MALAYSIA

Environmental Quality Report 2001

Department of Environment
Ministry of Science, Technology and the Environment
Malaysia

Department of Environment, Malaysia
DEPARTMENT OF ENVIRONMENT, MALAYSIA

Printed on Recycled Paper

ISSN 0127-6433

Design and printed by
D'FA PRINT SDN. BERHAD
No. 16, Jalan P/21, Sek. 10,
Selaman Light Industrial Park,
43650 Bandar Baru Bangi,
SELANGOR DARUL EHSAN
Tel: 03-8926 3808
Fax: 03-8926 3830

CONTENTS

FOREWORD

As required under Section 3(1)(i) of the Environmental Quality Act, 1974, I hereby submit the Environmental Quality Report, 2001.

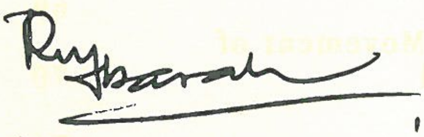
The year 2001 was an opportune time to take stock of the current environmental position as well as to strengthen our institutional capacity so that we could be on a stronger footing to deal with emerging environmental issues.

On the whole, the environmental quality in 2001 showed an improvement. In terms of water quality, the measurements indicated a reduction in the level of pollution in several rivers, the improvement attributable to a significant decrease in the levels of suspended solids in the water. The total number of clean river basins increased from 34 in 2000 to 60 in 2001. Similarly there had been an improvement in the marine water quality in respect of oil and grease and *E.*coli. In the case of air quality, good to moderate air quality was experienced most of the time, except at a number of industrial sites where the air quality reached unhealthy level for a few days, mainly due to high levels of ozone and sulphur dioxide, primarily the by-products of fuel combustion. There had been no occurrence of prolonged high particulate matter levels in the air that could bring about haze episodes, the like of which was experienced in 1997/1998.

It is hoped that the environmental quality will further improve. The Department of Environment will continue to be innovative and proactive to bring about more effective environmental management. More importantly, the participation and commitment of all stakeholders must also be brought to bear upon this noble task in the years ahead.

" Towards Cleaner Technology"

With Best Wishes



Hajah Rosnani Ibarahim
Director - General of Environmental Quality
Malaysia

30 September 2002

MALAYSIA Environmental Quality Report 2001

AIR QUALITY

AIR QUALITY MONITORING

INTRODUCTION

As in previous years, the Department of Environment continues to monitor the air quality status throughout the country to detect any significant change in the air quality that may cause harm to human health and the environment.

The air quality is monitored by way of actual continuous measurements of pollutants in the ambient air at 50 National Air Quality Monitoring Stations throughout the country. These stations are located strategically to meet specific objectives (Map 1, 1(a)). Most of them are located in residential areas to monitor population exposure to environmental pollution hazards, while others are located within industrial or commercial areas to monitor pollution trend in those localities.

The National Air Quality Monitoring network is complemented by Manual Air Quality Monitoring Stations located at 33 different sites. At these sites, total suspended particulate, particulate matter (PM10) and several heavy metals including lead are measured once in every six days using High Volume Samplers.

Air Quality Status

The air quality status for Malaysia is reported based on the Air Pollutant Index (API) (Table 1). The overall air quality for Malaysia throughout 2001 was good to moderate most of the time, with the exception of a few unhealthy days experienced during the dry season particularly in the month of July 2001. Particulate Matter (PM10) and Ozone were the prevalent pollutants throughout the country in 2001.

Air Quality Status in the Klang Valley

With mountains in the east and the Straits of Melaka on the west, and being highly developed and densely populated, the Klang Valley provides a conducive environment for pollutants to accumulate particularly when atmospheric conditions are stable.

In 2001, the number of good quality days in the Klang Valley was less than the year before and air quality was moderate more than 60 percent of the time. The number of unhealthy air quality days in the Klang Valley increased in 2001 ranging from 4 to 37 days, compared to between 11 to 32 days in 2000, measured at 7 different locations. (Figure 1)

Ozone is the main pollutant which contributed to unhealthy air quality in most locations in the Klang Valley, namely Shah Alam (19 days), Kajang(37 days), Gombak (19 days) and Kuala Lumpur (11 days). In the presence of sunlight, nitrogen oxides (NOx) and volatile organic compounds (VOCs), mainly from motor vehicles and industries, would react to form ozone usually in the afternoons between 2 pm to 5 pm.

The unhealthy days experienced in Klang (7 days) and Kuala Selangor (8 days) were mainly due to the presence of high particulate matter (PM10) from forest fires and open burning activities. In July 2001, the peat forest fires at Johan Setia, Klang and the Raja Musa Forest Reserve caused the air quality in Klang and Kuala Selangor to reach unhealthy levels. Figure 2 shows the overall air quality status in the Klang Valley.

Photo 1: Sources of Air Pollution (DOE Photo Library)

Air Quality in the Northern Region

In the northern region of the West Coast of Peninsular Malaysia which comprises the States of Perlis, Kedah, Pulau Pinang and Perak, the overall air quality ranged between good and moderate most of the time except the Prai area. More than 75 percent of the time the air quality in Langkawi, Kangar and Alor Setar was good, while moderate air quality was experienced for the other 25 percent of the time.

Prai is a heavily industrialised area with several petrochemical industries. Its air quality however improved slightly compared to the year 2000. In 2001, 5 and 9 unhealthy days were recorded respectively at two stations in this area as compared to 8 to 56 days the previous year. The main pollutant was sulphur dioxide (SO2) primarily from industrial activities in the area.

In Perak, all stations recorded good air quality more than 60 percent of the time with the exception of the Tasek industrial area. At Tasek, the air quality was moderate 89 percent of the time and good for the remaining 11 percent. Figure 3 describes the overall air quality for the West Coast of Peninsular Malaysia.

Air Quality in the Southern Region

Similarly, the air quality in the southern part of the West Coast of Peninsular Malaysia, which includes Negeri Sembilan, Melaka and Johore, was between good to moderate most of the time, with the exception of 3 and 15 unhealthy air quality days recorded at Seremban and Nilai respectively. Ozone was the main pollutant that contributed to the unhealthy days in both these areas.

In Melaka and Johore, several unhealthy air quality days were recorded due to high levels of Ozone. However Pasir Gudang in Johore experienced five (5) unhealthy air quality days due to high SO2 levels compared to eight(8) the previous year (Figure 4).

Air Quality in the East Coast

The air quality in the East Coast of Peninsular Malaysia was good most of the time. Areas such as Kuantan, Jerantut, Paka and Kota Bharu experienced good air quality more than 80% of the time, while at Kemaman, Pengkalan Chepa, Kuala Terengganu and Balok Baru, moderate air quality prevailed throughout the year. (Figure 5).

Air Quality in Sabah and Sarawak

In Sabah and Sarawak, the air quality was good 70 percent of the time throughout 2001, with the exception of two stations at Kapit and Tawau (Figure 6). Several unhealthy air quality days were experienced in Kapit (13 days), Sri Aman (9 days), Sibu (4 days), Bintulu (3 days), Samarahan (1 day) and Sarikei (1 day), mainly due to high particulate matter as a result of open burning activities from shifting agricultural practices carried out during June to July 2001.

Photo 2: Open Burning at an illegal Solid Wastes Dumping Site (DOE Photo Library)

Air Quality Trends

Six pollutants namely Carbon Monoxide (CO), Nitrogen Dioxide (NO2), Ozone (O3), Sulphur Dioxide (SO2), Total Suspended Particulate (TSP) and Particulate Matter (PM10) are continuously monited at 50 locations, while Lead (Pb) is measured once in every six days at 22 locations. The air quality trend described represents the average air pollutant concentrations throughout the country vis-a-vis the Malaysian Ambient Air Quality Guidelines (Table 2).

Particulate Matter (PM 10)

Particulate Matter is the general term used to describe respirable particles less than 10 micron in size, mainly from stationary, mobile as well as natural sources. They may be directly emitted from motor vehicle exhaust, heat and power generation, industrial processes and open burning activities. Particulate matter may also be formed in the atmosphere by the transformation of precursors such as SO2 and NOx (to form sulfates and nitrates). Over the past several years, Malaysia had been affected by transboundary pollution where significant amounts of fine particulate matter from uncontrolled biomass burning activities were transported into the country by southwesterly winds.

The accumulation of PM10 pollutant in the respiratory system is associated with numerous health effects related to respiratory diseases, decreased lung functions and eye and throat irritation. Sensitive groups such as the elderly, individuals with asthma and cardiopulmonary diseases and children are at greater risk to such health effects. PM10 can also contribute significantly to hazy conditions and reduced visibility especially during the dry season. Other environmental impacts occur when such particles are deposited onto soil, plants, water or materials. Depending on the chemical composition, when deposited in sufficient quantities, particulate matter may change nutrient balance and acidity in soil, interfere with plant metabolism and damage materials.

PM10 remains the prevalent pollutant in many parts of Malaysia. The annual average levels of PM10 concentration in the ambient air between 1996 to 2001 were just slightly below the Malaysian Ambient Air Quality Guideline, except during severe haze episodes in 1997. Figure 7 shows a 10 percent increase in the annual average PM10 concentrations across the country between 2000 and 2001. Figure 7(a) describes the breakdown of the annual average levels of PM10 for various categories of land use. Generally, higher levels of PM10 concentrations were recorded in urban and industrial areas. However, in 2001 high levels were also recorded in rural areas, mainly caused by open burning activities carried out as part of shifting agricultural practices particularly in Sarawak.

Photo 3: Air Pollution from Industries (DOE Photo Library)

Sulphur Dioxide (SO_2)

Sulphur dioxide is a colourless pungent, irritating, water-soluble and reactive gas. This gas is formed when fuel containing sulphur (oil, coal) is burned during the combustion process mainly from industrial activities. High concentrations of SO2 in the atmosphere increase the risk of adverse symptoms in asthmatic patients and irritate the respiratory system. Other effects associated with long-term exposure to high concentrations of SO2, together with high levels of particulate matter, include respiratory illnesses, alterations in lung defences and aggravation of existing cardiovascular diseases.

There are also other environmental concerns associated with high concentrations of SO2. SO2 along with NOx, is a major precursor of acidic deposition, which contributes to acidification of soils, lakes and streams and caused adverse impacts on the ecosystem. SO2 can also be harmful to plant life as well as accelerate the corrosion of buildings and monuments.

The annual average levels of sulphur dioxide in the ambient air between 1996 and 2001(Figure 8) were well below the Malaysian Ambient Air Quality Guideline. Figure 8(a) shows the annual average concentrations of sulphur dioxide for different categories of land use. The concentrations of SO2 are consistently higher in industrial areas where the main sources of emissions are located.

Nitrogen Dioxide (NO2)

Nitrogen dioxide (NO2) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Nitrogen oxides (NOx) is the term used to describe the sum total of NO, NO2 and other oxides of nitrogen. The major sources of man-made NOx emissions are high-temperature combustion processes such as those occurring in automobiles and power plants. Most of the NOx (95 percent) from combustion processes are emitted as NO, and the remaining largely NO2. NO is readily converted to NO2 in the environment.

Short term exposure to NO2 may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses, and increases respiratory illnesses in children. Long term exposure to these gases may lead to increased susceptibility to respiratory infection and may cause alterations in lung functions. Nitrogen oxides also react in the air to form ground-level ozone and fine particle pollution which are both associated with adverse health effects.

Nitrogen oxides contribute to a wide range of environmental effects, including the formation of acid rain and potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication of estuarine and coastal waters and increase levels of toxins harmful to fish and other aquatic life.

For the period between 1996 and 2000, the annual average concentrations of NO2 in the ambient air in Malaysia (Figure 9, 9(a)) were well below the Malaysian Ambient Air Quality Guideline. NO2 level from 1996 to 2000 were on a downward trend. However, in 2001 the concentration increased 14.7 percent as compared to the previous year. Generally NO2 levels were high in urban and industrial areas, mainly due to emissions from automobiles and combustion processes.

Ground Level Ozone (O3)

Ozone is not emitted directly into the air but is formed by the reaction of VOCs and NOx in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually in warm sunny conditions. VOCs can be emitted from various sources including motor vehicles, chemical plants, refineries, consumer and commercial products and other industrial sources, while nitrogen oxides are emitted from motor vehicles, power plants, and other sources of combustion. Changes in weather patterns can contribute to yearly differences in ozone concentrations. Ozone and the precursor pollutants that form ozone can be transported hundreds of kilometres depending on wind direction.

Exposures to high concentration of ground-level ozone have been linked to a number of health effects of concern. Repeated exposures to ozone can make people more susceptible to respiratory infection, lung inflammation and aggravate pre-existing respiratory diseases such as asthma.

Ozone also affects vegetation and ecosystems, leading to a reduction of agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to diseases, pests and other environmental stresses. In long-life species, these effects become evident only after several years or decades, thus having potential long-term effects on forest ecosystems.

Figure 10 shows the annual average daily maximum 1 hour ozone concentrations in the ambient air between 1996 to 2001. The highest level was recorded in 1997. This could be due to the meteorological conditions during that year when the whole region experienced prolong dry and hot weather as a result of the El-Nino phenomenon. Figure 10(a) describes the breakdown of the ozone concentrations for various land use categories throughout those years. Higher levels of ozone were consistently recorded in urban areas due to the presence of precursor ozone gases, namely NOx emitted mainly from motor vehicles.

Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless and at high concentration, a poisonous gas. Carbon monoxide is formed when the carbon present in fuel is not burned completely. CO is emitted mainly by motor vehicular exhausts, while other sources of CO emissions include industrial processes and open burning activities. Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to body organs and tissues. Health threat from exposure to CO is most serious to those who suffer from cardiovascular diseases. At high levels of exposure, CO can be poisonous even to healthy people. Visual impairment, reduced work capacity and poor learning ability are among the health effects associated with exposure to elevated CO levels.

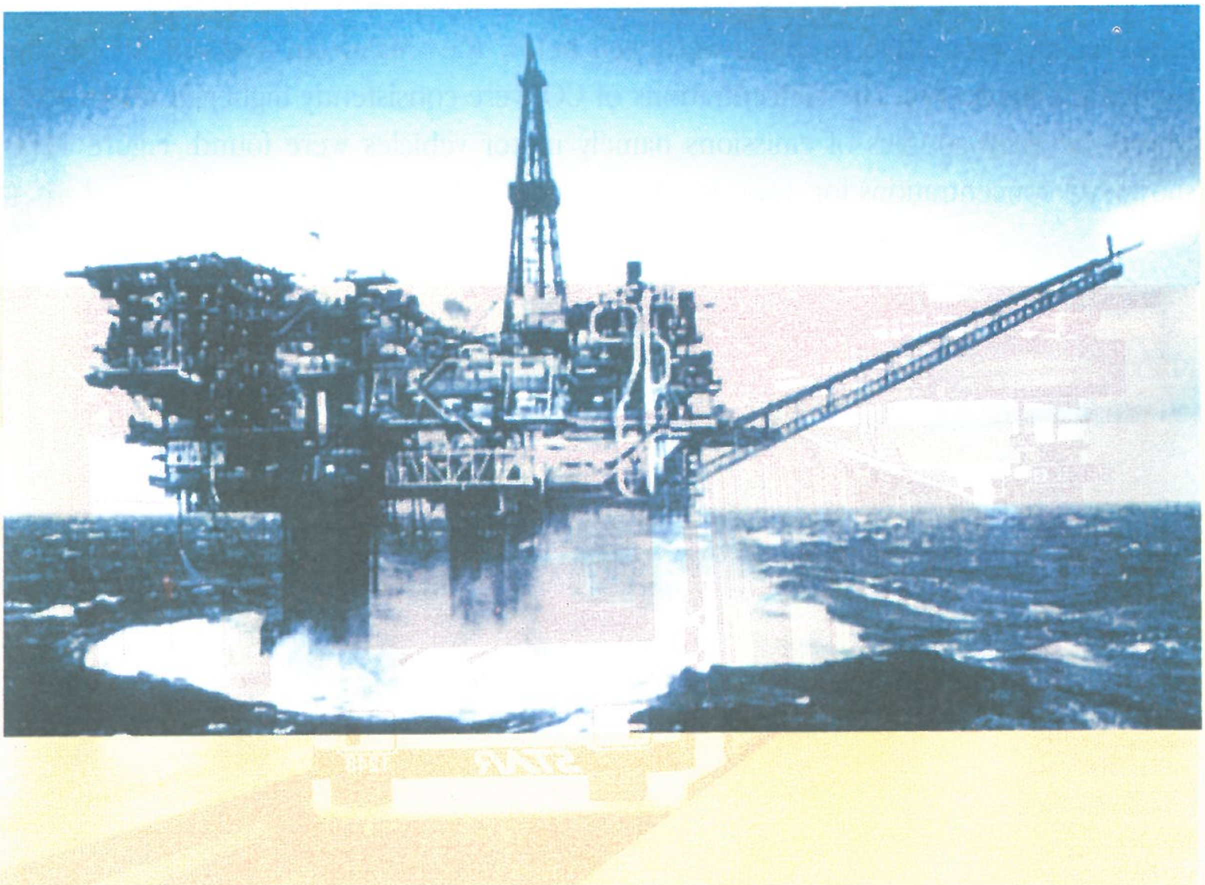
The annual 8 hourly average concentrations of carbon monoxide throughout the country measured between 1996 to 2001, were well below the Malaysian Ambient Air Quality Guideline (Figure 11). The concentrations of CO were consistently higher in urban areas where the main sources of emissions namely motor vehicles were found. Figure 11(a) shows CO concentrations for various categories of land use.

Photo 4: Mass Transport for Reducing Urban Air Pollution
(DOE Photo Library)

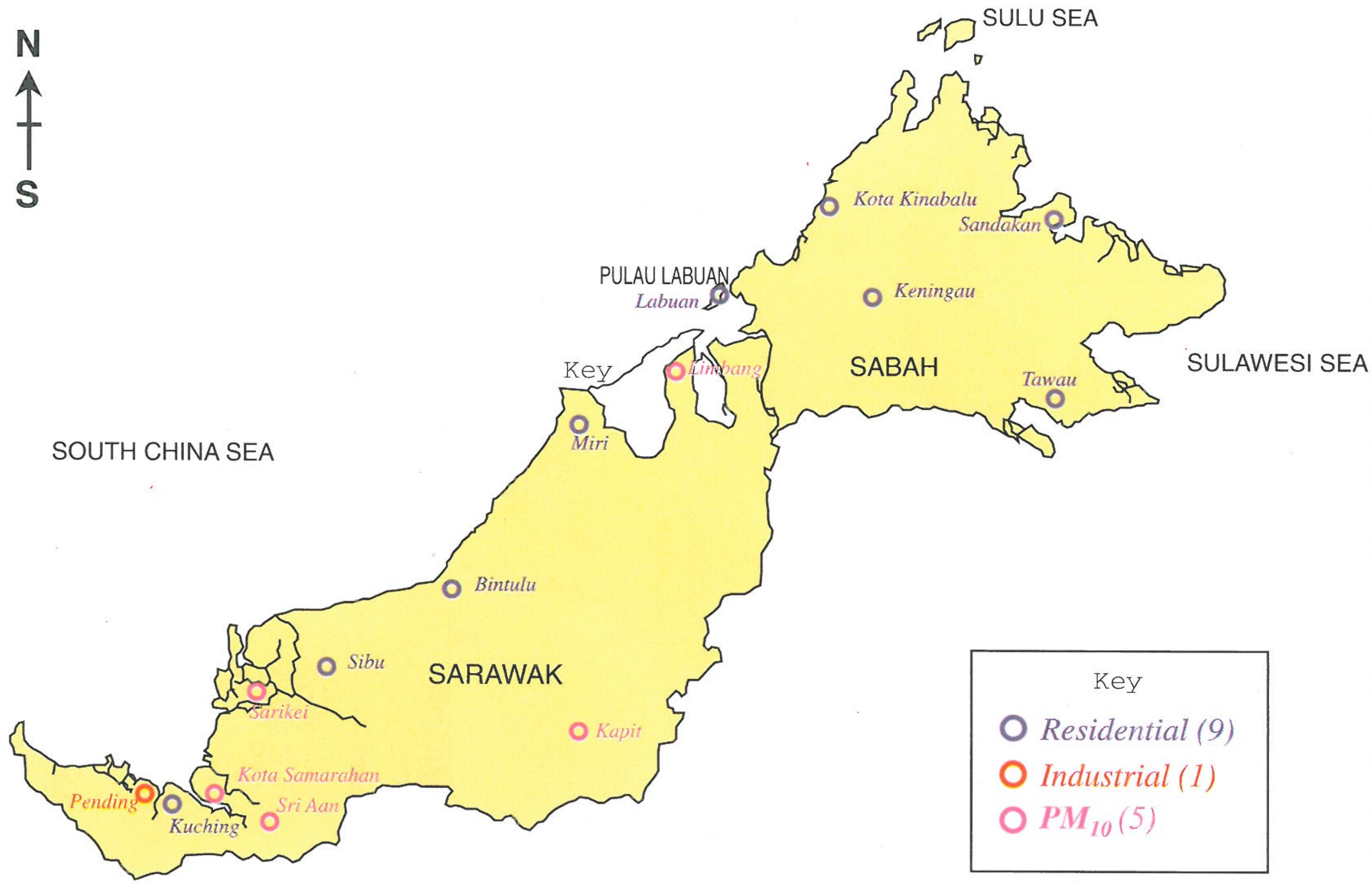
Lead Concentration (Pb)

Excessive exposure to lead may cause neurological impairment such as mental retardation and behavioural disorders. Even at low doses, lead exposure is associated with damage to the nervous systems of foetuses and young children resulting in learning deficiencies and lowered IQ.

In the past, motor vehicles had been the main sources of lead (Pb) emission into the atmosphere. Lead levels in the atmosphere were high in the eighties. However, as the result of the Government's effort in promoting the use of unleaded petrol since 1991 and the total phase out of leaded petrol in 1998, lead levels in the atmosphere had declined significantly. In 2001, the average level of lead monitored in the Klang Valley was 0.0257 ug/m3, well below the Malaysian Ambient Air Quality Guideline of 1.5 ug/m^3. (Figure 12)



Map 1 Malaysia : Location of Continuous Air Quality Monitoring Stations, 2001



Map 1 (a) Malaysia : Location of Continuous Air Quality Monitoring Stations, 2001

Table 1 Malaysia: Air Pollutant Index

API	Air Quality Status
0 - 50	Good
51 100	Moderate
101 - 200	Unhealthy
201 - 301	Very Unhealthy
> 300	Hazardous

Table 2 Malaysia: Ambient Air Quality Guidelines

Pollutant	**Averaging Time**	**Air Quality Guidelines**	
		ppm	**(ug/m^3)**
Ozone	1 Hour 8 Hour	0.10 0.06	200 120
Carbon Monoxide	1 Hour 8 Hour	30 9	35 10
Nitrogen Dioxide	1 Hour 24 Hour	0.17 0.04	320
Sulphur Dioxide	1 Hour 24 Hour	0.13 0.04	350 105
Particulate Matter (PM10)	24 Hour 1 Year		150 50
Total Suspended Particulate (TSP)	24 Hour 1 Year		260 90
Lead	3 Month		1.5

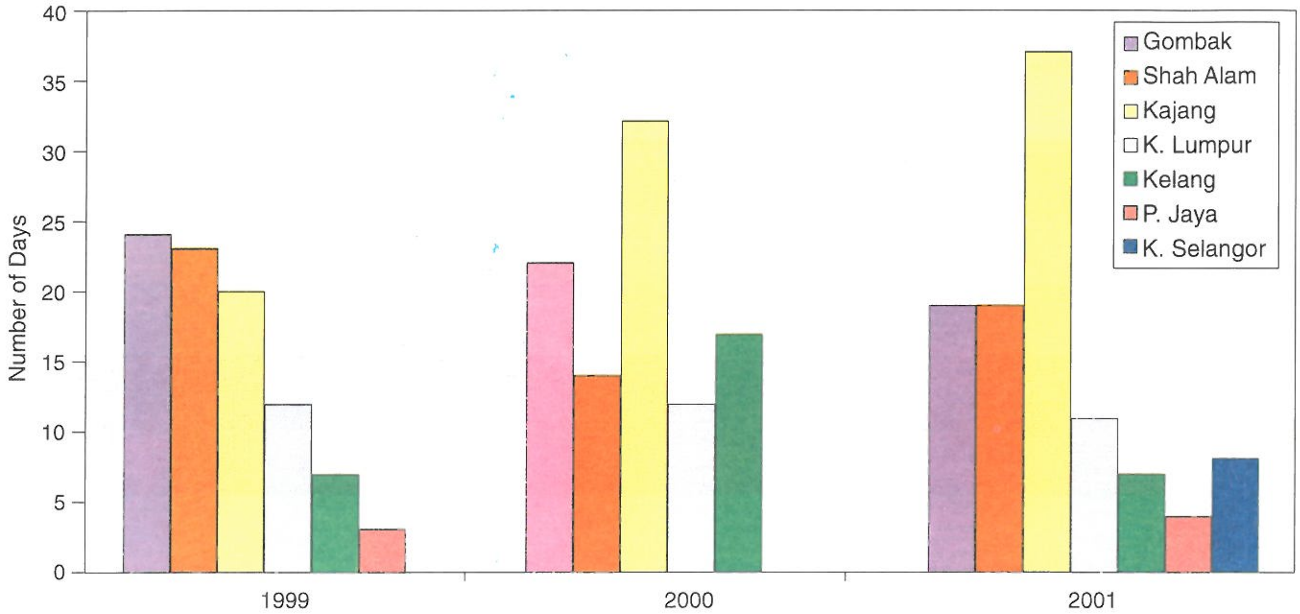


Figure 1 Department of Environment : Number of Unhealthy Days in the Klang Valley, 1999-2001

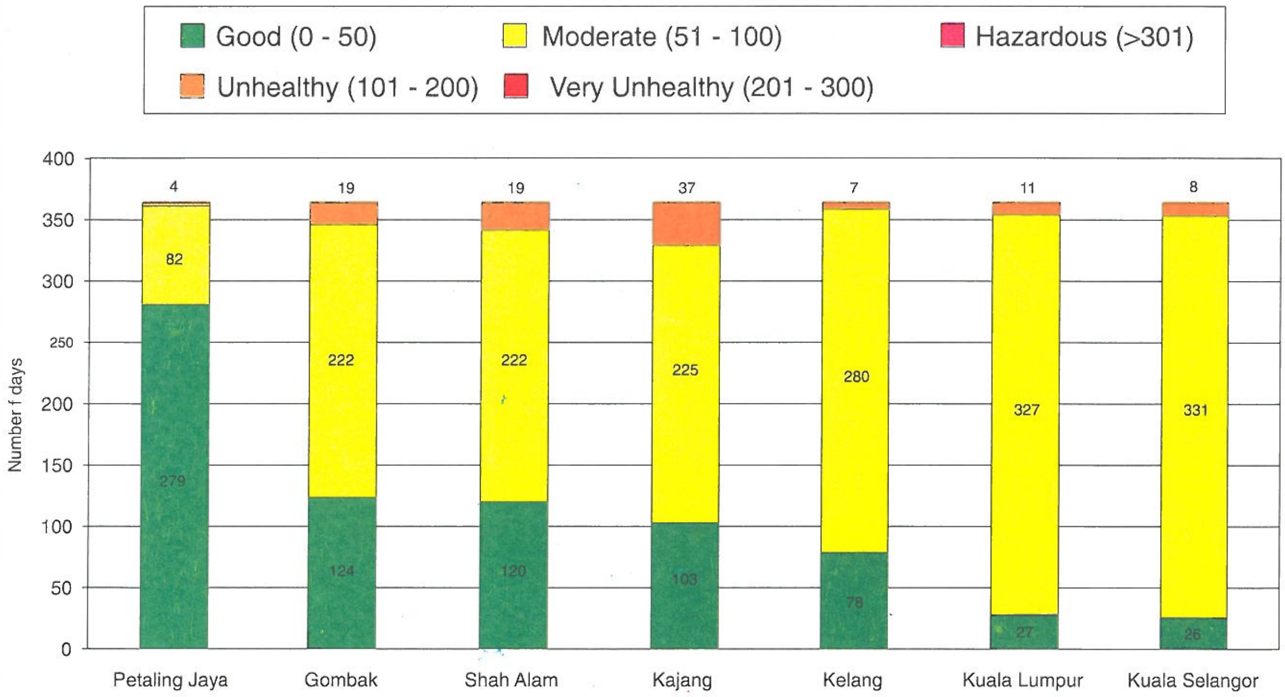


Figure 2 Department of Environment : Air Quality Status in the Klang Valley, 2001

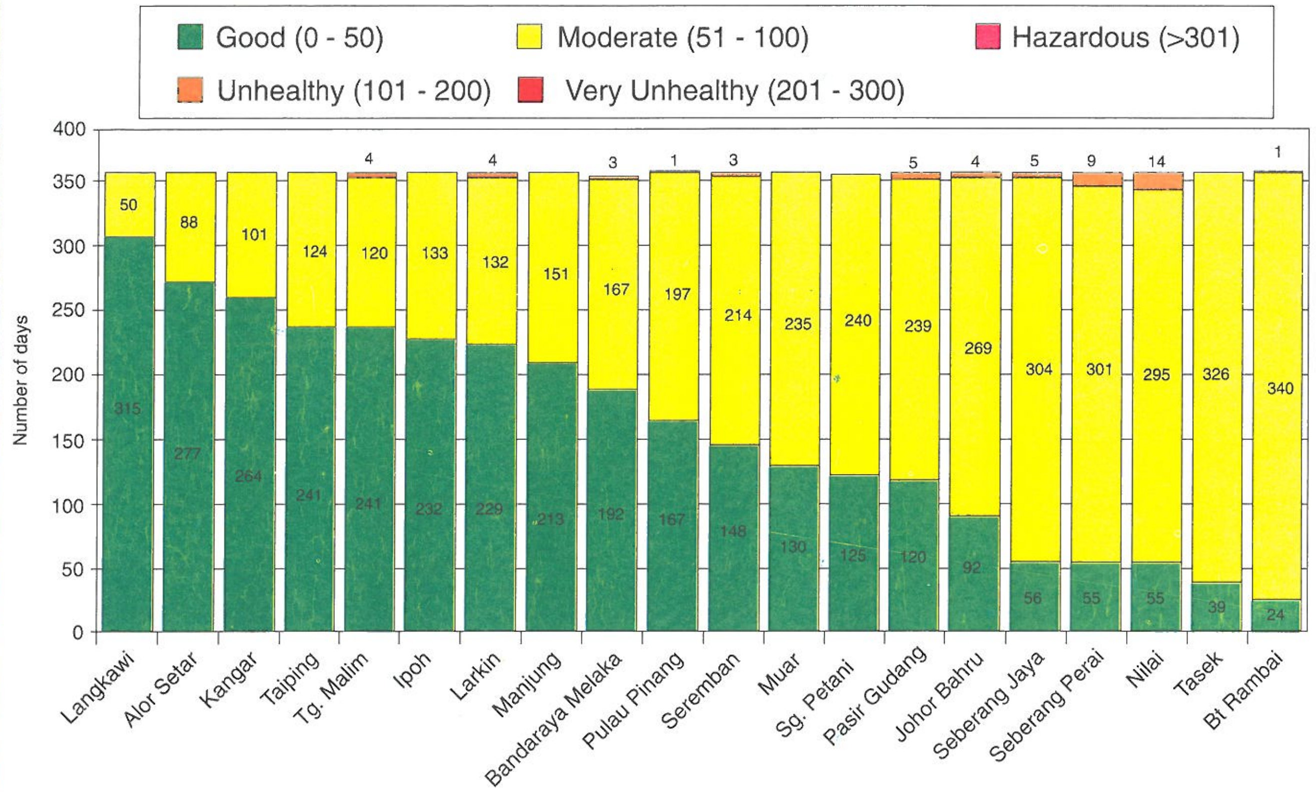


Figure 3 Department of Environment : Air Quality Status in Klang Valley, 2001

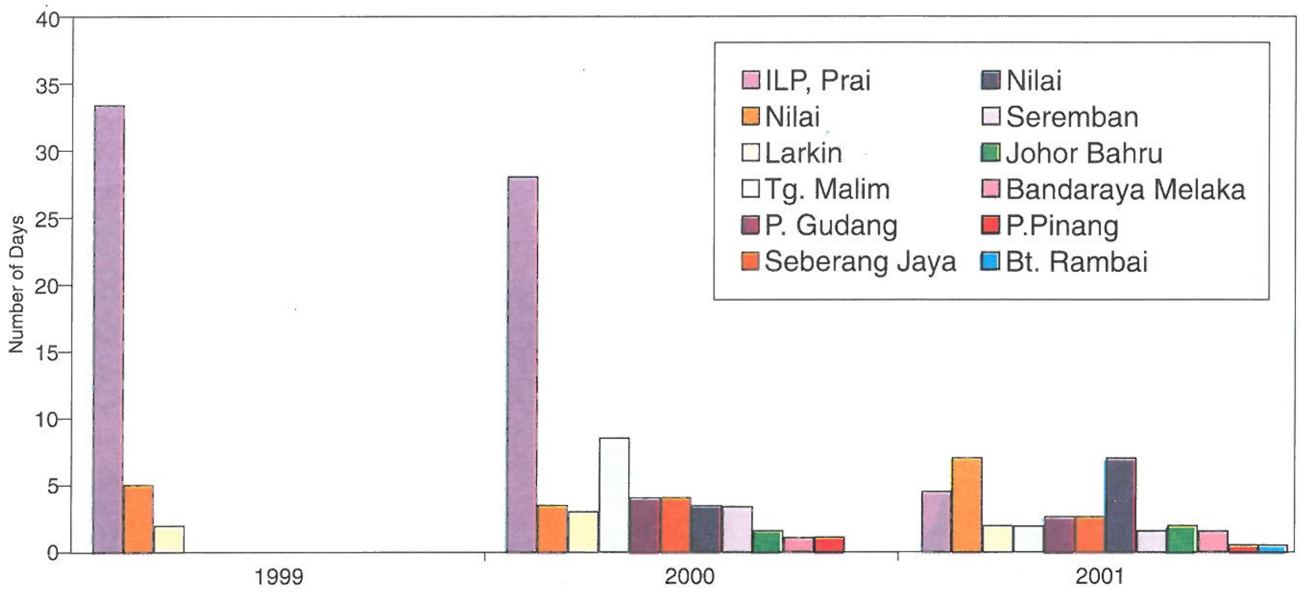


Figure 4 Department of Environment : Number of Unhealthy Days on West Coast of Peninsula, 1999-2001

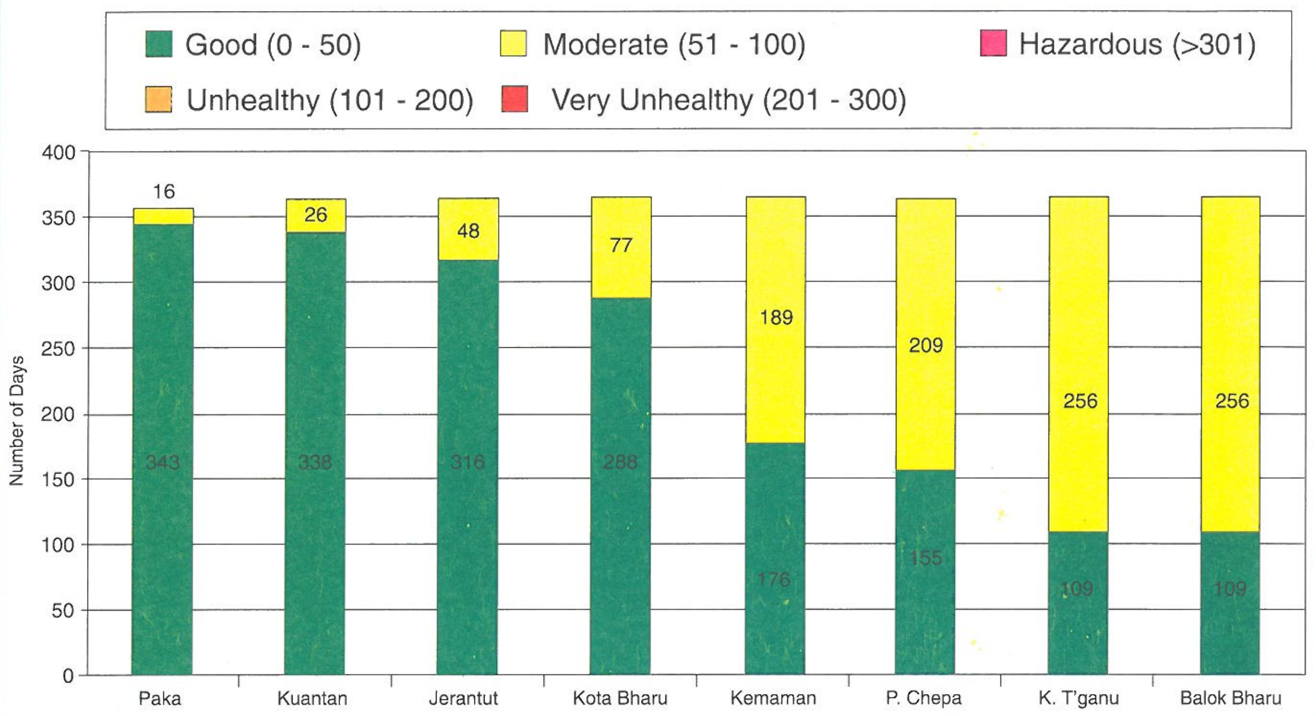


Figure 5 Department of Environment : Air Quality of East Coast of Peninsula, 2001

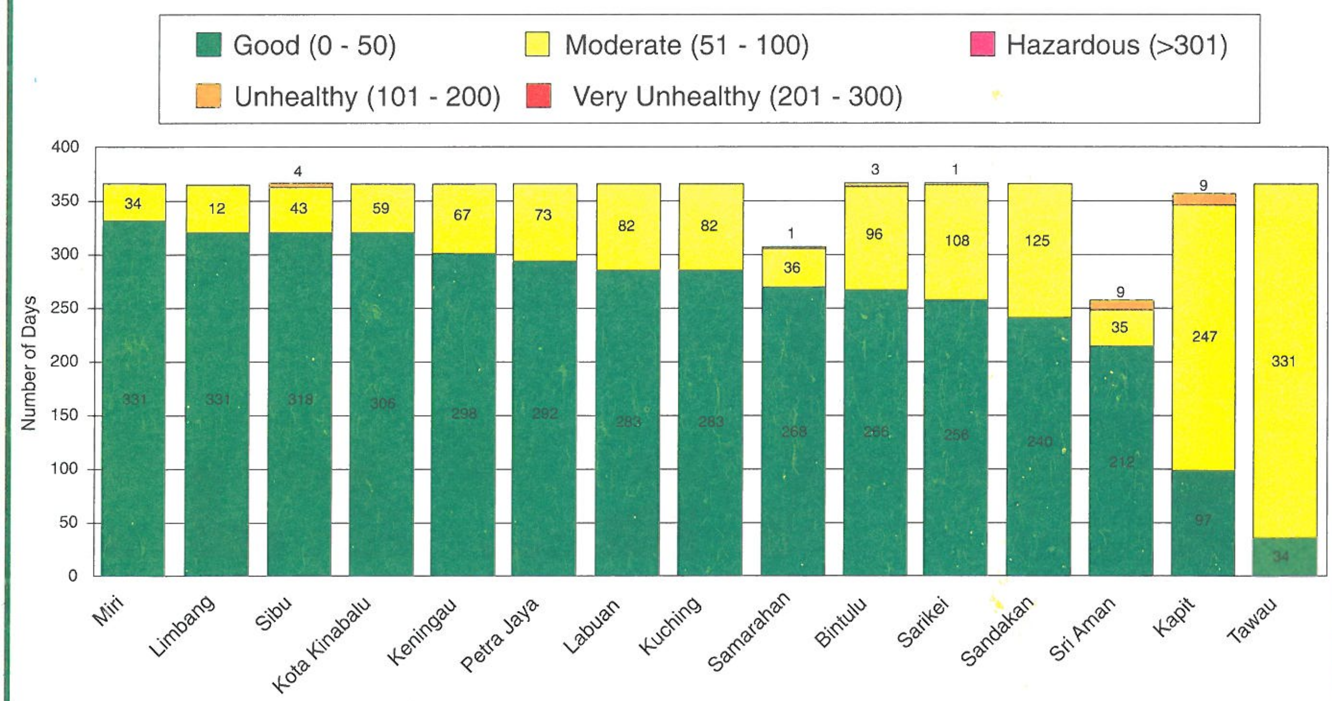
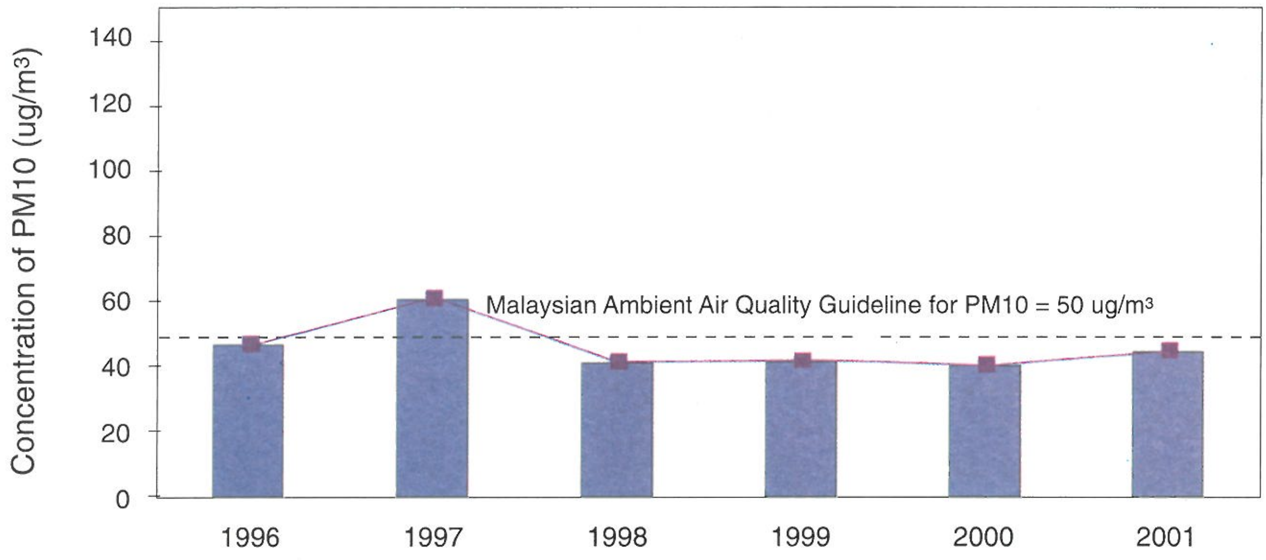
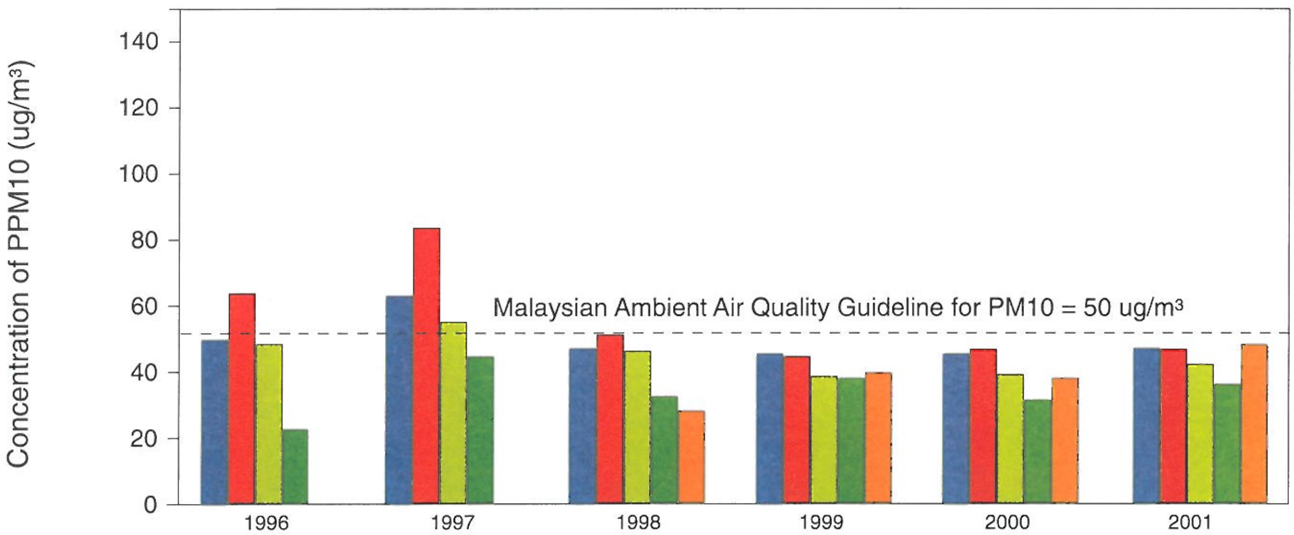


Figure 6 Department of Environment : Air Quality in Sabah and Sarawak, 2001



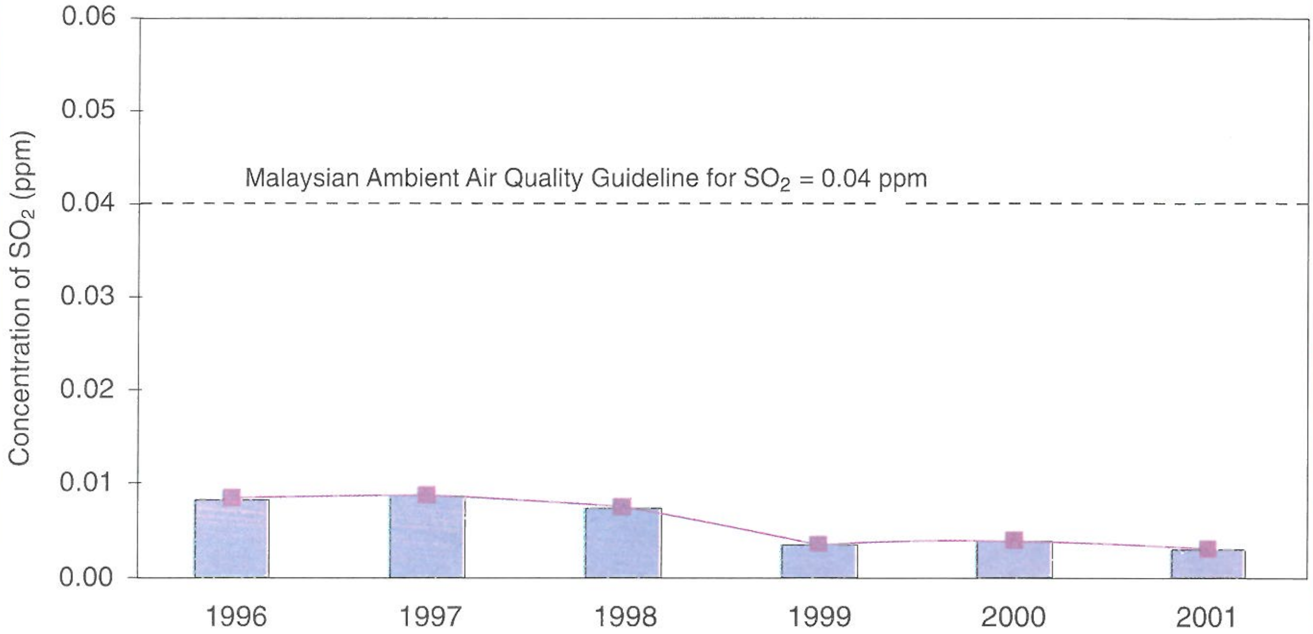
No. of sites	13	27	37	44	50	50

Figure 7 Malaysia : Annual Average Particulate Matter (PM10) Concentration, 1996-2001



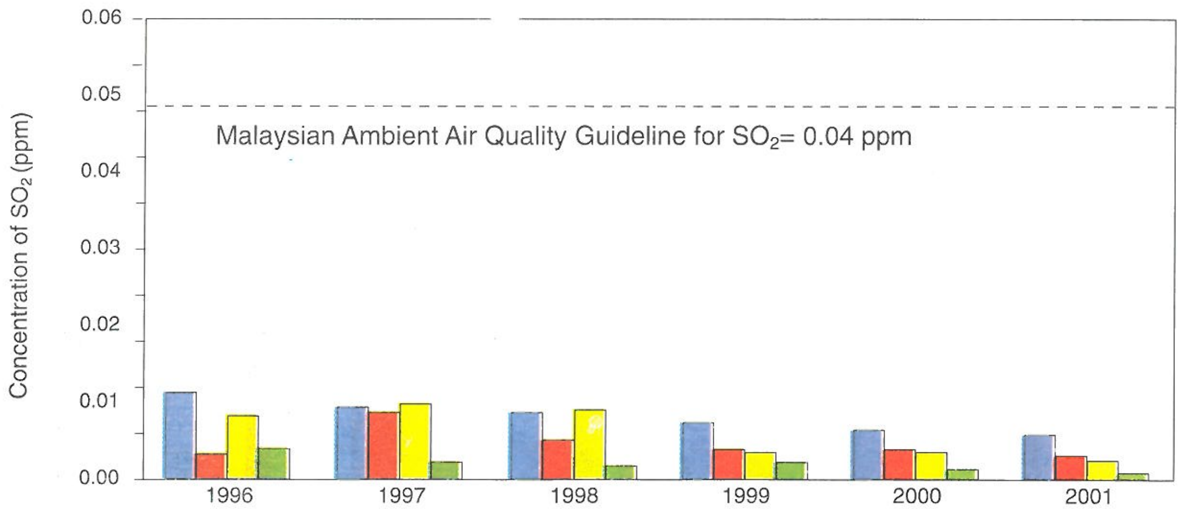
	1996	1997	1998	1999	2000	2001
Industry	50	62	47	45	45	47
Urban	64	83	51	45	46	46
Sub Urban	49	54	46	39	39	42
Background	23	44	32	38	31	36
Rural			28	40	38	48

Figure 7 (a) Malaysia : Annual Average PM10 Concentration by Landuse, 1996-2001



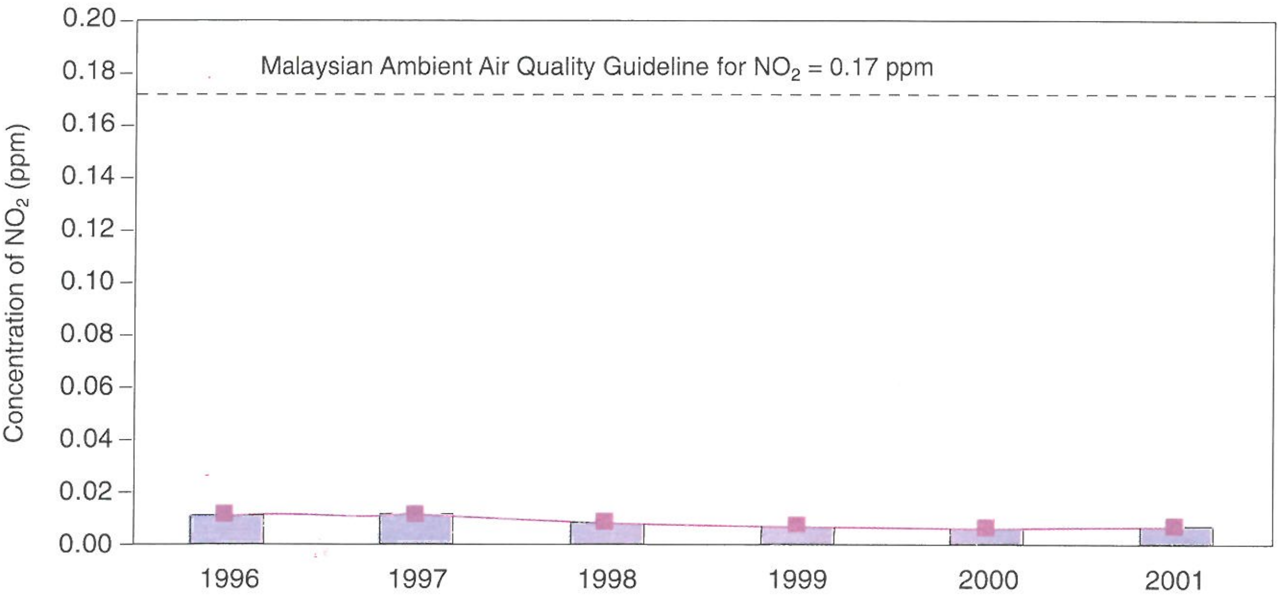
No. of sites	13	27	33	40	45	50

Figure 8 Malaysia : Annual Average SO_2 Concentration by Landuse, 1996-2001



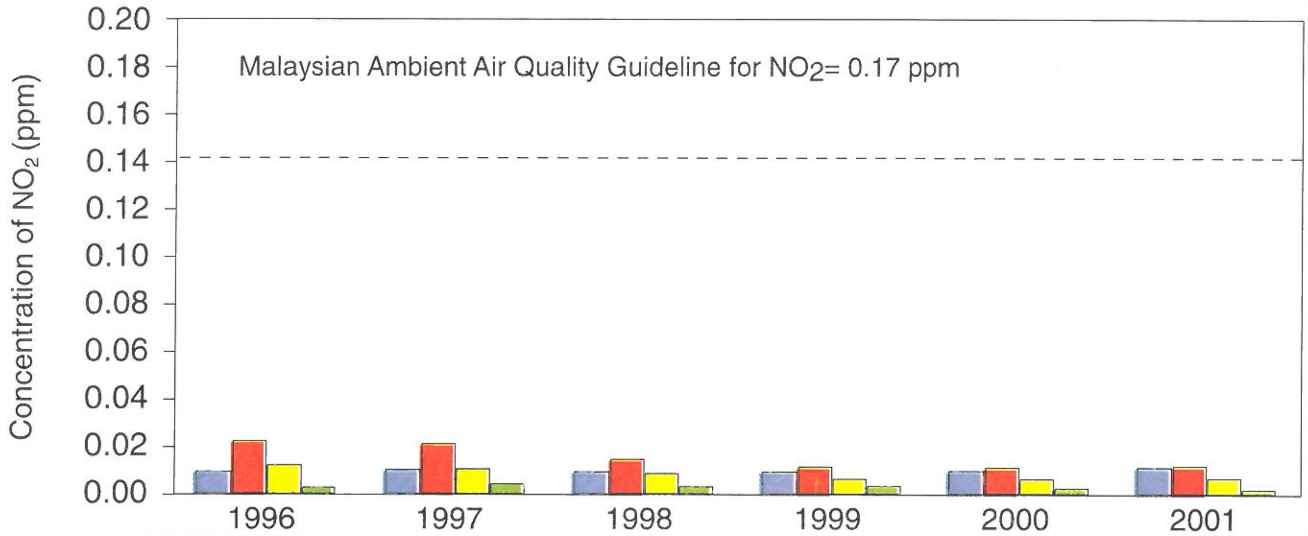
	1996	1997	1998	1999	2000	2001
Industry	0.0112	0.0093	0.0087	0.0073	0.0064	0.0057
Urban	0.0033	0.0089	0.0052	0.0039	0.0037	0.003
Sub Urban	0.0082	0.0097	0.0090	0.0036	0.0038	0.0024
Background	0.0040	0.0022	0.0017	0.0022	0.0013	0.0009

Figure 8 (a) Malaysia: Annual Average SO_2 Concentration by Landuse, 1996-2001



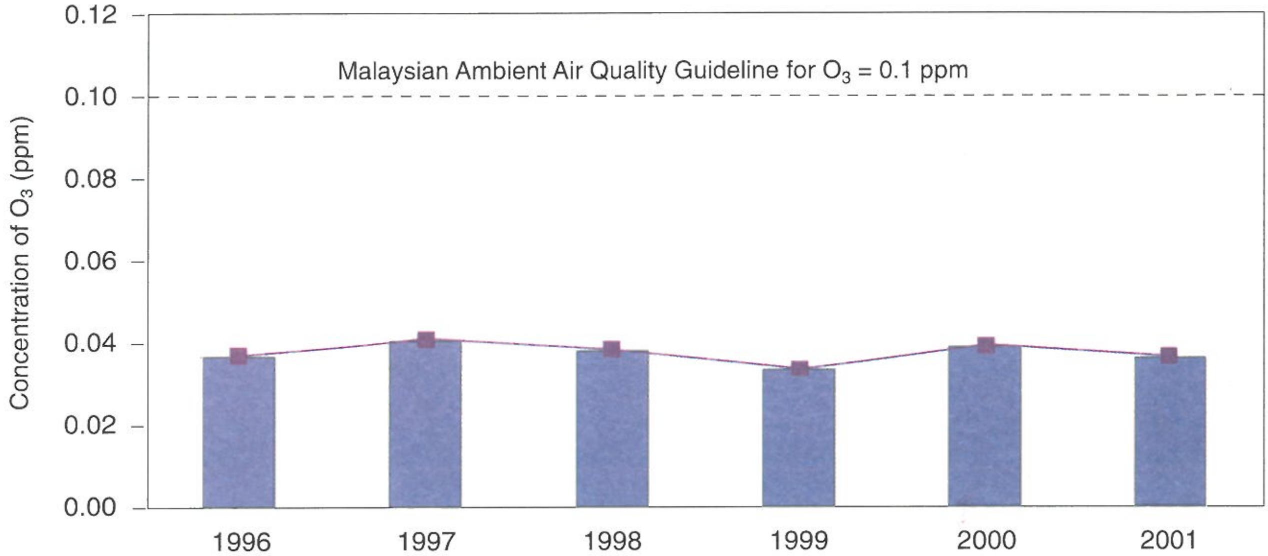
No. of sites	13	27	33	40	45	45

Figure 9 Malaysia : Annual Average NO2 Concentration, 1996-2001



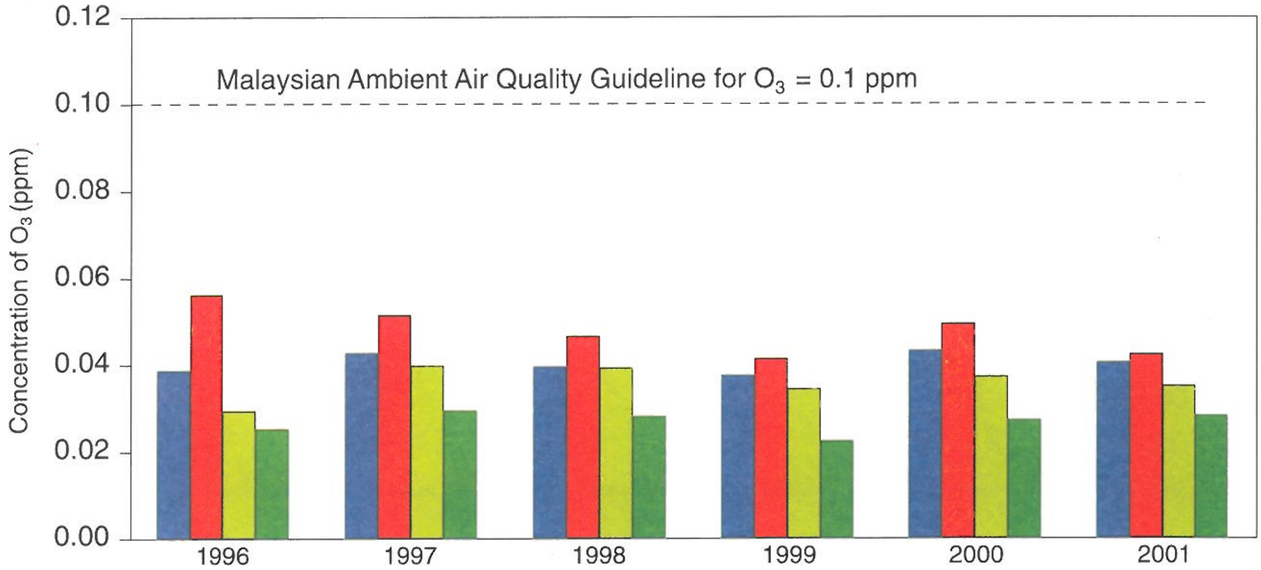
	1996	1997	1998	1999	2000	2001
Industry	0.0096	0.0100	0.0089	0.0096	0.0093	0.0105
Urban	0.0221	0.0210	0.0141	0.0112	0.0104	0.0113
Sub Urban	0.0123	0.0108	0.0084	0.0062	0.0062	0.0062
Background	0.0025	0.0033	0.0031	0.0030	0.0014	0.0013

Figure 9 (a) Malaysia : Annual Average NO_2 Concentration by Landuse, 1996-2001



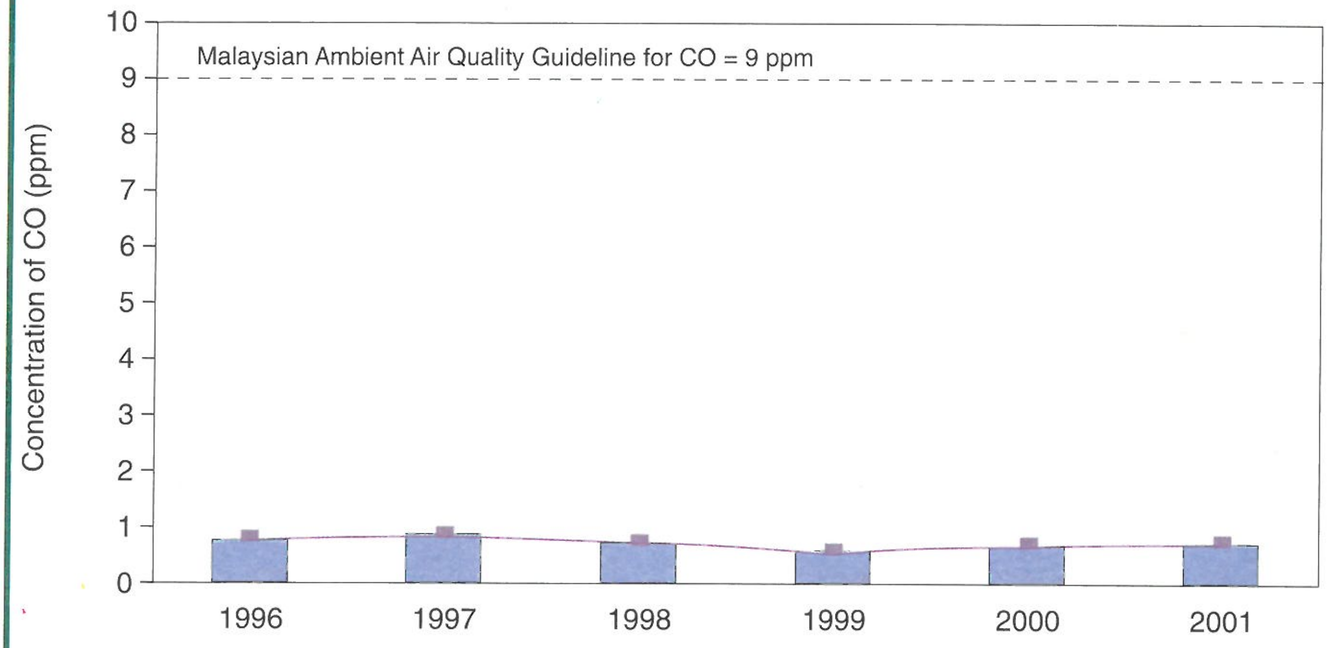
No. of sites	12	21	27	34	39	39

Figure 10 Malaysia : Annual Average Daily Maximum 1 Hour O_3 Concentration, 1996-2001



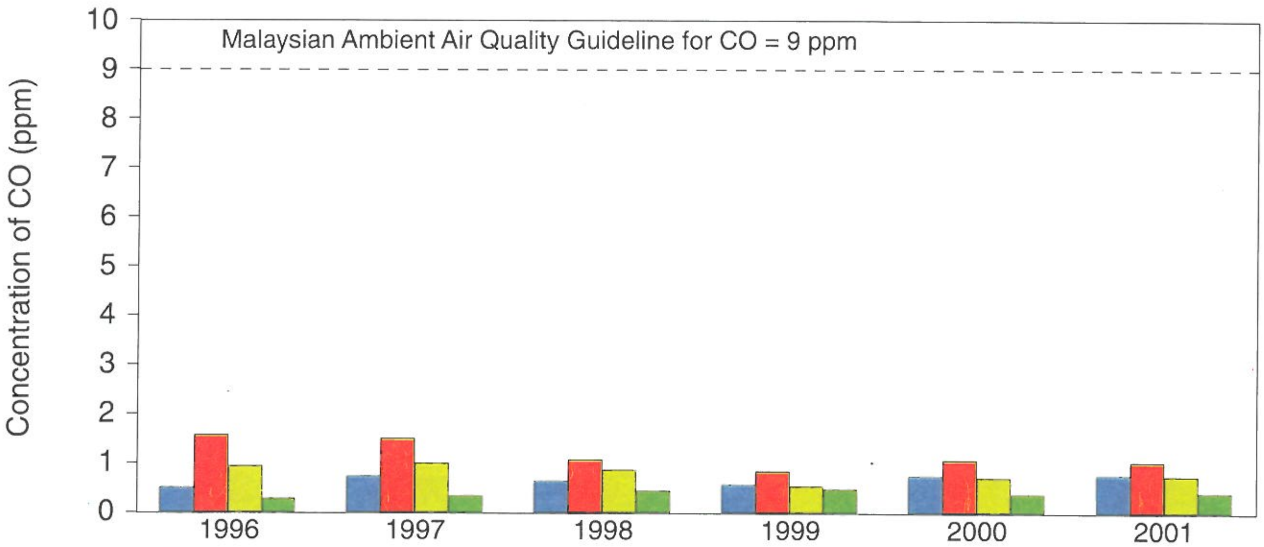
	1996	1997	1998	1999	2000	2001
Industry	0.038	0.043	0.039	0.038	0.043	0.0405
Urban	0.056	0.051	0.046	0.041	0.049	0.0426
Sub Urban	0.029	0.040	0.039	0.034	0.037	0.0348
Background	0.025	0.029	0.028	0.022	0.027	0.0279

Figure 10 (a) Malaysia : Annual Average Daily Maximum 1 Hour O_3 by Landuse, 1996-2001



No. of sites	12	21	27	34	39	39

Figure 11 Malaysia : Annual Average CO Concentration , 1996-2001



	1996	1997	1998	1999	2000	2001
Industry	0.501	0.726	0.627	0.555	0.739	0.7614
Urban	1.541	1.475	1.067	0.822	1.071	1.0091
Sub Urban	0.922	0.975	0.845	0.520	0.689	0.7169
Background	0.255	0.33	0.436	0.448	0.347	0.3978

Figure 11(a) Malaysia : Annual Average Concentration of Carbon Monoxide (CO) by Landuse, 1996-2001

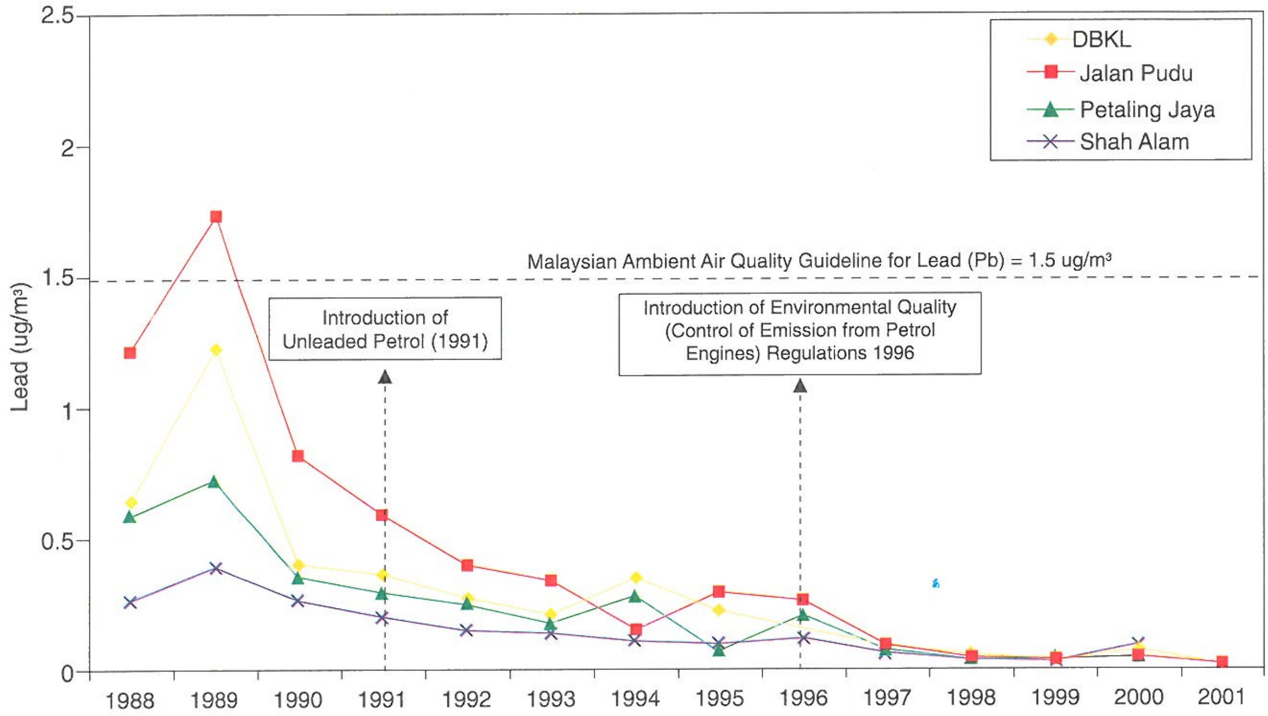


Figure 12 Malaysia : Ambient Lead Concentration in the Klang Valley, 1988-2001

MALAYSIA Environmental Quality Report 2001

NOISE MONITORING

NOISE MONITORING

Noise monitoring carried out by the Department of Environment in 2001 concentrated mainly in residential areas within the Klang Valley. The typical effects of noise in residential areas are: sleep disturbance, annoyance and speech interference. In 2001, ambient noise measurements were carried out in residential areas of Bangi, Serdang, Setapak, Gombak, Cheras, Shah Alam, Kelang, Kajang and Ampang. Data obtained from the monitoring program were then assessed against the values recommended by the World Health Organization (WHO).

The noise levels recorded at these areas were found to be in the range of 48.1 dB(A) to 66.7 dB(A) during daytime (7am to 10pm). These values indicated that the noise levels at these residential areas during daytime exceeded the limit of 55dB(A) recommended by the World Health Organization (WHO). Higher noise levels were recorded at Serdang, Shah Alam and Kajang. (Figure 13)

From measurements carried out during the night time (10pm to 7am) at the same areas, the noise levels were found to be in the range of 41.7 dB(A) to 66.7 dB(A). Similarly the night measurements indicated that most of the time the noise levels exceeded the WHO limited of 45 dB (A). Higher noise levels were recorded at Shah Alam, Ampang and Serdang during night time.

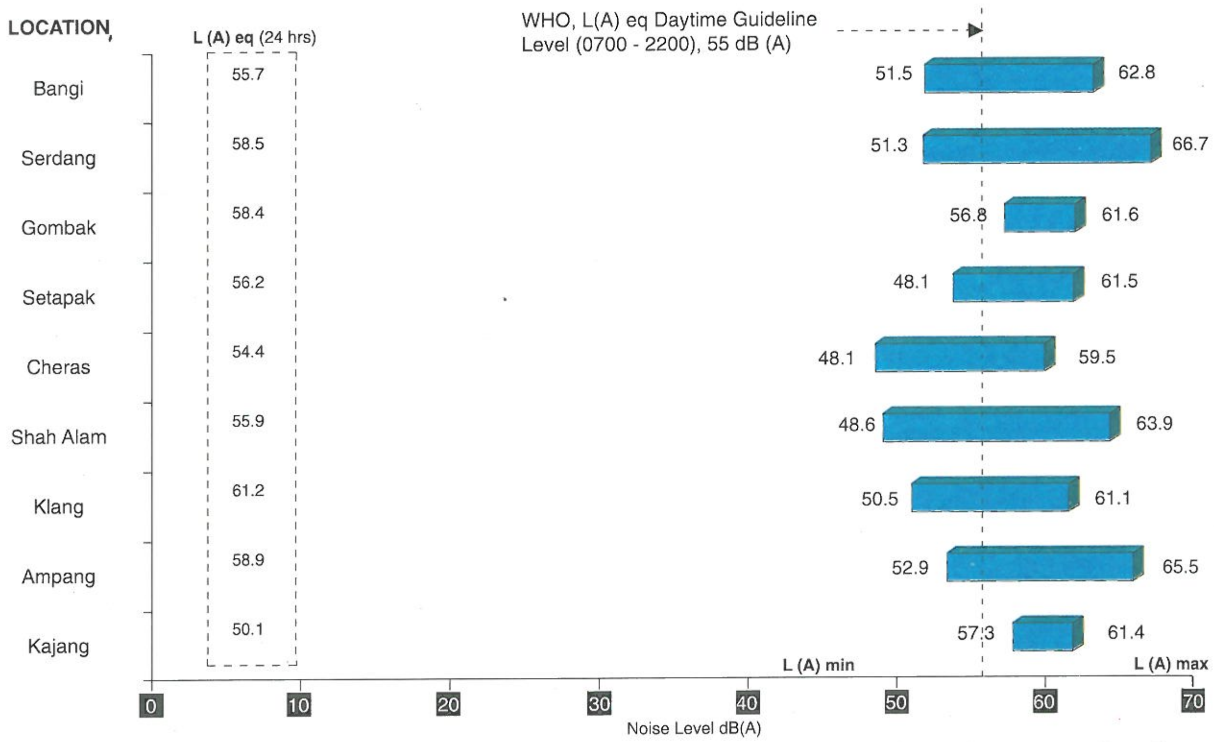


Figure 13 Department of Environment : Daytime Noise Levels at Residential Areas in the Klang Valley, 2001

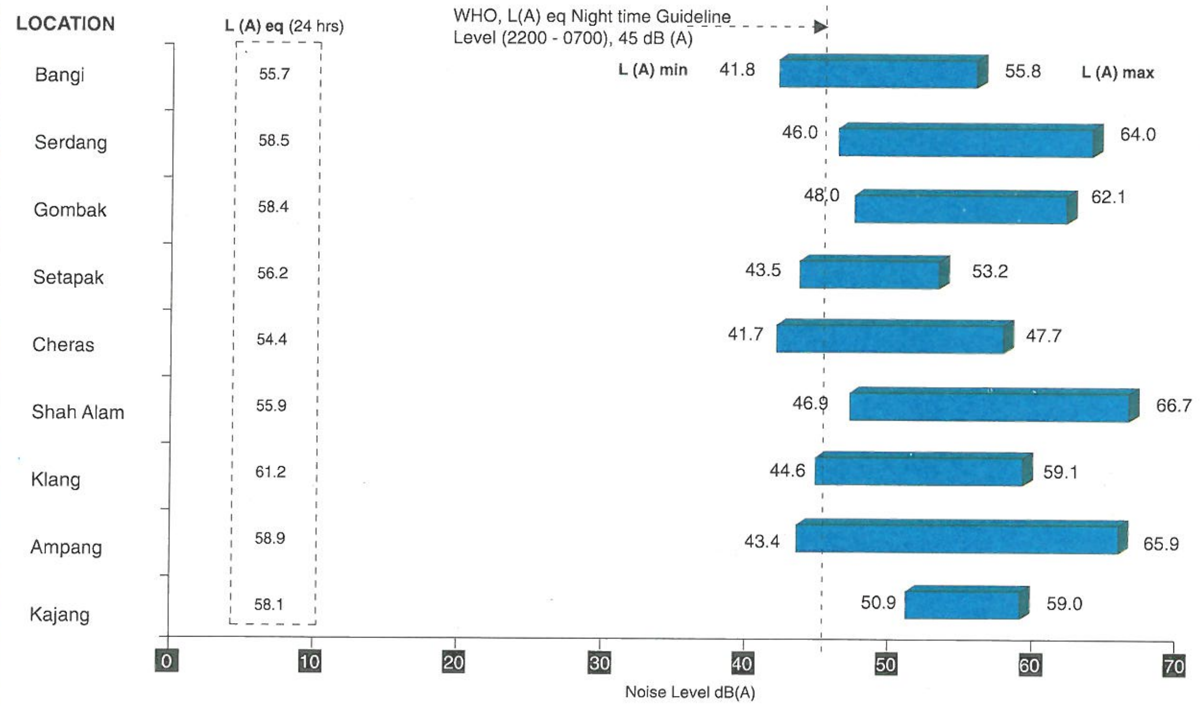


Figure 14 Department of Environment : Night time Noise Levels at Residential Areas in the Klang Valley, 2001

MALAYSIA Environmental Quality Report 2001

RIVER WATER QUALITY

RIVER WATER QUALITY

INTRODUCTION

Water is the essence of life. The demand for clean and portable water has increased tremendously due to rapid development and a growing population. Thus it is imperative that every effort be made to protect and conserve existing water sources, namely our rivers, for present and future needs.

Monitoring of river water quality in Malaysia by the Department of Environment started in 1978, initially to establish water quality baseline and subsequently to detect water quality changes and identify pollution sources. Samples had been regularly taken at predetermined stations, for in-situ and laboratory analysis and data interpretation in terms of their physico-chemical and biological characteristics. River water quality appraisal is based on the Water Quality Index (WQI) consisting of parameters such as Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammoniacal Nitrogen (NH3N), Suspended Solids (SS) and pH. The WQI serves as a basis for environmental assessment of a watercourse in relation to pollution categorization and designated classes of beneficial uses as provided for under the National Water Quality Standards for Malaysia (NWQS). (ANNEX)

Photo 5: A clean river in Malaysia
(DOE Photo Library)

RIVER WATER QUALITY STATUS

In 2001, a total of 931 manual water quality monitoring stations located within 120 river basins were monitored. Out of these 931 monitoring stations, 489 (53%) were found to be clean, 303 (33%) slightly polluted and 139 (15%) polluted. (Table 3(a),(b),(c)). Stations located upstream were generally clean, while those downstream were either slightly polluted or polluted. In terms of water quality on the basis of river basins, 60 basins (50%) were clean compared to 34 basins in 2000; 47 (39 %) slightly polluted compared to 74 in 2000; and 13 (11 %) polluted compared to 12 in 2000 (Figure 15).

In addition, 10 automatic water quality monitoring stations at strategic locations along major rivers had been installed to detect water quality changes on a continuous basis. Real time data on specific parameters can be transmitted to DOE. This would enable immediate investigations to be conducted on suspected pollution sources. Six of these stations were located nearby or upstream of water intake points at Sungai Perai, Sungai Perak, Sungai Linggi, Sungai Melaka, Sungai Skudai and Sungai Terengganu. Two stations were located at the recreational areas of Sungai Selangor and Sungai Sarawak. Another two stations were located at Sungai Kelang and Sungai Keratong to monitor domestic sources of pollution.

Photo 6: Discharge of Untreated Industrial Effluent (DOE Photo Library)

Water quality data compiled from the ten continuous water quality monitoring stations are presented in Figure 16, 17, 18 & 19. Based on the 90-percentile values, low dissolved oxygen levels were most frequent in Sg.Perai (51.1% saturation), followed by Sg.Klang (59.2% saturation) and Sg.Skudai (61.7% saturation) (Figure 16). High ammonium levels were recorded more frequently in Sg.Klang (7.9 mg/l), followed by Sg.Perai (6.5 mg/l) and Sg.Skudai (3.5 mg/l) (Figure 17). High turbidity levels were most frequently detected in Sg.Klang (1535 NTU), followed by Sg.Sarawak (932.5 NTU) and Sg.Linggi (903.7 NTU) (Figure 18). Low pH levels were detected in Sg. Selangor (pH 6.4), followed by Sg Perai (pH 6.4) and Sg Terengganu (pH 6.5). (Figure 19)

Photo 7: A Continous Water Quality Monitoring Station (DOE Photo Library)

Figure 20 illustrates the status of river water quality in relation to major pollution sources, whereby 18% of river basins were polluted by biochemical oxygen demand (BOD) due to sewage and discharges from agro-based and manufacturing industries; 20% of river basins were polluted by ammoniacal nitrogen (NH3-N) from sewage that included livestock farming and domestic sewage; and 33% by suspended solids (SS) due to earthworks and land-clearing activities. The corresponding figures in 2000 were 15%, 28% and 44% for BOD, NH3-N and SS respectively. The NH3-N improvement could be attributed to the increased numbers of refurbished sewage treatment facilities and the reduction in the total number of pig farms in Malaysia. SS improvement could be due to better control of earthworks and land clearing activities.

Analysis of heavy metals in 5,464 water samples revealed that almost all the samples complied with the Water Quality Standards for arsenic (As), mercury (Hg), cadmium (Cd), chromium (Cr), lead (Pb) and zinc(Zn), except iron (Fe) with 71.0% compliance.

As shown in Figure 15, the number of clean river basins in 2001 had increased from 34 to 60 (from 38% to 50%).This significant improvement was due to the fact that the 26 river basins that became clean (WQI >81) were already marginally in the slightly polluted category (WQI 76 - 80) over the past several years. A number of factors contributed to this improvement : reduction in land clearing activities, increased localised rainfall coupled with intensifed enforcement.

Photo 8: River water quality measurement
(DOE Photo Library)

Table 3(a) Malaysia : Water Quality Status within Clean River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	01PL	MELAKA	3	91 (89)	KISAP	1	93	C	II
					MELAKA	1	86	C	II
					PETANG	1	95	C	I
	03	KEDAH	6	83 (82)	KEDAH	1	68	SP	III
					PADANG TERAP	3	86	C	II
					PEDU	1	88	C	II
					TEKAI	1	84	C	II
KEDAH / P.PINANG	05	MUDA	9	83 (81)	JERUNG	2	74	SP	III
					KETIL	1	90	C	II
					MUDA	4	84	C	II
					TAWAR	2	87	C	II
PERAK	10T	TEMERLOH	2	83 (82)	TEMERLOH	2	83	C	II
	11	BERUAS	4	83 (83)	BRUAS	2	79	SP	II
					ROTAN	2	87	C	II
SELANGOR	16	SELANGOR	9	84 (81)	BATANG KALI	1	89	C	II
					KANCING	1	90	C	II
					KERLING	1	92	C	II
					SELANGOR	4	83	C	II
					SEMBAH	1	63	SP	III
					SERENDAH	1	84	C	II
JOHOR	30A	SEDILI BESAR	13	83 (83)	AMBAT	2	86	C	II
					DOHOL	1	88	C	II
					MUPUR	1	74	SP	III
					SEDILI BESAR	5	80	SP	II
					SEMANGGOT KANAN	1	90	C	II
					SEMANGGOT KIRI	1	89	C	II
					TEMUBOR KANAN	2	84	C	II
	30C	PALOI	2	82 (76)	PALOI	2	82	C	II
	31A	MERSING	1	91 (86)	MERSING	1	91	C	II
	31B	JEMALUANG	2	81 (79)	JEMALUANG	2	81	C	II
	32/33	PONTIAN	3	81 (75)	PONTIAN	2	87	C	II
					SEPAYANG	1	69	SP	III
	32AE	ANAK ENDAU	2	87 (81)	ANAK ENDAU	2	87	C	II
PAHANG	33	ROMPIN	18	84 (79)	AUR	1	89	C	II
					BAKAR	1	64	SP	III
					JEKATIH	2	89	C	II
					JERAM	1	91	C	II
					KEPASING	1	84	C	II
					KERATONG	4	81	C	II
					PUKIN	3	88	C	II
					REKOH	1	81	C	II
					ROMPIN	4	86	C	II
	34	BEBAR/ MERCHONG	8	83 (78)	BEBAR	1	76	SP	III
					KELAYAT	1	88	C	II
					MERBA	1	86	C	II
PAHANG					MERCHONG	1	63	SP	III
					SERAI	2	89	C	II

Table 3(a) Malaysia : Water Quality Status within Clean River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
					TEMIANG	2	86	C	II
	35B	BERA	5	82 (77)	BERA	3	79	SP	II
					TASIK BERA	1	86	C	II
					TRIANG	1	86	C	II
	35CH	BERTAM	10	86 (80)	BERTAM	2	86	C	II
					BURUNG	1	87	C	II
					HABU	1	91	C	II
					LENGGOK	1	91	C	II
					RINGLET	1	79	SP	II
					TELOM	2	84	C	II
					TERLA	1	85	C	II
					TRINGKAP	1	83	C	II
	35L	LEPAR	10	85 (84)	ANAK SG. LEPAR	1	61	SP	III
					BELAYAR	1	92	C	II
					BERKAPOR	2	89	C	II
					CHINI	1	80	SP	II
					LEPAR	3	90	C	II
					T. PAYA BUNGOR	1	88	C	II
					TASIK CHINI	1	84	C	II
	35M	MENTIGA	2	82 (81)	MENTIGA	2	82	C	II
	35P	PAHANG	51	88 (84)	BATU	1	86	C	II
					BENTONG	4	86	C	II
					BENUS	2	90	C	II
					BILUT	1	87	C	II
					JELAI	2	88	C	II
					JEMPOL	2	90	C	II
					JENGKA	2	87	C	II
					KELAU	2	81	C	II
					KERTAM	1	89	C	II
					KOYAN	1	91	C	II
					KUNDANG	1	79	SP	II
					LIPIS	3	91	C	II
					LUIT	1	89	C	II
					MARAN	2	87	C	II
					PAHANG	9	87	C	II
					PENJURING	1	93	C	I
					PERTANG	2	84	C	II
					PERTING	1	92	C	II
					SEMANTAN	3	88	C	II
					SIAM	1	87	C	II
					TANGLIR	1	88	C	II
					TEKAL	1	87	C	II
					TEKAM	2	87	C	II
PAHANG					TELANG	1	88	C	II
					TELEMONG	2	93	C	II
					TERANUM	1	93	C	II
					TERAS	1	93	C	II
TERENGGANU	38	KEMAMAN	10	81 (77)	CHERUL	2	89	C	II
					KEMAMAN	2	90	C	II
					NERAM	2	75	SP	II
					PERASING	2	87	C	II

Table 3(a) Malaysia : Water Quality Status within Clean River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
					RANSAN		64	SP	III
	39K	KERTIH	1	89 (87)	KERTIH	1	89	C	II
	40	PAKA	10	83 (83)	BESUL	2	89	C	II
					PAKA	4	85	C	II
					RASAU	2	84	C	II
					RENGAT	2	73	SP	III
	41	DUNGUN	4	89 (86)	DUNGUN	2	91	C	II
					TELEMBOH	2	87	C	II
	43	TERENGGANU	9	85 (85)	BERANG	2	92	C	II
					NERUS	3	89	C	II
					PUEH	2	77	SP	II
					TERENGGANU	2	81	C	II
	44	SETIU	3	89 (82)	SETIU	1	91	C	II
					TARONG	2	88	C	II
	46	BESUT	4	88 (85)	BESUT	2	91	C	II
					JERTIH	2	86	C	II
KELANTAN	47K	KEMASIN	1	86 (75)	KEMASIN	1	86	C	II
	47S	SEMERAK	2	86 (71)	SEMERAK	2	86	C	II
	48	KELANTAN	38	88 (84)	ARING	2	90	C	II
					BELATOP	2	79	SP	II
					BER	1	91	C	II
					BEROK	2	85	C	II
					BETIS	1	92	C	II
					CHIKU	2	88	C	II
					GALAS	1	88	C	II
					KELANTAN	4	87	C	II
					KELESA	2	92	C	II
					KERAK	2	90	C	II
					KERILLA	2	92	C	II
					KETIL	2	91	C	II
					NAL	3	93	C	II
					PEHI	2	87	C	II
					PENGKALAN CHEPA	1	69	SP	III
					PENGKALAN DATU	3	82	C	II
					PERGAU	2	91	C	II
					PERTOK	2	86	C	II
					RELAI	2	88	C	II
KELANTAN	49	GOLOK	4	84 (81)	GOLOK	2	90	C	II
					TASIK GARU	2	78	SP	II
SARAWAK	50	KAYAN	4	84 (84)	KAYAN	3	81	C	II
					SEMATAN	1	92	C	II
	53	LUPAR	7	83 (77)	AI	1	88	C	II
					LUPAR	3	77	SP	II
					SEKERANG	1	90	C	II
					SETERAP	1	84	C	II
					UNDUP	1	90	C	II
	56	RAJANG	18	81 (78)	BINATANG	1	86	C	II
					JULAU	1	88	C	II
					MERADONG	1	82	C	II
					RAJANG	14	80	SP	II
					SARIKEI	1	85	C	II
	59	BALINGIAN	2	83 (79)	BALINGIAN	2	83	C	II
	60	TATAU	1	86 (79)	TATAU	1	86	C	II

Table 3(a) Malaysia : Water Quality Status within Clean River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
	61	KEMENA	3	82 (79)	KEMENA	2	83	C	II
					SIBIU	1	81	C	II
	62	SIMILAJAU	1	90 (83)	SIMILAJAU	1	90	C	II
	63	SUAI	1	85 (79)	SUAI	1	85	C	II
	68	LIMBANG	5	83 (79)	LIMBANG	5	83	C	II
	69	TRUSAN	1	86 (85)	TRUSAN	1	86	C	II
	70	LAWAS	2	86 (85)	LAWAS	2	86	C	II
SABAH	71	MENGGALONG	3	86 (82)	LAKUTAN	1	86	C	II
					LINGKUNGAN	1	87	C	II
					MENGGALONG	1	86	C	II
	72	PADAS	7	86 (85)	BUNSIT	1	92	C	II
					LIAWAN	1	92	C	II
					PADAS	3	81	C	II
					PANGATAN	1	86	C	II
					TANDULU	1	92	C	II
	73	MEMBAKUT	1	85 (80)	MEMBAKUT	1	85	C	II
	75	PAPAR	2	88 (86)	PAPAR	2	88	C	II
	76	MOYOG	11	81 (80)	INANAM	3	83	C	II
					LIKAS	1	65	SP	III
					MENGGATAL	2	85	C	II
					MOYOG	3	91	C	II
					TELIPOK	2	66	SP	III
	77	DAMIT/TUARAN	6	89 (87)	DAMIT	2	89	C	II
					SONG SAI	1	89	C	II
					TUARAN	3	90	C	II
	78	KEDAMAIAN	3	89 (86)	TEMPASUK	2	90	C	II
					TENGHILAN	1	89	C	II
	80	BENGKOKA	1	88 (85)	BENGKOKA	1	88	C	II
	83	SUGUT	6	91 (88)	BONGKUD	1	91	C	II
SABAH					LOHAN	2	90	C	II
					MERALI	1	89	C	II
					SUGUT	2	92	C	II
	84	LABOK	8	88 (85)	KINIPIR	2	88	C	II
					LIWAGU	2	88	C	II
					MALIAU	1	91	C	II
					SAPI	2	87	C	II
					SUALONG	1	91	C	II
	85	KAYA	1	89 (84)	MOUNAD	1	89	C	II
	86	KINABATANGAN	4	82 (77)	KINABATANGAN	2	81	C	II
					KOYAH	1	85	C	II
					TENEGANG BESAR	1	81	C	II
	87	SEGAMA	1	84 (80)	SEGAMA	1	84	C	II
	88	SILABUKAN	2	81 (80)	SILABUKAN	2	81	C	II
	89	TINGKAYU	1	81 (79)	TINGKAYU	1	81	C	II
	91	TAWAU	5	87 (82)	APAS	1	91	C	II
					BALUNG	1	86	C	II
					TAWAU	3	85	C	II
	93	UMAS-UMAS	1	81 (79)	UMAS-UMAS	1	81	C	II
	94	BRANTIAN	1	81 (80)	BRANTIAN	1	81	C	II
	95	KALABAKAN	2	81 (75)	KALABAKAN	2	81	C	II

NOTE:

1. WQI BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, pH, DO, NH3-N

2. RIVER WATER QUALITY STATUS: C : CLEAN, SP : SLIGHTLY POLLUTED, P : POLLUTED

3. RIVER CLASS BASED ON NWQS

4. OVERALL WQI FOR YEAR 2000 IS IN BRACKET, ( )

Table 3(b) Malaysia : Water Quality Status within Slightly Polluted River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
PERLIS	01	PERLIS	10	79 (78)	ARAU	1	73	SP	III
					JARUM	1	83	C	II
					JERNIH	2	82	C	II
					KOK MAK	1	81	C	II
					NGULANG	1	79	SP	II
					PERALIT	1	87	C	II
					PERLIS	1	68	SP	III
					SERAI	1	74	SP	III
					TASOH	1	77	SP	II
PULAU PINANG/ KEDAH	06P	PERAI	22	63 (62)	AIR MELINTAS	1	37	P	IV
					JARAK	6	70	SP	III
					KELADI	1	65	SP	III
					KEREH	4	54	P	III
					KUBANG SEMANG	2	59	P	III
					KULIM	3	84	C	II
					PERAI	2	65	SP	III
					SELUANG	1	44	P	IV
					SELUANG BAWAH	2	45	P	IV
PULAU PINANG/ PERAK	08	KERIAN	10	76 (72)	KECHIL	3	72	SP	III
					KERIAN	4	80	SP	II
					SELAMA	2	72	SP	III
					SERDANG	1	84	C	II
	09	KURAU	5	79 (76)	ARA	1	85	C	II
					KURAU	4	77	SP	II
	10	SEPETANG	10	76 (73)	BATU TEGUH	2	75	SP	III
					JANA	1	92	C	II
					LARUT	1	68	SP	III
PERAK					LIDIN	1	66	SP	III
					MALAI	1	61	SP	III
					SEPETANG	3	78	SP	II
					TUPAI	1	86	C	II
	12	RAJA HITAM	6	65 (60)	DERHAKA	2	52	P	III
					MANJONG	2	75	SP	III
	12W	WANGI/ DERALIK	4	62 (69)	RAJA HITAM	2	68	SP	III
					DERALIK	2	61	SP	III
	13	PERAK	53	76 (77)	WANGI	2	64	SP	III
					BATANG PADANG	3	84	C	II
					BIDOR	3	80	SP	II
					CHENDERIANG	2	90	C	II
					CUAR	2	90	C	II
					KAMPAR	2	88	C	II
					KANGSAR	2	90	C	II
					KEPAYANG	2	66	SP	III
					KERDAH	2	71	SP	III
					KINTA	6	64	SP	III
					KLAH	2	81	C	II
					KLIAN BARU	2	70	SP	III
					KUANG	1	81	C	II
					PARI	2	60	SP	III
					PELUS	2	86	C	II

Table 3(b) Malaysia : Water Quality Status within Slightly Polluted River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
					PERAK	8	84	C	II
					PINJI	2	55	P	III
					RAIA	2	82	C	II
					SELUANG	1	78	SP	II
PERAK					SEROKAI	2	41	P	IV
					SUNGKAI	2	88	C	II
					SUNGKAI MATI	2	67	SP	III
					TUMBOH	1	66	SP	III
PERAK/ SELANGOR	14	BERNAM	10	79 (79)	BERNAM	6	74	SP	III
						2	87	C	II
						2	88	C	II
SELANGOR	15	TENGI	2	80 (75)	TENGI	2	80	SP	II
	19	LANGAT	30	66 (68)	ANAK CHUAU	1	80	SP	II
					BALAK	1	35	P	IV
					BATANG BENAR	2	51	P	IV
					BATANG LABU	2	70	SP	III
					BATANG NILAI	2	41	P	IV
					BERANANG	1	83	C	II
					BUAN	1	75	SP	III
					CHUAU	3	80	SP	II
					JIJAN	1	84	C	II
					LANGAT	9	64	SP	III
					LIMAU MANIS	1	48	P	IV
					LUI	1	91	C	II
					PAJAM	1	75	SP	III
					RINCHING	1	78	SP	II
SELANGOR					SEMENYIH	3	79	SP	II
	20	SEPANG	3	68 (66)	SEPANG	3	68	SP	III
NEGERI	20J	LUKUT	1	72 (73)	LUKUT	1	72	SP	III
SEMBILAN	21	LINGGI	15	75 (75)	BATANG PENAR	1	59	P	III
					CHEMBONG	1	81	C	II
NEGERI					KEPAYONG	1	66	SP	III
SEMBILAN				68 (72)	KUNDUR BESAR	1	87	C	II
					LINGGI	6	71	SP	III
					PEDAS	1	89	C	II
					REMBAU	2	86	C	II
					SIMIN	1	73	SP	III
					TEMIANG	1	80	SP	II
MELAKA	22	MELAKA	17	67 (72)	BTG.MELAKA	2	81	C	II
				75 (70)	DURIAN TUNGGAL	1	82	C	II
					MELAKA	9	65	SP	III
					PUTAT	2	55	P	III
					REMBIA	2	63	SP	III
					TAMPIN	1	87	C	II
	23	DUYONG	3		DUYONG	3	67	SP	III
	24	KESANG/ MERLIMAU	8		CHOHONG	2	86	C	II
					KESANG	3	75	SP	III
					MERLIMAU	3	67	SP	III

Table 3(b) Malaysia : Water Quality Status within Slightly Polluted River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
JOHOR/NEGERI SEMBILAN	25	MUAR	43	77 (75)	GEMENCHEH	3	86	C	II
					JUASSEH	2	87	C	II
					KELAMAH	2	69	SP	III
					LABIS	4	81	C	II
					MERBUDU	1	71	SP	III
					MERLIMAU	1	58	P	III
					MUAR	16	78	SP	II
					P. MENKUANG	1	86	C	II
					PALONG	4	80	SP	II
					SEGAMAT	1	88	C	II
					SENARUT	2	60	SP	III
					SEROM	1	66	SP	III
					SPG. LOI	2	73	SP	III
					TEMARONG	1	89	C	II
					TENANG	2	71	SP	III
JOHOR	26	BATU PAHAT	23	75 (75)	AMRAN	2	69	SP	III
					BATU PAHAT	1	55	P	III
					BEKOK	4	81	C	II
					BERLIAN	2	81	C	II
					CHAAH	2	84	C	II
					LENIK	1	80	SP	II
					MEREK	2	88	C	II
					MERPO	2	85	C	II
					SEMBERONG	2	66	SP	III
	27B		7	74 (71)	SIMPANG KANAN	2	61	SP	III
					SIMPANG KIRI	3	63	SP	III
		BENUT			BENUT	4	73	SP	III
	28A		5	60 (64)	PT. HAJI YASSIN	2	71	SP	III
	28B		2	70 (70)	ULU BENUT	1	86	C	II
	28C	PONTIAN BESAR	14	66 (67)	AIR HITAM	1	58	P	III
					AYER MERAH	1	44	P	IV
	28D		5	71 (76)	PONTIAN BESAR	3	65	SP	III
		PONTIAN KECIL			PONTIAN KECIL	2	70	SP	III
		SKUDAI			MELANA	2	56	P	III
					SKUDAI	12	68	SP	III
		TEBRAU			PLENTONG	1	52	P	III
					TEBRAU	4	76	SP	III
JOHOR	29	JOHOR	44	78 (76)	ANAK SG. SAYONG	3	68	SP	III
					BERANGAN	2	84	C	II
					BKT. BESAR	2	56	P	III
					CHEMANGAR	1	83	C	II
					JOHOR	4	83	C	II
					LAYANG	1	88	C	II
					LAYAU KIRI	2	85	C	II
					LEBAM	2	78	SP	II
					LINGGIU	1	85	C	II
					PENGGELI	2	87	C	II
					REMIS	2	82	C	II
					SANTI	1	79	SP	II
					SAYONG	4	84	C	II

Table 3(b) Malaysia : Water Quality Status within Slightly Polluted River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
	30B	SEDILI KECIL	5	71 (69)	SEBOL	2	78	SP	II
					SEMANGER	1	83	C	II
					SEMENCHU	2	81	C	II
	32	ENDAU	29	76 (76)	SENING	2	71	SP	III
					SERAI	2	72	SP	III
					TELOR	2	89	C	II
					TEMON	2	81	C	II
					TIRAM	4	69	SP	III
					ANAK SEDILI KECIL	1	41	P	IV
					BAHAN	2	81	C	II
					SEDILI KECIL	2	75	SP	III
					A.S. SEMBERONG	2	80	SP	II
					DENGAR	2	84	C	II
					ENDAU	1	79	SP	II
JOHOR	32	ENDAU			JEBONG	1	70	SP	III
					LENGA	2	61	SP	III
					LENGGOR	2	84	C	II
					MAMAI	2	82	C	II
					MELANTAI	2	71	SP	III
					MENGKIBOL	3	74	SP	III
					PALOH	2	87	C	II
					PAMOL	1	50	P	IV
					SEMBERONG	5	79	SP	II
					SINGOL	2	63	SP	III
					TAMOK	2	88	C	II
PAHANG	35	SERTING	7	68 (68)	MOKEK	2	64	SP	III
					SERTING	5	69	SP	III
	36	KUANTAN	11	80 (80)	BELAT	1	87	C	II
					CHARU	1	87	C	II
					GALING BESAR	1	38	P	IV
					GALING KECIL	1	52	P	IV
					KENAU	1	92	C	II
					KUANTAN	4	89	C	II
					PINANG	1	85	C	II
					RIAU	1	81	C	II
	37	BALOK/ TONGGOK	5	74 (68)	BALOK	2	71	SP	III
					TONGGOK	3	77	SP	II
	37A	CERATING	1	74 (73)	CERATING	1	74	SP	III
TERENGGANU	39C	CHUKAI	5	80 (78)	CHUKAI	1	78	SP	II
					IBOK	2	87	C	II
					RUANG	2	74	SP	III
TERENGGANU	42I	IBAI	3	77 (75)	IBAI	3	77	SP	II
	42M	MARANG	5	80 (76)	KERAK	2	73	SP	III
					MARANG	1	83	C	II
					TEMALA	2	85	C	II
SARAWAK	51	SARAWAK	15	78 (79)	KUAP	2	73	SP	III
					MAONG KIRI	1	72	SP	III
					SANTUBONG	1	80	SP	II

Table 3(b) Malaysia : Water Quality Status within Slightly Polluted River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
	51BS	SAMARAHAN	2	76 (75)	SAMARAHAN	2	76	SP	III
	52	SADONG	6	80 (80)	KARANGAN	1	82	C	II
					SADONG	3	73	SP	III
					TARAT	2	88	C	II
	54	SARIBAS	2	78 (76)	RIMBAS	1	82	C	II
					SARIBAS	1	74	SP	III
	55	KERIAN	3	78 (73)	KERIAN	2	77	SP	II
					SEBLAK	1	79	SP	II
	57	OYA	3	79 (79)	OYA	3	79	SP	II
	58	MUKAH	4	80 (77)	MUKAH	4	80	SP	II
	64	NIAH	5	72 (70)	NIAH	2	85	C	II
					SEKALOH	3	64	SP	III
	65	KABULOH	6	79 (75)	KABULOH	2	69	SP	III
					KAJAPIL	1	86	C	II
					SATAP	1	84	C	II
	66	MIRI/LUTONG	7	66 (69)	SIBUTI	2	82	C	II
					ADONG	1	62	SP	III
					DALAM	1	67	SP	III
					LUTONG	2	68	SP	III
					MIRI	2	65	SP	III
					PADANG LIKU	1	77	SP	II
	67	BARAM	4	79 (75)	BARAM	4	79	SP	II
SABAH	79	BINGKONGAN	3	74(72)	BANDAU	1	89	C	II
					MENGGARIS	1	42	P	IV
					TANDEK	1	89	C	II
	90	KALUMPANG	5	80(77)	INTAN	1	84	C	II
					KALUMPANG	2	88	C	II
					PANG BURONG 1	1	79	SP	II
					PANG BURONG 2	1	58	P	III

NOTE:
1. WQI BASED ON 6 MAJOR PARAMETERS:BOD, COD, SS, pH, DO, NH3-N
2. RIVER WATER QUALITY STATUS: C : CLEAN, SP : SLIGHTLY POLLUTED, P : POLLUTED
3. RIVER CLASS BASED ON NWQS
4. OVERALL WQI FOR YEAR 2000 IS IN BRACKET, ( )

Table 3(c) Malaysia : Water Quality Status within Polluted River Basins, 2001

STATE	CODE	RIVER BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	04	MERBOK	10	59 (59)	BAKAR ARANG	1	55	P	III
					BATU	1	29	P	V
					BONGKOK	1	66	SP	III
					BUKIT MERAH	1	67	SP	III
					KOROK	1	38	P	IV
					MERBOK	1	60	SP	III
					PETANI	1	48	P	IV
					TOK PAWANG	2	76	SP	III
					TUPAH	1	70	SP	III
PULAU PINANG	06J	JURU	8	49 (53)	ARA	1	53	P	III
					JURU	1	49	P	IV
					KILANG UBI	2	48	P	IV
					PASIR	1	42	P	IV
					RAMBAI	3	50	P	IV
	06PP	PINANG/KLUANG	12	46 (41)	AIR ITAM	5	48	P	IV
					AIR TERJUN	1	93	C	II
					DONDANG	3	43	P	IV
					JELUTONG	1	29	P	V
					KLUANG	1	55	P	III
					PINANG	1	37	P	IV
	07	JEJAWI	5	53 (54)	CEMPEDAK	1	40	P	IV
					JAWI	3	57	P	III
					JUNJONG	1	51	P	IV
SELANGOR	17	BULOH	5	53 (58)	BULOH	5	53	P	III
	18	KLANG	24	51 (53)	AMPANG	1	53	P	III
					BATU	2	57	P	III
					DAMANSARA	3	53	P	III
					GOMBAK	3	69	SP	III
					JINJANG	1	41	P	IV
					KERAYONG	1	47	P	IV
					KEROH	1	44	P	IV
					KLANG	10	50	P	IV
					KUYOH	1	53	P	III
					PENCALA	1	31	P	V
JOHOR	27A	AIR BALOI	3	51 (56)	AIR BALOI	3	51	P	IV
	28	SEGGET	6	44 (51)	SEGGET	6	44	P	IV
	28E	KEMPAS	2	46 (52)	KEMPAS	2	46	P	IV
	28F	DANGA	2	51 (59)	DANGA	2	51	P	IV
	28G	RAMBAH	2	58 (60)	RAMBAH	2	58	P	III
	29B	TUKANG BATU	5	45 (44)	BULUH	1	33	P	IV
					LATOH	1	55	P	III
					MASAI	1	59	P	III
					PEREMBI	1	49	P	IV
					TUKANG BATU	1	31	P	V
TERENGGANU	42L	LANDAS	2	55 (56)	LANDAS	2	55	P	III

NOTE:
1. *WQI BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, pH, DO, NH3-N*
2. *RIVER WATER QUALITY STATUS: C : CLEAN, SP : SLIGHTLY POLLUTED, P : POLLUTED*
3. *RIVER CLASS BASED ON NWQS*
4. *OVERALL WQI FOR YEAR 2000 IS IN BRACKET, ( )*

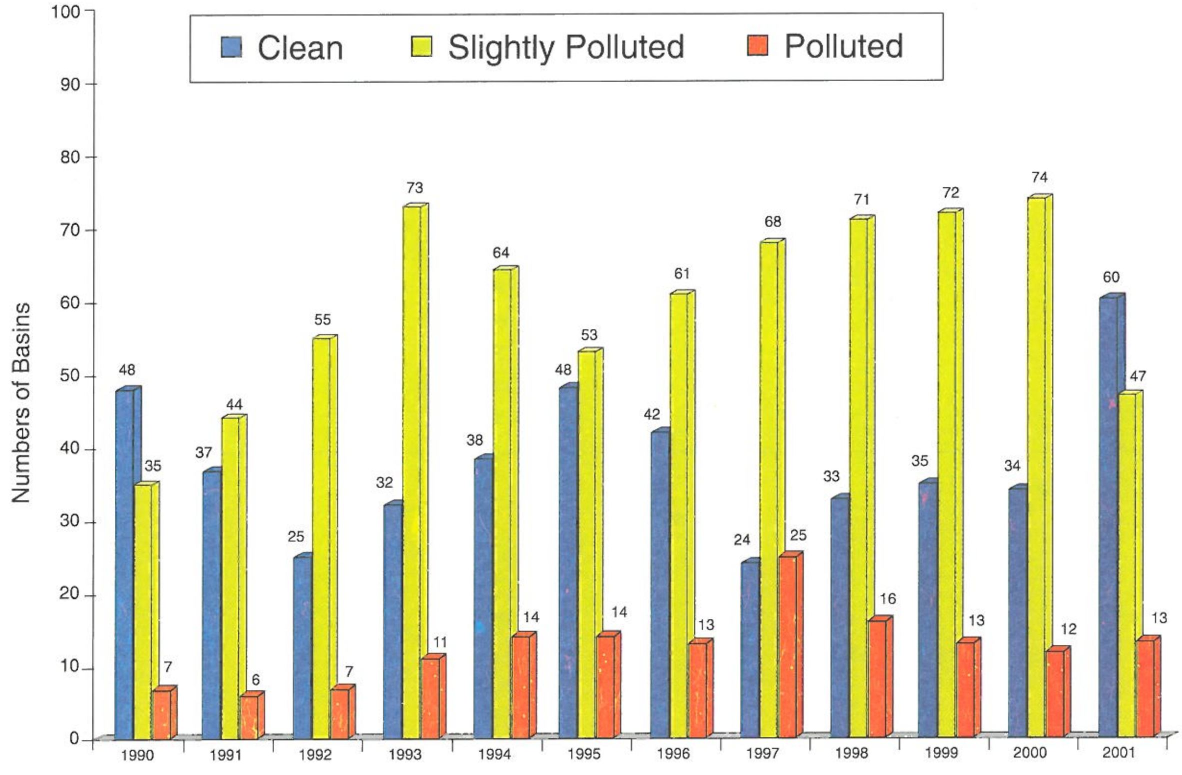


Figure 15 Malaysia : River Basins Water Quality Trend (1990-2001)

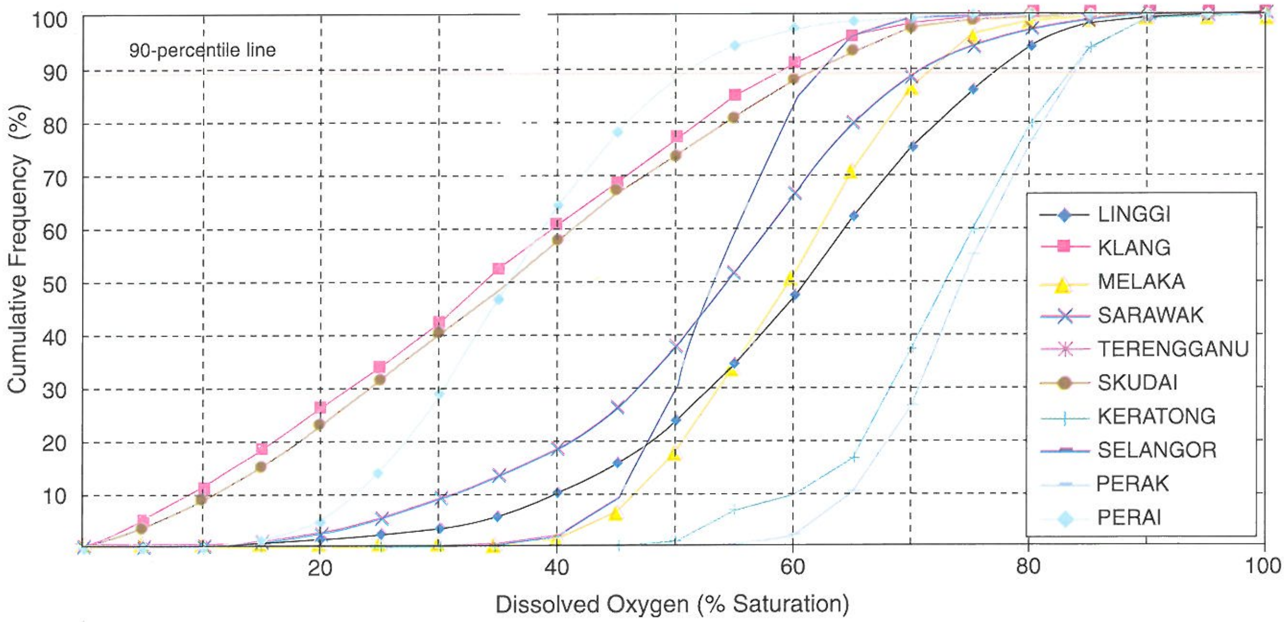


Figure 16 Malaysia : Comparison of Cumulative Frequency for Dissolved Oxygen : 1 January - 31 December 2001

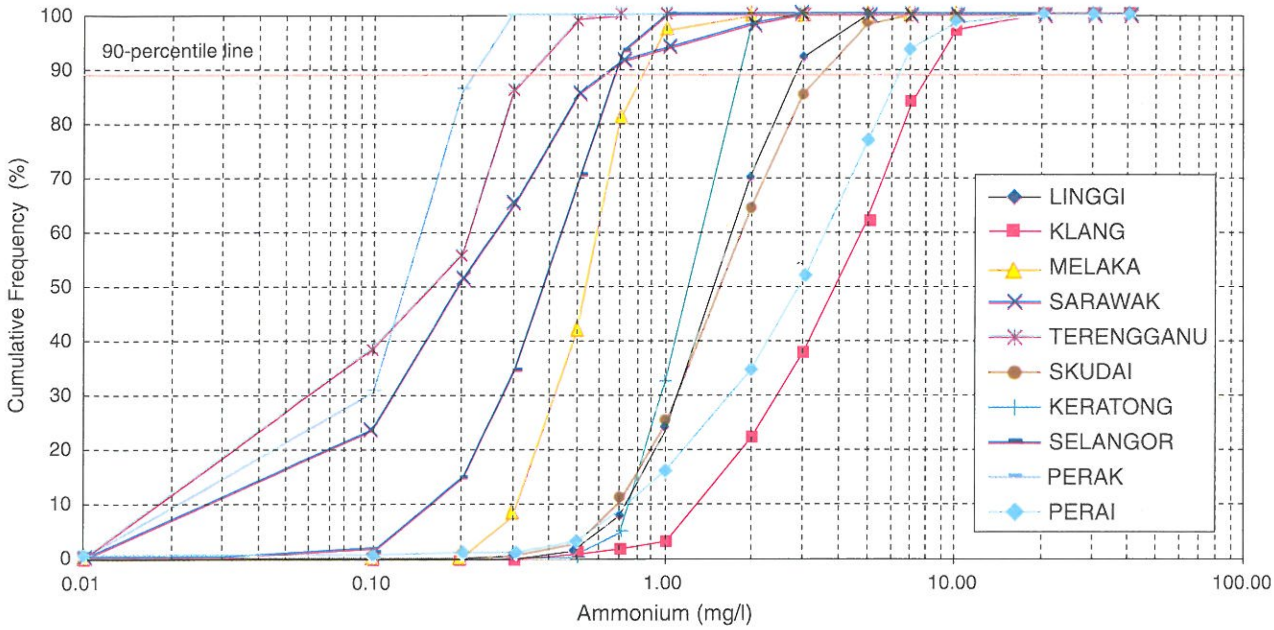


Figure 17 Malaysia : Comparison of Cumulative Frequency for Ammonium: 1 January - 31 December 2001

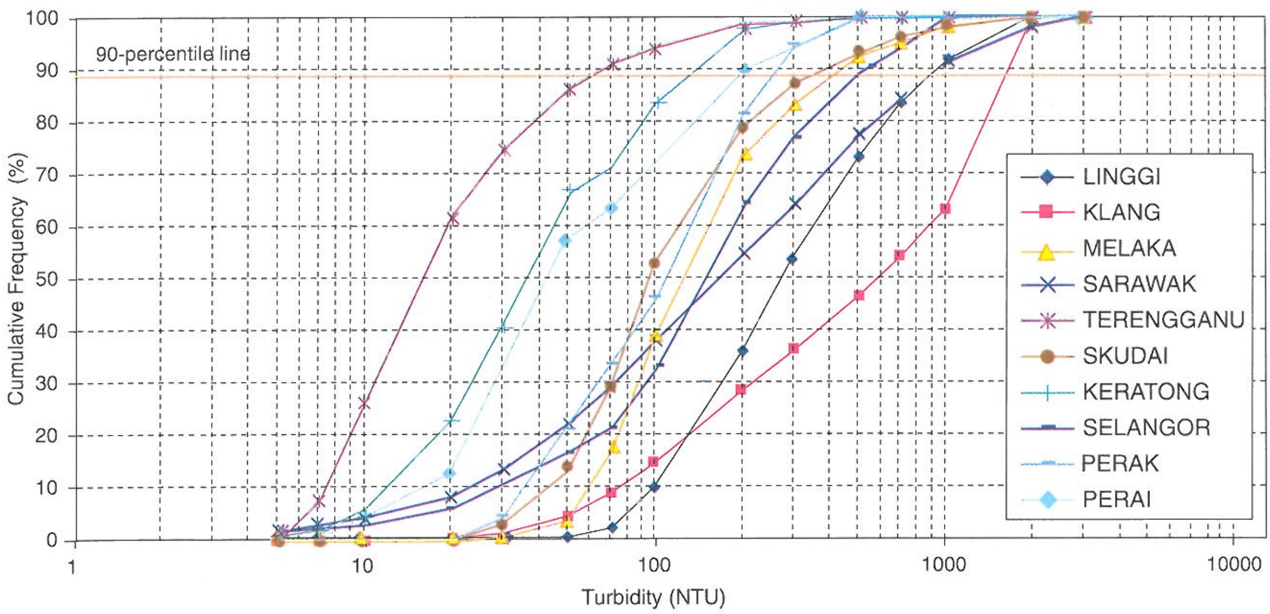


Figure 18 Malaysia : Comparison of Cumulative Frequency for Turbidity : 1 January - 31 December 2001

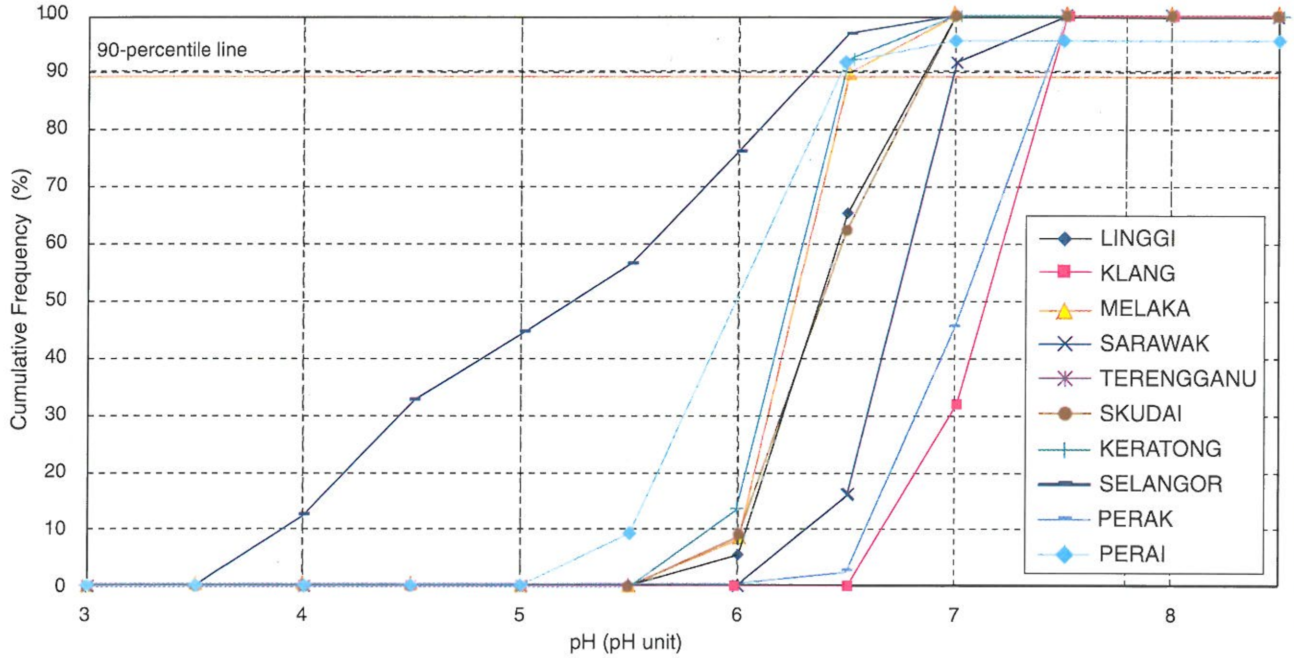
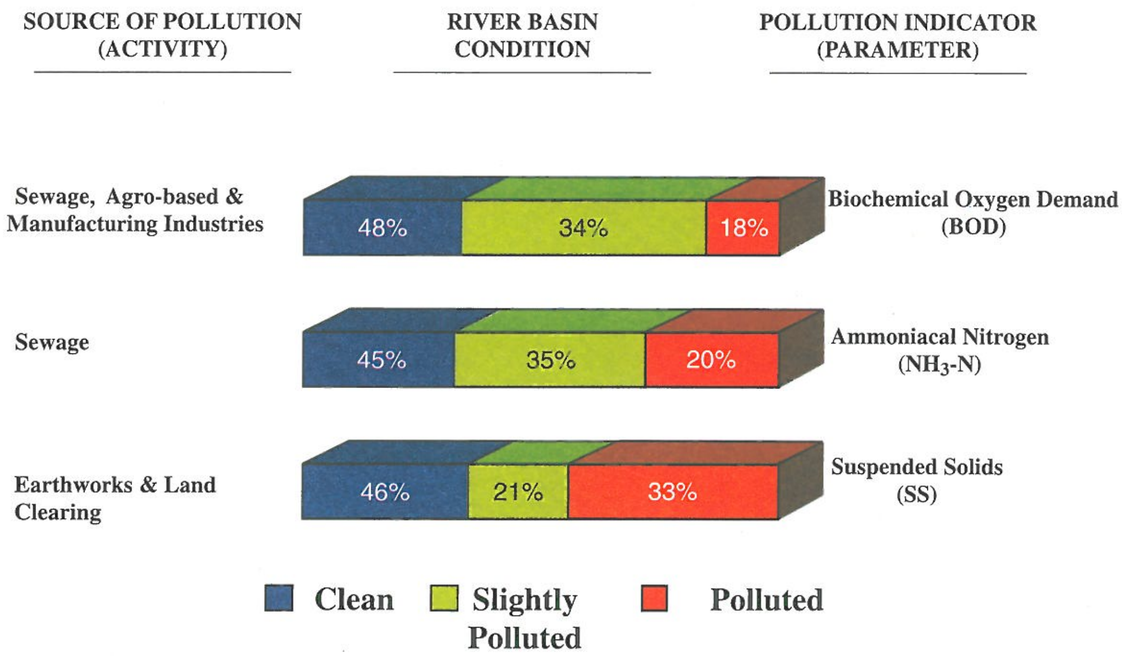


Figure 19 Malaysia : Comparison of Cumulative Frequency for pH : 1 January - 31 December 2001

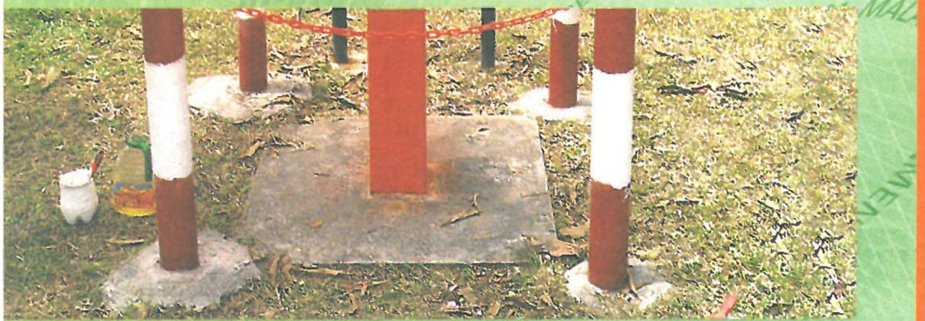


Notes:-

Number of River Basins Monitored = 120
Number of Monitoring Stations = 931

Figure 20 Malaysia : Status of River Basin Water Quality, 2001

MALAYSIA Environmental Quality Report 2001



GROUND WATER QUALITY

GROUNDWATER QUALITY

INTRODUCTION

The potential of groundwater as an alternative source of water is increasingly gaining importance since the water crisis a few years ago. As the demand for clean water increases in tandem with population growth and other socio-economic development activities, this potential source of water needs to be protected.

Groundwater quality is influenced by soil conditions and geological formation. DOE has taken the preliminary step to determine the quality of groundwater by initiating a national groundwater monitoring program.

Photo 9:
Groundwater Monitoring Station at an industrial site (DOE Photo Library)

Groundwater Quality Monitoring

The national groundwater monitoring programme started in 1997. By 2001, 79 monitoring wells had been established at 48 sites in Peninsular Malaysia. Another 19 wells are currently under construction in Sarawak and groundwater monitoring program for this State will commence in 2002. The sites were selected and categorised based on the surrounding landuse such as agricultural, urban/suburban, rural, industrial, solid waste landfills, golf courses, radioactive landfills and animal burial areas.

Groundwater Quality Status

In 2001, 217 samples were taken from the 79 monitoring wells compared to 188 the previous year (Table 4). The samples were analysed for volatile organic compounds (VOC), pesticides, heavy metals, anions, bacteria, phenolic compounds, radioactivity, total hardness, total dissolved solids (TDS), pH, temperature, conductivity and dissolved oxygen. The groundwater quality status was determined by comparing with the National Guidelines for Raw Drinking Water Quality (1990 (Table 5) as the benchmark. Iron (Fe) levels exceeding the standard were recorded in all samples (Figure 21). Between 24% to 83% of samples taken showed high levels of iron.

The sampling results also showed that between 10% to 50% of samples taken in all areas recorded manganese (Mn) levels exceeding the benchmark. Between 7% to 17% of samples were found to exceed the nitrate benchmark in all areas except in radioactive landfills. Arsenic levels exceeding the benchmark were recorded at solid waste landfills (31%), radioactive landfills (12%) and agricultural areas (6%). Other parameters exceeding the acceptable values are shown in Figure 21. Samples taken from industrial areas were found to have more parameters exceeding the acceptable benchmark values.

Photo 10: Groundwater sampling (DOE Photo Library)

Table 4 Malaysia: Groundwater Sampling by Landuse Category, 2001

Landuse Category	Number of Samples
Agriculture	34
Urban/Suburban	19
Industrial	50
Solid Waste Landfill	42
Rural	12
Golf Course	15
Radioactive Landfill	4
Animal Burial	41
Total	217

Table 5 Malaysia: National Guidelines for Drinking Water Quality

CHEMICAL	SYMBOL	BENCHMARK
SULPHATE	SO4	400 mg/l
HARDNESS	CaCO3	500 mg/l
NITRATE	NO3	10 mg/l
COLIFORM	-	10 MPN
MANGANESE	Mn	0.2 mg/l
CHROMIUM	Cr	0.05 mg/l
ZINC	Zn	1.5 mg/l
ARSENIC	As	0.05 mg/l
SELENIUM	Se	0.01 mg/l
CHLORIDE	Cl	250 mg/l
PHENOLICS	-	0.002mg/l
TDS	-	1500mg/l
IRON	Fe	1mg/l
COPPER	Cu	1mg/l
LEAD (PLUMBUM)	Pb	0.1mg/l
CADMIUM	Cd	0.005mg/l
MERCURY	Hg	0.001mg/l

Source: Ministry of Health, Malaysia

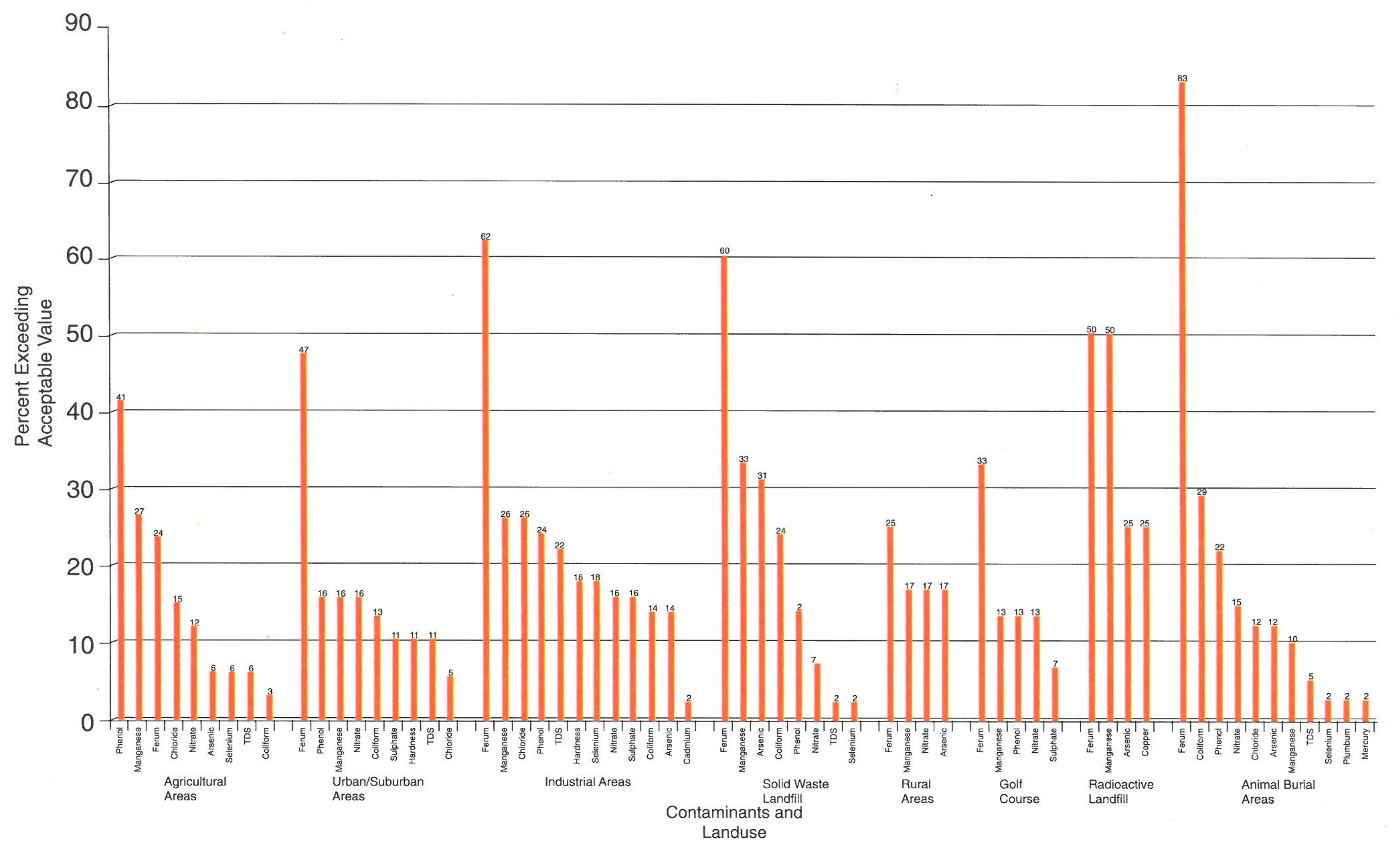


Figure 21 Peninsula : Percentage of Non-Compliance of Selected Containants, 2001

MALAYSIA Environmental Quality Report 2001

MARINE ENVIRONMENTAL QUALITY

INTRODUCTION

Coastal zones have always been important to human communities since civilization began. In the tropics in particular, the earliest settlements started along the coast and river mouth for ease of transportation and to facilitate trading activities. Human use of the coasts has since intensified. The coastal zone is now subject to multiple uses, including fishing, siting of human settlements, industrial complexes and transportation facilities, waste disposal and recreation. Therefore, valuable coastal resources are under threat due to intensive development and other human interferance.

The Department of Environment (DOE) has been monitoring the quality of coastal water of Peninsular Malaysia since 1978, Sabah and Sarawak since 1985 and the coastal water of selected islands in Malaysia since 1999.

To date there are 165 coastal monitoring stations along the coastal areas of Peninsular Malaysia, 26 in Sabah and 14 in Sarawak. The locations of these stations have been determined based on beneficial uses of the coastal waters especially recreation. The 71 islands involved in the Island Monitoring Programme have been categorized into four categories: Development, Resort, Marine Park and Protected Islands.

The proposed Interim Standards for Marine Water Quality is as shown in Table 6.

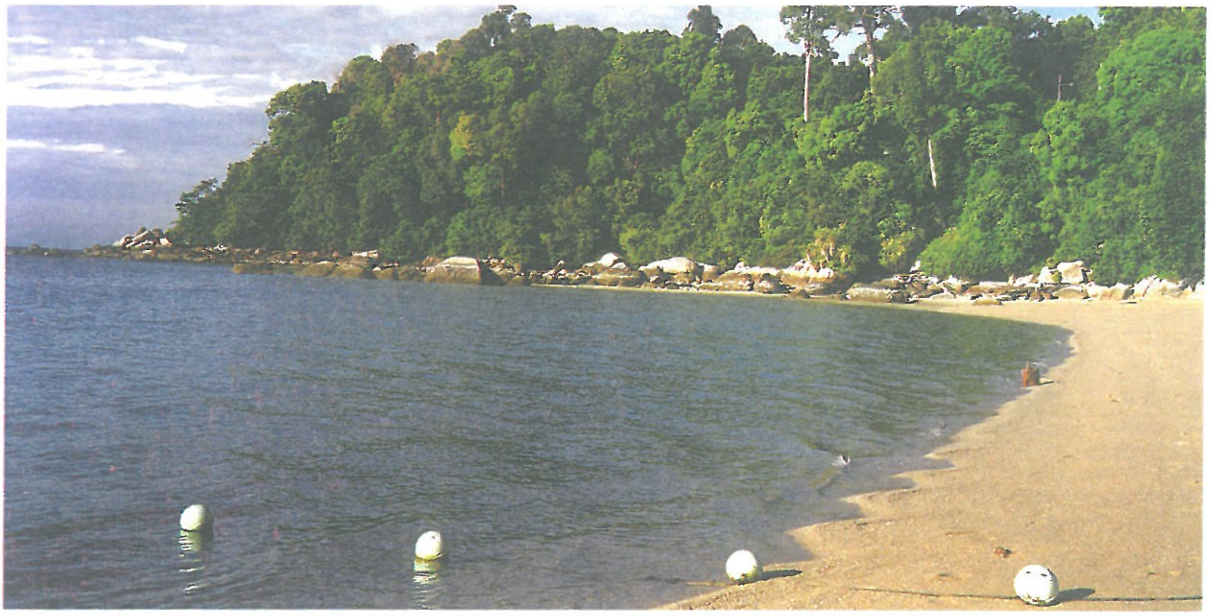


Photo 11: A Recreational Beach (DOE Photo Library)

Coastal Marine Water Quality Status

In 2001, a total of 988 samples were collected from 205 monitoring stations. The status of coastal water quality for various States in Malaysia has been summarized in Table 7. The main contaminants of the coastal waters in most States were total suspended solids (TSS), oil and grease (O&G) and Escherichia coli (E. coli).

Of the 988 samples analyzed, 74.4 % of samples exceeded the interim standard for total suspended solids, 34.7 % exceeded the interim standard for oil and grease and 34.7 % exceeded the interim standard for E. coli. (Figure 22). The levels of oil and grease and E. coli were found to be improving compared to the results for 2000. Table 8 highlights the levels of the main contaminants and their possible sources.

Island Marine Water Quality Status

In 2001, 683 samples were collected from 85 monitoring stations situated off 71 islands throughout the country. The main pollutants detected were oil and grease, total suspended solids and Escherichia coli (E.coli). Islands categorized for Development showed higher percentages of contaminants exceeded benchmark levels: 23.3 % of samples exceeded benchmark for oil and grease; 20.8 % for total suspended solids; and 20 % for E.coli (Figure 23). The status of contamination of island marine water and their possible sources is as shown in Table 9.

Photo 12: Marine water sampling (DOE Photo Library)

Tarball

Tarball monitoring was also carried out in conjunction with the Coastal and Island Marine Monitoring Programmme. In 2001, 59 tarball samplings were done. Except at two beaches in Terengganu, the beaches in other States were free of contamination by tarballs (Table 10). However tarballs were sighted on the beaches of Pulau Lang Tengah and Pulau Redang in Terengganu, Puteri Dewi (Pulau Pangkor) and Tanjung Rhu (Pulau Langkawi)(Table 10 (a)), principally due to discharges of oily wastes from passing vessels and fishing boats.

Table 6 Malaysia : Interim Marine Water Quality Standards

PARAMETERS		UNIT	INTERIM STANDARDS
Escherichia coli	E_Coli	MPN / 100 ml	100
Oil & Grease	O & G	mg/l	0
Total Suspended Solids	TSS	mg/l	50
Arsenic	As	mg/l	0.1
Cadmium	Cd	mg/l	0.1
Chromium (total)	Cr	mg/l	0.5
Copper	Cu	mg/l	0.1
Lead	Pb	mg/l	0.1
Mercury	Hg	mg/l	0.001

Table 7 Malaysia: Status Of Marine Water Quality, 2001

State	No. of Station	No. of Sample	Parameter Exceeding Interim Standard (%)								
			Total Suspended Solids	Oil and Grease	Escherichia coli	Lead	Copper	Mercury	Cadmium	Arsenic	Chromium
Pahang	11	44	100.0	9.1	0.0	0	0	0	15	0	0
Johor	39	213	16.0	28.3	60.8	3	0	43	4	1	1
Kedah/P.Langkawi	14	80	100.0	25.0	37.0	0	53	45	0	0	0
Perlis	2	14	100.0	50.0	0.0	0	29	21	0	0	0
Kelantan	10	40	65.0	55.0	0.0	83	0	0	0	0	0
Melaka	10	19	100.0	31.6	52.6	0	0	5	0	0	0
Pulau Pinang	23	153	100.0	26.7	95.4	2	50	0	1	0	0
Perak	13	51	100.0	50.0	0.0	7	0	0	0	0	0
Sabah	26	88	4.6	0.0	0.0	10	0	0	0	0	0
Sarawak	14	110	38.2	26.4	8.0	6	0	0	2	0	0
Terengganu	16	53	50.0	45.3	55.8	79	6	0	0	0	0
N. Sembilan	13	65	96.9	38.5	71.9	0	0	0	0	0	0
Selangor	14	58	97.1	65.7	69.4	0	6	0	0	11	0
Total	205	988									
Average (%)			74.4	34.7	34.7	14.6	11.1	8.7	1.7	1.0	0.1

Marine Interim Standards								
TSS	**O & G**	**E.coli**	**Lead**	**Cu**	**Hg**	**Cd**	**As**	**Cr**
(50 mg/l)	(0 mg/l)	(100MPN/100ml)	(0.1 mg/l)	(0.1 mg/l)	(0.001 mg/l)	(0.1 mg/l)	(0.1 mg/l)	(0.5 mg/l)

Table 8 Malaysia:
Status of Main Contaminants of Coastal Waters and Possible Sources, 2001

NO	STATUS	POSSIBLE SOURCES
1	Suspended solids were highest in coastal waters off Pahang, Kedah, Perlis, Melaka, Pulau Pinang and Perak.	• sand dredging • illegal logging
2	Oil and grease detected in the coastal waters off Selangor, Kelantan and Perak	• discharges from vessels • illegal disposal of oil from motorized boats.
3	High E.coli levels were observed in the coastal waters off Pulau Pinang, Negeri Sembilan, Selangor and Johor	• untreated domestic sewage and animal wastes. • partially or untreated industrial effluents
4	Heavy metals Lead (Pb) higher in Kelantan (83 %) and Terengganu (79 %) Copper and Mercury higher in Kedah.	• other land-based sources.

Table 9 Malaysia:
Status of Main Contaminants and Possible Sources for Island Marine Water, 2001

NO	STATUS	POSSIBLE SOURCES
1	High level of oil and grease recorded off Development Islands (23.3 %), followed by Resort Islands (12.7%) and Marine Park Islands (10.5 %).	• boating activities for tourism and fisheries
2	High E.coli levels observed off Pulau Pinang (11.4%) and Marine Park Islands (0.7%)	• untreated domestic sewage and animal wastes.
3	High total suspended solids found off Development Islands particularly at Gertak Sanggul (Pulau Pinang).	• development activities such as for tourism • construction activities without adequate control

**TABLE 10 MALAYSIA:
COASTAL TARBALL MONITORING, 2001**

STATE	NO.OF BEACHES	MONITORED	POLLUTED
JOHOR	7	5	0
MELAKA	6	1	0
NEGERI SEMBILAN	-	-	0
P.LANGKAWI/KEDAH	14	4	0
PERAK	7	3	0
PERLIS	23	12	0
PULAU PINANG	14	6	0
SELANGOR	14	6	0
TERENGGANU	7	4	2
PAHANG	11	4	0
KELANTAN	10	3	0
SABAH	26	3	0
SARAWAK	7	8	0
TOTAL	146	59	2

**TABLE 10(a) MALAYSIA
ISLAND TARBALL MONITORING 2001**

ISLAND CATEGORY	NO.OF BEACHES	MONITORED	FOLLUTED
PROTECTED (5 ISLANDS)	3	3	0
DEVELOPMENT (3 ISLANDS)	5	5	2
RESORT (25 ISLANDS)	22	22	1
MARINE PARK (38 ISLANDS)	17	17	1
TOTAL	47	47	4

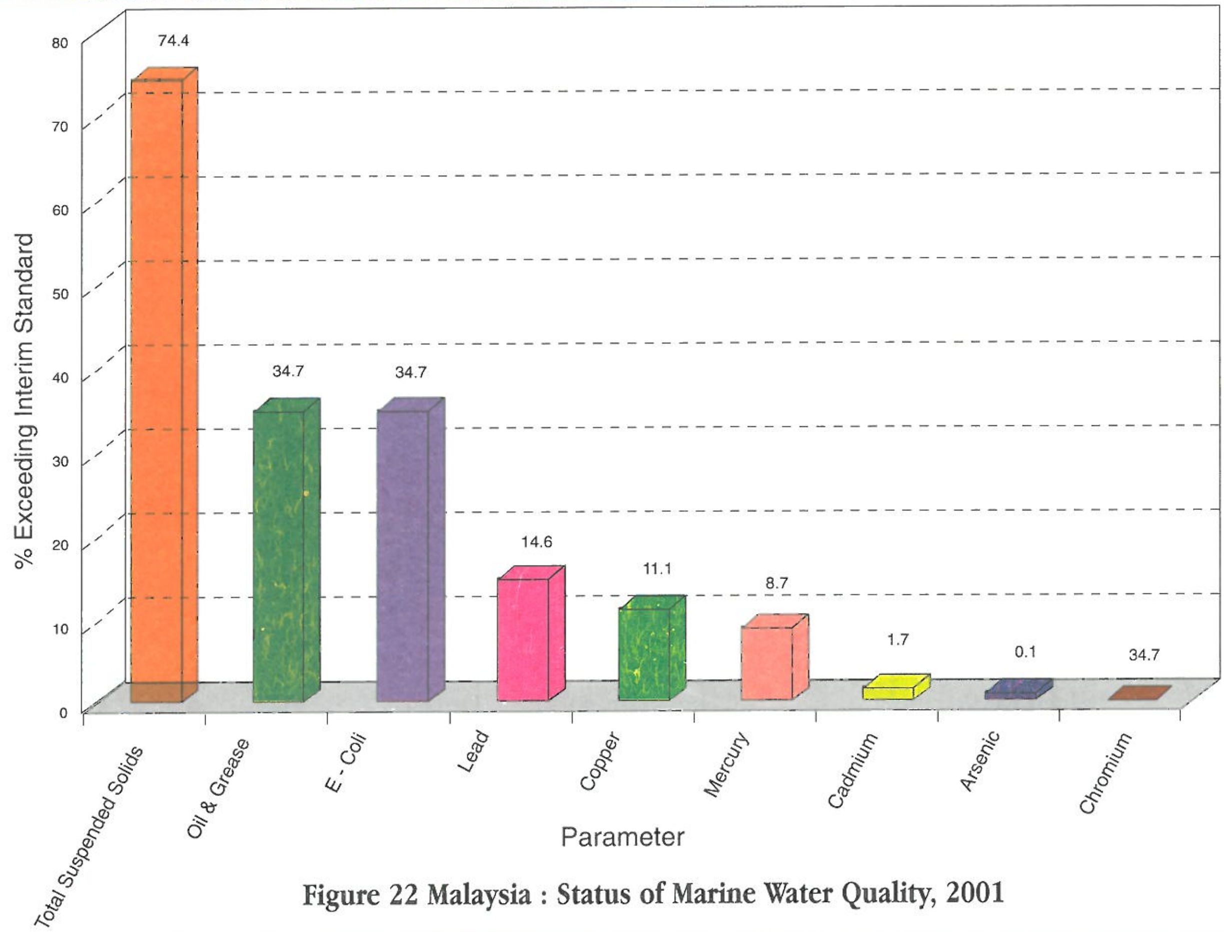


Figure 22 Malaysia : Status of Marine Water Quality, 2001

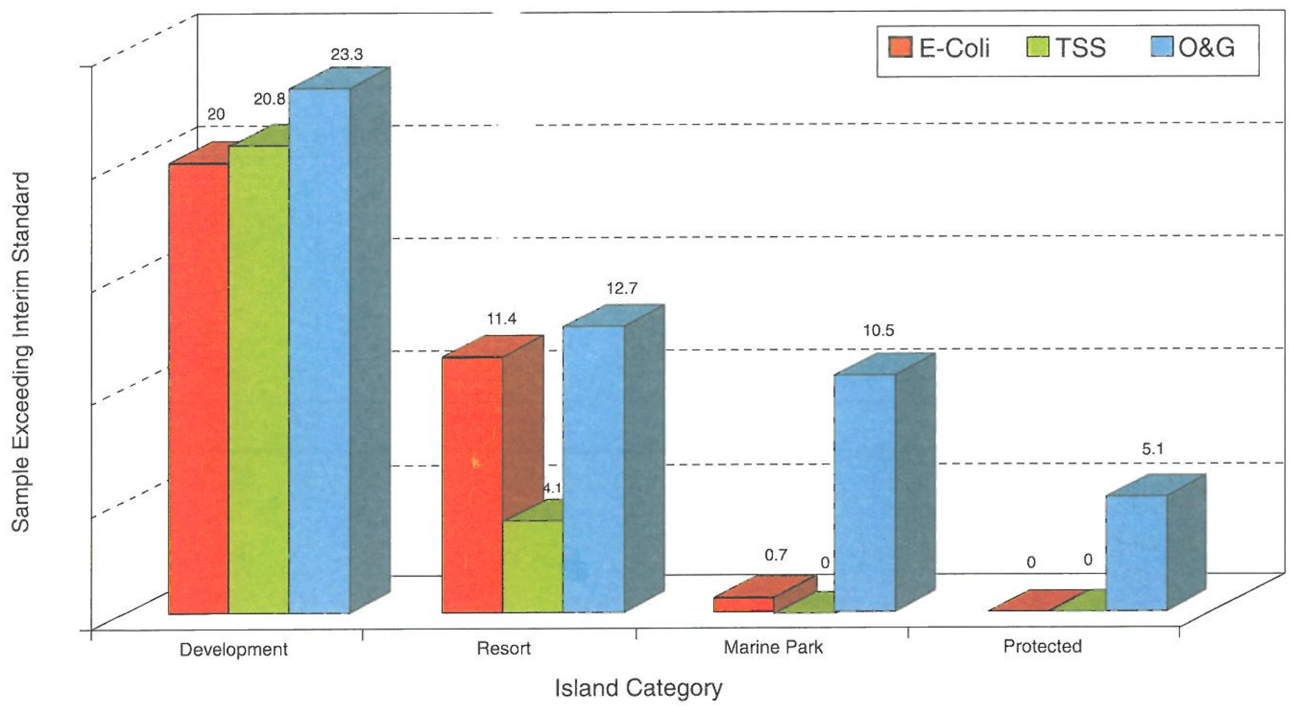


Figure 23 Malaysia : Status of Island Marine Water Quality by Category, 2001

MALAYSIA Environmental Quality Report 2001

POLLUTION SOURCES INVENTORY

POLLUTION SOURCES INVENTORY

Water Pollution Sources

The estimated number of effluent-related sources for 2001 was 13,160 comprising mainly of agro-based industries, manufacturing industries, pig farms and sewage treatment plants (Figure 24). Available records showed that 6,693 sources (51%) were domestic sewage facilities, followed by manufacturing industries (5,086, 39%), pig farms (909, 7%) and agro-based industries (472, 3%), which altogether significantly discharged effluents that affected river water quality.

Based on DOE inventory compilation in 2001, a total of 5,558 agro-based and manufacturing industries were identified (Figure 25) which had been categorized into 16 types. The main sources in term of numbers were food and beverage industries (1,410 sources) constituting 25.4%, followed by chemical-based industries (800, 14.4%), paper products industries (532, 9.6%), rubber-based industries (435, 7.8%), textile industries (408, 7.3%), electric and electronic industries (358, 6.4%), crude palm oil mills (355, 6.3%) and raw natural rubber factories (117, 2.1%).

Of the total number of identified sources in the agro-based and manufacturing sector, the highest number were in Johor (1,597, 28.7%), followed by Selangor (1,486, 26.7%) and Perak (572, 10.3%). Perlis had the least number (19, 0.3%) (Figure 26).

The total standing pig population (SPP) in Malaysia had increased from 1.5 million in 2000 to 1.6 million in 2001 although the number of farms had reduced from 1,047 in 2000 to 909. These pig farms were concentrated mainly in 3 States; Pulau Pinang (296, 32.6%), Perak (166, 18.3%) and Selangor (131, 14.4%).

The number of sewage treatment plants identified in 2001 had increased to 6,693 from 6,457 in 2000. Selangor had the highest number of sewage treatment plants (1,777, 27%), followed by Perak (1037, 16%), Negeri Sembilan (767, 12%) and Johor (653, 10%) (Figure 27).

BOD Pollution Load

Overall domestic sewage discharges remained the largest contributor of organic pollution load with an estimated biochemical oxygen demand (BOD) load of 1,101 tonnes / day.

Out of the total (BOD) load for sewage discharge, 548 tonnes/day or 49.8% were contributed by IWK sewage treatment plants. Besides domestic sewage, pig farming activities contributed 35 tonnes/day, manufacturing industries 23.6 tonnes/day and agro-based industries 22 tonnes/day. Figure 28 shows the organic pollution load by sectors between 1997 to 2001. In terms of organic pollution load by types of industry (Figure 29), palm oil mills with 19.9 tonnes/day were the largest contributor of organic pollution load, followed by food & beverages (12.9 tonnes/day), paper products (5.1 tonnes/day), chemical-based industry (2.2 tonnes/day) and rubber mills (2.1 tonnes/day).

Photo 13: River pollution near an industrial site

(DOE Photo Library)

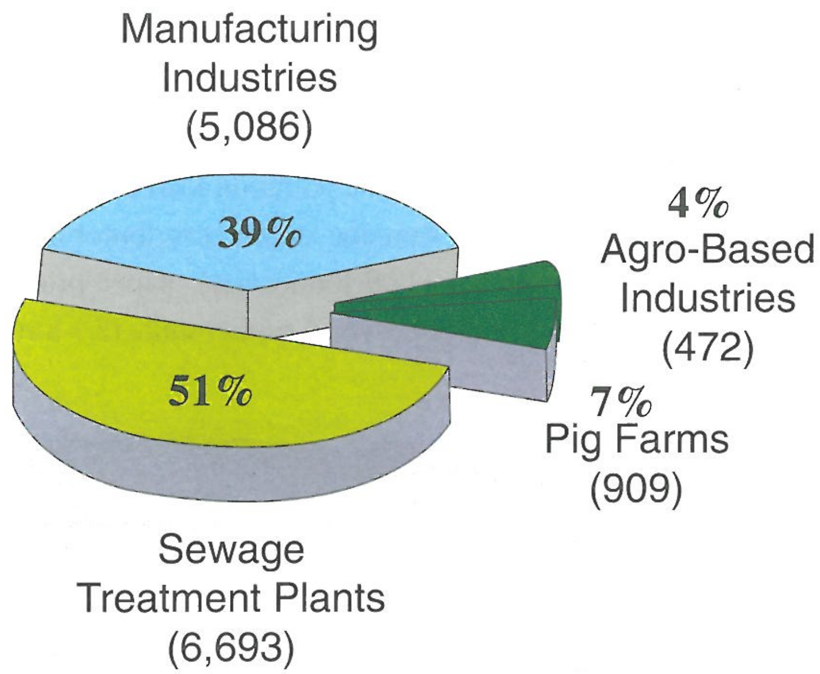


Figure 24 Malaysia : Water Pollution Sources by Sector, 2001

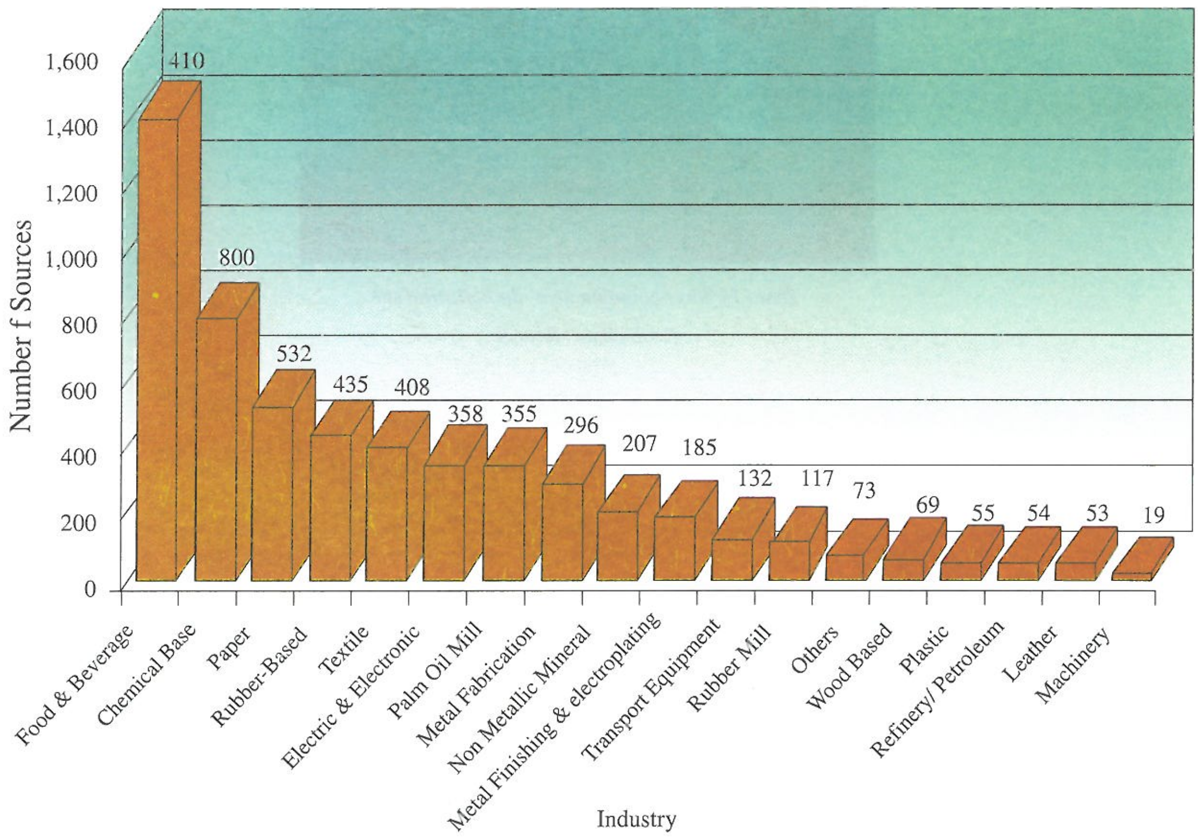


Figure 25 Malaysia : Industrial Water Pollution Sources (Agro-based and Manufacturing Industries), 2001

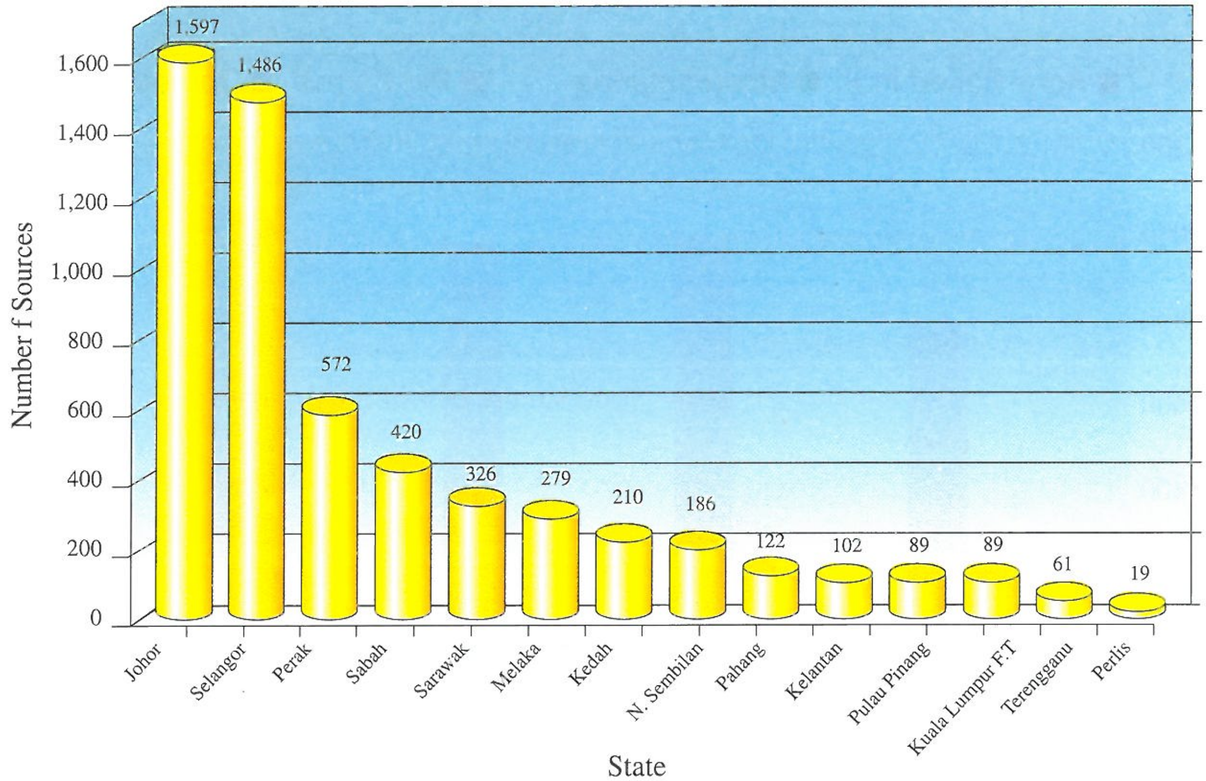


Figure 26 Malaysia : Industrial Water Pollution Sources (Agro-based and Manufacturing Industries) By State, 2001

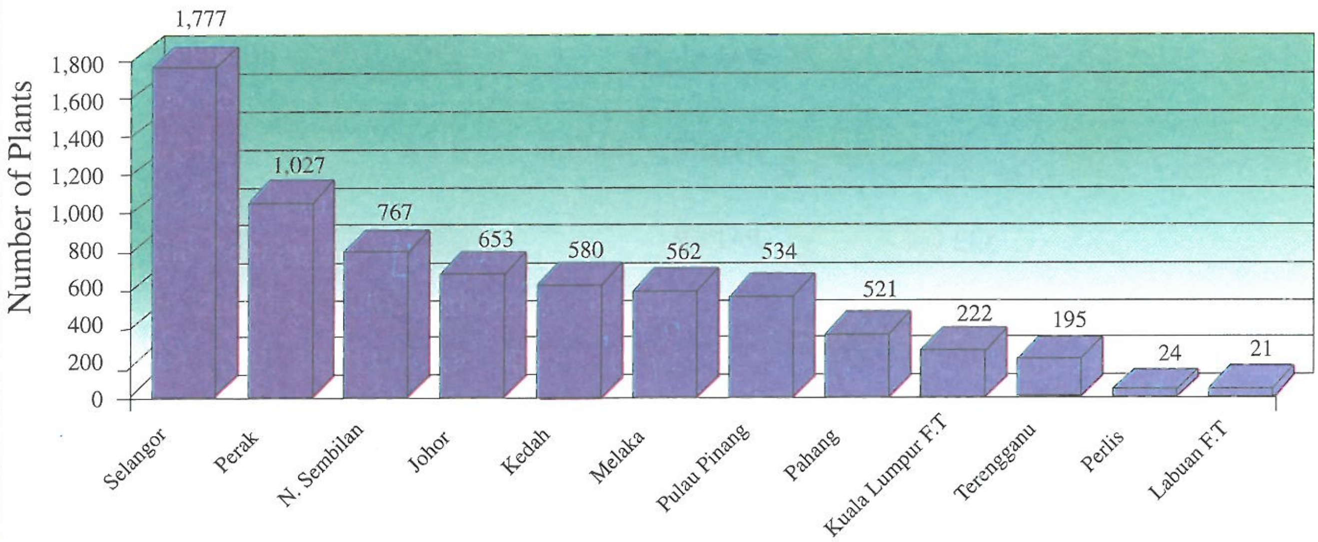


Figure 27 Malaysia : Sewage Treatment Plants By State, 2001

(Source : Indah Water Konsortium Sdn. Bhd.)

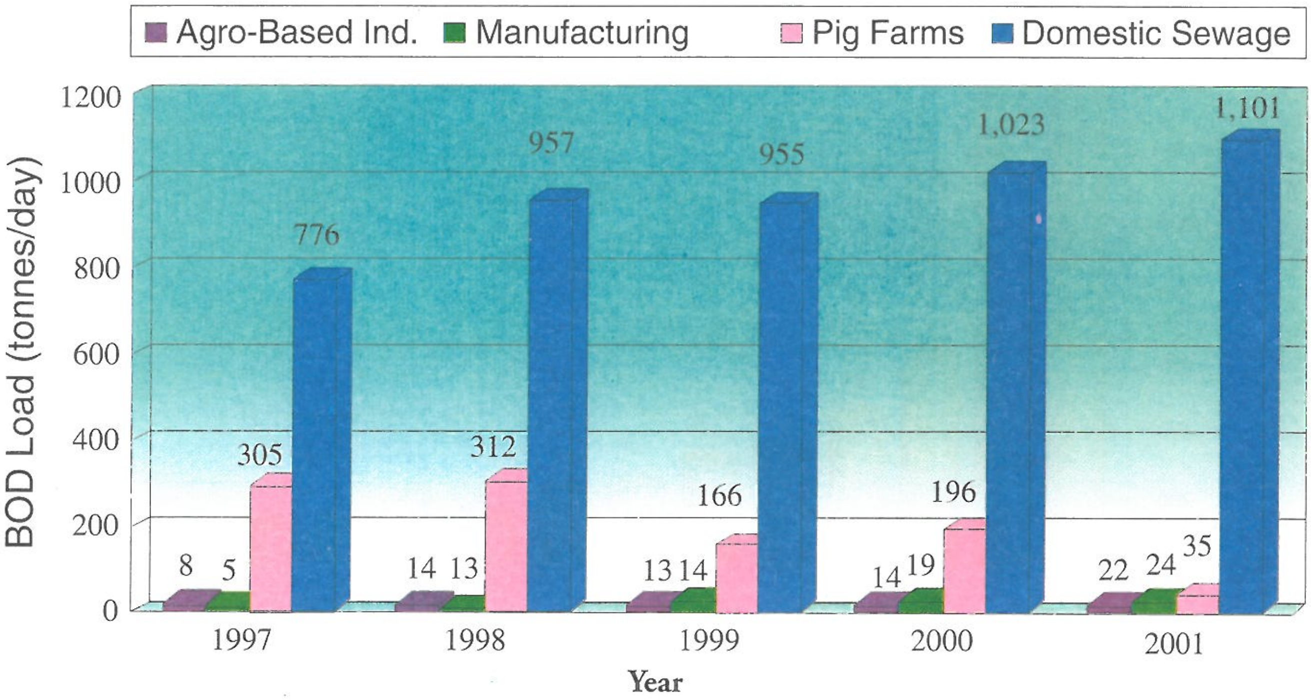


Figure 28 Malaysia : Estimated BOD Load By Major Sectors, 1997-2001

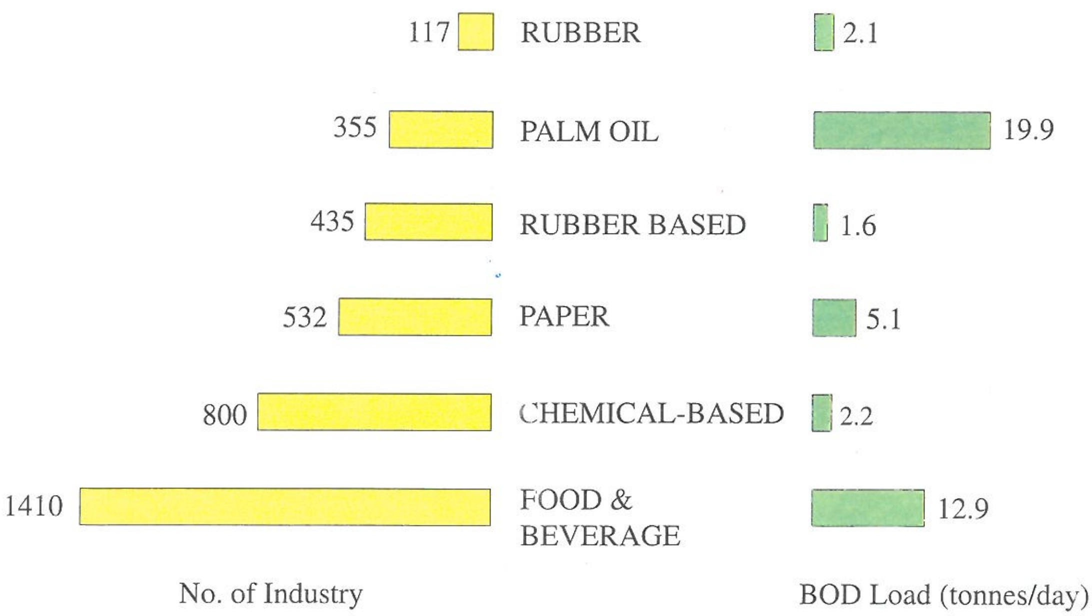


Figure 29 Malaysia : Estimated Organic Pollution Load (BOD) by Industrial Types, 2001

Air Pollution Sources

As in previous years, emissions from mobile sources, stationary sources and open burning activities still remained the most significant sources of air pollution. Emissions from a vehicular population of 11,302,545 were the principal contributors of air pollution (Figure 30). In 2001, 2,357,971 (20.9%) vehicles were registered in the Federal Territories of Kuala Lumpur and Labuan, followed by Johor (1,569,389) (13.9%) and Selangor (1,386,408) (12.3%), while Perlis had the least number of vehicles (44,347) (0.4%).

The total number of stationary air pollution sources identified in 2001 were 14,137, a reduction of 5.5 % compared to the year 2000 (14,966) (Figure 31). Selangor reported the highest number of stationary sources (2599, 18.4%), followed by Sarawak (2011, 14.2%), Kedah (1917, 13.6%), Johor (1706, 12.1%) and the least number in Perlis (0.3%)

Photo 14: Mobile source of air pollution (DOE Photo Library)

Photo 15: Open burning at a plantation site (DOE Photo Library)

Air Pollution Load

The combined air emission load for 2001 was about 2,260,841.83 mt of carbon monoxide; 128,234.13 mt of hydrocarbons; 247,597.12 mt of oxides of nitrogen; 167,958.39 mt of sulphur dioxide and 73,727.41 mt of particulate matter. Emissions from mobile sources were the most significant contributors to air pollution (89%), followed by emissions from stationary sources, such as industrial fuel consumption (9.2%); industrial processes (1.5%); and open burning at solid waste dumping sites (0.3%) (Figure 32). The mobile air pollution sources in Kuala Lumpur, Johor, Selangor, Pulau Pinang and Perak accounted for more than half of the total air pollution load for the year 2001.

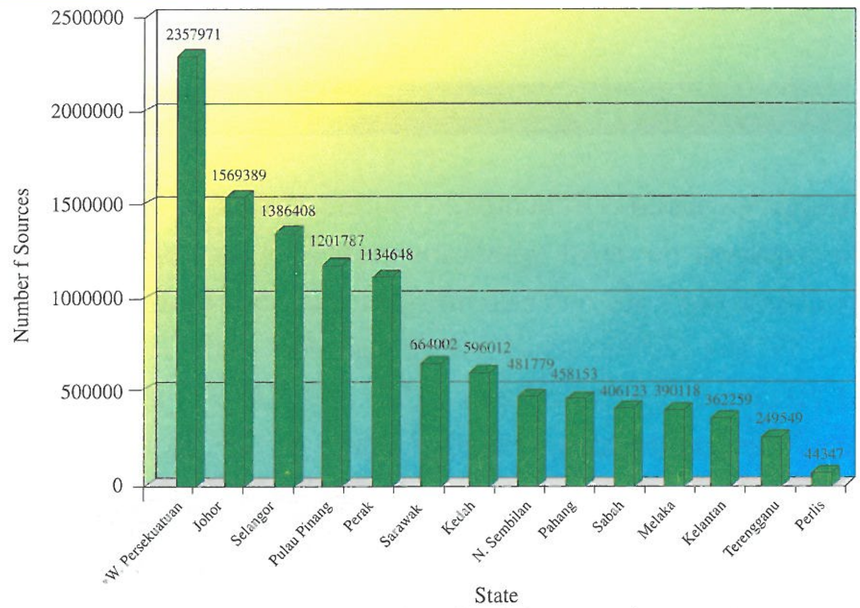


Figure 30 Malaysia : Number of Mobile Sources by State, 2001

(Source : Road Transport Department)

• W.Persekutuan Kuala Lumpur & W.Persekutuan Labuan

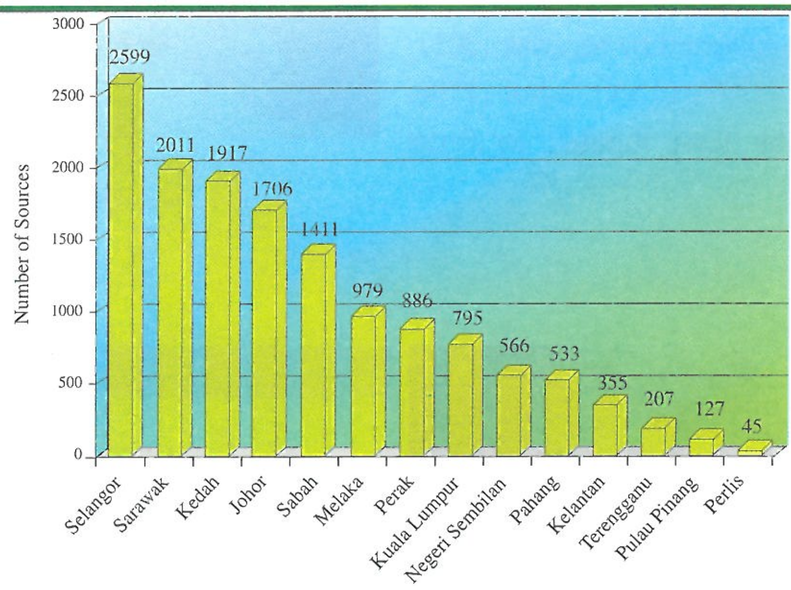


Figure 31 Malaysia : Industrial Air Pollution Sources by State, 2001

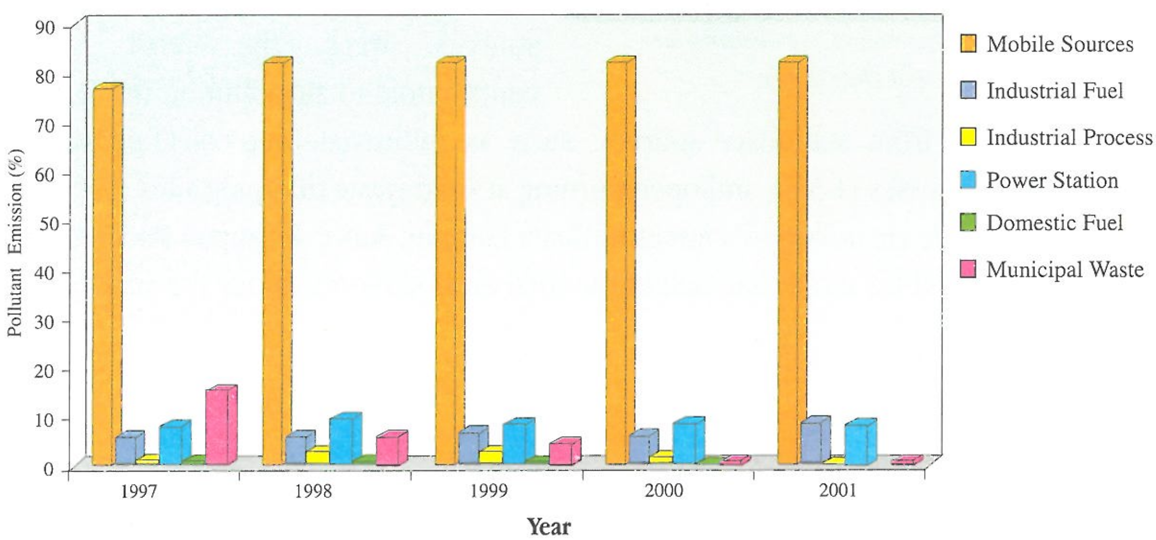


Figure 32 Malaysia : Trend of Air Pollutant Emissions by Sources, 1997-2001

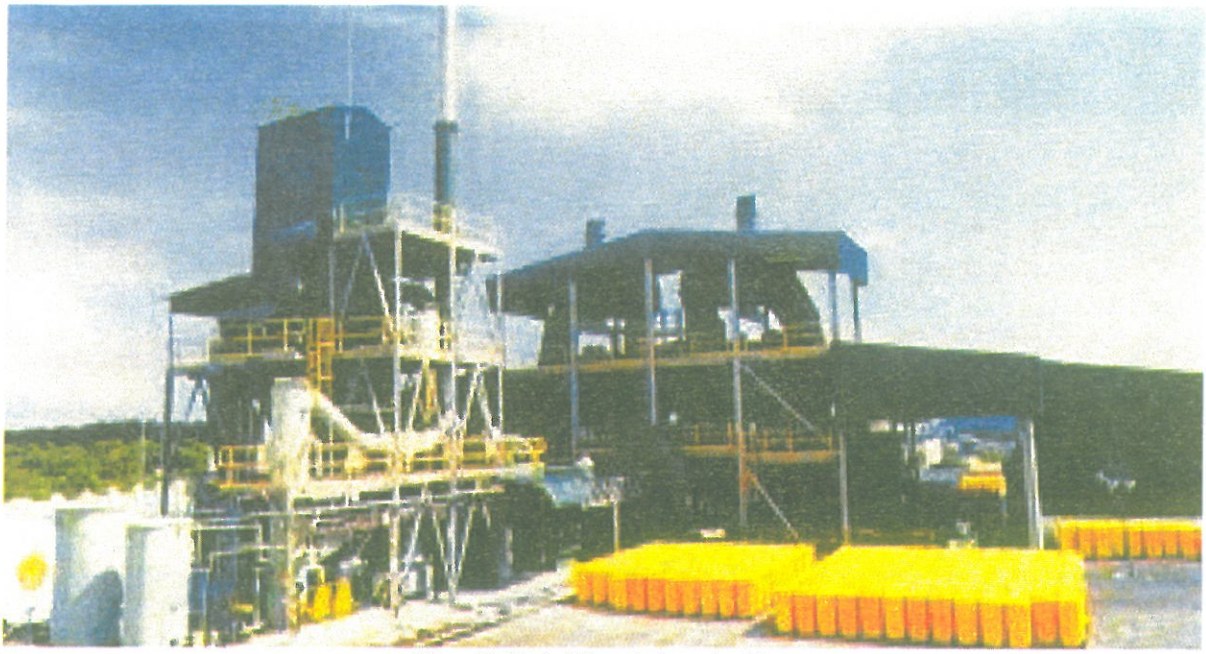


Photo 16: Clinical Waste Incineration Plant
(DOE Photo Library)

SCHEDULED WASTE INVENTORY

A total of 420,198 tonnes of scheduled wastes were produced by 3,741 waste generators based on notifications received by DOE in 2001. Dross/slag/clinker, mineral sludge and oil/hydrocarbon made up the main categories of wastes produced in the country. The breakdown according to waste categories and industry type is given in Figures 33 and 34 respectively.

Of the total wastes produced, 76,334 tonnes (18.2%) were treated and disposed at Kualiti Alam; 7,863 tonnes (1.9%) of clinical wastes were incinerated at licenced off-site facilities; 2,675 tonnes (0.6%) were exported for recovery purposes; 123,670 tonnes (29.4%) of scheduled wastes were recovered at off-site local facilities and an estimated 209,656 tonnes (49.9%) were treated and stored on-site at waste generators' premises (Table 11). Six landfarms and 34 on-site waste incinerators were licenced by the Department to allow for on-site treatment and incineration respectively. The on-site facilities handled an estimated 156,619 tonnes (37.3%) of the total wastes produced in the country.

Table 11 Malaysia: Handling of Scheduled Wastes, 2001

Facility	Tonnes	Percentage (%)
KA facility	76,334	18.2
Export to foreign recovery facilities	2,675	0.6
Delivered to local off-site recovery facilities	123,670	29.4
Off-site clinical waste incinerators	7,863	1.9
On-site treatment	156,619	37.3
On-site storage	53,037	12.6
Total	420,198	100.0

THE BASEL CONVENTION ON CONTROL OF TRANSBOUNDARY MOVEMENT OF HAZARDOUS WASTES AND THEIR DISPOSAL

In 2001, 9 Written Approvals were issued for the import of 69,942 tonnes of wastes for use as raw materials. The wastes comprised of spent fluid cracking catalyst (1565 tonnes, 2.2%), granulated blast furnace slag (31766 tonnes, 45.4%) and copper slag (36611tonnes, 52.4%). Figure 35 illustrates the quantities of wastes imported over 5 years (1997- 2001). The catalyst and furnace slag were used as raw materials in cement manufacturing plants and copper slag was used in sand blasting operations.

A total of 2,675 tonnes of scheduled wastes were exported. The exported wastes were derived from 21 waste generators and comprised of sand blasting material (19 tonnes, 0.7%), glass cutlet (45 tonnes, 1.7%), spent industrial catalysts (816 tonnes, 30.5%) and metal hydroxide sludges (1795 tonnes, 67.1%). The wastes were exported for recovery in foreign countries as shown in Table 12. The quantities of wastes exported based on waste types is shown in Figure 36.

TABLE 12 MALAYSIA: QUANTITY OF SCHEDULED WASTES EXPORTED (TONNES), 1997-2001

Country	1997	1998	199	2000	2001
AUSTRALIA	-	638	280	69	-
GERMANY	-	-	80	470	159
HOLLAND	-	1,500	1,266	1,234	487
ITALY	-	-	-	-	107
JAPAN	450	740	1,103	1,530	68
FRANCE	-	150	80	108	-
PHILIPPINES	-	-	1,073	-	532
SINGAPORE	-	-	27	500	-
SOUTH AFRICA	-	-	45	-	-
SOUTH KOREA	-	-	23	-	-
SWEDEN	-	60	102	203	27
SWITZERLAND	-	-	-	10	-
USA	674	610	1,107	753	1,295
TOTAL	1,124	3,698	5,186	4,878	2,675

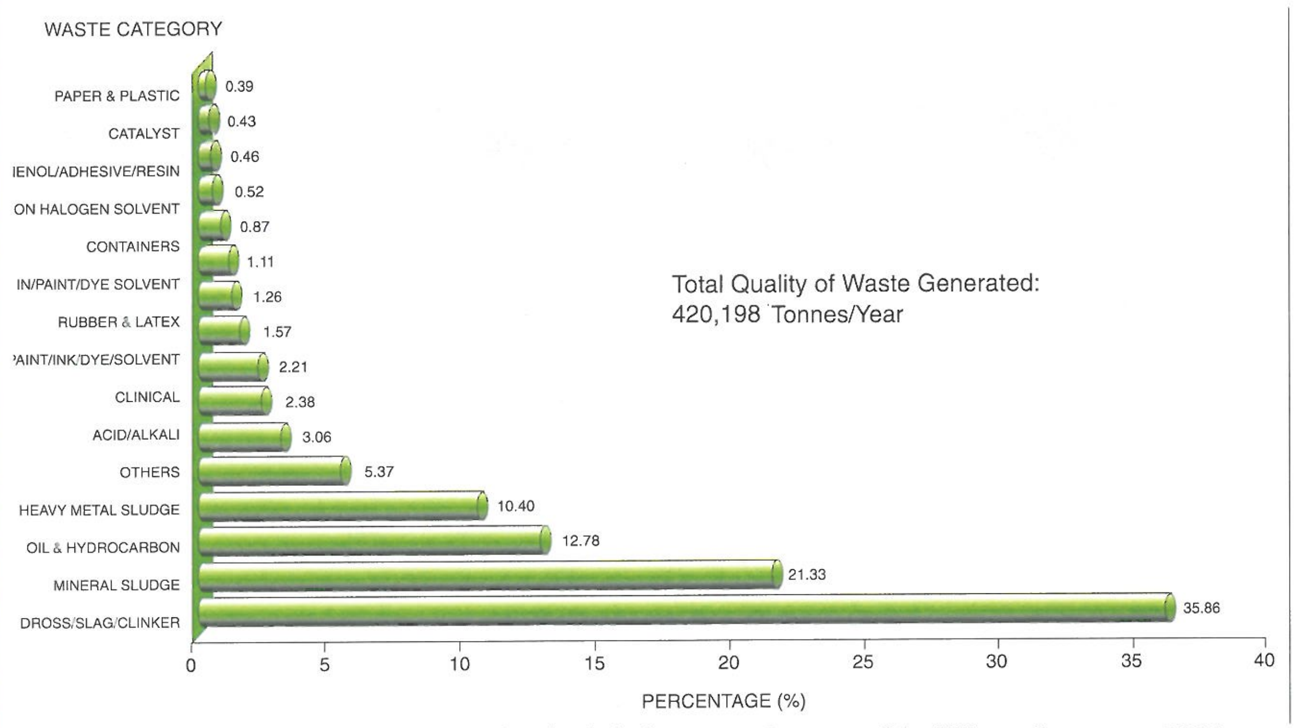


Figure 33 Malaysia : Quantity of Scheduled Wastes Generated by Waste Category, 2001

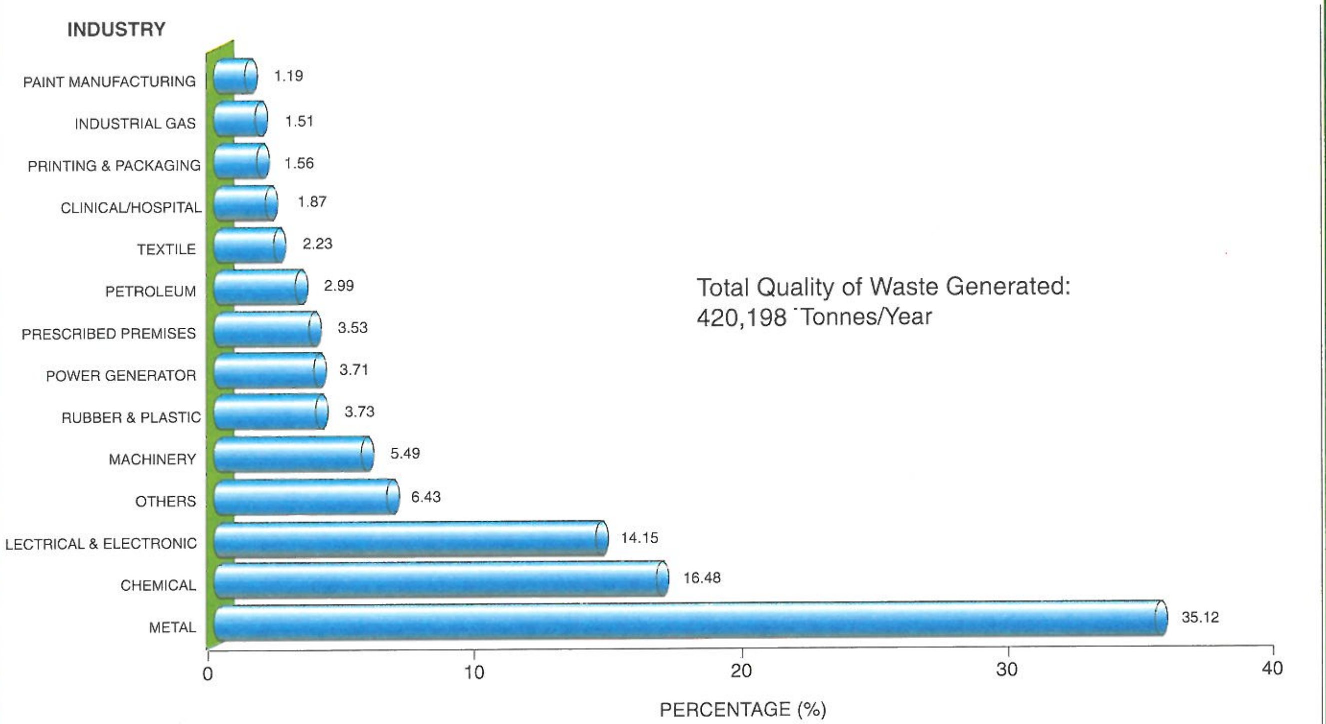


Figure 34 Malaysia : Quantity of Scheduled Wastes Generated by Industries, 2001

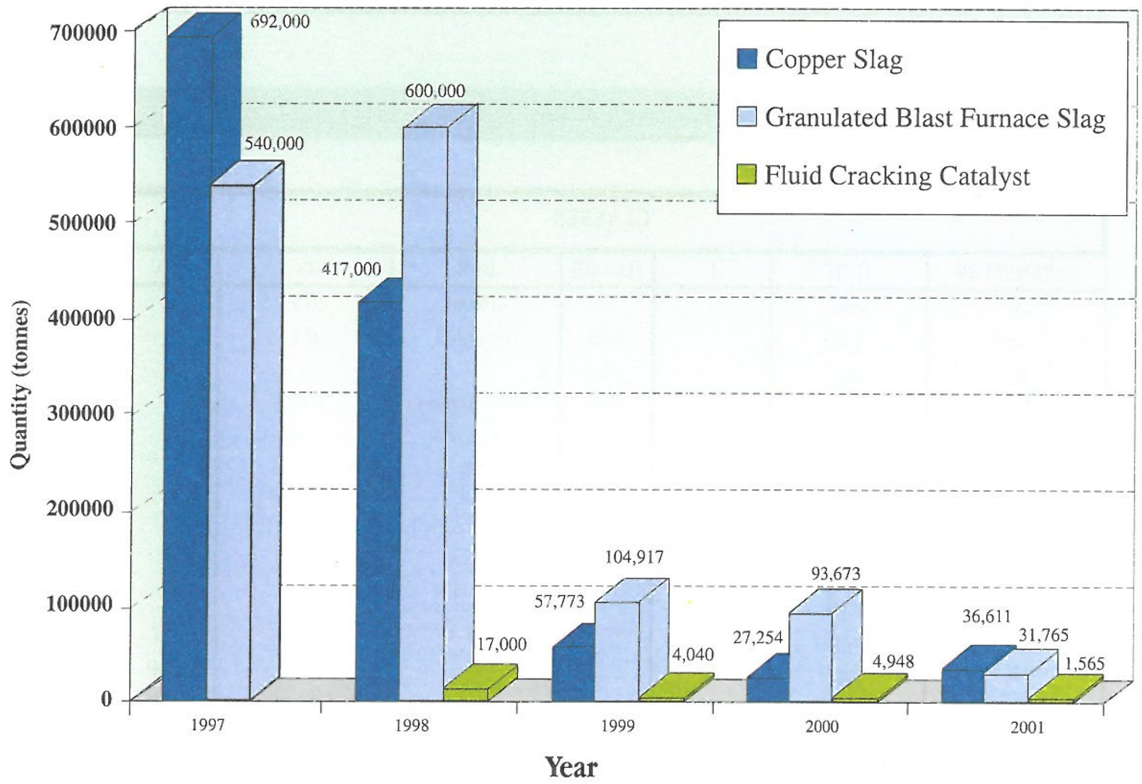


Figure 35 Malaysia : Quantity of Wastes Imported by Waste Types (Tonnes), 1997-2001

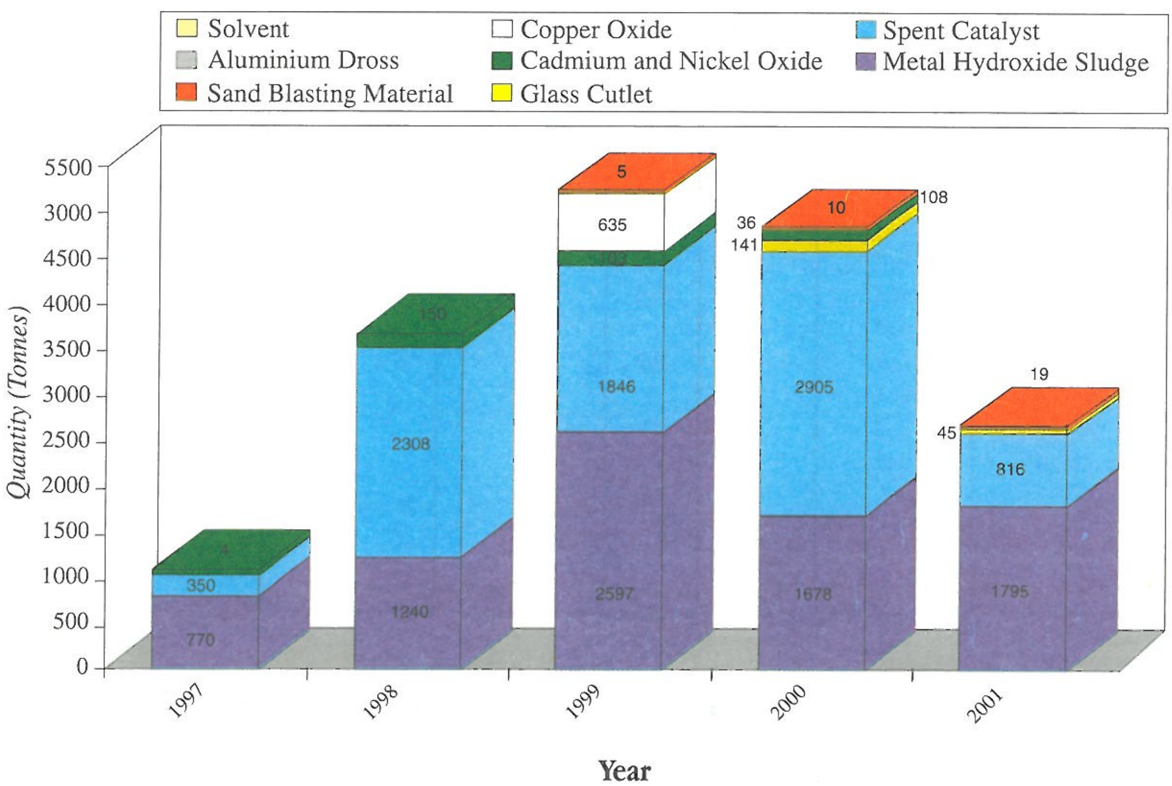


Figure 36 Malaysia : Quantity of Wastes Imported by Waste Types (Tonnes), 1997-2001

NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

		CLASSES				
PARAMETERS	UNIT	I	IIA / IIB	III#	IV	V
Al	mg/l		-	- (0.06)	0.5	
As	mg/l		0.05	0.4 (0.05)	0.1	
Ba	mg/l		1	-	-	
Cd	mg/l		0.01	0.01* (0.001)	0.01	
Cr (IV)	mg/l		0.05	1.4 (0.05)	0.1	
Cr (III)	mg/l		-	2.5	-	
Cu	mg/l		0.02	-	0.2	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l	N	-	-	3 SAR	L
K	mg/l	A	-	-	-	E
Fe	mg/l	T	1	1	1 (Leaf) 5(Others)	V
Pb	mg/l	U	0.05	0.02* (0.01)	5	E
Mn	mg/l	R	0.1	0.1	0.2	L
Hg	mg/l	A	0.001	0.004 (0.0001)	0.002	S
Ni	mg/l	L	0.05	0.9*	0.2	
Se	mg/l		0.01	0.25 (0.04)	0.02	A
Ag	mg/l	L	0.05	0.0002	-	B
Sn	mg/l	E	-	0.004	-	O
U	mg/l	V	-	-	-	V
Zn	mg/l	E	5	0.4 *	2	E
B	mg/l	L	1	- (3.4)	0.8	
Cl	mg/l	S	200	-	80	IV
Cl2	mg/l			- (0.02)	-	
CN	mg/l		0.02	0.06 (0.02)	-	
F	mg/l		1.5	10	1	
NO2	mg/l		0.4	0.4 (0.03)	-	
NO3	mg/l		7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l		50	-	-	
SO4	mg/l		250	-	-	
S	mg/l		0.05	- (0.001)	-	
CO2	mg/l			-	-	
Gross - alfa	Bq/L		0.1	-	-	
Gross - beta	Bq/L		1	-	-	
Ra - 226	Bq/L		<0.1	-	-	
Sr - 90	Bq/L		<1	-	-	

** = At hardness 50 mg/l CaCO3*
 # = Maximum (unbracket) and 24 - hour average (bracketed) concentrations

PARAMETERS	UNIT	CLASSES I	IIA / IIB	III#	IV	V
CCE	ug/l	N	500	-	-	-
MBAS/BAS	ug/l	A	500	5000 (200)	-	-
O & G (Mineral)	ug/l	T	40 ; N	N	-	-
O & G (Emulsified edible)	ug/l		7000 ; N	N	-	-
PCB	ug/l	L	0.1	6 (0.05)	-	-
Phenol	ug/l	E	10	-	-	-
Aldrin/Dieldrin	ug/l	V	0.02	0.2 (0.01)	-	-
BHC	ug/l	E	2	9 (0.1)	-	-
Chlordane	ug/l	L	0.08	2 (0.02)	-	-
t - DDT	ug/l	S	0.1	(1)	-	-
Endosulfan	ug/l		10	-	-	-
Heptachlor / Epoxide	ug/l	OR	0.05	0.9 (0.06)	-	-
Lindane	ug/l		2	3 (0.4)	-	-
2,4 -D	ug/l	A	70	450	-	-
2,4,5 - T	ug/l	B	10	160	-	-
2,4, 5 - TP	ug/l	S	4	850	-	-
Paraquat	ug/l	E	10	1800	-	-
		N				
		T				

N = Free from visible film sheen, discoloration and deposits

 # = Maximum (unbracketed) and 24 - hour average (bracketed) concentrations

NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

		CLASSES					
PARAMETERS	**UNIT**	**I**	**IIA**	**IIB**	**III**	**IV**	**V**
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	>2.7
BOD	mg/l	1	3	3	6	12	>12
COD	mg/l	10	25	25	50	100	>100
DO	mg/l	7	5 - 7	5 - 7	3 - 5	<3	<1
pH		6.5 - 8.5	6 - 9	6 - 9	5 - 9	5 - 9	-
Colour	TCU	15	150	150	-	-	-
Elec. Conductivity *	umhos/cm	1000	1000	-	-	6000	-
Floatables		N	N	N	-	-	-
Odour		N	N	N	-	-	-
Salinity (%)	%	0.5	1	-	-	2	-
Taste		N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature (C)	oC	-	Normal +20C		Normal +20C	-	-
Turbidity (NTU)	NTU	5	50	50	-	-	-
Faecal Coliform **	counts/100mL	10	100	400	5000 (20000)a	5000 (20000)a	-
Total Coliform	counts/100mL	100	5000	5000	50000	50000	>50000

Notes

N : No visible floatable materials or debris or No objectionable odour, or No objectionable taste
** : Related parameters, only one recommended for use*
*** : Geometric mean*
a : Maximum not to be exceeded

Class		**Uses**
CLASS I	:	Conservation of natural environment, water supply 1 - practically no treatment necessary. Fishery 1 - very sensitive aquatic species
CLASS IIA	:	Water Supply II - conventional treatment required Fishery ll - sensitive aquatic species
CLASS IIB	:	Recreational use with body contact
CLASS III	:	Water Supply lll - extensive treatment required Fishery lll - common, of economic value, and tolerant species; livestock drinking
CLASS IV	:	Irrigation
CLASS V	:	None of the above

ANNEX

DOE WATER QUALITY INDEX CLASSIFICATION

Parameter	Unit	Class				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 - 3	3 - 6	6 - 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 - 25	25 - 50	50 - 100	> 100
Dissolved Oksigen	mg/l	> 7	5 - 7	3 - 5	1 - 3	< 1
pH	mg/l	> 7.0	6.0 - 7.0	5.0 - 6.0	< 5.0	> 5.0
Total Suspended Solids	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300
Water Quality Index		> 92. 7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	< 31.0

ANNEX

Water quality : Classification Based on Water Quality Index

Parameter	Index Range		
	Clean	Slightly Polluted	Polluted
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59
Biochemical Oxygen Demand (BOD)	91 - 100	80 - 90	0 - 79
Ammoniacal Nitrogen (NH3-N)	92 - 100	71 - 91	0 - 70
Suspended Solids (SS)	76 - 100	70 - 75	0 - 69