CHAPTER 4
AIR, WATER AND NOISE POLLUTION

AIR POLLUTION

The air pollution problem in the Klang Valley has become a serious concern particularly when it is recognised that it has a high potential for air pollution because of its inherent topography (Sham 1979). Early investigations on the air quality show a clear deterioration which is associated with particulate matter and gaseous emissions from motor vehicles. Studies on air pollution in the Klang Valley are relatively well documented (Sham 1979, Sham 1984a, Sham 1984b, Chow & Lim 1984, Sham 1987a, 1987b, Lim & Leong 1991; Sham *et al.* 1991, Zainal Abidin *et al.* 1993, Malaysia Meteorological Service 1995. A discussion of the air pollution problem in the Klang Valley will be presented in the next sections.

Air Pollution Sources

Transport vehicles and industrial emissions are the major sources of pollutants in the Klang Valley atmosphere, a problem that has been aggravated by the tremendous increase in the number of mobile sources.

A study conducted by the Klang Environmental Improvement Project in 1987 indicated that the situation in the Valley is likely to continue for sometime even if control measures are started straight away, especially as the number of motor vehicles is expected to continue to increase. Moreover, electric power generation and industries (based on combustion processes) are also increasing. Studies have also shown that domestic open burning, construction-originated wind-blown dust, solid waste disposal and incineration are all important sources of pollution in the Klang Valley (Sham *et al.* 1991).

The best estimate of air pollutant emissions for the Klang Valley was given by the Klang Valley Environmental Improvement Project report in 1987. It was estimated that the total pollutant emission was about 433,400 tonnes per year (Sham *et al.* 1991), of which transport accounted for 78.7%, contributing the greatest share of SPM, CO, HC and NO. SPM levels were also found to be significantly influenced by open burning of waste and biomass.

Air Pollution Levels

In their review of the air quality monitoring in the Klang Valley area, Zainal Abidin *et al.* (1988) stated that air quality monitoring was first carried out by the Division of Environment in 1977.

This work consisted mainly of short surveys, which produced limited data and subsequently limited analysis. Even though most of these studies suffered from the absence of smaller time interval sampling, they did give a useful insight on the air quality in the country. The monitoring was divided into two periods, the "early years" (1978-1982) and the "later years" (1983 onwards).

In the early years, the first long term air monitoring was carried out at an industrial and residential zone in Petaling Jaya in the Klang Valley in 1978. Total suspended particulate (TSP) and sulphur dioxide were the measured parameters. Results revealed that for TSP, the proposed standard (a 24-hour average of 0.1 mg/m^3 for industrial zone and 0.05 mg/m^3 for non-industrial zone) was exceeded 93% of the time at the industrial zone and 95% of the time at the residential zone. Carbon monoxide levels in Kuala Lumpur were also reported to exceed the proposed standard, even though the proposed standard for sulphur dioxide was never exceeded. These were the first indications of air quality deterioration in this area.

In the later years, the air quality over most of the areas monitored in 1983 failed 50% of the time or more to comply with the proposed standard for TSP of 0.075 mg/m^3 (24-hour average), while the proposed standard for SO_2 of 0.05 mg/m^3 (24-hour average) was satisfactorily met in the areas monitored between 1981 and 1983. Lead, which is associated with TSP, also continued to be present at rather high levels and will be dealt with separately. In general it is clear that TSP is the major air pollution problem faced by Kuala Lumpur and the Klang Valley. The air pollution levels as monitored by DBKL for TSP (or SPM), O_3, NO_2 and CO are shown in Figure 4.1, 4.2, 4.3 and 4.4 respectively for the period 1992-1996. All of the results show that while O_3, NO_2 and CO levels lie within recommended values, TSP is a problem. This issue is now discussed in more detail.

Total Suspended Particulate and Haze

Monitoring of TSP has shown that the annual concentration remained high in the industrial and trafficked areas. The recommended Malaysian guideline was exceeded in nine DOE stations in 1988. The levels of TSP concentration among different DOE sites were summarized by Sham *et al*. (1991) as the following:

- Mean figures ranged from 0.09 to 0.107 mg/m^3
- In the commercial and residential areas they ranged from 0.06 to 0.076 mg/m^3
- The rural stations showed a mean value of 0.049 mg/m^3

Long term system monitoring studies were begun by the Malaysian Meteorological Service (MMS) in 1991 at Petaling Jaya although *ad hoc* monitoring had already commenced prior to that. Annual mean concentrations ranged from 0.065-0.104 mg/ m^3 although daily values as high as 0.474 mg/ m^3 have been recorded (Lim & Leong 1991).

A trend analysis of the TSP concentrations measured in Petaling Jaya shows a downward annual trend during the years 1984-1988 but subsequently increased (Figure 4.5). Seasonal trends were found to reflect the change in windflow pattern in this part of the world (Soleiman *et al*. 1996a) and were found to have inverse matching with the seasonal rainfall amount (Soleiman *et al*. 1996b). Maximum and minimum seasonal TSP concentrations were found to coincide well with the dry and wet seasons respectively. With respect to monthly trends, TSP was found to be high during dry months, while low levels occurred during the wet months of the year. Following the pattern of working days, the TSP weekly trend was found to be high except for Saturday and Sunday since Saturdays are half working days and Sunday is a holiday (Soleiman *et al*. 1996c).

The general influence of rainfall amount on all TSP trends in the Valley which was found in the study carried out by Soleiman *et al*. (1996c) gives an indication that meteorological factors can significantly influence TSP concentrations.

In addition to the TSP problem, the haze phenomenon, as an indication of air deterioration in the Klang Valley, became a regular feature, notably during the dry months of February-March and June-August of the year (Sham *et al*. 1991). A number of researchers who reported the haze episodes stated that more attention should be paid to this phenomenon. Possible causes were suggested and meteorological conditions were thought to be associated with each of the haze episodes.

For the September 1982 haze episode Sham (1984a) reported an average concentration of 0.43 mg/m^3 in the Klang Valley. He added that this value was almost nine times that of the normal level for Petaling Jaya (0.09 mg/m^3) although this pollution level already exceeded the WHO standard. Furthermore, it was still unclear whether this haze could be attributed to sources outside Malaysia and the extent to which it was caused by local sources.

The second occurrence of persistently high particulate load caused a thick haze in April 1983. Although the maximum particulate concentration recorded (0.244 mg/m^3) was significantly less than that recorded in the 1982 haze, this haze was more persistent (Chow & Lim 1984).

These two haze episodes coincided with the occurrence of widespread bush fires and agricultural waste burning in a neighbouring country (Sham *et al*. 1991).

In the nineties, the TSP problem continued to become more serious. This was indicated by the repeated occurrence of haze episodes in August 1990 (Sham *et al*. 1991), June 1991 October 1991 (Cheang *et al*. 1991; Zainal Abidin *et al*. 1993), August-October 1994 (MMS 1995) and more recently in 1997.

High concentrations of TSP, four times the ambient mean value, were recorded during all these episodes. The one in August 1990 was associated with local open-burning while injection of suspended ash particulates from volcanic eruption (Mount Pinatubo) was cited as the cause of the June 1991 episode. Both the October 1991 and August-October 1994 episodes were associated with the advent of prevailing winds which transported suspended particulates from large forest fires and open burning in neighbouring countries (MMS 1995).

This episode was then followed by the most intense and most prolonged haze episode in 1997. Lasting several months, it was also caused by forest fires in a neighbouring country and cost the country dearly in terms of loss of revenue derived from tourism. Public fear was high because of the extreme nature of the phenomenon.

There is scarcity of data and literature on the chemical composition of the TSP in Malaysia. Lim and Leong (1991) reported that the TSP in Kuala Lumpur was found to consist of a high concentration of lead, calcium, nickel, iron, sodium, potassium and bromine compounds plus other elements such as barium, etc.

Pollution from Motor Vehicles

The transportation sector accounts for 78.7% and contribute the greatest share of TSP, CO, HC and NO_x. Unfortunately the Klang Valley is showing signs of becoming more car-oriented than any other Asian metropolis. Urban transport expert Paul Barter from Murdoch University said total private vehicle use per capita in the Klang Valley is 4,944 km per year compared with 3,198 in Bangkok, 1,597 in Jakarta, and 901 in Manila (The Star 1998). According to Barter, private vehicle use in the Klang Valley is already almost at European levels of 5,025 km per year. No city can cope with the sort of rapid increase in vehicle numbers as experienced in the Klang Valley over the last 10 years. In addition the Klang Valley also has a low usage of public transportation compared with other Asian cities.

In addition to gaseous pollutants, the automobile is also a source of toxic heavy metals. There are eight metals in the atmosphere which represent potential or real threats to public health, viz., beryllium, cadmium, chromium, lead, manganese, mercury, nickel and vanadium. With the exception of lead, these toxic metals only generally give rise to concern for the public living near to specific toxic metal sources (industrial plants and waste dumps). What makes lead exceptional when compared with other toxic metals is that man uses vast quantities of this metal. The major dispersive non-recoverable use of lead is in the manufacture of alkyl-lead fuel additives. Tetraalkyl lead compounds, especially Pb $(C_2H_5)_4$, are added to engine fuels as an inexpensive means of increasing their octane ratings.

The long term variations in annual mean lead concentration from 1984 to 1996 is shown in Figure 4.6. It is very noticeable that lead levels show a general downward trend throughout this period.

Suppliers began gradually reducing lead content in petrol from 1984 in order to meet the government 1986 deadline of 0.4 gm/liter. Hence the slight increase in the year 1987 is anomalous. Leong *et.al*. (1989) attributed the increase to the general improvement of the national economy since 1987 and other factors as follows:

- Expansion of industrial activities;
- Increase in number of vehicles on the road
- Increase in vehicles use;
- Increase from other sources including unauthorised garbage burning.

The general reduction in lead levels observed over the years is due in large part to the gradual reduction of lead content in petrol, from 0.84 g/liter in early 1980's to 0.4 g/liter in 1986, and to 0.15 g/liter in 1990. It is therefore clear that the reduction of lead content in fuel has had a positive effect on the environmental. On the other hand, because the number of vehicles in the area has steadily increased over the years this partly negated the positive effects of reducing lead in petrol.

WATER POLLUTION

The Major Issues

The major environmental problems of the rivers in the Klang Valley are related to solid waste collection and disposal, sewerage and sewage disposal and river pollution. There are many pollutants entering the rivers, from soluble and suspended pollutants derived from treated and untreated domestic and industrial waste waters to solid waste indiscriminately dumped in the rivers or left on the river banks which are floated off during rain storms when the river levels rise. As a result, we have problems of both water quality and aesthetics.

Current environmental problems also arise as a result of the rapid development of Kuala Lumpur and its environs with the construction of satellite townships, housing development, commercial and industrial complexes and infrastructure works. Erosion is a major problem resulting from intensive development activities for housing and commerce. Also, the construction of major highways, pipelines and other infrastructure works have caused a tremendous increase in the amount of suspended solids in the river system. Measurements have shown an increase of six times the base flow suspended solids from less than 10 to 60 milligrams per litre and a 10-fold increase at high flows from an average of 250 milligrams per litre on undisturbed land to 2,500 milligrams per litre on logged areas of the Ulu Gombak reserve (Ariyathavaratnam 1986). The developments in the upper reaches of the river system within the Selangor State, such as the new townships of Selayang, the housing estates in Pudu and the Ampang and Ulu Klang areas, have considerably aggravated the siltation problem in recent years.

Organic pollution of the Klang River and its major tributaries as they proceed through the city of Kuala Lumpur is severe. An analysis of water quality monitoring data over five years showed that the quality of the Klang River has deteriorated, with the dissolved oxygen levels of 1.5 milligrams per litre being recorded on occasions up to the confluence with the Ampang River, whereas previously such low levels were only recorded downstream of the confluence with the Gombak River. The deterioration would be much greater if the policy of full sewerage treatment for new development areas had not been adopted and if the Phase 1 of the Kuala Lumpur Sewerage Master Plan had not been implemented. According to the Klang Valley Environmental Improvement Project (KVIP) (GOM 1987), dilution levels in the Klang River in the Kuala Lumpur area are expected to be very low at the end of the planning period, probably in the region of 1 volume of waste to 2.5 volume of river flow. On the basis of maintaining a base level of ‘no nuisance’ quality effluent, BOD levels would have to be in the order of 20mg/l, rather than 50mg/l as it is at present.

There are a number of industries that discharge their pollutants into the river system. Some of these are along the river reserve and affect the desilting and improvement works. Others are illegal industries and there are others that, under the Kuala Lumpur Structure Plan, have to be resited because they are in the wrong landuse zones. According to the KVIP, 10% of the major industries contribute to 90% of the industrial pollutant of the rivers. DBKL actively serves notices on industries that pollute the rivers and is serious in their effort to relocate industries in accordance with the Kuala Lumpur Structure Plan.

Urban and Industrial Pollution Loading

Figure 4.7 shows the sources of water pollution in the Klang Valley, and Figure 4.8 shows the estimated total pollution loadings for 1985/1995/2005 based on the BOD parameters (GOM 1987).

The most significant parameters for expressing riverine water pollution conditions are Suspended Solids (SS), Ammoniacal Nitrogen (NH_3-N) and Biological Oxygen Demand (BOD). The monitoring data collected by DOE (1996a) suggests that the former two parameters have deteriorated for the Klang River while the BOD improved. Overall, however, the Water Quality Index deteriorated (Table 4.1). The heavy metals content of the Klang River continues to show severe pollution levels, with lead, mercury, chromium, and ferrum showing values much above recommended DOE standards (Table 4.2).

Table 4.1 Water Quality of Klang River 1989 - 1995

Parameter	1989	1990	1991	1992	1993	1994	1995	Trend
Water Quality Index (WQI)	60	56	56	58	53	55	55	Deteriorated
Suspended Solids (SS)	50	59	51	55	49	48	48	Deteriorated
Ammoniacal Nitrogen (NH_3-N)	21	7	9	7	9	11	10	Deteriorated
Biological Oxygen Demand (BOD)	79	71	79	82	76	74	80	Improved

Source: DOE (1996a)

NB	WQI :	0 - 59 : Very polluted	60 - 80 : Slightly polluted
	SS :	0 - 69 : Very polluted	70 - 75 : Slightly polluted
	NH_3-N :	0 - 70 : Very polluted	71 - 91 : Slightly polluted
	BOD :	0 - 79 : Very polluted	80 - 90 : Slightly polluted

Table 4.2 Heavy Metals Content of the Klang River 1992 - 1996

Metal	DOE standard (mg/l)	1992	1993	1994	1995	1996
Cd	(0.01)	0.0025	0.0040	0.0048	0.0129	0.002
Pb	(0.01)	0.0280	0.0210	0.0186	0.0259	0.008
As	(0.4)	0.0300	0.0056	0.0113	0.0115	-
Hg	(0.0001)	0.0011	0.0007		0.0026	0.001
Zn	(0.4)	0.0100	0.0417	0.0436	0.0424	0.087
Cr	(0.004)	-	0.0071	0.0075	0.0052	0.006
Fe	(1.0)	-	3.4600	-	2.5287	3.920
Mn	-	-	0.0060	-	-	-

Source: DOE (1996a and 1996b)

Industrial waste load estimates for 1985 were derived from monitoring data of the DOE and from the sewerage master plan studies carried out for Kuala Lumpur, Shah Alam, Klang, and Bangi by various consultants. A list of major polluting industries and characteristics of the wastewater generated by these industries are shown in Table 4.3. These industries generated 83% of the total industrial wastewater flows and 92% of the total industrial BOD load in 1985 and represented 2% of the total number of 1,060 industries as listed in the DOE records. However, the DOE records were incomplete for smaller industries and “backyard” industries.

NOISE POLLUTION

Noise is the most frequently overlooked form of pollution because while water and air are regarded vital to life, noise is merely an annoyance to most people. This oversight is a mistake because noise affects man both physically, psychologically and socially. While it can at the outset interfere with communication and be annoying, it will damage hearing if the intensity is too high and at a less obvious level it can cause tiredness and reduce efficiency (Saenz and Stephens 1986).

It has been clearly proven that long durations in extremely noisy environment can lead to permanent reduction of hearing sensitivity. This damage is irreversible and is the reason why noise dosage is clearly stipulated for the work environment (Bugliarello *et al*. 1976).

Noise Monitoring in Kuala Lumpur and the Klang Valley

Noise monitoring is carried out by DOE only intermittently and on an *ad hoc* basis, depending largely on complaints received.

In 1991 noise levels at several construction sites in the Klang Valley were measured. The levels ranged from 60.5 to 73.4 dB(A) (DOE 1991). In 1993 several community areas were monitored (Table 4.4), while in 1994 several industry areas were studied (Table 4.5). Figure 4.9 shows that the noise levels in Kuala Lumpur are higher than other urban centres in Malaysia (DOE 1996a).

Table 4.3 Major Polluting Industrial Categories In Klang Valley and their Effluent Characteristics.

Industrial Category		BOD	Load (Kg/Day) SS	AN
Breweries	(i)	6250	4630	14
	(ii)	57	6	-
	(iii)	3	35	-
Soft Drink Industries	(i)	21	36	-
	(ii)	708	271	-
	(iii)	256	15	-
Food Processing Industries	(i)	384	-	-
	(ii)	491	118	-
	(iii)	281	246	-
	(iv)	42	51	-
	(v)	71	1000	-
Chemical Manufacturing Industries	(i)	511	682	-
	(ii)	45	22	-
	(iii)	11	-	1
Semi-Conductor and Electrical Industries	(i)	150	300	200
Rubber Processing Industries	(i)	106	-	-
	(ii)	90	54	89
	(iii)	599	80	62
	(iv)	26	31	89
	(v)	28	43	9
	(vi)	9	19	9
	(vii)	341	532	21
	(viii)	119	234	11
	(ix)	64	60	25
	(x)	6	10	0.2
	(xi)	66	29	6
Palm Oil Processing Industries	(i)	85	973	83
	(ii)	0.6	4	0.01
	(iii)	40	442	36
	(iv)	18	18	14

Source: GOM 1987

In 1996 DOE (1996b) reported that many complaints were received on the LRT construction sites from Klang Valley residents. The report also recorded that hospitals in the urban area have emission levels exceeding 65 dB(A) on 50% of the monitoring occasions, and schools, 30%. Both these numbers are worrying and special action needs to be taken. The report listed traffic and construction activities as the main sources of noise.

Table 4.4 Kuala Lumpur : Noise Level At Selected Community Areas, 1993

District	Vicinity of	Date	Time	LEQ
Kuala Lumpur	Ruang Legar Stesen Keretapi Kuala Lumpur	930421	0850	73.6
Kuala Lumpur	Ruang Legar Stesen Bas Pudu Raya	930421	0905	81.1
Kuala Lumpur	Ruang Legar Stesen Teksi Pudu Raya	930421	0920	78.8
Kuala Lumpur	Rumah Pangsa Jalan Loke Yew	930421	0920	66.0
Kuala Lumpur	Lorong Enggang 9, Taman Keramat	930420	1015	54.3
Kuala Lumpur	Kampung Periuk	930421	0945	57.1
Kuala Lumpur	Pusat Membeli-belah The Mall	930422	1115	66.6
Kuala Lumpur	Pasar Chow Kit	930422	1050	70.7
Kuala Lumpur	Taman Tasik Titiwangsa	930420	1050	48.6

Unit: dB(A) Source: DOE 1996a

Table 4.5 Wilayah Persekutuan : Noise Level at Selected Industry Areas, 1994

District	Industry Area	Class	Vicinity of	Date	Time	MAXP	MAXL	LEQ
Sg. Besi	Jalan Chan Sow Lin	M	Syt. Tai Lee	940303	0900 2000	114.7 91.5	83.4 74.5	67.5 57.8
Sg. Besi	Jalan Chan Sow Lin	M*	UtuMan Security Printing	940303	1000 2100	92.7 93.5	79.4 77.9	67.4 65.2
Sg. Besi	Jalan Kuchai Lama	M*	Aji No Moto (M) Sdn. Bhd.	940303	1100 2200	97.1 96.7	81.2 80.4	69.7 70.9
Kepong	Kepong	M*	Mytex Garments (M) Sdn. Bhd.	940303	0900 2000	114.4 86.6	82.4 71.2	67.1 59.5
Kepong	Kepong	M*	Thiam Huat Plastic Ind. (M) Bhd.	930303	1000 2100	94.2 85.1	80.9 73.7	71.6 70.1

Industry Class:- L - Light Industry M - Moderate Industry H - Heavy Industry
* - Factory operates day and night
Unit: dB(A) Source: DOE 1996a

Figure 4.1: Suspended particulate matter as monitored by DBKL (1992-1996).

Figure 4.2: Ozone concentration as monitored by DBKL (1992-1996).

Figure 4.3: Nitrogen dioxide concentration as monitored by DBKL (1992-1996).

Figure 4.4: Carbon monoxide concentration as monitored by DBKL (1992-1996).

Figure 4.5: Annual mean TSP concentration in the Klang Valley (1984-1995).
Source of data: Malaysia Meteorological Services Department.

Figure 4.6: Changes in annual lead levels for Petaling Jaya (1984-1996).
Source of data: Malaysia Meteorological Services Department.

Figure 4.7: Significant sources of water pollution in the Klang Valley (1985).
Source: GOM 1987.

Figure 4.8: Pollution loadings at locations specified in Figure 4.7.
Source: GOM 1987.

Figure 4.9: Traffic noise patterns at selected sites in urban areas (1992).
Source: DOE 1996a.