and its main tributaries' *Alam Sekitar*, v. 1, p. 26–33.

The Environmental Quality Act of 1974 contains clauses designed to limit water pollution by industry, but these cannot be effectively enforced until water quality standards are specified.

Tests on samples from major categories of industrial pollutors in the Kuala Lumpur–Petaling Jaya area suggest that the greatest pollution loads come from factories which operate for 24 hours/day with large regular or irregular discharges although only less than 7.0 percent of the factories belong to this category (Table I)[16]. The percentage contribution of BOD, COD (Chemical Oxygen Demand), SS (suspended solids), and toxic and deleterious substances by the different categories of pollutors is shown in Table II.

WASTE DISPOSALS

Water pollution and industrial waste water represent only one problem of an ever-increasing urbanization. Kuala Lumpur–Petaling Jaya faces another problem, one of human waste and waste waters.

In Kuala Lumpur, a water-borne sewerage system was brought into operation in 1958 and, together with the extensions constructed since, an estimated population of 150,000 out of a total population of 500,000 is now served by the system. Domestic sewage is given a primary treatment at the Pantai Sewage Treatment Works before being discharged into the Sg. Kelang. Approximately 11,000 septic tanks are in use with in the former city boundary, serving a population of about 75,000. The sewerage system and the septic tanks were designed to accept both foul and sullage water, as required by the City by-laws.

In Petaling Jaya, all foul wastes from the population of approximately 94,000, drain either to septic tanks or to Imhoff tanks; the septic tanks normally serve individual properties while the Imhoff tanks treat flows from group of properties such as rows of shophouses and Government housing areas. Whilst the by-laws require that the sullage water be connected to the septic tanks and Imhoff tanks, the latter were not designed to accept these flows and all sullage water is discharged into the surface water drains.

In addition to those served by a water-borne system, almost 50 percent of the population have to use much less satisfactory systems. The 1970 census recorded that 206,000 persons used the night soil bucket system; over 200,000 persons used pit or over-water latrines, and there were others for whom the facility used was not recorded, although it is probable that in most of these cases there was no facility available[17].

16 D.Balfour & Sons, 1974. see footnote 13.
17 Figures were quoted from D.Balfour & Sons, 1974. see footnote 13.

TABLE 1: A SUMMARY OF THE IMPORTANT POLLUTION LOADS FROM INDUSTRIES IN KUALA LUMPUR AND PETALING JAYA

	Kuala Lumpur area					Petaling Jaya area				
Classification	No. of establishments sampled	BOD (Ibs/day)	COD (Ibs/day)	SS (Ibs/day)	Flow '000gal/day	No. of establishments sampled	BOD (Ibs/day)	COD (Ibs/day)	SS (Ibs/day)	Flow '00gal/day
Category 1	10	16,528	45,191	11,036	3,049	18	11,250	18,760	15,180	884
2	11	472	863	218	363	29	1,320	1,177	1,250	661
3	10	301	354	113	52	40	452	984	679	517
4	6	7	3	24	12	21	13	22	51	75
5	354	95	113	140	263	38	4	22	25	48
Total	391	17,404	46,523	11,530	3,738	146	13,039	22,378	17,185	2,184

Category: 1. Major Pollutors — Factories operating for 24-hour/day with large regular or irregular discharges.
2. Significant Pollutors — Factories similar to those in category I but generally operating for 8–12 hours/day.
3. Small Pollutors — Generally factories having small, uniform flows of waste water.
4. Minor Pollutors — Basically factories with dry processes and low water usage.
5. Insignificant Pollutors — Factories with no industrial waste water discharge e.g. canteen facilities.

(Source: Balfour & Sons, 1974)

TABLE 2: DISTRIBUTION OF POLLUTION LOADS AMONG FIVE CATEGORIES OF INDUSTRIAL POLLUTORS IN KUALA LUMPUR—PETALING JAYA

Characteristics	% of characteristics attributable to factors in categories**			
	1	2	3	4 and 5
BOD	94.2	4.0	1.4	0.4
COD	93.2	5.1	1.2	0.3
SS	88.2	8.3	2.5	0.9
toxic and deleterious substances	87.1	11.5	1.4	*

* negligible
** categories are similar to those given in Table I
(Source: Balfour & Sons, 1974)

Several authorities are employed in the collection of night soil and many methods used for its disposal. The Urban Services Department of City Hall collects nightly soil from over 6,000 buckets from all areas within the former city boundary except for Kg. Datuk Keramat, Ulu Kelang, Kg. Pandan Luar, and Ayer Panas. Several purpose-made tankers operate the service and the night soil collected is transported to the Pantai Sewage Treatment Works for treatment. A private contractor is employed by the Urban Services Department to collect night soil from a total of over 1,400 buckets located in Dato Keramat, Ulu Kelang, Kg. Pandan Luar and Ayer Panas which are subsequently discharged at the Pantai Sewage Treatment Works. A number of local councils provide services to their own areas. The extent of the service provided is often determined by the resources of the authority and the importance they attach to the collection and disposal of night soil in relation to the other services provided.

In the squatter areas where there are over 16,000 night soil buckets in 1970, no night soil collection is made from them by any of the authorities[18]. Collection within these areas is generally carried out by a private contractor under individual arrangements made with each household. There are no records of the methods of disposal employed but it would appear that whilst some trenching is employed, the most frequent method is to discharge the night soil into a river or stream or disused mining pools.

It can be seen therefore, that the night soil collection and disposal systems described above are crude and unhygenic methods of disposing of

18 D.Balfour & Sons, 1974. see footnote 13.

human excrement. Similarly, the use of pit and over-water latrines are unhygenic methods of disposal which, as well as causing fly and odour problems, can result in the pollution of ground water and river system. Also night soils may contain pathogenic organisms. Direct contact with night soil in the household, by the night soil collection workers and in the fields where it is dumped or used as fertilizer, together with indirect contact through uncooked vegetables, vermin and flies, exposes the population to serious health risks.

Population growth has had an equally dramatic impact in the area of solid waste disposal. This factor is coupled with the fact that as society becomes more affluent, the volume of materials it discards also becomes greater. Figures obtained over the past years indicate that the quantity of refuse disposed of per day ranges from about 2.0 Ibs/head of population in European countries to 4.0 or 5.0 Ibs/head per day in the United States[19].

Information on the quantities of refuse and other solid wastes in the Kuala Lumpur–Petaling Jaya area are meagre. However, Lee[20] indicated that the amount of refuse in Kuala Lumpur as collected by the municipal vehicles had increased from about 150 tons/day in 1967 to about 270 tons/day by end of 1975. He envisaged that the extension of the refuse collection services to the Federal Territory during 1975 would increase the quantity collected to about 400 tons/day. Balfour & Sons[21], using refuse generation ratios of 1.0 and 1.2 Ibs/person/day for 1975 and 1985 respectively, suggest a figure of 305 tons/day for 1975 and 600 tons/day for 1985.

Officials of the Public Health Department of Petaling Jaya Town Board estimate that, on the average, about 80 tons/day of refuse are collected from the Petaling Jaya area alone. There are no records from which reliable estimates can be made of the quantities of waste collected by contractors from commercial and industrial premises.

Both figures given by Lee for Kuala Lumpur and those given by the Petaling Jaya Town Board do not, of course, include those collected by private contractors from new housing estates. No records are available from these sources.

In a survey carried out by the City Hall[22] it was found that about 70 percent of the houses in Kuala Lumpur did own decent acceptable refuse bins whilst the rest used a varied assortment of cans, tins, and paper bags as refuse receptacles. Most shops in the commercial area favour the use of 44-gallon oil drums. Although the Municipal by-laws stipulate that the owner of every house shall provide and maintain in good order a sound,

19 N. Y. Kirov, 1968. 'Refuse disposal—a growing world problem' *Clean Air*, v. 2, p. 7–12.
20 H.S. Lee, 1975. 'Urban services in the City of Kuala Lumpur with particular emphasis on solid wastes' (unpublished).
21 D.Balfour & Sons, 1974. see footnote 13.
22 H.S. Lee, 1975. see footnote 20.

covered dustbin of a capacity of not more than 3 cubic feet and of a pattern and material approved by the authority, it is most difficult to enforce this law particularly in the low income group.

The City Hall itself maintains a network of about 2900 round bins of capacity 1½ cubic yards each which are placed 'strategically' all over the city. These are however becoming obsolete and more often than not unhygenic. Normally baskets of refuse have to be lifted above the bin rim, which is 5 feet above the ground and often spillage occurs with a tendency for heavy baskets to be emptied on the ground. Also, the large bins have no covers to keep rain off the contents, which are also accessible to flies and vermin and give off a very strong smell. This is indeed very disturbing particularly when these bins happen to be close to open air restaurants and eating stalls. New large bins of a conveniently low height are however being introduced in order to minimize spillage. Besides the 2900 round bins, the City Hall also maintains a network of some 1500 little bins concentrated particularly in areas where people congregate e.g. bus stops, parks and open spaces. However, because of the attractive designs and ease of removal they have become the target of much petty thieving.

At present, method of refuse disposal in Kuala Lumpur and Petaling Jaya is by controlled tipping. The dumping sites are at Salak South, 3¾ Mile Jalan Sg. Besi (for Kuala Lumpur) and at Sg. Way (for Petaling Jaya). Besides these official tips there are numerous instances of unofficial tips developing and of flagrant wayside dumping of rubbish.

Refuse disposal by controlled tipping can be both cheap and useful provided, of course, the process is carried out in accordance with well-established principles. However, where landfill operations are not as carefully controlled as is desirable, odours of partly decomposed refuse can become very offensive in the neighbourhood of the tip and inadequate compaction and covering of refuse leads to infestation by flies and vermin.

EROSION AND FLOODING

Erosion and flooding are generally observed to increase, often dramatically, when areas under natural vegetation or agriculture are converted to urban use. The impact of urban development upon stream discharges and suspended sediment loads in mid-latitude areas is relatively well-documented, and hydrological models, essential for the design of appropriate structures, have been established for many large urban complexes[23]. Comparable data for urban areas in the humid tropics are limited, but the effect of injudicious human activities probably will be more pronounced

23 D.G. Anderson, 1970. *Effect of Urban Development on Floods in Northern Virginia*, Water Supply Paper No. 2001–C, Washington, D.C., U.S. Geological Survey; and M.G. Wolman, 1967. 'A cycle of sedimentation and erosion in urban river channels' *Geografiska Annaler*, v. 49A, p. 385–395.

than in many mid-latitude areas due to the deeply weathered regolith, high rainfall totals, and the frequency of high intensity storms[24].

Agricultural land around Kuala Lumpur and Petaling Jaya, particularly land under rubber, is frequently allowed to deteriorate in anticipation of urban development[25]. When terraces and cover crops are not well maintained, small rills and gullies begin to form. The efficiency of the drainage system is enhanced, and greater quantities of water and sediment reach the rivers after rain. More pronounced changes occur when development begins. It is common practice to remove all vegetation from large tracts of land before construction is commenced. Erosion need not be serious if sites are carefully prepared and construction proceeds rapidly, but frequently large areas are cleared and left bare for long periods, sometimes exceeding a year. In such cases, the soil is exposed to the full impact of the rain, and erosion can be severe, even on relatively gentle slopes.

High sediment loads have been recorded in streams draining areas undergoing development. A small stream draining a housing development area in Bangsar Height was reported to have a suspended sediment concentration of 80,000 p.p.m. at peak discharge following a storm of very high intensity, whereas a nearby tributary draining an area under cultivation had low flow concentration of less than 10 p.p.m.[26].

Prior to the introduction of the Municipal and Town Board (Amendment) Act in early 1975, there were few constraints upon land developers to ensure that erosion from construction sites was minimized, and that drainage ways which had become choked with sediments were cleared. This Act requires developers to submit detailed plans to Government appointed bodies before site preparation and construction can commence.

An increase in localized flooding within the built-up areas in recent years can also be directly attributed to urban development and to attendent increases in peak discharges. Higher flood peaks exceed the capacity of natural drainage channels and storm drain networks, particularly those which have become choked with sediments and debris. The storm drain networks in some new suburban areas are also inadequate to cope with high intensity storms[27].

CONCLUSION

The rapid urban growth within and around Kuala Lumpur–Petaling Jaya has given rise to many problems relating to the environment. Certain water courses are already badly polluted and need serious attention, while

24 S.R. Aiken & C.H. Leigh, 1975. see footnote 2.
25 I.Douglas, 1972. *The Environment Game*, Armidale, Australia, p. 1–23.
26 I.Douglas, 1972. see footnote 25.
27 H.C. Lee, 1972. 'Storm water drainage of housing estates' *Journal Technical Association of Malaysia*, v. 22, p. 23–34.

air pollution, although still highly localized in nature, is now slowly becoming a hazard. In the Batu Caves area, dustfall concentrations have far exceeded even the standards recommended for heavy industries. The ever increasing number of road vehicles and traffic congestion following the expansion of Kuala Lumpur provides a good potential for photochemical smog formation particularly when coupled with an abundant supply of sunshine. Population growth has had an equally dramatic impact in the area of waste disposal particularly that of sewage and sullage water. The magnitude of the problems has been well-documented[28]. Erosion and localized flooding within the built-up areas in recent years also represent another problem which is generally related to urban developments.

Each one of these problems need careful attention. However without the co-operation of the public, not even the best strategy of environmental conservation can be completely successful. Public education and awareness must be cultivated in order to ensure a well-conserved environment.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. Sanusi Jangi, Biology Department, Universiti Kebangsaan Malaysia, for reading the script. The diagrams were drawn by the Cartographic Section, Department of Geography, Univesiti Kebangsaan Malaysia, Kuala Lumpur.

28 D.Balfour & Sons, 1974. see footnote 13.