Malaysia
Environmental Quality Report

Air

Land

Water

2002

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

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Environmental Quality Report

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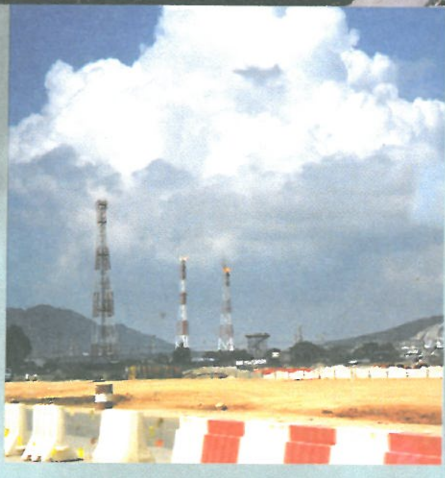

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2002

FOREWORD

It is my duty as the Director-General under Section 3(1)(i) of the Environmental Quality Act, 1974 to submit the Environmental Quality Report 2002.

From the institutional point of view, 2002 is a landmark in the annals of the department. The eagerly awaited restructuring exercise finally came to a conclusion upon the approval of the Public Service Department and the endorsement of the Treasury. This would entail the recruitment of 925 additional personnel over the next three years, bringing the total complement to 1568 for the entire department. Much of the new work force (almost 85%) would be deployed to the state and district offices throughout the country to bring about a stronger and more effective operational presence at the ground level; the Head Office at Putrajaya will deal with planning, development and policy matters.

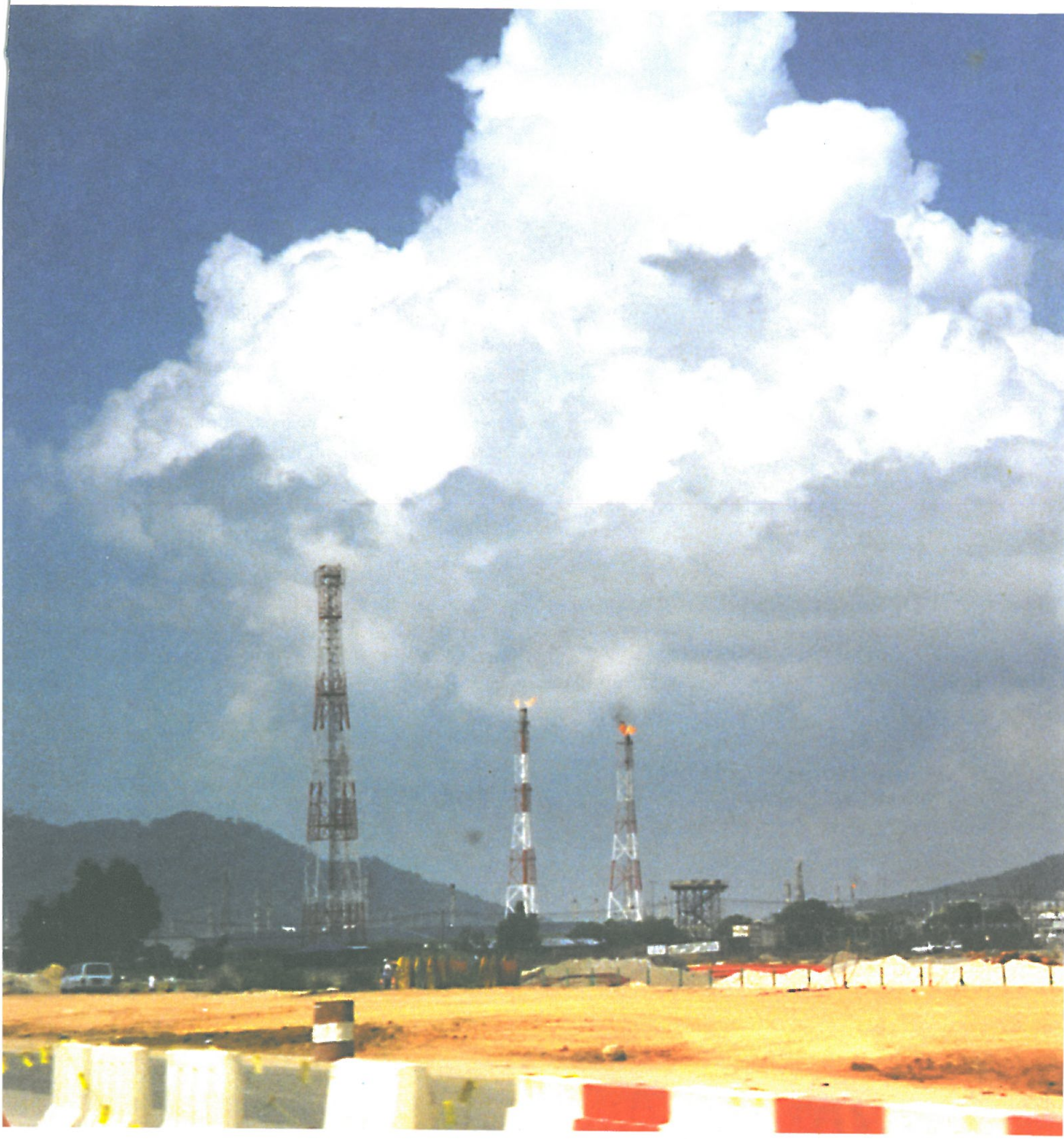
While much more can still be done for the betterment of the environment, it is gratifying to note that the efforts so far expended have shown positive results, albeit at various stages of achievements. For instance, the water quality has shown positive signs of improvement over the past three years, not by coincidence, but due to a determined effort to make it happen.

A clean and healthy environment can only be achieved with the commitment and cooperation of all stakeholders.

"Clean Environment for Healthy Living"

With Best Wishes,

Hajah Rosnani Ibarahim
Director-General of Environmental Quality
Malaysia
30 September 2003



chapter 1

AIR QUALITY

AIR QUALITY

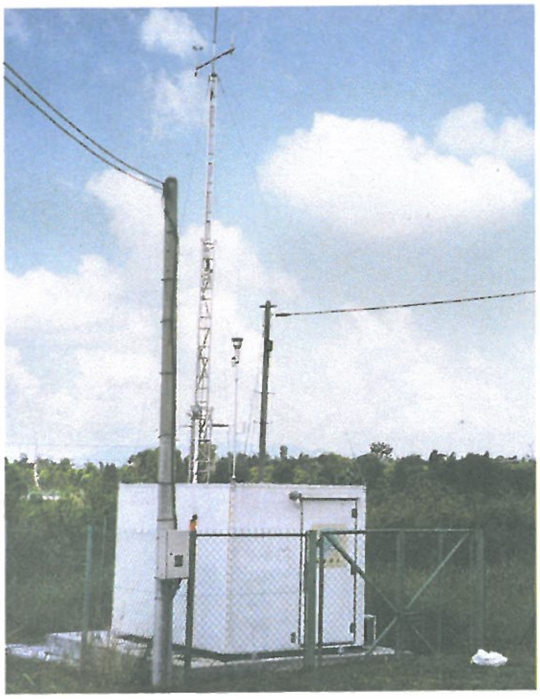


Photo 1 : Continuous Air Quality Monitoring Station (Background Level) (DOE Photo Library)

AIR QUALITY MONITORING

The Department of Environment monitors the status of air quality throughout the country to detect any significant change which may cause harm to human health and the environment. This involves the continuous measurement of pollutants in the ambient air at 50 monitoring sites throughout the country (Map 1.0 and 2.0) to meet specific objectives. Most of the stations are located within residential areas, while others are located in industrial areas.

The National Air Quality Monitoring Programme is also complemented by a network of manual air quality monitoring stations located at 33 different sites throughout the country. The parameters monitored include Total Suspended Particulates, Particulate Matter (PM10) and several airborne heavy metals including lead which are measured once every six days using High Volume Samplers. The air quality is reported in terms of the Air Pollutant Index (API).

Air Quality Status in 2002

The overall air quality for Malaysia in 2002 dropped slightly compared to 2001. Generally, the air quality was between good to moderate most of the time, except for a number of unhealthy days at various locations in the States of Selangor, Negeri Sembilan and Sarawak. The overall air quality was affected by peat swamp burning and forest fires during the dry periods between February and March and from mid-July to September 2002. The unhealthy air quality in the Klang Valley from February to March 2002 was due to peat swamp and forest fires in several areas of Selangor and Kuala Lumpur. Likewise, the unhealthy air quality recorded in Sarawak from the middle of July to September 2002 was mainly due to transboundary pollution caused by forest fires in a neighbouring country. Other than that, no other serious air pollution episode was detected in 2002. Particulate Matter (PM10) and Ozone were the prevalent pollutants recorded throughout the country.

Air Quality in the Klang Valley

From the geographical and development point of view, the Klang Valley is most prone to serious air pollution compared to other parts of the country.

During February to March 2002, many areas in the Klang Valley experienced hot and dry weather with reduced rainfall, conditions ideal for peat swamp and forest fires in many areas of Selangor and Kuala Lumpur. This caused the air quality to deteriorate from moderate to unhealthy level. The number of unhealthy air quality days recorded in the Klang Valley in 2002 was more than 2001 and the air quality was moderate more than 70 percent of the time throughout the year. The number of days with unhealthy air quality conditions ranged from 17 to 67 days, compared to 4 to 37 days in 2001, at 7 different locations (Figure 1.0).

Ozone was the main contributory pollutant giving rise to unhealthy air quality in Shah Alam, Kajang, Gombak and Kuala Lumpur, especially between 2 pm to 5 pm in the daytime. About 70 percent of the unhealthy air quality condition was due to the presence of high particulate matter (PM10) and the

Photo 2 : Mobile Sources of Urban Air Pollution
(DOE Photo Library)

remaining 30 percent due to high ozone levels. Similarly for Kuala Selangor, the unhealthy air quality days were mainly due to the presence of high particulate matter (PM10) in the air. Figure 2.0 shows the overall air quality status in the Klang Valley in 2002.

Air Quality in the Northern Region

In the northern region of the west coast of Peninsular Malaysia, comprising the States of Perlis, Kedah, Pulau Pinang and Perak, the overall air quality ranged between good and moderate most of the time except at Prai. More than 60 percent of the time the air quality in Langkawi and Alor Setar was good, while for Kangar and Sungai Petani, the air quality was good only 47 and 22 percent of the time respectively. For the rest of the time the air quality was moderate in these areas.

As Prai is a heavily industrialised area with several petrochemical complexes, the air quality remained at the moderate level more than 90 percent of the time. Figure 3.0 shows that the number of unhealthy days recorded at two Prai stations in 2002 was more than that of 2001. The main pollutant of concern was sulphur dioxide (SO2) caused by industrial fuel combustion. By way of comparison, the air quality at Universiti Sains Malaysia in Minden on Penang Island, was moderate more than 60 percent of the time and good the remaining 40%.

In Perak, the overall air quality experienced in 2002 was moderate as compared to good the previous year. In Sri Manjung, Ipoh and Tanjung Malim, the air quality was 70 percent of the time moderate with some unhealthy days. As expected the air quality at the Tasek industrial area was predominantly moderate 96 percent of the time, good only 3 percent of the time, and unhealthy the remaining 1 percent. Figure 4.0 describes the overall air quality status for the West Coast of Peninsular Malaysia.

Air Quality in the Southern Region

Similarly, the of air quality observed in the southern part of the west coast of Peninsular Malaysia, which covers the States of Negeri Sembilan, Melaka and Johore was between good to moderate almost all the time, with the exception of 3 and 4 unhealthy days recorded in Seremban and Nilai respectively. Ozone was the main pollutant contributing to unhealthy conditions in both these areas.

At Bandaraya Melaka, the air quality was moderate more than 60 percent of the time, while in Bukit Rambai it was moderate 99 percent of the time. All four stations in Johor experienced several unhealthy air quality days in 2002. The industrial area of Pasir Gudang, east of Johor Bharu, recorded 2 unhealthy air quality days due to high levels of sulphur dioxide. However 66 percent of the time the air quality was moderate and the remaining time good. Similarly at Muar, and Taman Perling, Johor Bharu, the air quality was moderate most of the time, except for 4 unhealthy days recorded in both areas due to high levels of particulate matter and ozone. (Figure 4.0).

Air Quality in the East Coast

As in previous years, the air quality in the East Coast remained comparatively better than the West Coast of Peninsular Malaysia. Areas such as Kuantan, Jerantut, Paka and Kota Bharu experienced good air quality more than 70 percent of the time, while Kemaman, Pengkalan Chepa, Kuala Terengganu and Balok Baru experienced more moderate than good air quality days throughout 2002. No unhealthy air quality was recorded in the east coast in 2002. (Figure 5.0).

Air Quality in Labuan, Sabah and Sarawak

The air quality in Sandakan, Kota Kinabalu and Keningau in Sabah was good more than 60 percent of the time, while in Tawau more moderate than good air quality days were recorded. Sabah did not experienced any unhealthy days in 2002. However in Labuan, the air quality was moderate more than 60 percent of the time.

The overall air quality in Sarawak deteriorated due to transboundary haze pollution between July to September 2002. Except for the Limbang station, all other stations in Sarawak recorded unhealthy levels between 3 to 22 days, due to high levels of particulate matter in the air. If not for these haze episodes, the air quality in Sarawak was generally good. (Figure 6.0)

Air Quality Trend

Carbon Monoxide (CO), Nitrogen Dioxide (NO2), Ozone (O3), Sulphur Dioxide (SO2) and Particulate Matter (PM10) were monitored continuously at 50 locations throughout the country, while Lead (Pb) concentration was measured once every six days at 23 locations.

Photo 3 : Open Burning at illegal Solid Waste Dumping Site (DOE Photo Library)

The air quality trend was computed by averaging direct measurements from these monitoring stations on a yearly basis.

Particulate Matter (PM 10)

The term Particulate Matter basically refers to respirable particles less than 10 micron in size, mainly from stationary, mobile as well as natural sources. They are emitted from motor vehicle exhausts, heat and power generation plants, industrial processes and open burning activities. Particulate matter may also be formed in the atmosphere from precursor emissions such as SO2 and NOx to form sulfates and nitrates. In addition, transboundary pollution of fine particulate matter arising from biomass burning activities could be transported by wind into the country.

Accumulation of this pollutant in the respiratory system is associated with numerous health effects related to respiratory diseases, decreased lung functions and eye and throat irritations. Sensitive groups such as the elderly, individuals with asthma or cardiopulmonary diseases as well as children are at great risk to such health effects. Particulate matter can also cause other adverse impacts such as reduced visibility and haze especially during the dry season. Depending on their chemical composition, when deposited in sufficient quantities, particulate matter may change nutrient balance and soil acidity, interfere with plant metabolism and damage materials.

PM10 remained the prevalent pollutant in many areas of Malaysia. The annual average level of PM10 in the ambient air between 1996 to 2002 were just slightly below the Malaysian Ambient Air Quality Guideline, except during the 1997 severe haze incident. In 2002, the annual average concentration of PM10 was 50 ug/m3, on par with the Malaysian Ambient Air Quality Guideline value. Figure 7.0 shows a 13 percent increase in the annual average PM10 concentrations across the country in 2002 compared to 2001. Figure 7.0(a) shows the annual average levels of PM10 for various land use categories between 1996 to 2002. Higher levels of PM 10 were recorded in urban and industrial areas. However, high levels of PM 10 were also recorded in the rural areas of Sarawak due to transboundary pollution between July to September 2002.

Sulphur Dioxide (SO2)

Sulphur dioxide is a colourless pungent, irritating, water-soluble and reactive gas, formed when fuel containing sulphur undergoes combustion processes such as industrial activities. High SO2 in the atmosphere increases the risk of adverse symptoms in asthmatic patients and irritates 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 are major precursors for acidic deposition which contributes to the acidification of soil, lakes and streams. SO2 is harmful to plant life and can also accelerate the corrosion of buildings and monuments.

The annual average levels of sulphur dioxide in the ambient air between 1996 and 2002 (Figure 8.0) were well below the Malaysian Ambient Air Quality Guideline. Figure 8.0(a) shows the annual average concentrations of sulphur dioxide for different land use categories. The concentrations of SO2 were consistently higher at industrial areas where the major emission sources were 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 of NO, NO2 and other oxides of nitrogen. The major sources of man-made nitrogen oxides are high-temperature combustion processes, such as those occurring in automobiles and power plants. Most of NOx (95 percent) from combustion processes are emitted as NO, and the remaining as 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 illness, as well as increases respiratory illness in children. Long term exposure may lead to increased susceptibility to respiratory infections and may cause alteration in lung functions. Nitrogen oxides also react in the air to form ground-level ozone and fine particle pollution, both associated with adverse health effects. Nitrogen oxides contribute to a wide range of environmental effects, including the formation of acid rain, changes in the composition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, and increases in levels of toxins harmful to fish and other aquatic life.

For the period of 1996 to 2002, the annual average concentrations of NO2 in the ambient air in Malaysia were well below the Malaysian Ambient Air Quality Guideline (Figure 9). However the 2002 NO2 concentrations increased by 12 percent from the previous year. NO2 concentrations were high in urban and industrial areas, mainly due to emissions from automobiles and combustion processes. The annual average NO2 concentrations for various land uses for 1996-2002 is presented in Figure 9(a).

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 under warm sunny conditions. VOCs are emitted from various sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. Nitrogen oxides are emitted from motor vehicles, power plants, and other sources of combustion. Changes in weather conditions contribute to yearly differences in ozone concentrations. Ozone and the precursor pollutants that form ozone can also be transported great distances by wind.

Exposure to high concentration of ground-level ozone has been linked to a number of health effects of

Photo 4 : Open Burning at Landfill Site (DOE Photo Library)

Photo 5 : Air Pollution from Agricultural Land Clearing Site (DOE Photo Library)

concern. Repeated exposures to ozone can make people more susceptible to respiratory infections, lung inflammation, and aggravate pre-existing respiratory diseases such as asthma. Ozone also affects vegetation and ecosystems, leading to reduction in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to diseases, pests, and other environmental stresses. Such effects may only be evident after several years or even decades, thus resulting in long-term effects on forest ecosystems.

Figure 10.0, shows the annual average daily maximum 1 hour ozone concentrations in the ambient air between 1996 to 2002. The highest level was recorded in 1997 due to the prolonged dry and hot weather as a result of El-Nino. In 2002, the annual average daily maximum 1 hour ozone concentration increased by 4.7 percent from the previous year. Figure 10.0(a) shows ozone concentrations at various land use categories between 1996 to 2002. Higher levels of ozone were consistently recorded in urban areas, principally due to precursor ozone gases, namely NOx from motor vehicles.

Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless and at high concentration, a poisonous gas, formed when carbon present in fuel is not burned completely. CO is emitted mainly from motor vehicle 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 organs and tissues. Health threat from exposure to CO is most serious to those with cardiovascular problems. At high levels of exposure, CO can be poisonous even to healthy people. Visual impairment, reduced work productivity 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 2002, were well below the Malaysian Ambient Air Quality Guideline (Figure 11.0). The concentrations of CO were consistently higher in urban areas, principally due to motor vehicles. Figure 11.0 (a) shows CO concentrations at various land use categories for 1996-2002.

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 were the main source of lead (Pb) emission into the atmosphere. Atmospheric lead levels in the eighties were high. However, since the introduction of unleaded petrol in 1991 and the total phase-out of leaded petrol in 1998, the lead level in the atmosphere had declined significantly. In 2002, the average level of lead monitored in the Klang Valley remained low as in the previous year. (Figure 12).

Map 1.0 : Location of Continuous Air Quality Monitoring Stations, 2002

Map 2.0 : Location of Continuous Air Quality Monitoring Stations, 2002

Pollutant	Averaging Time	Malaysia Guideline	
		ppm	(ug/m³)
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 I Year		150 50
Total Suspended Particulate (TSP)	24 Hour I Year		260 90
Lead	3 Month		1.5

Table 1: Malaysian Ambient Air Quality Guidelines

Photo 6 : Air Pollution from Palm Oil Mill (DOE Photo Library)

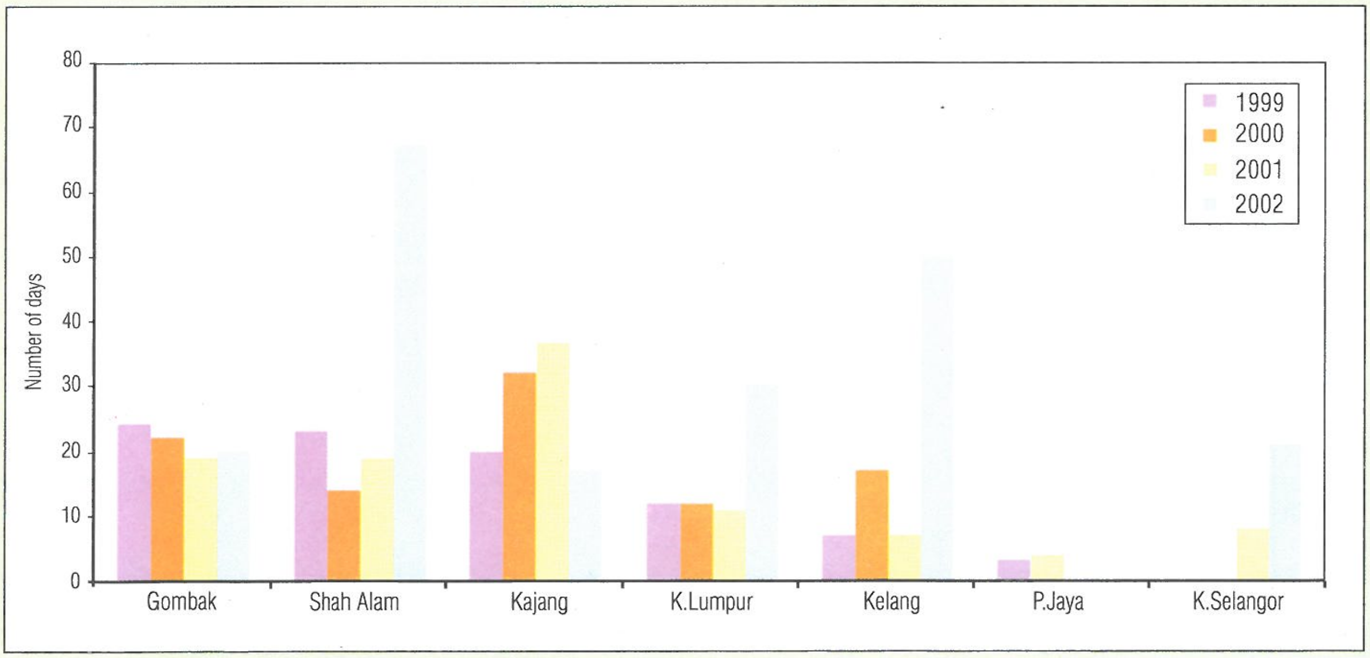


Figure 1 Department of Environment: Unhealthy Air Quality in the Klang Valley,1999-2002

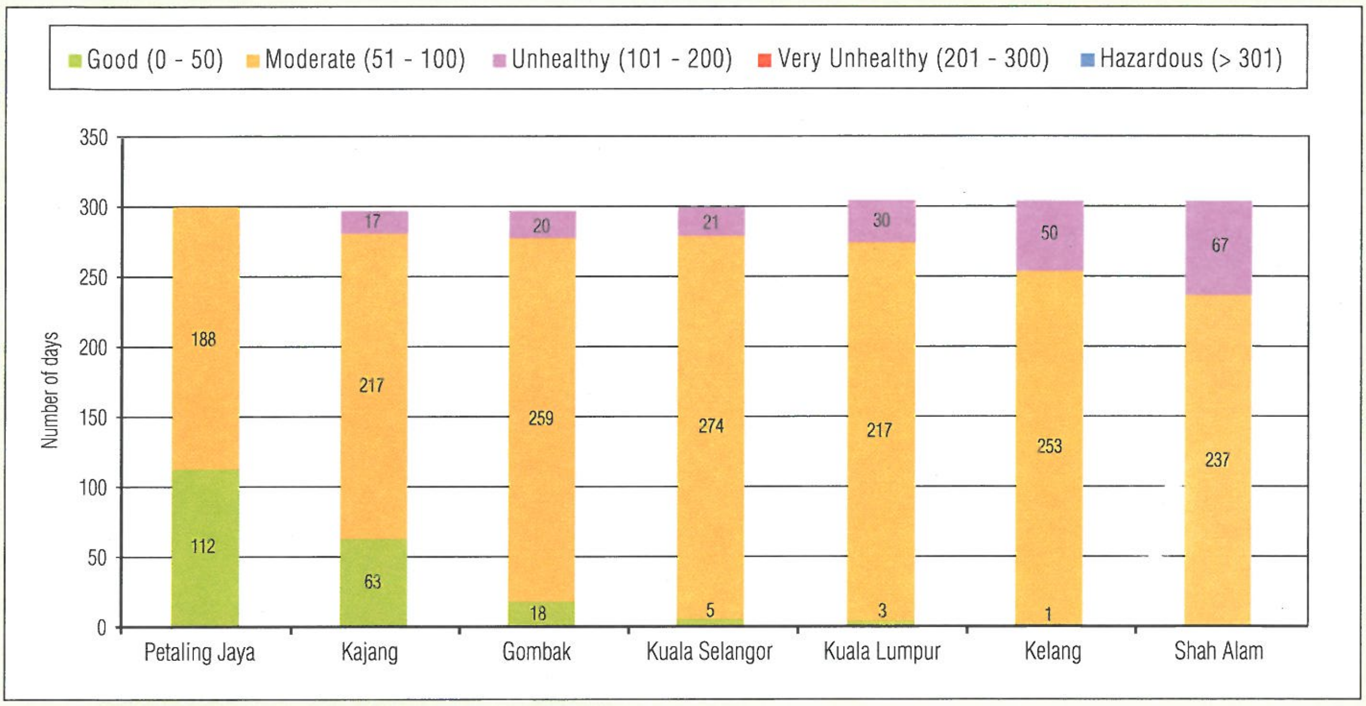


Figure 2. Department of Environment : Air Quality in the Klang Valley, 2002

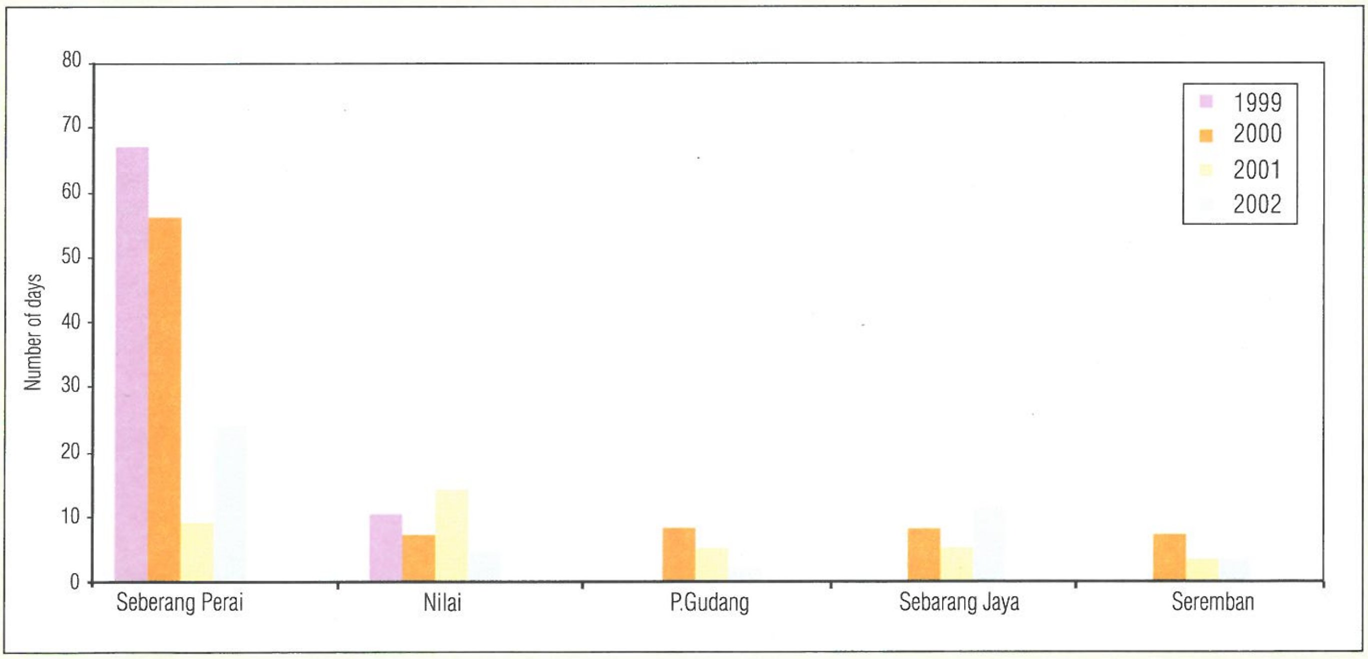


Figure 3 Department of Environment: Unhealthy Air Quality Days, West Coast Peninsular Malaysia, 1999 - 2002

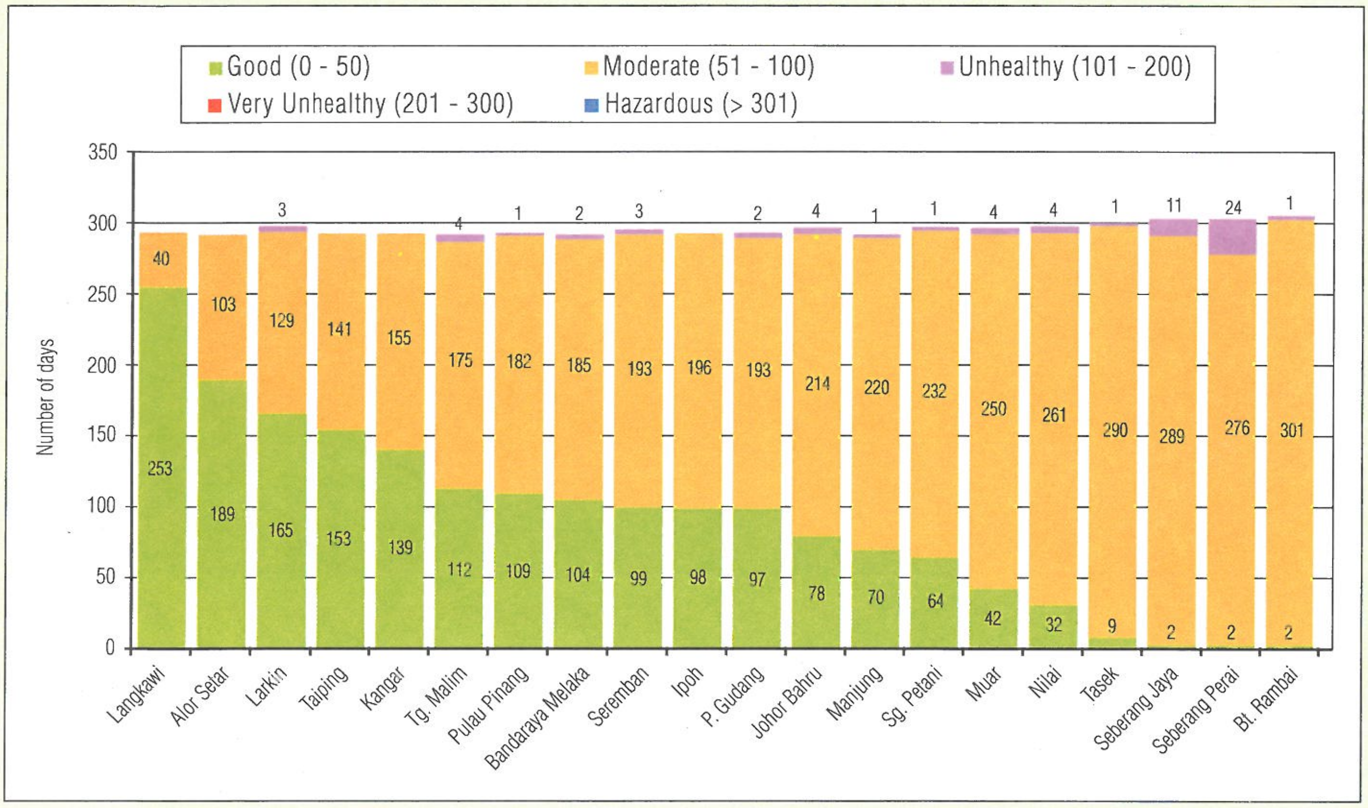


Figure 4. Department of Environment : Air Quality of West Coast Peninsular Malaysia, 2002

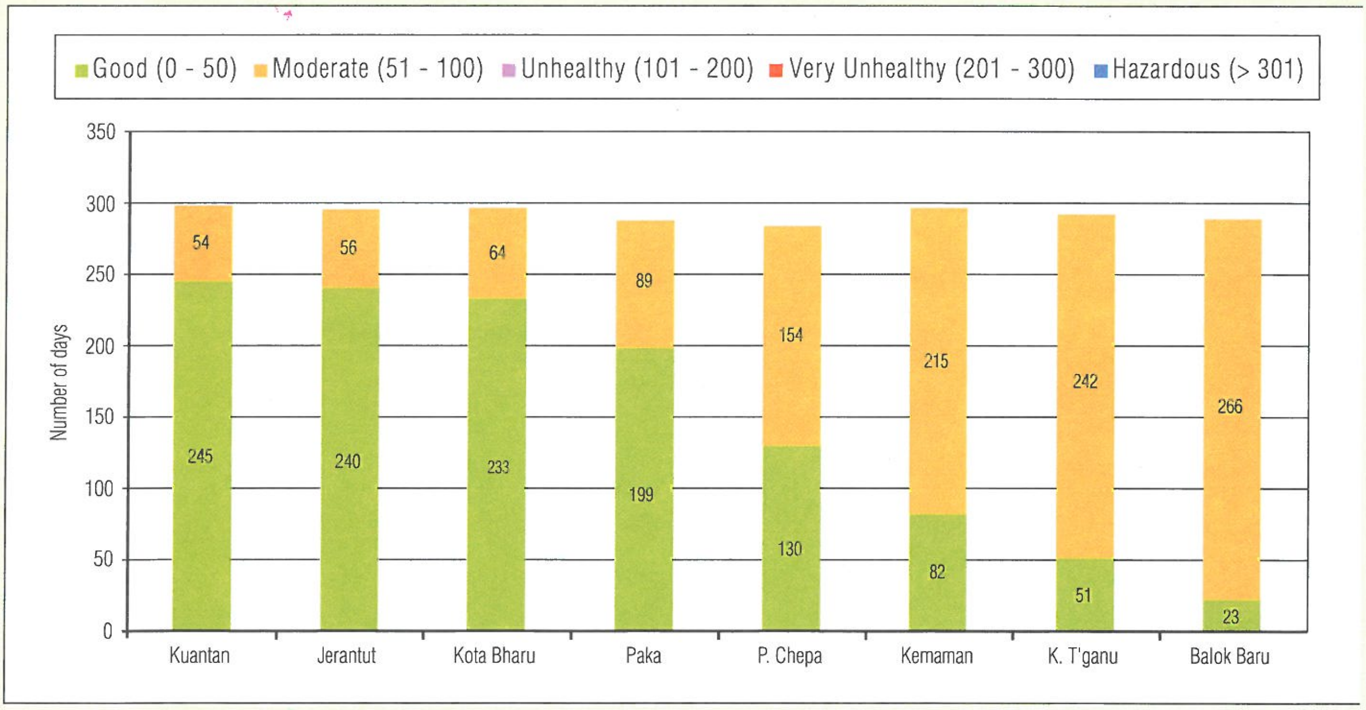


Figure 5. Department of Environment : Air Quality of East Coast Peninsular Malaysia, 2002

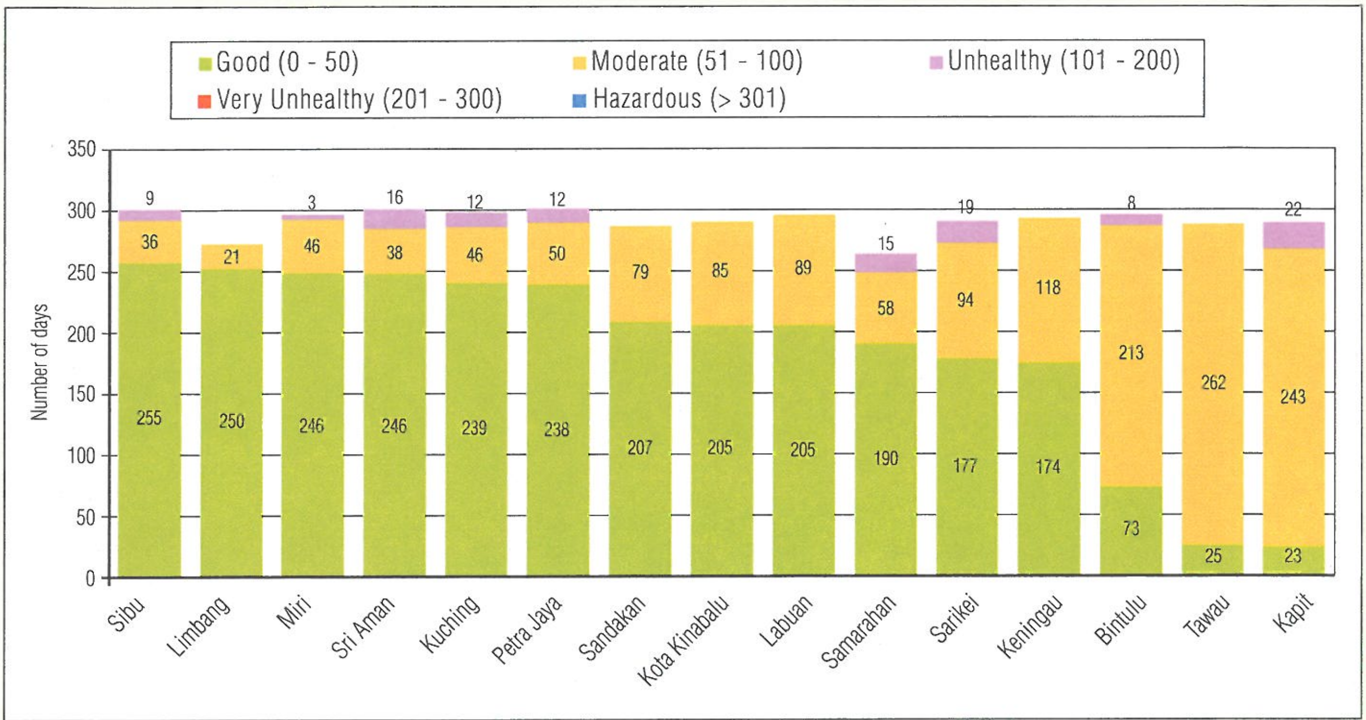
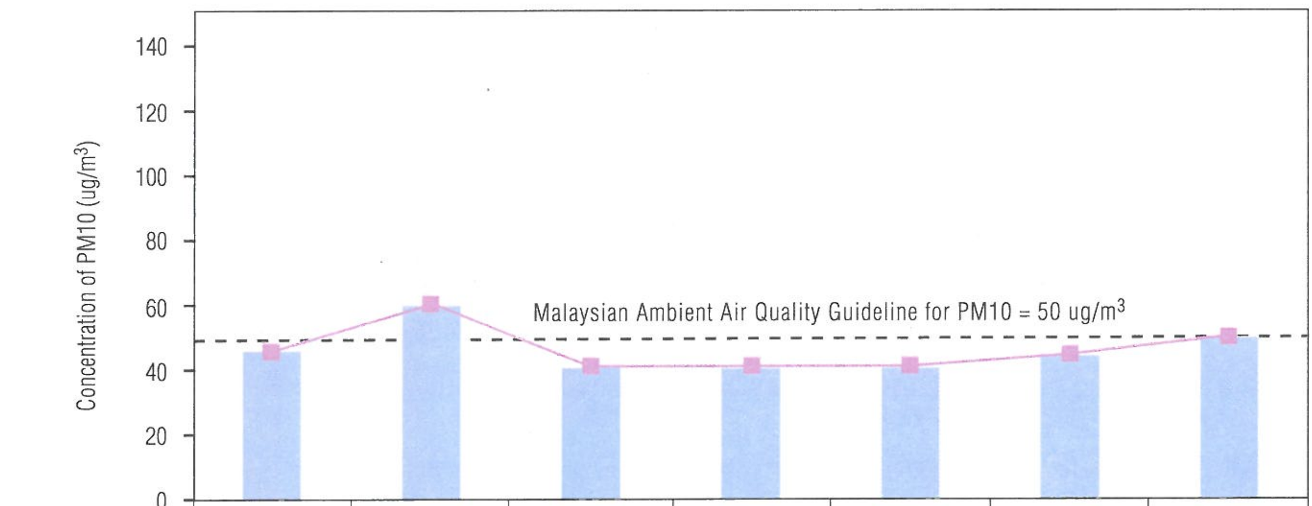
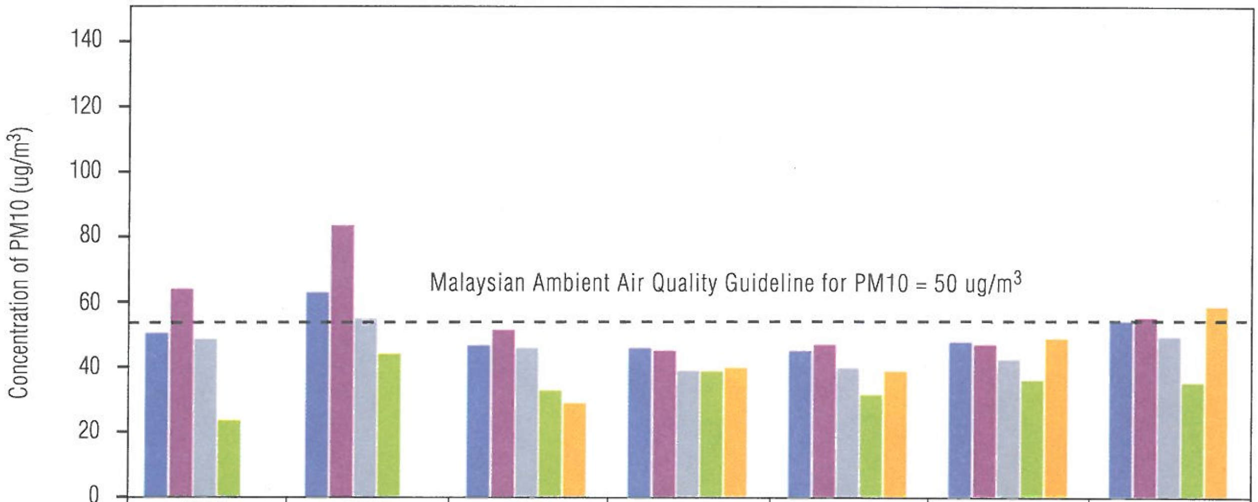


Figure 6. Department of Environment : Air Quality in Sabah and Sarawak, 2002



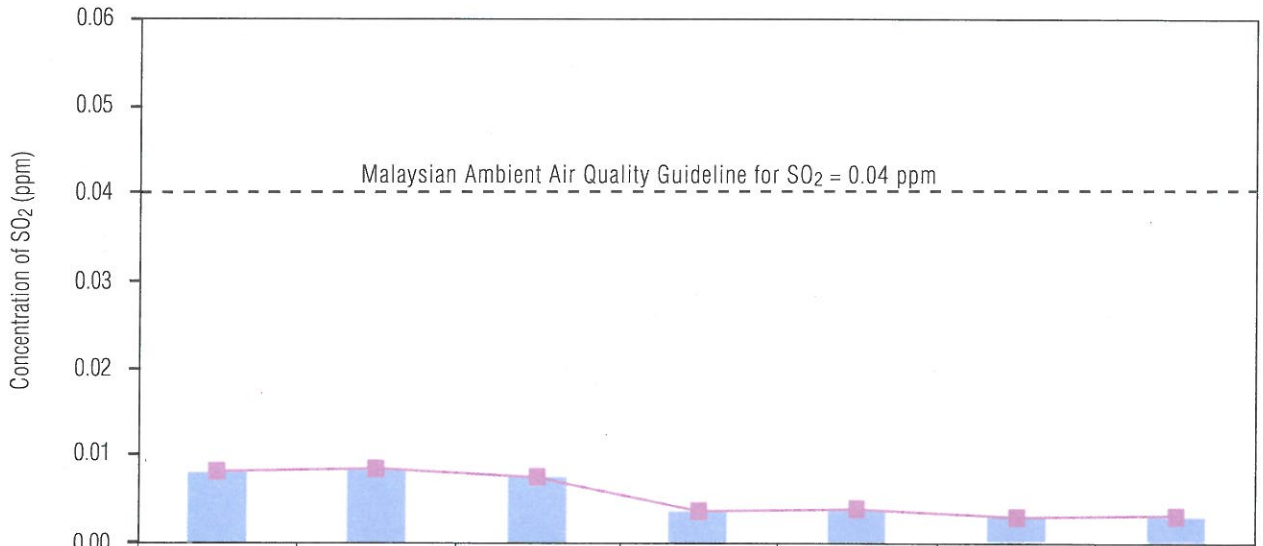
	1996	1997	1998	1999	2000	2001	2002
No. of site	13	27	37	45	50	50	50

Figure 7 Malaysia : Annual Average Particulate Matter (PM10) Concentration, 1996-2002



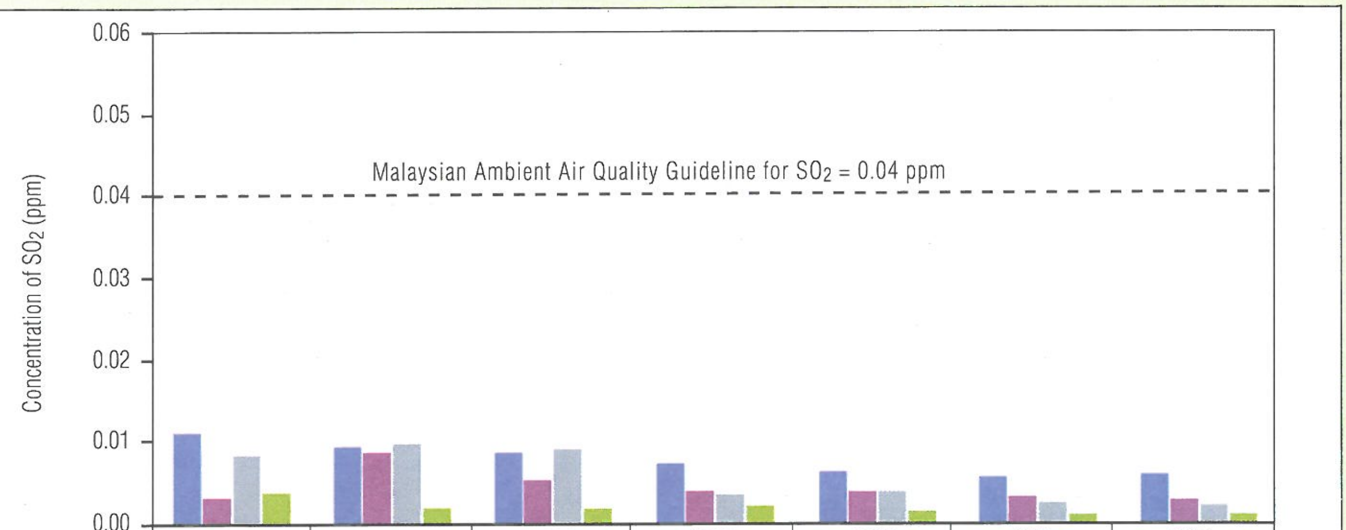
	1996	1997	1998	1999	2000	2001	2002
Industrial	50	62	47	45	45	47	54
Urban	64	83	51	45	46	46	55
Sub Urban	49	54	46	39	39	42	49
Background	23	44	32	38	31	36	35
Rural			28	40	38	48	58

Figure 7(a) Malaysia : Annual Average PM10 Concentration by Landuse, 1996-2002



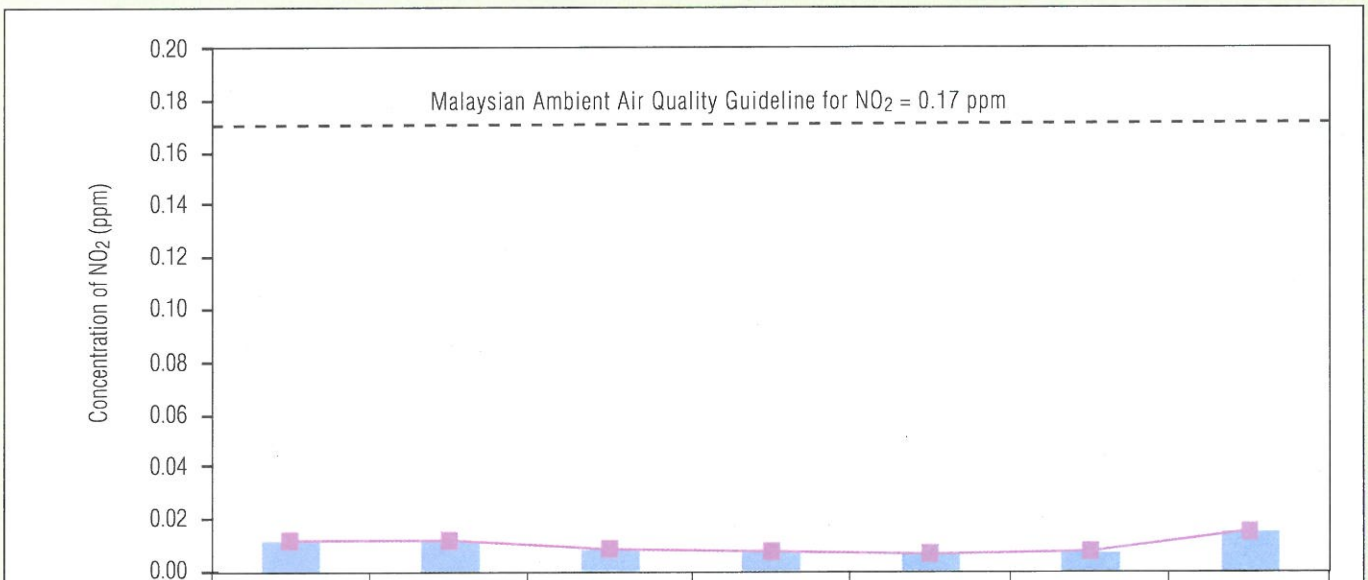
	1996	1997	1998	1999	2000	2001	2002
No. of site	13	27	33	39	43	43	43

Figure 8 Malaysia : Annual Average Sulphur Dioxide (SO_2) Concentration, 1996-2002



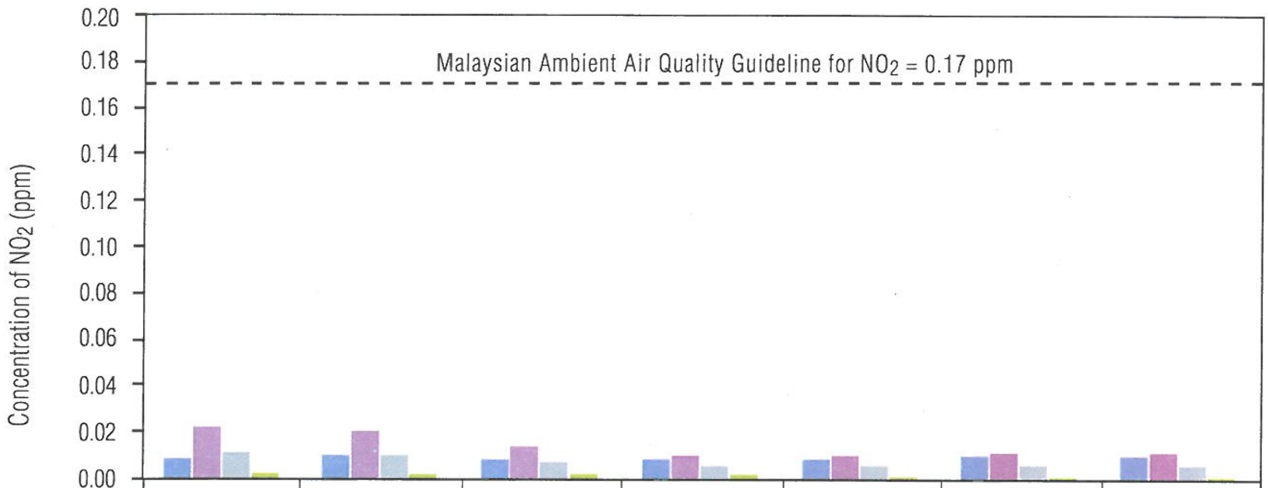
	1996	1997	1998	1999	2000	2001	2002
Industrial	0.0112	0.0093	0.0087	0.0073	0.0064	0.0057	0.0058
Urban	0.0033	0.0089	0.0052	0.0039	0.0037	0.003	0.0027
Sub Urban	0.0082	0.0097	0.0090	0.0036	0.0038	0.0024	0.0020
Background	0.0040	0.0022	0.0017	0.0022	0.0013	0.0009	0.0009

Figure 8(a) Malaysia : Annual Average SO_2 Concentration by Landuse, 1996-2002



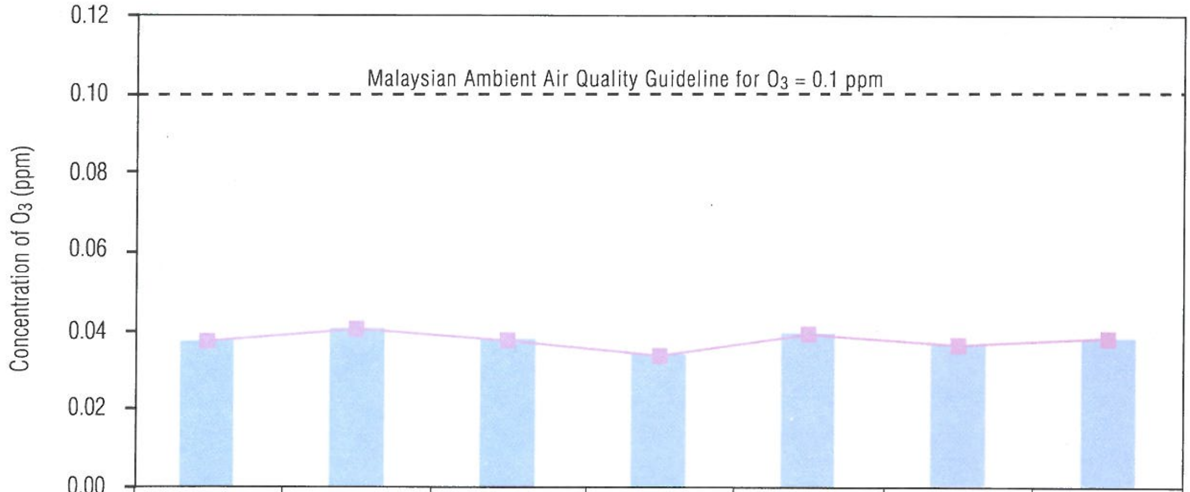
	1996	1997	1998	1999	2000	2001	2002
No. of site	13	27	33	39	43	43	43

Figure 9 Malaysia : Annual Average Nitrogen Dioxide (NO_2) Concentration, 1996-2002



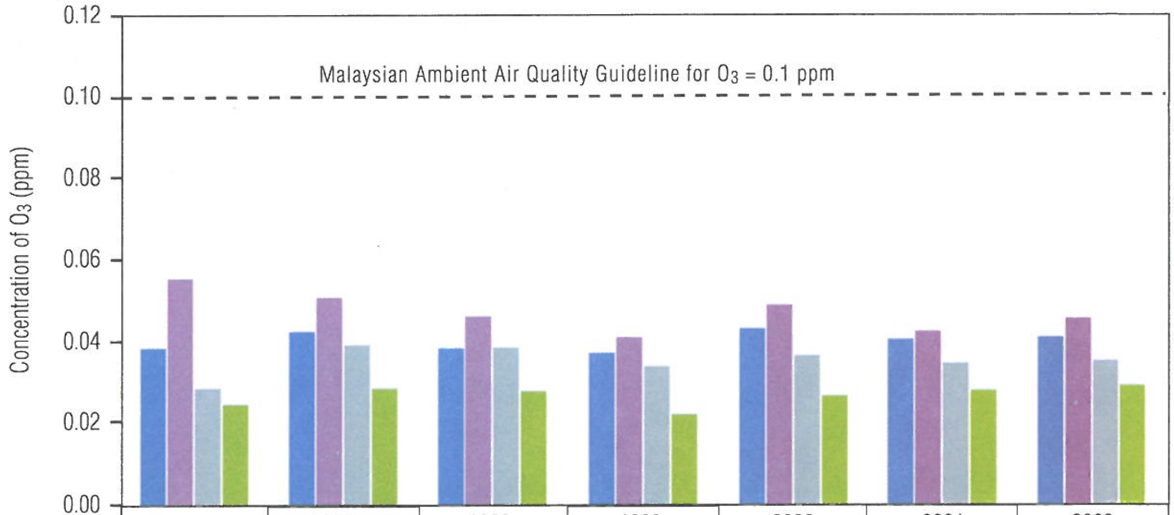
	1996	1997	1998	1999	2000	2001	2002
Industrial	0.0096	0.0100	0.0089	0.0096	0.0093	0.0105	0.0106
Urban	0.0221	0.0210	0.0141	0.0112	0.0104	0.0113	0.0122
Sub Urban	0.0123	0.0108	0.0084	0.0062	0.0062	0.0062	0.0065
Background	0.0025	0.0033	0.0031	0.0030	0.0014	0.0013	0.0018

Figure 9(a) Malaysia : Annual Average NO_2 Concentration by Landuse, 1996-2002



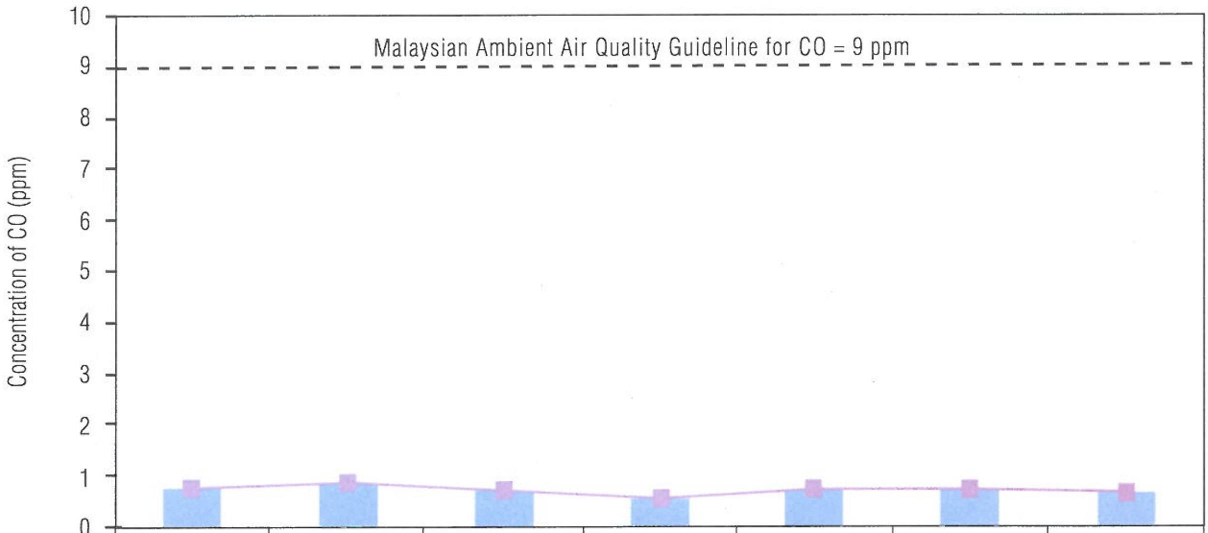
	1996	1997	1998	1999	2000	2001	2002
No. of site	12	21	27	35	39	39	39

Figure 10 Malaysia : Annual Average Daily Maximum 1 Hour Ozone (O_3) Concentration, 1996-2002



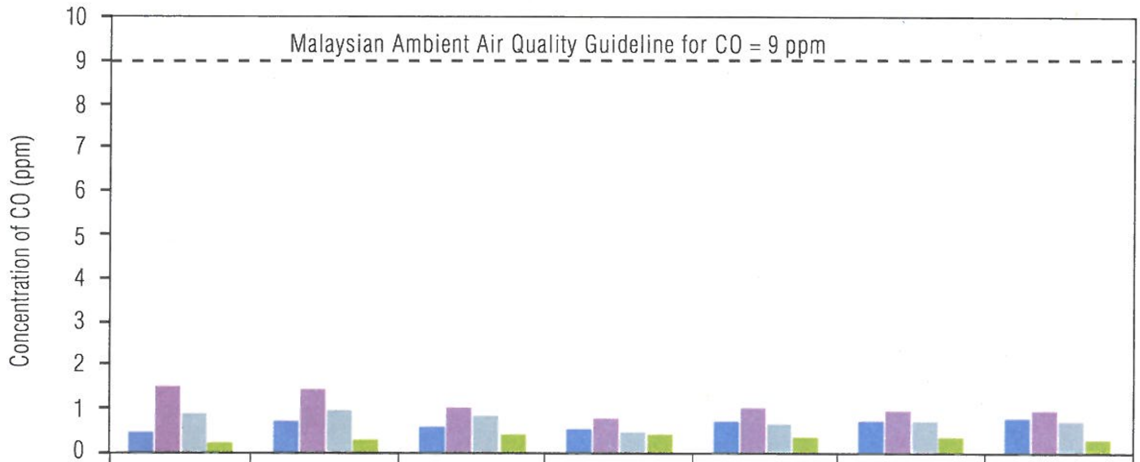
	1996	1997	1998	1999	2000	2001	2002
Industrial	0.038	0.043	0.039	0.038	0.043	0.0405	0.0413
Urban	0.056	0.051	0.046	0.041	0.049	0.0426	0.0461
Sub Urban	0.029	0.040	0.039	0.034	0.037	0.0348	0.0355
Background	0.025	0.029	0.028	0.022	0.027	0.0279	0.0298

Figure 10(a) Malaysia : Annual Average Daily Maximum 1 Hour O_3 by Landuse, 1996-2002



	1996	1997	1998	1999	2000	2001	2002
No. of site	12	21	27	35	39	39	39

Figure 11 Malaysia : Annual Average Carbon Monoxide (CO) Concentration, 1996-2002



	1996	1997	1998	1999	2000	2001	2002
Industrial	0.501	0.726	0.627	0.555	0.739	0.7614	0.7676
Urban	1.541	1.475	1.067	0.822	1.071	1.0091	0.9934
Sub Urban	0.922	0.975	0.845	0.520	0.689	0.7169	0.7187
Background	0.255	0.33	0.436	0.448	0.347	0.3978	0.3182

Figure 11(a) Malaysia : Annual Average CO Concentration by Landuse, 1996-2002

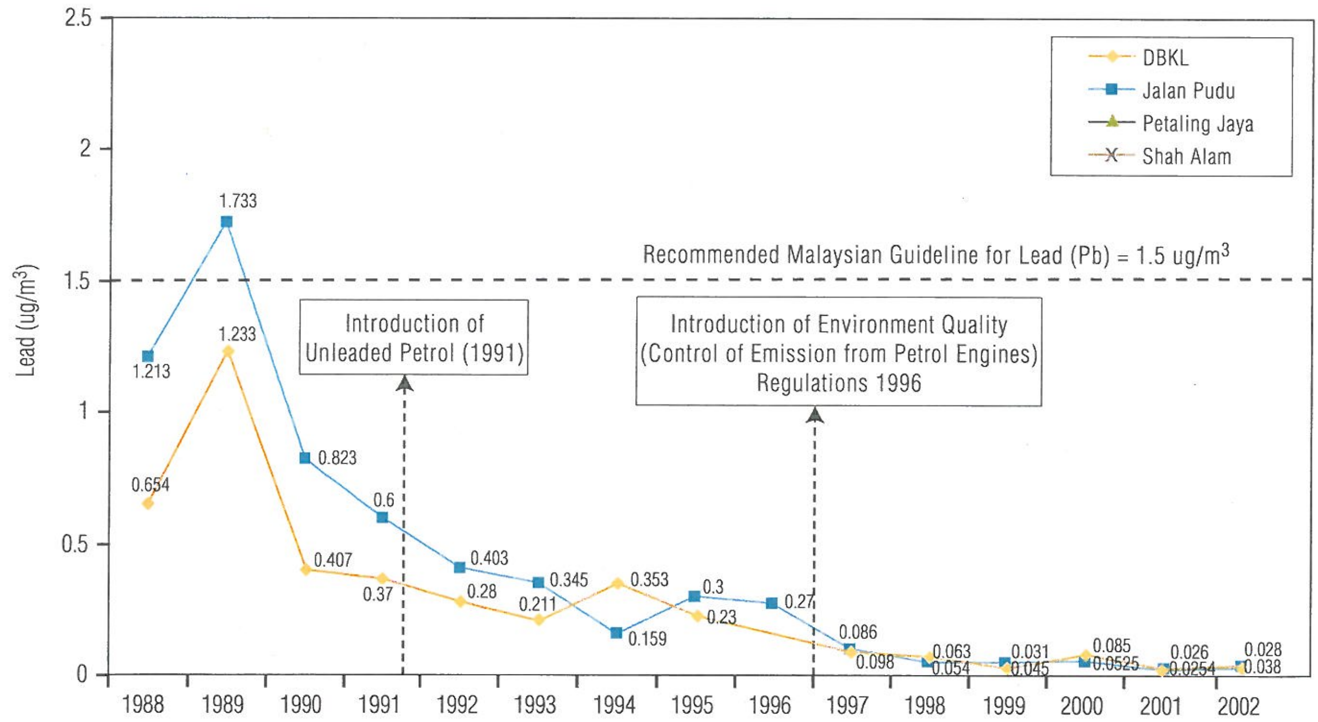


Figure 12 Malaysia: Ambient Lead Concentration in the Klang Valley, 1988-2002

chapter 2

NOISE LEVEL

NOISE LEVEL

Photo 7 : Noise Level Monitoring (DOE Photo Library)

NOISE MONITORING

Ambient noise level measurements conducted by the Department of Environment in 2002 were concentrated essentially in residential areas throughout the country (Table 2). The data obtained were assessed against the recommended benchmark levels set by the World Health Organization (WHO). Typical impacts of noise in residential areas were sleep disturbance, annoyance and speech interference.

Table 2. Malaysia: Residential Noise Monitoring Locations, 2002

STATES	LOCATION
Selangor	Bangi Gombak Setapak Serdang Kajang
Pahang	Tmn. Kempadang, Kuantan Sungai Isap, Kuantan Tmn. Setongkol, Kuantan
Johor	Tmn. Perling, Johor Bharu Kampung Melayu, Johor Bahru
Pulau Pinang	Butterworth Bukit Mertajam Kepala Batas
Perak	Tmn. Desa Tambun, Ipoh Jln. Sultan Azlan Shah, Ipoh
Sabah	Tmn. Sri Gaya, Kota Kinabalu Tmn. Sempelang, Kota Kinabalu Tmn. Bersatu, Kota Kinabalu
Sarawak	Lorong Surabaya, Kuching Tmn. Hussin, Kuching Tmn. Mas, Kuching Jln. Dongan, Kuching

The noise levels recorded at these areas are shown in Figure 13 to Figure 19. The readings indicated that noise levels in residential areas during daytime (7am to 10pm) exceeded the limit recommended by the World Health Organization (WHO). During night time (10pm to 7 am), the noise levels at these similar locations most of the time also exceeded the 45 dB(A) limit recommended by the World Health Organization (WHO). Higher noise levels were recorded in the Klang Valley compared to other locations around the country.

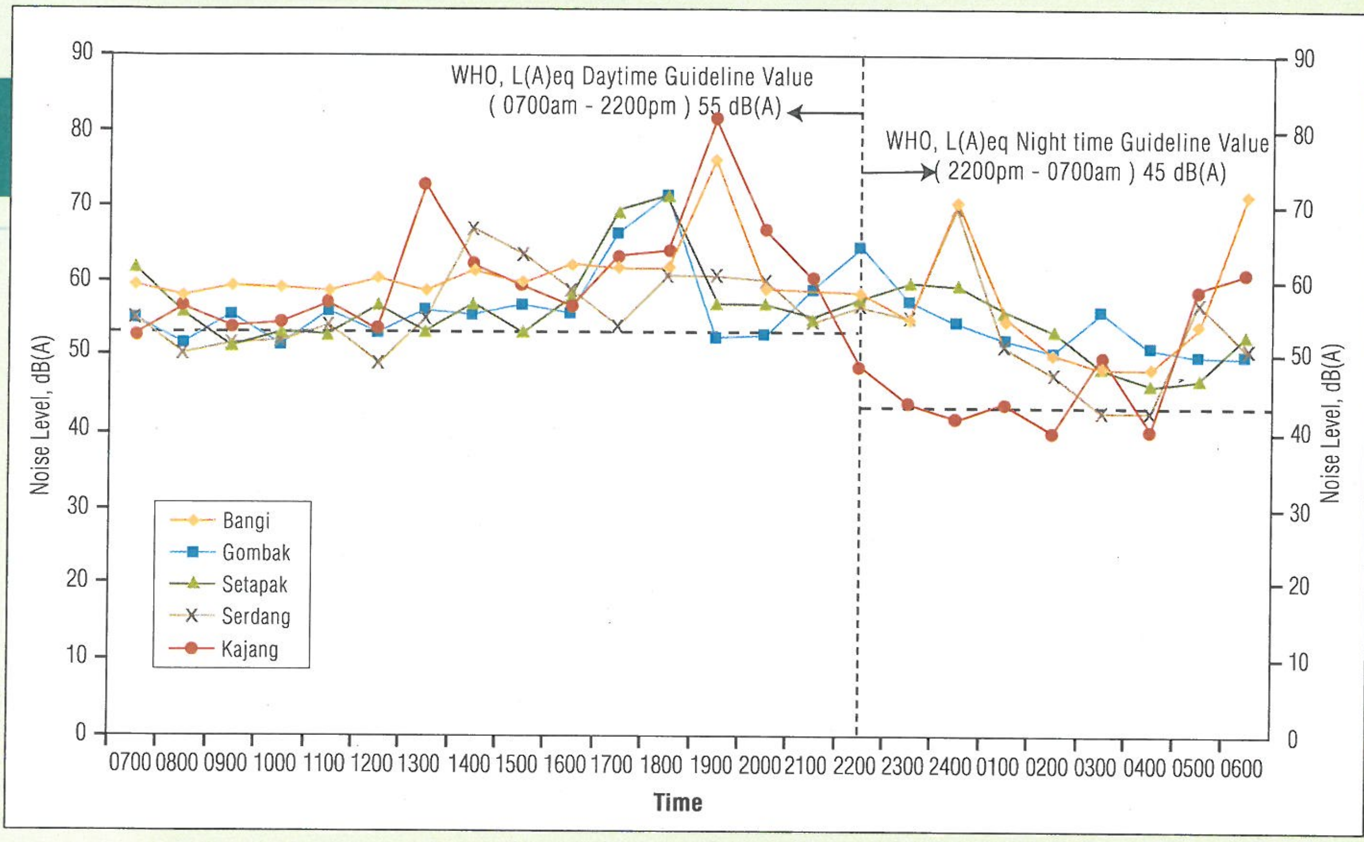


Figure 13: Department of Environment : Noise Level At Residential Areas, Klang Valley, 2002.

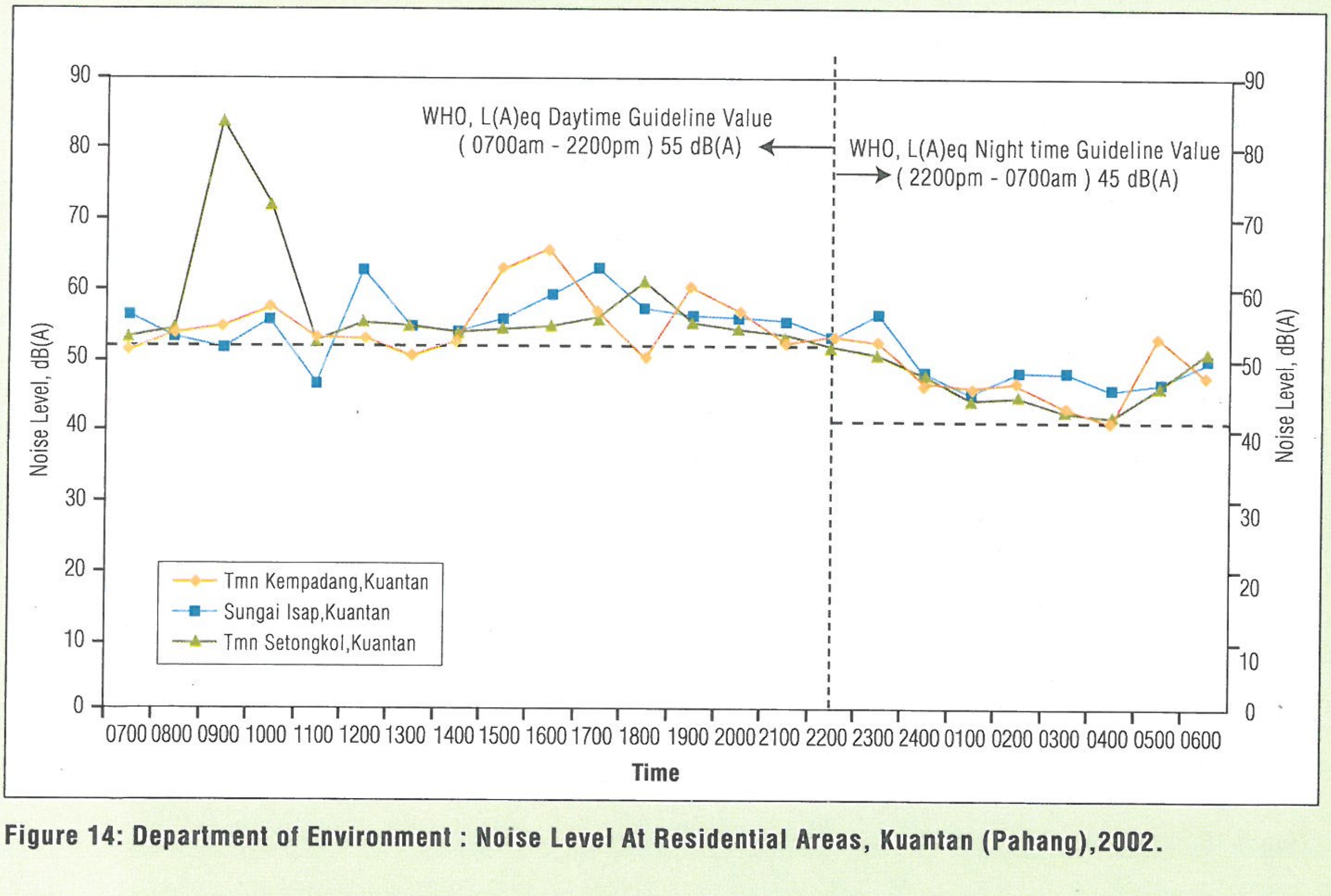


Figure 14: Department of Environment : Noise Level At Residential Areas, Kuantan (Pahang),2002.

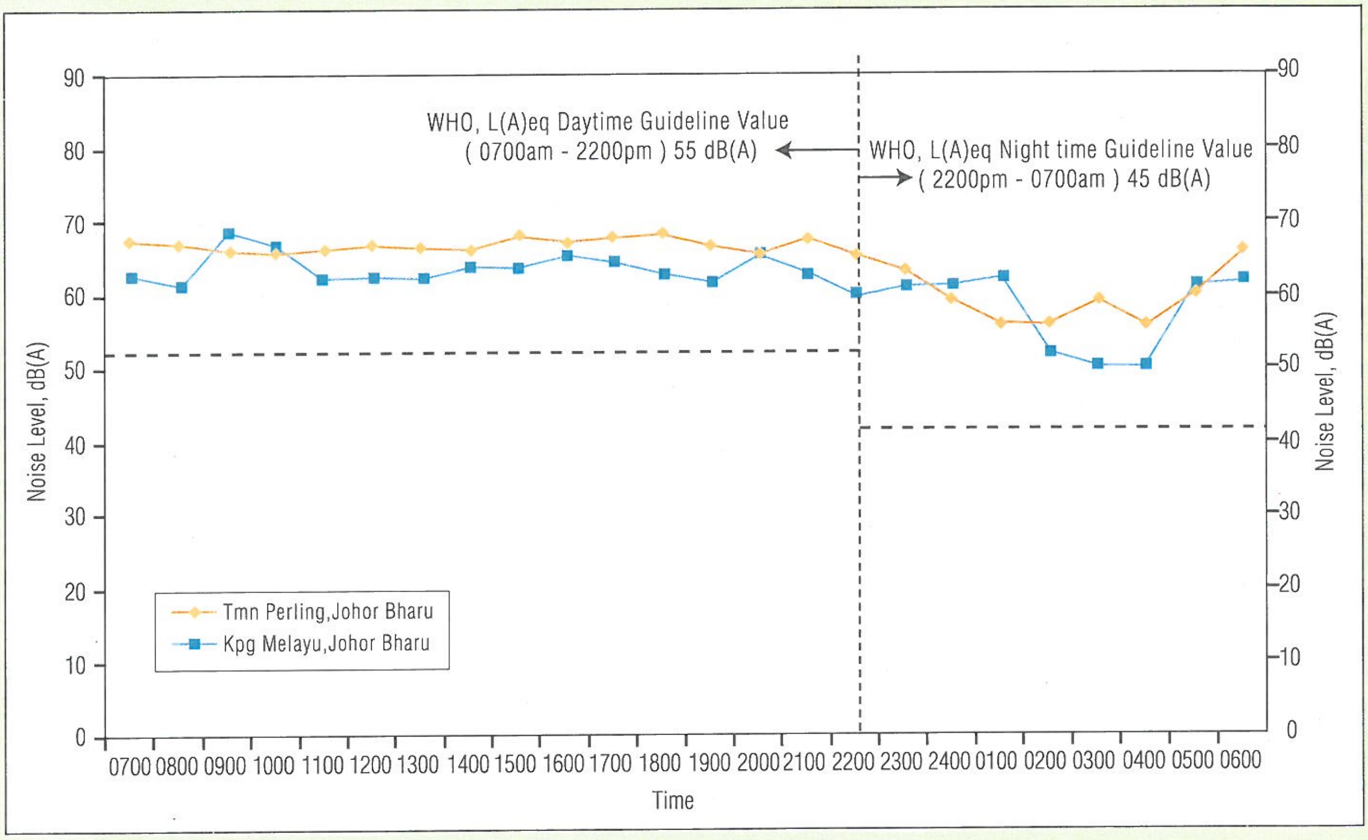


Figure 15: Department of Environment : Noise Level At Residential Areas, Johor Bharu (Johor), 2002.

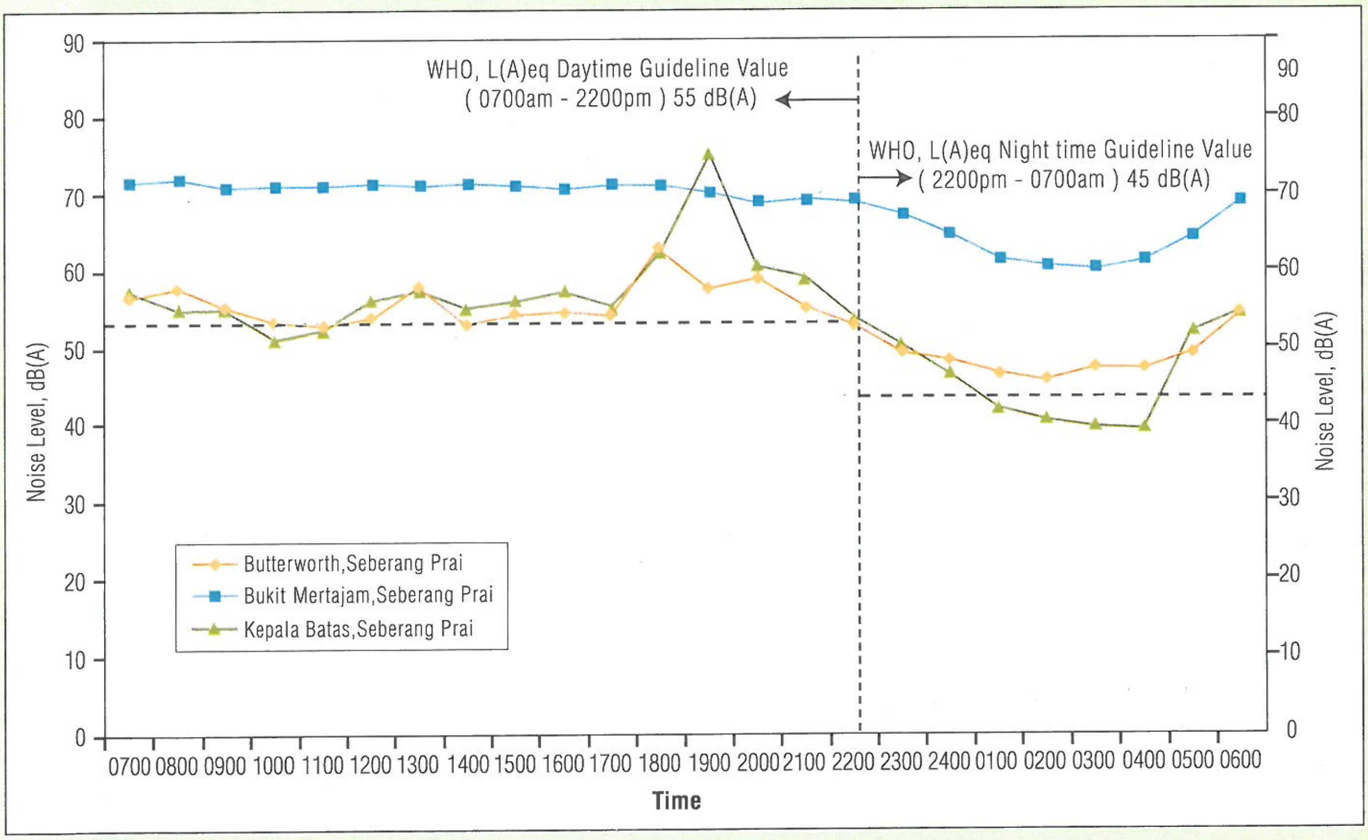


Figure 16: Department of Environment : Noise Level At Residential Areas, Pulau Pinang, 2002.

chapter 3

RIVER WATER QUALITY

RIVER WATER QUALITY

RIVER WATER QUALITY

The Department of Environment started monitoring of river water quality in 1978, initially to establish water quality baselines 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 physico-chemical and biological characteristics. The 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 load categorization and designation of classes of beneficial uses as provided for under the National Water Quality Standards for Malaysia (NWQS). (Annex)

River Water Quality Status

In 2002, a total of 927 water quality monitoring stations located within 120 river basins were monitored. Out of these 927 monitoring stations, 489 (53%) were found to be clean, 303 (33%) slightly polluted and 139 (15%) polluted. (Table 3.0(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, 63 river basins (52.5%) were clean compared to 60 (50.0%) river basins in 2001; 43 (35.8 %) slightly polluted compared to 47 (39.0%) in 2001; and 14 (11.7 %) polluted compared to 13 (11%) in 2001 (Figure 20).

In addition, 15 automatic water quality-monitoring stations at strategic locations along major rivers had been installed to detect river water quality changes on a continuous basis. Real time data of specific parameters could be transmitted to DOE. This would enable immediate investigations to be conducted on suspected pollution sources. Six of these stations were located upstream of water intake points at Sungai Perai, Sungai Perak, Sungai Linggi, Sungai Melaka, Sungai Skudai and Sungai Terengganu. Two stations had been established at the recreational areas of Sungai Selangor and Sungai Sarawak, while two other stations had also been established at Sungai Kelang and Sungai Keratong to monitor domestic sources of pollution. Another five stations had been established at Sungai Labu, Sungai Putat, Sungai Langat, Sungai

Photo 8 : A Clean River at Recreational Site (DOE Photo Library)

Batang Benar and Sungai Rajang under the Pollution Prevention and Water Quality Improvement Programme for Malaysian Rivers.

Cumulative water quality data compiled from the fifteen continuous water quality monitoring stations are presented in Figure 21,22,23 & 24. Based on the 90-percentile values, low dissolved oxygen levels were most frequent in Sg.Perai (45.1% saturation), followed by Sg.Klang (59.2% saturation), Sg. Selangor (59.2% saturation) and Sg.Skudai (62.9% saturation) (Figure 21). High ammonium levels were recorded more frequently in Sg.Klang (9.1 mg/l), followed by Sg. Langat (7.3 mg/l) and Sg.Putat (6.2 mg/l) (Figure 22). High turbidity levels were most frequently detected in Sg. Langat (1236.4 NTU), Sg. Putat (1132.3 NTU) and Sg. Rajang (1057.7 NTU) (Figure 23). pH value of 6.3 was recorded in Sg. Selangor , pH 6.4 in Sg. Terengganu and pH 6.5 in Sg. Melaka (Figure 24).

Figure 25 illustrates the status of river water quality in relation to major pollution sources: 18% of river basins were polluted by biochemical oxygen demand (BOD) due to sewage and discharges from agro-based and manufacturing industries; 24% of river basins were polluted by ammoniacal nitrogen (NH3-N) from sewage that included livestock farming and domestic sewage; and 23% of river basins by suspended solids (SS) due to earthworks and land-clearing activities. The corresponding figures in 2001 were 18%, 20% and 33% for BOD, NH3-N and SS respectively. The significant improvement in water quality in terms of suspended solids could be attributed to better environmental control and management of earthworks and land clearing activities.

Analysis of heavy metals in 5,634 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 64.0% compliance.

As shown in Figure 20, there was an overall improvement of water quality in 2002. The number of clean river basins in 2002 had increased from 60 to 63, while the slightly polluted basins dropped from 47 in 2001 to 43 in 2002. This general improvement could be due to the fact that the 3 river basins namely Sg. Kuantan (Pahang), Sg. Chukai (Terengganu) and Sg. Sadong (Sarawak) that became clean (WQI >81) were already marginally in the slightly polluted category (WQI 76–80) over the past several years. This improvement could be attributed to several contributory factors such as reduction and better environmental management of land clearing activities (which accounted for the improvement in suspended solids levels), increased localised rainfall and intensifed enforcement efforts.

Photo 9 : River Water Quality Manual measurement (DOE Photo Library)

Table 3.0(a) Malaysia: Water Quality Status within Clean River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	01PL	MELAKA	3	84 (91)	KISAP	1	86	C	II
					MELAKA	1	72	SP	III
					PETANG	1	92	C	II
	03	KEDAH	6	82 (83)	KEDAH	1	60	SP	III
					PADANG TERAP	3	87	C	II
					PEDU	1	90	C	II
					TEKAI	1	84	C	II
KEDAH / P.PINANG	05	MUDA	9	87 (85)	JERUNG	2	62	SP	III
					KETIL	1	88	C	II
					MUDA	4	84	C	II
					TAWAR	2	87	C	II
PERAK	09	KURAU	5	82 (79)	ARA	1	92	C	II
					KURAU	4	79	SP	II
	10T	TEMERLOH	2	84 (83)	TEMERLOH	2	84	C	II
	11	BERUAS	4	82 (83)	BRUAS	2	78	SP	II
					ROTAN	2	87	C	II
PERAK/SELANGOR	14	BERNAM	10	82 (79)	BERNAM	6	76	SP	III
					SLIM	2	91	C	II
					TEROLAK	2	93	C	I
SELANGOR	16	SELANGOR	9	84 (84)	BATANG KALI	1	88	C	II
					KANCING	1	92	C	II
					KERLING	1	92	C	II
					SELANGOR	4	84	C	II
					SEMBAH	1	61	SP	III
					SERENDAH	1	88	C	II
JOHOR	29	JOHOR	44	81 (78)	ANAK SG. SAYONG	3	72	SP	III
					BERANGAN	2	82	C	II
					BKT. BESAR	2	72	SP	III
					CHEMANGAR	1	85	C	II
					JOHOR	4	85	C	II
					LAYANG	1	89	C	II
					LAYAU KIRI	2	84	C	II
					LEBAM	2	83	C	II
					LINGGIU	1	85	C	II
					PENGGELI	2	89	C	II
					REMIS	2	88	C	II
					SANTI	1	80	SP	II
					SAYONG	4	88	C	II
					SEBOL	2	82	C	II
					SEMANGER	1	86	C	II
					SEMENCHU	2	76	SP	III
					SENING	2	68	SP	III
					SERAI	2	71	SP	III
					TELOR	2	90	C	II
					TEMON	2	87	C	II
					TIRAM	4	72	SP	III
	30A	SEDILI BESAR	13	84 (83)	AMBAT	2	86	C	II
					DOHOL	1	89	C	II
					MUPUR	1	66	SP	III
					SEDILI BESAR	5	83	C	II
					SEMANGGOT KANAN	1	87	C	II
					SEMANGGOT KIRI	1	90	C	II
					TEMUBOR KANAN	2	86	C	II
	30C	PALOI	2	82 (82)	PALOI	2	82	C	II
	31A	MERSING	1	91 (91)	MERSING	1	91	C	II
	31B	JEMALUANG	2	83 (81)	JEMALUANG	2	83	C	II
PAHANG	32AE	ANAK ENDAU	2	87 (87)	ANAK ENDAU	2	87	C	II
	33	ROMPIN	18	86 (84)	AUR	1	86	C	II
					BAKAR	1	71	SP	III
					JEKATIH	2	91	C	II
					JERAM	1	93	C	I
					KEPASING	1	85	C	II
					KERATONG	4	85	C	II
					PUKIN	3	92	C	II
					REKOH	1	72	SP	III
					ROMPIN	4	88	C	II
	34	BEBAR/ MERCHONG	8	83 (83)	BEBAR	1	74	SP	III
					KELAYAT	1	85	C	II
					MERBA	1	87	C	II
					MERCHONG	1	72	SP	III
					SERAI	2	87	C	II
					TEMIANG	2	85	C	II
	35B	BERA	5	82 (82)	BERA	3	81	C	II
					TASIK BERA	1	85	C	II
					TRIANG	1	83	C	II
	35CH	BERTAM	10	87 (86)	BERTAM	2	85	C	II
					BURUNG	1	91	C	II

Table 3.0(a) Malaysia: Water Quality Status within Clean River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
PAHANG	35CH	BERTAM	10	87 (86)	HABU	1	92	C	II
					LENGGOK	1	92	C	II
					RINGLET	1	81	C	II
					TELOM	2	86	C	II
					TERLA	1	90	C	II
					TRINGKAP	1	86	C	II
	35L	LEPAR	10	83 (85)	ANAK SG. LEPAR	1	68	SP	III
					BELAYAR	1	93	C	II
					BERKAPOR	2	89	C	II
					CHINI	1	76	SP	III
					LEPAR	3	89	C	II
					T. PAYA BUNGOR	1	88	C	II
					TASIK CHINI	1	84	C	II
	35M	MENTIGA	2	82 (82)	MENTIGA	2	82	C	II
	35P	PAHANG	51	88 (88)	BATU	1	89	C	II
		BENTONG	4	87	C	II			
					BENUS	2	90	C	II
					BILUT	1	85	C	II
					JELAI	2	88	C	II
					JEMPOL	2	90	C	II
					JENGKA	2	85	C	II
					KELAU	2	88	C	II
					KERTAM	1	88	C	II
					KOYAN	1	91	C	II
					KUNDANG	1	83	C	II
					LIPIS	3	89	C	II
					LUIT	1	89	C	II
					MARAN	2	90	C	II
					PAHANG	9	88	C	II
					PENJURING	1	92	C	II
					PERTANG	2	91	C	II
					PERTING	1	93	C	I
					SEMANTAN	3	87	C	II
					SIAM	1	92	C	II
					TANGLIR	1	92	C	II
					TEKAL	1	83	C	II
					TEKAM	2	89	C	II
					TELANG	1	91	C	II
					TELEMONG	2	91	C	II
					TERANUM	1	88	C	II
					TERAS	1	89	C	II
	36	KUANTAN	11	82 (80)	BELAT	1	88	C	II
					CHARU	1	92	C	II
					GALING BESAR	1	45	P	IV
					GALING KECIL	1	63	SP	III
					KENAU	1	92	C	II
					KUANTAN	4	90	C	II
					PINANG	1	78	SP	II
					RIAU	1	81	C	II
TERENGGANU	39C	CHUKAI	5	86 (80)	CHUKAI	1	82	C	II
					IBOK	2	89	C	II
					RUANG	2	86	C	II
	39K	KERTIH	1	88 (89)	KERTIH	2	87	C	II
	40	PAKA	10	84 (83)	BESUL	2	90	C	II
					PAKA	4	84	C	II
					RASAU	2	80	SP	II
					RENGAT	2	81	C	II
	41	DUNGUN	4	90 (89)	DUNGUN	2	92	C	II
					TELEMBOH	2	88	C	II
	42I	IBAI	3	83 (77)	IBAI	3	83	C	II
	42M	MARANG	5	83 (80)	KERAK	2	78	SP	II
	42M	MARANG	5	83 (80)	MARANG	1	84	C	II
					TEMALA	2	87	C	II
	43	TERENGGANU	9	87 (85)	BERANG	2	90	C	II
					NERUS	3	90	C	II
					PUEH	2	85	C	II
					TERENGGANU	2	82	C	II
	46	BESUT	4	91 (88)	BESUT	2	93	C	I
					JERTIH	2	88	C	II
KELANTAN	47S	SEMERAK	2	83 (86)	SEMERAK	2	83	C	II
	48	KELANTAN	38	88 (88)	ARING	2	91	C	II
					BELATOP	2	83	C	II
					BER	1	91	C	II
					BEROK	2	87	C	II
					BETIS	1	90	C	II
					CHIKU	2	92	C	II
					GALAS	1	91	C	II
					KELANTAN	4	88	C	II
					KELESA	2	93	C	II
					KERAK	2	91	C	II
					KERILLA	2	91	C	II

Table 3.0(a) Malaysia: Water Quality Status within Clean River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
KELANTAN	48	KELANTAN	38	88 (88)	KETIL	2	93	C	II
					NAL	3	91	C	II
					PEHI	2	91	C	II
					PENGKALAN CHEPA	1	76	SP	III
					PENGKALAN DATU	3	83	C	II
					PERGAU	2	92	C	II
					PERTOK	2	78	SP	II
					RELAI	2	89	C	II
	49	GOLOK	4	85 (84)	GOLOK	2	91	C	II
					TASIK GARU	2	79	SP	II
SARAWAK	50	KAYAN	4	86 (84)	KAYAN	3	83	C	II
					SEMATAN	1	92	C	II
	52	SADONG	6	83 (80)	KARANGAN	1	85	C	II
					SADONG	3	76	SP	III
					TARAT	2	93	C	I
	53	LUPAR	7	84 (83)	AI	1	82	C	II
					LUPAR	3	80	SP	II
					SEKERANG	1	89	C	II
					SETERAP	1	86	C	II
					UNDUP	1	91	C	II
	54	SARIBAS	2	82 (78)	RIMBAS	1	89	C	II
					SARIBAS	1	75	SP	III
	57	OYA	3	81 (79)	OYA	3	81	C	II
	59	BALINGIAN	2	82 (83)	BALINGIAN	2	82	C	II
	60	TATAU	1	82 (83)	TATAU	1	82	C	II
	61	KEMENA	3	81 (82)	KEMENA	2	81	C	II
	61	KEMENA	3	81 (82)	SIBIU	1	82	C	II
	62	SIMILAJAU	1	89 (90)	SIMILAJAU	1	89	C	II
	63	SUAI	1	84 (85)	SUAI	1	84	C	II
	68	LIMBANG	5	82 (83)	LIMBANG	5	82	C	II
	69	TRUSAN	1	87 (86)	TRUSAN	1	87	C	II
	70	LAWAS	2	85 (86)	LAWAS	2	85	C	II
SABAH	71	MENGGALONG	3	88 (86)	LAKUTAN	1	86	C	II
					LINGKUNGAN	1	89	C	II
					MENGGALONG	1	89	C	II
	72	PADAS	7	88 (86)	BUNSIT	1	91	C	II
					LIAWAN	1	91	C	II
					PADAS	3	84	C	II
					PANGATAN	1	86	C	II
					TANDULU	1	92	C	II
	73	MEMBAKUT	1	82 (85)	MEMBAKUT	1	82	C	II
	75	PAPAR	2	89 (88)	PAPAR	2	89	C	II
	77	DAMIT/TUARAN	6	90 (89)	DAMIT	2	89	C	II
					SONG SAI	1	92	C	II
					TUARAN	3	90	C	II
	78	KEDAMAIAN	3	91 (89)	TEMPASUK	2	93	C	II
					TENGHILAN	1	88	C	II
	80	BENGKOKA	1	86 (88)	BENGKOKA	1	86	C	II
	83	SUGUT	6	92 (91)	BONGKUD	1	93	C	I
					LOHAN	2	92	C	II
					MERALI	1	92	C	II
					SUGUT	2	93	C	II
	84	LABOK	8	89 (88)	KINIPIR	2	91	C	II
					LIWAGU	2	90	C	II
					MALIAU	1	93	C	II
					SAPI	2	81	C	II
					SUALONG	1	93	C	I
	85	KAYA	1	84 (89)	MOUNAD	1	84	C	II
	86	KINABATANGAN	4	83 (82)	KINABATANGAN	2	83	C	II
					KOYAH	1	84	C	II
					TENEGANG BESAR	1	81	C	II
	87	SEGAMA	1	85 (84)	SEGAMA	1	84	C	II
	88	SILABUKAN	2	82 (81)	SILABUKAN	2	82	C	II
	89	TINGKAYU	1	87 (81)	TINGKAYU	1	87	C	II
	91	TAWAU	5	85 (87)	APAS	1	90	C	II
					BALUNG	1	83	C	II
					TAWAU	3	84	C	II
	93	UMAS-UMAS	1	90 (81)	UMAS-UMAS	1	90	C	II
	94	BRANTIAN	1	85 (81)	BRANTIAN	1	85	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 Classification based on INWQS
4. ( ) Overall WQI for 2001

Table 3.0(b) Malaysia: Water Quality Status within Slightly Polluted River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
PERLIS	1	PERLIS	10	77 (79)	ARAU	1	68	SP	III
					JARUM	1	81	C	II
					JERNIH	2	81	C	II
					KOK MAK	1	81	C	II
					NGULANG	1	79	SP	II
					PERALIT	1	86	C	II
					PERLIS	1	63	SP	III
					SERAI	1	75	SP	III
					TASOH	1	77	SP	II
P. PINANG/KEDAH	06P	PERAI	22	61 (63)	AIR MELINTAS	1	29	P	V
					JARAK	6	70	SP	III
					KELADI	1	59	P	III
					KEREH	4	49	P	IV
					KUBANG SEMANG	2	51	P	IV
					KULIM	3	85	C	II
					PERAI	2	65	SP	III
					SELUANG	1	48	P	IV
					SELUANG BAWAH	2	52	P	IV
P. PINANG/PERAK	08	KERIAN	10	71 (76)	KECHIL	3	64	SP	III
					KERIAN	4	78	SP	II
					SELAMA	2	67	SP	III
					SERDANG	1	76	SP	III
PERAK	10	SEPETANG	10	69 (76)	BATU TEGUH	2	73	SP	III
					JANA	1	87	C	II
					LARUT	1	57	P	III
					LIDIN	1	41	P	IV
					MALAI	1	59	P	III
					SEPETANG	3	75	SP	III
					TUPAI	1	81	C	II
	12	RAJA HITAM/ MANJONG	6	69 (65)	DERHAKA	2	57	P	III
					MANJONG	2	81	C	II
					RAJA HITAM	2	69	SP	III
	12W	WANGI/DERALIK	4	64 (62)	DERALIK	2	64	SP	III
					WANGI	2	65	SP	III
	13	PERAK	53	78 (76)	BATANG PADANG	3	85	C	II
					BIDOR	3	82	C	II
					CHENDERIANG	2	92	C	II
					CUAR	2	86	C	II
					KAMPAR	2	89	C	II
					KANGSAR	2	88	C	II
					KEPAYANG	2	66	SP	III
					KERDAH	2	67	SP	III
					KINTA	6	70	SP	III
					KLAH	2	89	C	II
					KLIAN BARU	2	71	SP	III
					KUANG	1	86	C	II
					PARI	2	57	P	III
					PELUS	2	86	C	II
					PERAK	8	83	C	II
					PINJI	2	64	SP	III
					RAIA	2	86	C	II
					SELUANG	1	76	SP	III
					SEROKAI	2	56	P	III
					SUNGKAI	2	87	C	II
					SUNGKAI MATI	2	65	SP	III
					TUMBOH	1	65	SP	III
SELANGOR	15	TENGI	2	80 (80)	TENGI	2	80	SP	II
	19	LANGAT	30	66 (66)	ANAK CHUAU	1	82	C	II
					BALAK	1	48	P	IV
					BATANG BENAR	2	57	P	III
					BATANG LABU	2	77	SP	II
					BATANG NILAI	2	41	P	IV
					BERANANG	1	84	C	II
					BUAN	1	77	SP	II
					CHUAU	3	88	C	II
					JIJAN	1	85	C	II
					LANGAT	8	68	SP	III
					LIMAU MANIS	1	48	P	IV
					LUI	1	93	C	II
					PAJAM	1	82	C	II
					RINCHING	1	75	SP	III
					SEMENYIH	3	79	SP	II
	20	SEPANG	3	73 (68)	SEPANG	3	73	SP	III
NEGERI SEMBILAN	20J	LUKUT	1	77 (72)	LUKUT	1	77	SP	II
	21	LINGGI	15	75 (75)	BATANG PENAR	1	57	P	III
					CHEMBONG	1	79	SP	II
					KEPAYONG	1	72	SP	III
					KUNDUR BESAR	1	92	C	II
					LINGGI	6	71	SP	III

Table 3.0(b) Malaysia: Water Quality Status within Slightly Polluted River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
NEGERI SEMBILAN	21	LINGGI	15	75 (75)	PEDAS	1	90	C	II
					REMBAU	2	83	C	II
					SIMIN	1	68	SP	III
					TEMIANG	1	78	SP	II
					BTG.MELAKA	2	81	C	II
					DURIAN TUNGGAL	1	83	C	II
MELAKA	22	MELAKA	17	69 (68)	MELAKA	9	70	SP	III
					PUTAT	2	53	P	III
					REMBIA	2	60	SP	III
					TAMPIN	1	86	C	II
	23	DUYONG	3	72 (67)	DUYONG	3	72	SP	III
	24	KESANG/MERLIMAU	8	71 (75)	CHOHONG	2	86	C	II
					KESANG	3	78	SP	II
					MERLIMAU	3	54	P	III
JOHOR/ NEGERI SEMBILAN	25	MUAR	43	78 (77)	GEMENCHEH	3	89	C	II
					JUASSEH	2	89	C	II
					KELAMAH	2	56	P	III
					LABIS	4	81	C	II
					MERBUDU	1	71	SP	III
					MERLIMAU	1	56	P	III
					MUAR	16	83	C	II
					P. MENKUANG	1	89	C	II
					PALONG	4	82	C	II
					SEGAMAT	1	88	C	II
					SENARUT	2	61	SP	III
					SEROM	1	52	P	IV
					SPG. LOI	2	78	SP	II
					TEMARONG	1	92	C	II
					TENANG	2	68	SP	III
JOHOR	26	BATU PAHAT	23	75 (75)	AMRAN	2	67	SP	III
					BATU PAHAT	1	55	P	III
					BEKOK	4	79	SP	II
					BERLIAN	2	83	C	II
					CHAAH	2	88	C	II
					LENIK	1	81	C	II
					MEREK	2	86	C	II
					MERPO	2	88	C	II
					SEMBERONG	2	67	SP	III
					SIMPANG KANAN	2	55	P	III
					SIMPANG KIRI	3	65	SP	III
	27B	BENUT	7	78 (74)	BENUT	4	75	SP	III
					PT. HAJI YASSIN	2	79	SP	II
					ULU BENUT	1	90	C	II
	28B	PONTIAN KECIL	2	65 (70)	PONTIAN KECIL	2	65	SP	III
	28C	SKUDAI	14	68 (66)	MELANA	2	63	SP	III
					SKUDAI	9	70	SP	III
	28D	TEBRAU	5	72 (71)	PLENTONG	1	54	P	III
					TEBRAU	4	76	SP	III
	30B	SEDILI KECIL	5	74 (71)	ANAK SEDILI KECIL	1	43	P	IV
					BAHAN	2	82	C	II
					SEDILI KECIL	2	82	C	II
	32	ENDAU	29	76 (76)	A.S. SEMBERONG	2	85	C	II
					DENGAR	2	80	SP	II
					ENDAU	1	84	C	II
					JEBONG	1	66	SP	III
					LENGA	2	59	P	III
					LENGGOR	2	82	C	II
					MAMAI	2	79	SP	II
					MELANTAI	2	71	SP	III
					MENGKIBOL	3	78	SP	II
					PALOH	2	81	C	II
					PAMOL	1	35	P	IV
					SEMBERONG	5	82	C	II
					SINGOL	2	67	SP	III
					TAMOK	2	88	C	II
PAHANG	32/33	PONTIAN	3	80 (81)	PONTIAN	2	88	C	II
					SEPAYANG	1	65	SP	III
	35	SERTING	7	77 (68)	MOKEK	2	81	C	II
					SERTING	5	73	SP	III
	37	BALOK/TONGGOK	5	77 (74)	BALOK	2	74	SP	III
					TONGGOK	3	79	SP	II
	37A	CERATING	1	79 (74)	CERATING	1	79	SP	II
TERENGGANU	38	KEMAMAN	10	80 (81)	CHERUL	2	85	C	II
					KEMAMAN	2	89	C	II
					NERAM	2	79	SP	II
					PERASING	2	86	C	II
					RANSAN	2	61	SP	III
	44	SETIU	3	77 (89)	SETIU	1	91	C	II
					TAROM	2	70	SP	III

Table 3.0(b) Malaysia: Water Quality Status within Slightly Polluted River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
KELANTAN	47K	KEMASIN	1	80 (86)	KEMASIN	1	80	SP	II
SARAWAK	51	SARAWAK	15	80 (78)	KUAP	2	77	SP	II
					MAONG KIRI	1	68	SP	III
					SANTUBONG	1	79	SP	II
					SARAWAK	6	85	C	II
					SARAWAK KANAN	1	82	C	II
					SARAWAK KIRI	1	89	C	II
					SEMENGGOH	2	71	SP	III
					TABUAN	1	75	SP	III
	51BS	SAMARAHAN	2	77 (76)	SAMARAHAN	2	77	SP	II
	55	KERIAN	3	80 (78)	KERIAN	2	79	SP	II
	55	KERIAN	3	80 (78)	SEBLAK	1	83	C	II
	56	RAJANG	18	80 (81)	BINATANG	1	90	C	II
					JULAU	1	86	C	II
					MERADONG	1	86	C	II
					RAJANG	14	78	SP	II
					SARIKEI	1	87	C	II
	58	MUKAH	4	79 (80)	MUKAH	4	79	SP	II
	64	NIAH	5	70 (72)	NIAH	2	86	C	II
					SEKALOH	3	56	P	III
	65	KABULOH	6	75 (79)	KABULOH	2	58	P	III
					KEJAPIL	1	87	C	II
					SATAP	1	83	C	II
					SIBUTI	2	83	C	II
	66	MIRI/LUTONG	7	67 (66)	ADONG	1	59	P	III
					DALAM	1	67	SP	III
					LUTONG	2	69	SP	III
					MIRI	2	64	SP	III
					PADANG LIKU	1	80	SP	II
	67	BARAM	4	77 (79)	BARAM	4	77	SP	II
SABAH	76	MOYOG	11	80 (81)	INANAM	3	82	C	II
					LIKAS	1	58	P	III
					MENGGATAL	2	83	C	II
					MOYOG	3	91	C	II
					TELIPOK	2	67	SP	III
	79	BINGKONGAN	3	76 (74)	BANDAU	1	93	C	I
					MENGGARIS	1	52	P	III
					TANDEK	1	83	C	II
	90	KALUMPANG	5	78 (80)	INTAN	1	88	C	II
					KALUMPANG	2	91	C	II
					PANG BURONG 1	1	76	SP	III
					PANG BURONG 2	1	43	P	IV
					KALABAKAN	2	80	SP	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 Classification based on INWQS
4. ( ) Overall WQI for 2001

Table 3.0(c) Malaysia: Water Quality Status within Polluted River Basins, 2002

STATE	CODE	BASIN	NUMBER OF STATIONS	OVERALL WQI	RIVER	NUMBER OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	04	MERBOK	10	54 (59)	BAKAR ARANG	1	53	P	III
					BATU	1	26	P	V
					BONGKOK	1	62	SP	III
					BUKIT MERAH	1	68	SP	III
					KOROK	1	42	P	IV
					MERBOK	1	58	P	III
					PETANI	1	45	P	IV
					TOK PAWANG	2	70	SP	III
					TUPAH	1	41	P	IV
PULAU PINANG	06J	JURU	8	44 (49)	ARA	1	40	P	IV
					JURU	1	45	P	IV
					KILANG UBI	2	44	P	IV
					PASIR	1	36	P	IV
					RAMBAI	3	47	P	IV
	06PP	PINANG/KLUANG	12	44 (46)	AIR ITAM	5	46	P	IV
					AIR TERJUN	1	93	C	I
					DONDANG	3	40	P	IV
					JELUTONG	1	27	P	V
					KLUANG	1	48	P	IV
					PINANG	1	35	P	IV
	07	JEJAWI	5	53 (53)	CEMPEDAK	1	40	P	IV
					JAWI	3	60	SP	III
					JUNJONG	1	45	P	IV
SELANGOR	17	BULOH	5	56 (53)	BULOH	5	56	P	III
	18	KLANG	24	53 (51)	AMPANG	1	53	P	III
					BATU	2	57	P	III
					DAMANSARA	3	53	P	III
					GOMBAK	3	71	SP	III
					JINJANG	1	49	P	IV
					KERAYONG	1	49	P	IV
					KEROH	1	42	P	IV
					KLANG	10	53	P	III
					KUYOH	1	53	P	III
					PENCALA	1	30	P	V
JOHOR	27A	AIR BALOI	3	47 (51)	AIR BALOI	3	47	P	IV
	28	SEGGET	6	46 (44)	SEGGET	5	53	P	III
	28A	PONTIAN BESAR	5	59 (60)	AIR HITAM	1	57	P	III
					AYER MERAH	1	36	P	IV
					PONTIAN BESAR	3	68	SP	III
	28E	KEMPAS	2	45 (46)	KEMPAS	2	46	P	IV
	28F	DANGA	2	52 (51)	DANGA	2	53	P	III
	28G	RAMBAH	2	57 (58)	RAMBAH	2	57	P	III
	29B	KAW. PASIR GUDANG (TUKANG BATU)	5	45 (45)	BULUH	1	30	P	V
					LATOH	1	59	P	III
					MASAI	1	60	SP	III
					PEREMBI	1	48	P	IV
					TUKANG BATU	1	28	P	V
TERENGGANU	42L	LANDAS	2	58 (55)	LANDAS	2	58	P	III

NOTE: 1. WQI based on 6 major parameters:BOD, COD, SS, pH, DO, NH_3-N

2. River Water Quality Status: C: Clean, SP: Slightly Polluted, P: Polluted

3. River Classification based on INWQS

4. ( ) Overall WQI for 2001

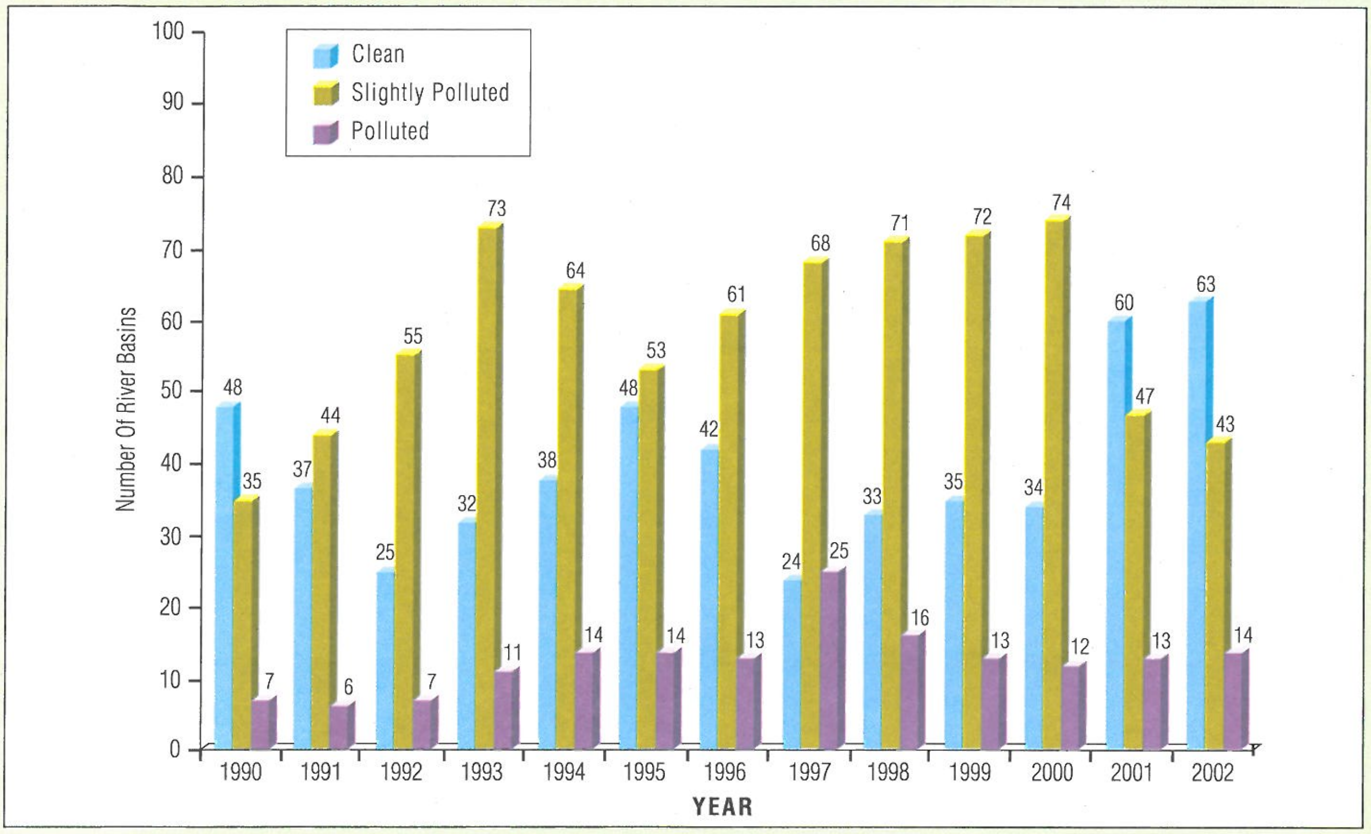


Figure 20 Malaysia : River Basins Water Quality Trend (1990-2002)

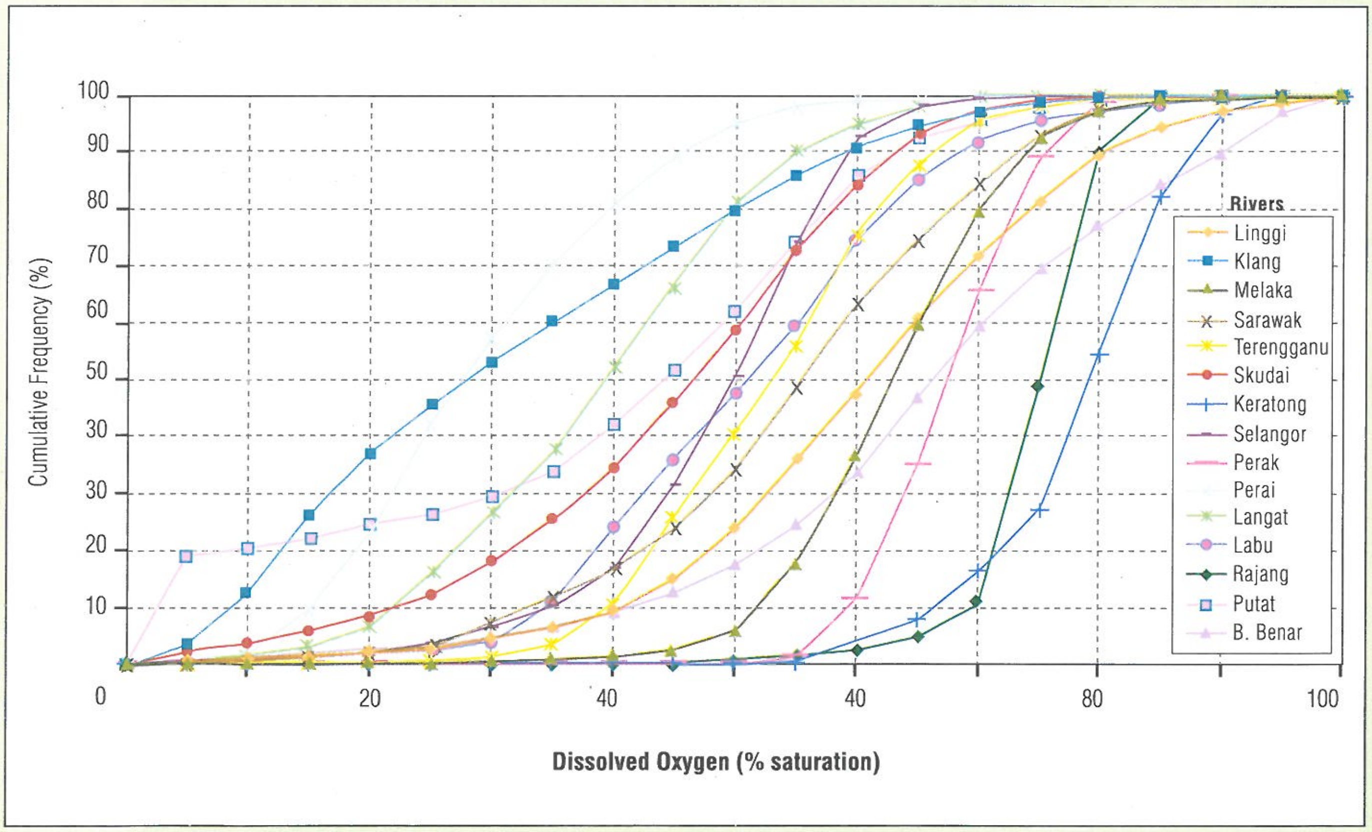


Figure 21. Malaysia: Dissolved Oxygen Cumulative Frequency : (January-December 2002)

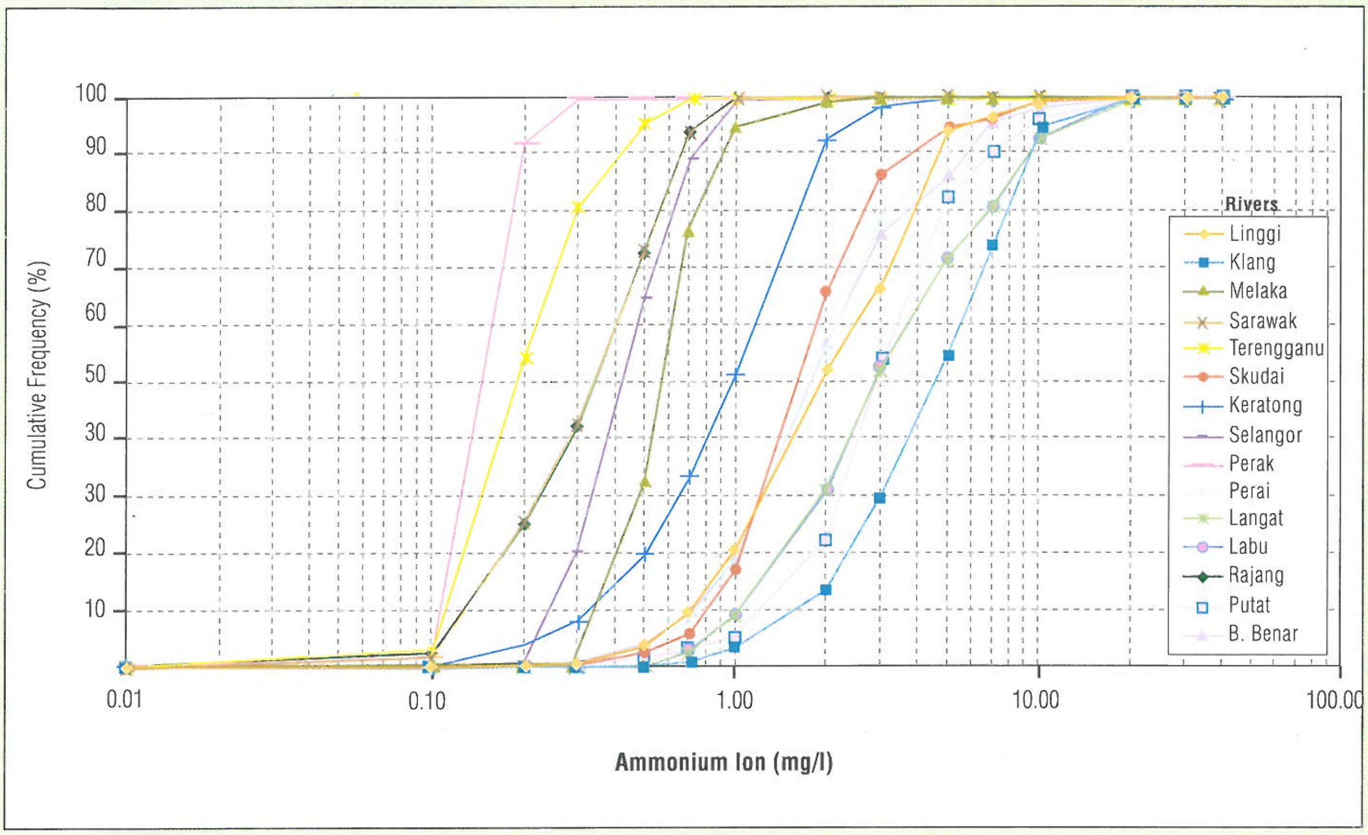


Figure 22. Malaysia : Ammonium Concentration Cumulative Frequency : (January - December 2002)

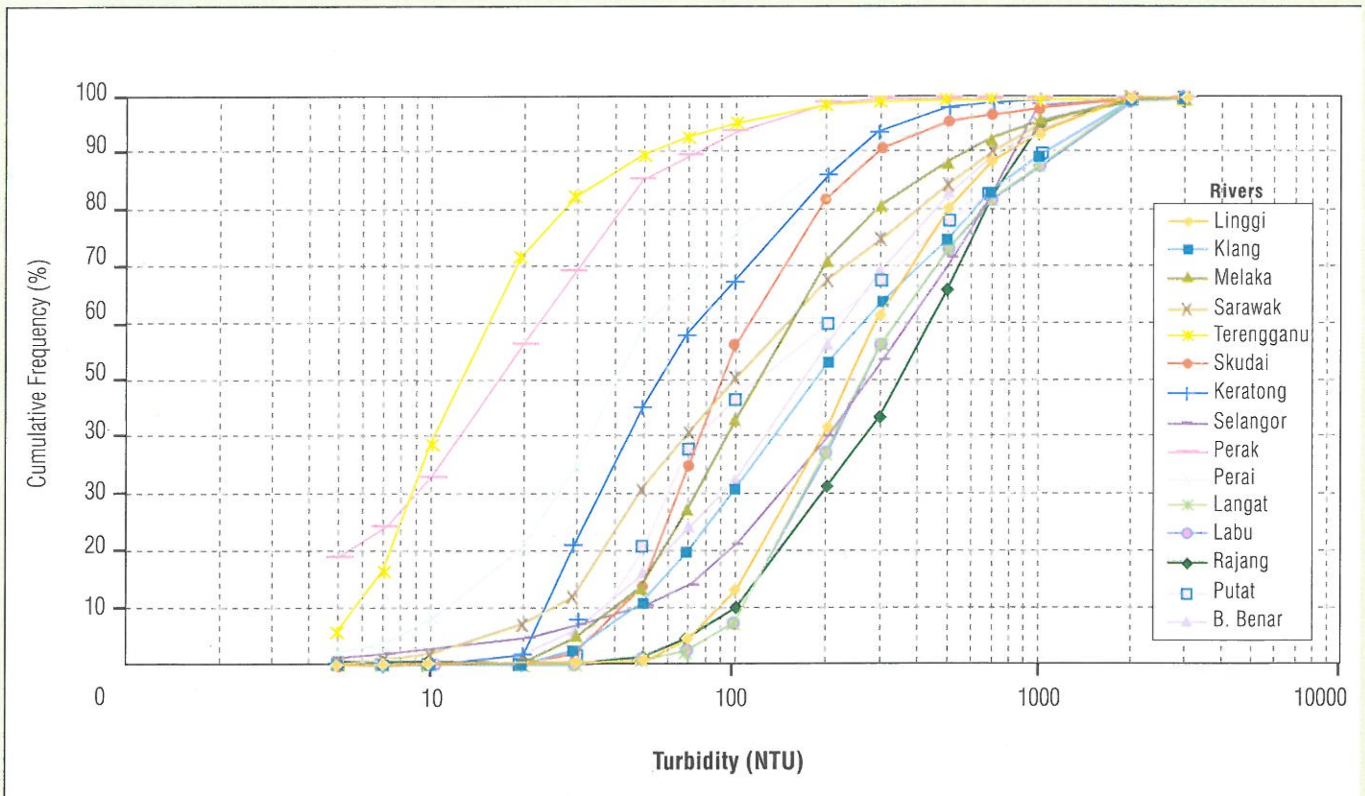


Figure 23. Malaysia:Turbidity Cumulative Frequency : (January - December 2002)

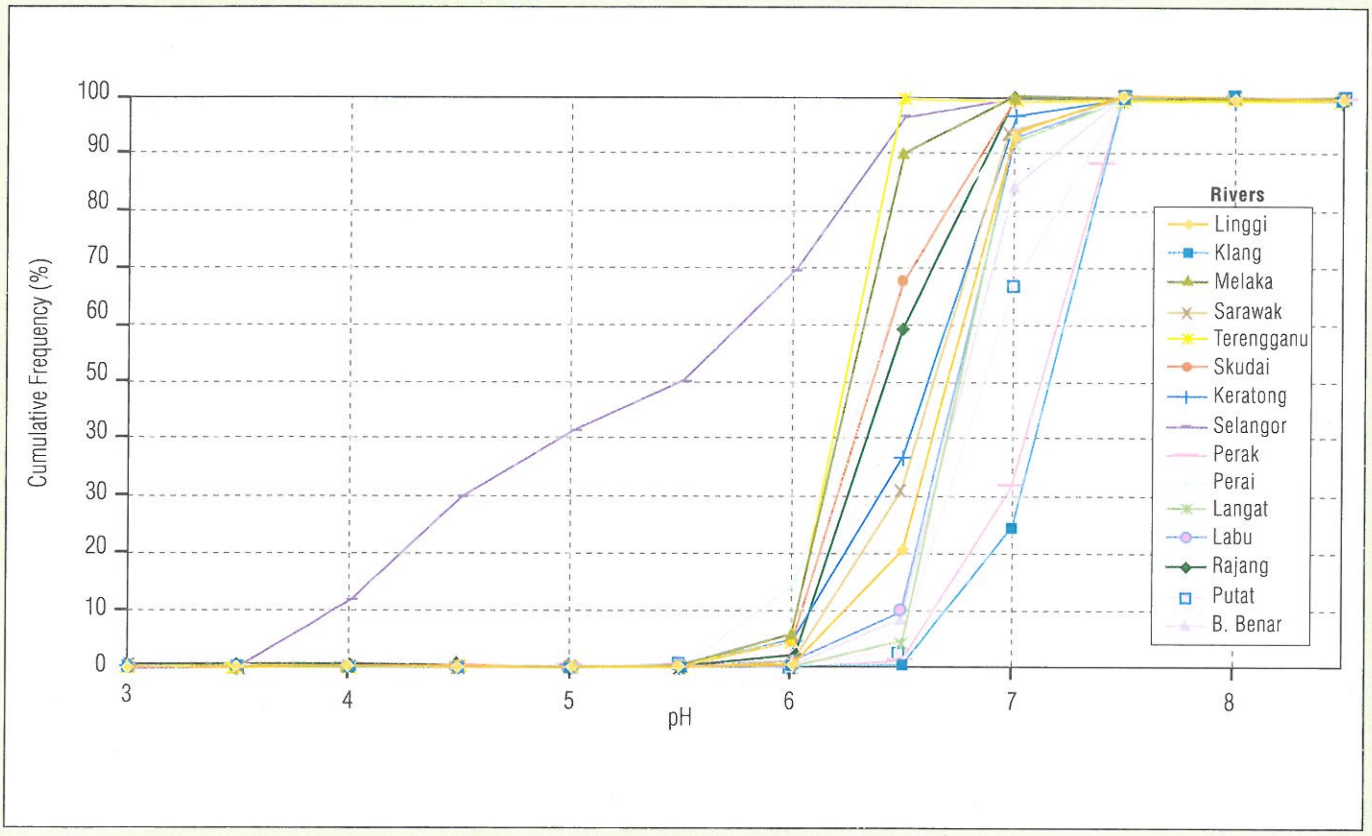


Figure 24. Malaysia: pH Cumulative Frequency : (January - December 2002)

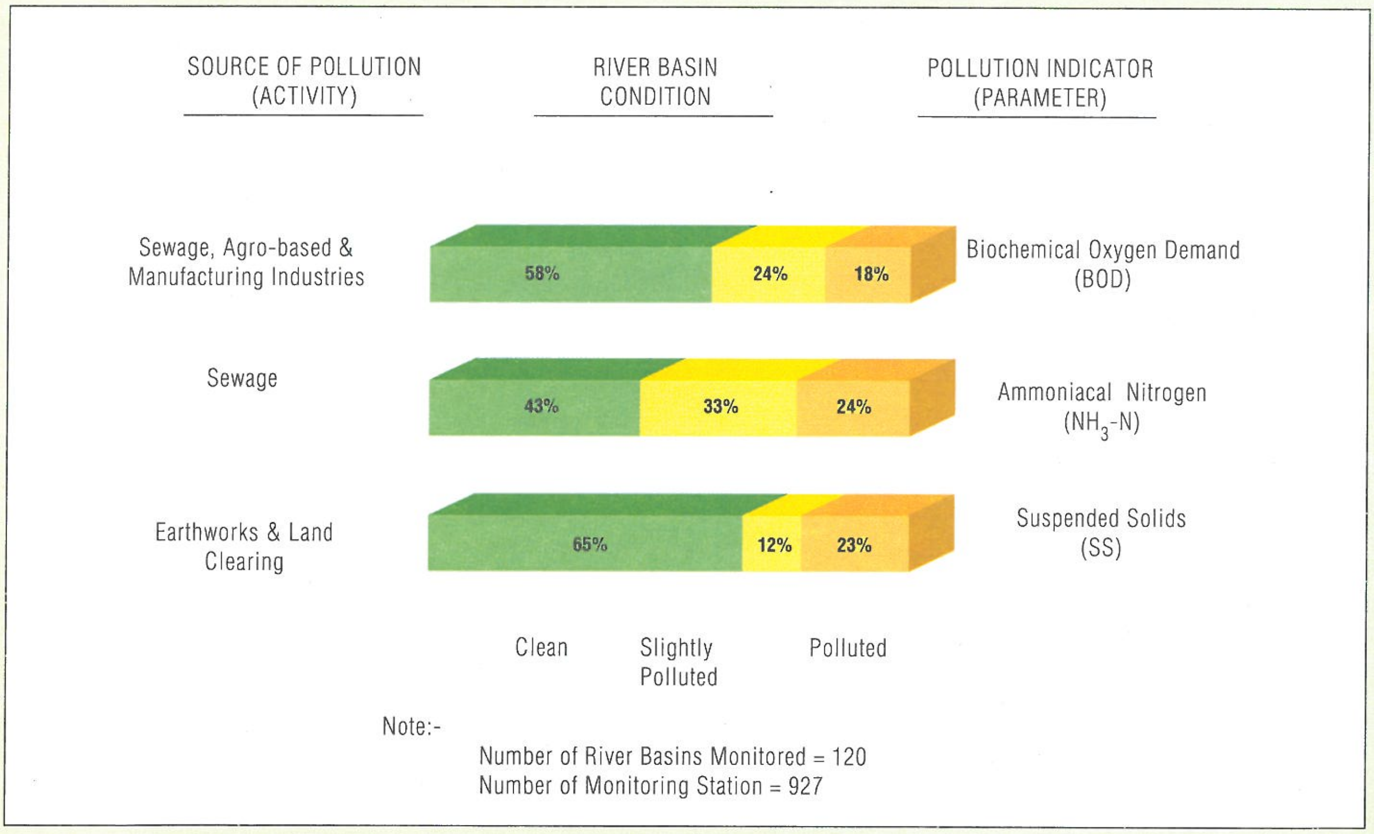


Figure 25. Malaysia : Status of River Basin Water Quality, 2002

chapter 4

GROUNDWATER QUALITY

GROUNDWATER QUALITY

Photo 10 : Groundwater Sampling in progress (DOE Photo Library)

GROUNDWATER QUALITY

The potential of groundwater as an alternative source of water is increasingly gaining importance. However its quality is influenced by soil conditions, human activity and geological formations.

Groundwater Quality Monitoring

The national groundwater monitoring programme was initiated by DOE in 1997. By 2002, 79 monitoring wells had been established at 48 sites in Peninsular Malaysia, 19 in Sarawak and 15 wells in Sabah (Table 4). The sites were selected and categorised according to the surrounding landuse such as agricultural, urban/suburban , rural, industrial , solid waste landfills, golf courses, radioactive landfills, animal burial areas and resorts as well as for monitoring water supply sites and leachate.

Groundwater Quality Status

In 2002, 177 water samples were taken from these monitoring wells compared to 217 the previous year. 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 was determined by comparing with the National Guidelines for Drinking Water Quality (1990) as the Reference Benchmark. (Table 5)

As in previous years, iron (Fe) levels exceeding the standard were recorded in all samples. Between 12.5% to 100% of the samples analysed showed high levels of iron . The sampling results also showed that between 12.5% to 100% of samples taken in all areas recorded manganese (Mn) levels exceeding the benchmark. Between 12.5% to 25% of samples were found to exceed the nitrate benchmark in all areas except in radioactive landfills and golf courses.

Arsenic levels exceeding the benchmark were recorded at radioactive landfills (100%) , solid waste landfills (50%), industrial areas (14.3%), rural areas (12.5%), and agricultural areas (7.1%). Other parameters exceeding the acceptable values are shown in Figure 26. As always, samples taken in industrial areas were found to have more parameters exceeding benchmark values. (Figure 26)

Table 4. Malaysia: Distribution of Groundwater Monitoring Wells, 2002

Category	Number of Wells
Agriculture	12
Urban/Suburban	12
Industrial	18
Solid Waste Landfill	27
Rural	5
Golf Course	7
Radioactive Landfill	1
Animal Burial	16
Resort	1
Municipal Water Supply	11
Leachate (Gold Mine)	3
Total	**113**

Table 5 Malaysia : National Guidelines for Drinking Water Quality, (1992)

PARAMETER		REFERENCE BENCHMARK
Sulphate	S04	400 mg/l
Hardness	CaC03	500 mg/l
Nitrate	N03	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	-	0.002 mg/l
Total Dissolved Solids	-	1500 mg/l
Iron	Fe	1 mg/l
Copper	Cu	1 mg/l
Lead (Plumbum)	Pb	0.1 mg/l
Cadmium	Cd	0.005 mg/l
Mercury	Hg	0.001 mg/l

Photo 11 : Urban/Suburban Groundwater Monitoring Station (DOE Photo Library)

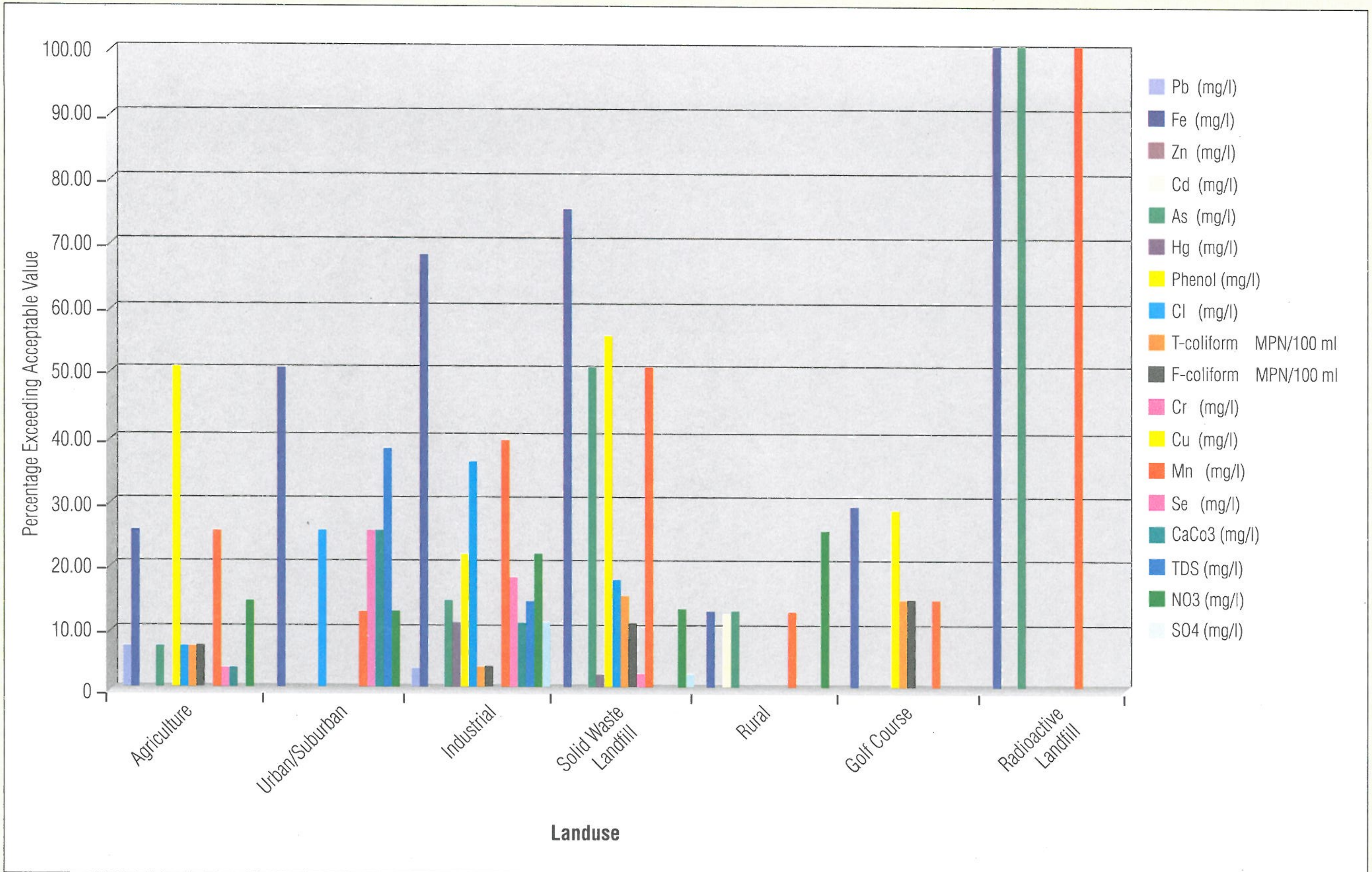
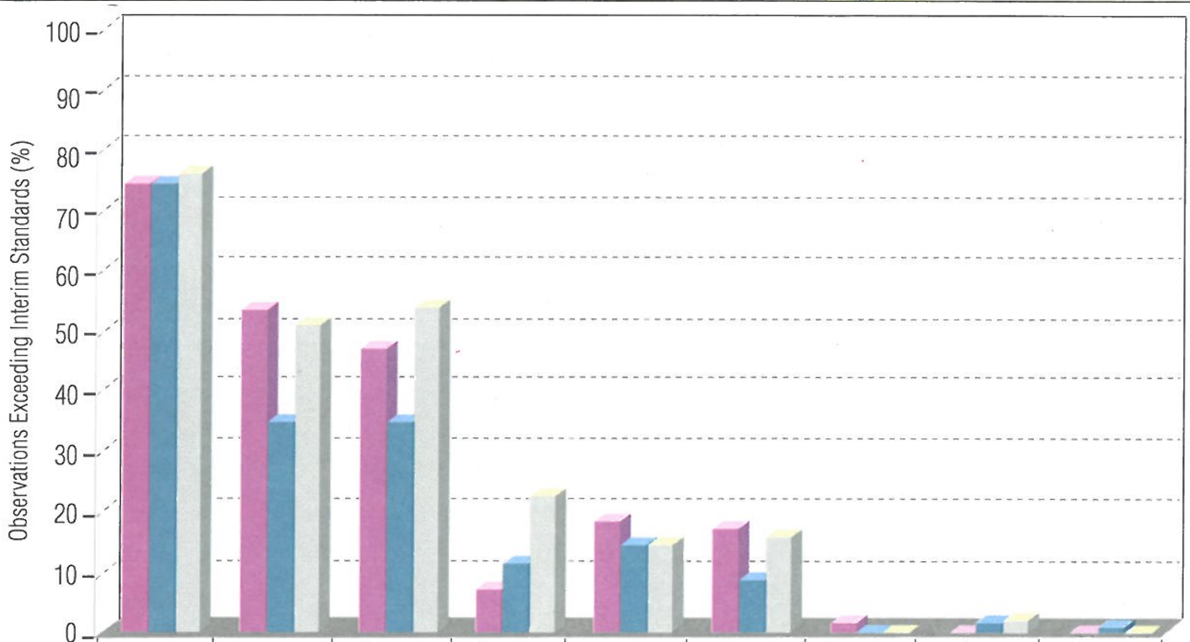


Figure 26 Peninsular : Percentage of Non Compliance of Selected Contaminants by Landuse, 2002

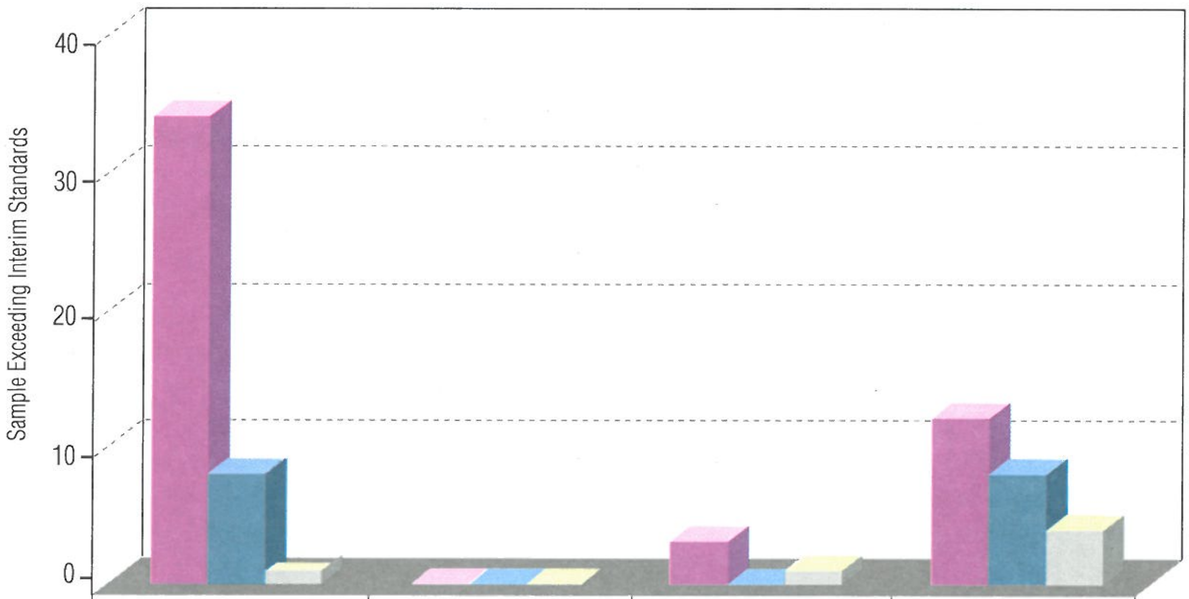
chapter 5

MARINE ENVIRONMENTAL QUALITY



Year	Total Suspended Solids	Oil & Grease	E- Coli	Cuprum	Lead	Mercury	Chromium	Cadmium	Arsenic
2000	74.3	53.3	46.9	7.1	18.3	17.3	1.8	0.0	0.1
2001	74.3	34.7	34.7	11.1	14.6	8.7	0.1	1.7	1.0
2002	75.7	50.5	53.3	22.4	14.5	15.8	0	1.9	0.1

Figure 27 Malaysia : Marine Water Quality, 2000-2002



	Development	Resort	Marine Park	Protected
E-Coli	3.4	0.0	0.3	1.2
TSS	0.8	0.0	0.0	0.8
O&G	0.1	0.0	0.1	0.4

Figure 28 Malaysia : Status of Island Marine Water Quality, 2002

Table 8 Malaysia: Main Contaminants of Coastal Waters and Possible Sources, 2002

NO.	STATUS	POSSIBLE SOURCE
1.	Suspended Solids were highest in coastal waters off Kedah, Perak, Negeri Sembilan, Melaka, Pulau Langkawi and Wilayah Pesekutuan Labuan.	* sand dredging * illegal logging
2.	Oil and Grease detected in the coastal waters off Perak, Kelantan, Selangor and Sarawak	* discharges from vessels * illegal disposal of oil from motorized boats
3.	High E. Coli levels were observed in the coastal waters off Pulau Pinang,Sarawak, Negeri Sembilan dan Selangor.	* untreated/partially treated dosmetic sewage and animal wastes * untreated/partially treated industrial effluents
4.	Heavy Metals: lead (Pb) Higher in Perak (69%) and Terengganu (65%); copper highest in Kedah and Langkawi (11%); mercury highest in Perlis and Kedah (50%) (% exceeding Interim Standards)	* other land-based sources

Table 9 Malaysia : Main Contaminants off Islands and Possible Sources, 2002

NO.	STATUS	POSSIBLE SOURCES
1.	High level of oil and grease recorded off Development Islands, followed by Resort Islands and Marine Park Islands	* boating activities for tourism and fisheries
2.	High E. Coli levels observed off Pulau Pinang and Development Islands	* untreated/partially treated domestic sewage and animal wastes * boating activities
3.	High total suspended solids detected off Development Islands at Gertak Sanggol (Pulau Pinang)	* development activities such as for tourism purposes * construction activities without adequate control

Table 10 Malaysia : Island Tarball Monitoring, 2002

Island Category	No. of Islands	No. of Beaches Monitored	No. of Beaches Polluted
Protected	5	3	0
Development	3	5	1
Resort	25	22	0
Marine Park	38	17	1
TOTAL	**71**	**47**	**2**

Photo 14 : Beach Tar Pollution (DOE Photo Library)

chapter 6

POLLUTION SOURCES INVENTORY

POLLUTION SOURCES INVENTORY

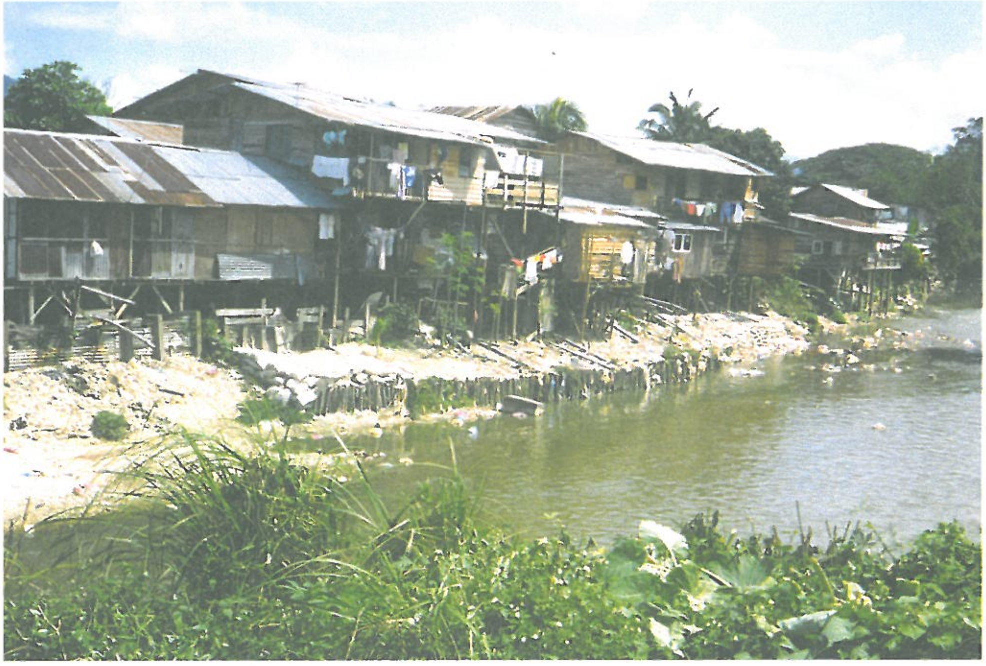


Photo 15 : A Polluted River running through Squatter Area (DOE Photo Library)

WATER POLLUTION SOURCES

The estimated number of water pollution sources for 2002 was 13,540 comprising mainly of sewage treatment plants, agro-based industries, manufacturing industries and animal farms (Figure 29). About 53% of the total number of sources were domestic sewage facilities (7,126 sources), followed by manufacturing industries (5,137, 38%), pig farms (807, 6%) and agro-based industries (470, 3%).

Figures 30 and 31 represent the distribution of agro-based and manufacturing compiled by DOE in 2002 based on field surveys and returned questionaires. A total of 5,607 sources were identified which were categorized into 16 types. The food and beverage sector with 1,451 sources constituted 25.9% of the total number, followed by chemical-based industries (813, 14.5%), paper products industries (547, 9.8%), rubber-based industries (435, 7.8%), crude palm oil mills (364, 6.5%) and raw natural rubber factories (106, 1.9%).

Of the total number of effluent sources identified, Johor had the highest number (1,675, 29.9%), followed by Selangor (1,485, 26.5%) and Perak (573, 10.2%) and Perlis had the least number (14, 0.25%).

The total standing pig population (SPP) in 2002 reduced to 1.5 million compared to 1.6 million in 2001. Correspondingly, the number of farms reduced 11.2% from 909 in 2001 to 807 in 2002. The existing pig farms were concentrated mainly in 3 States, namely Pulau Pinang (231,28.6%), Perak (158, 19.6%) and Selangor (135, 16.7%).

The number of sewage treatment plants identified in 2002 had increased to 7,126 from 6,693 in 2001. Selangor had the highest number of sewage treatment plants (1,978, 27.8%), followed by Perak (1082, 15.2%), Negeri Sembilan (791, 11.1%) and Johor (706, 9.9%) (Figure 32).

BOD Pollution Load

Domestic sewage discharges remained the largest contributor of organic pollution load with an estimated biochemical oxygen demand (BOD) load of 1,144 tonnes per day in the form of treated and untreated sewage. Out of the total BOD load from sewage, 612 tonnes/day (53.5%) were contributed by IWK sewage treatment plants. The estimated BOD loadings for other major sectors were manufacturing (21.9% tonnes/day), agro-based industries (21.5 tonnes/day) and pig farms (17.2 tonnes/day). Figure 33 shows the estimated BOD load of major pollution sources for 1998-2002. Palm oil mills accounted for 19.6 tonnes/day, food and beverage (14.8 tonnes/day), rubber-based industries (3.9 tonnes/day), chemical-based (3 tonnes/day) and paper products (2.1 tonnes/day). (Figure 34)

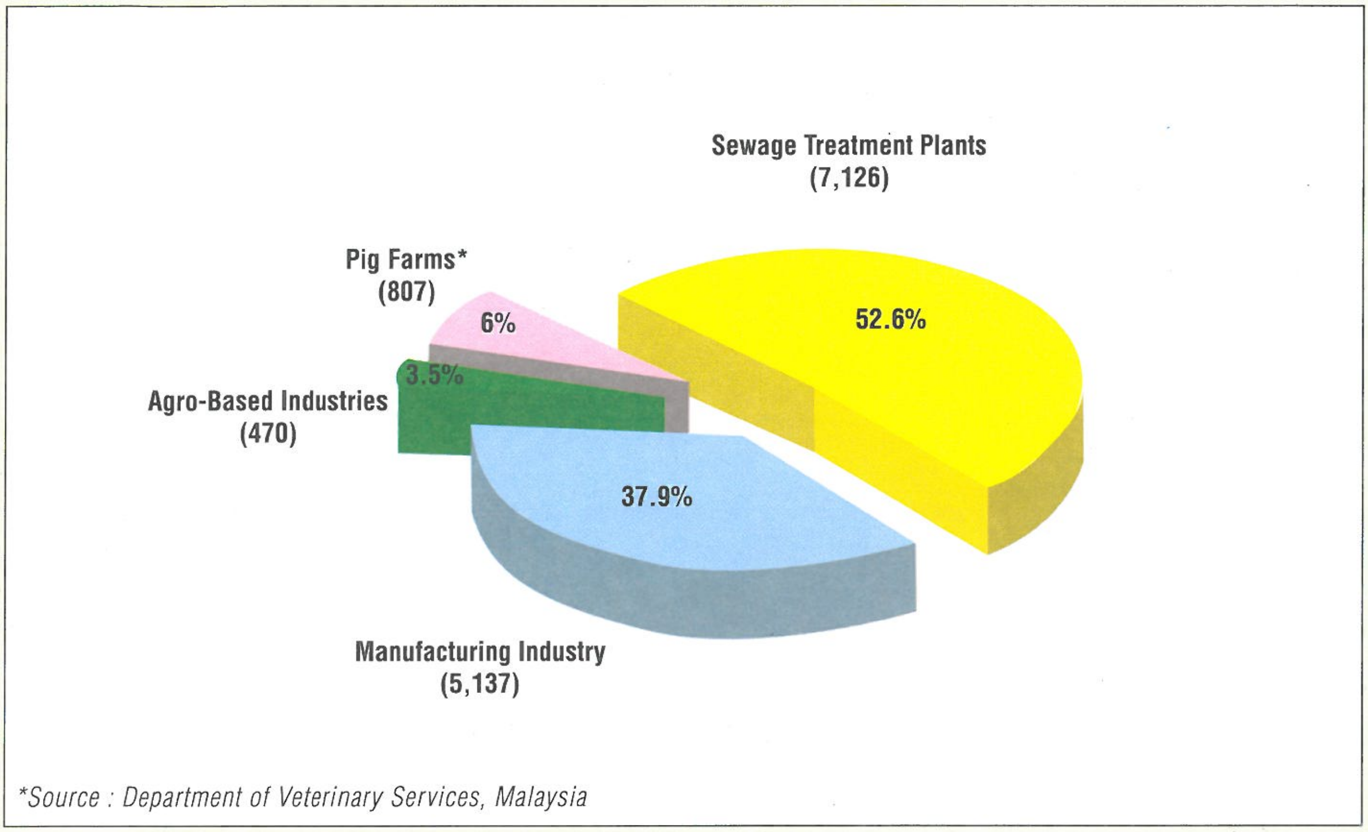


Figure 29 Malaysia : Water Pollution Sources by Sector, 2002

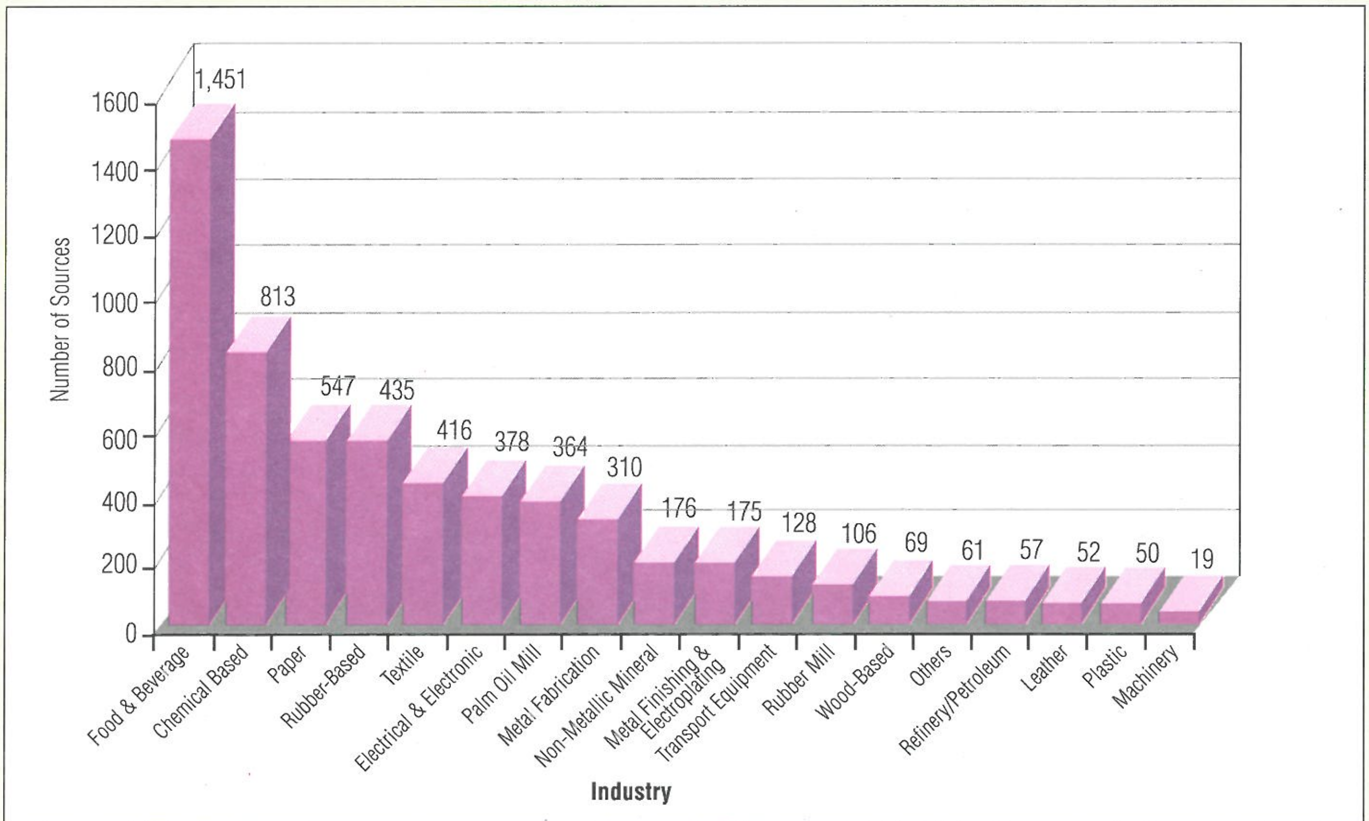


Figure 30 Malaysia: Industrial Water Pollution Sources (Agro-based and Manufacturing Industries), 2002

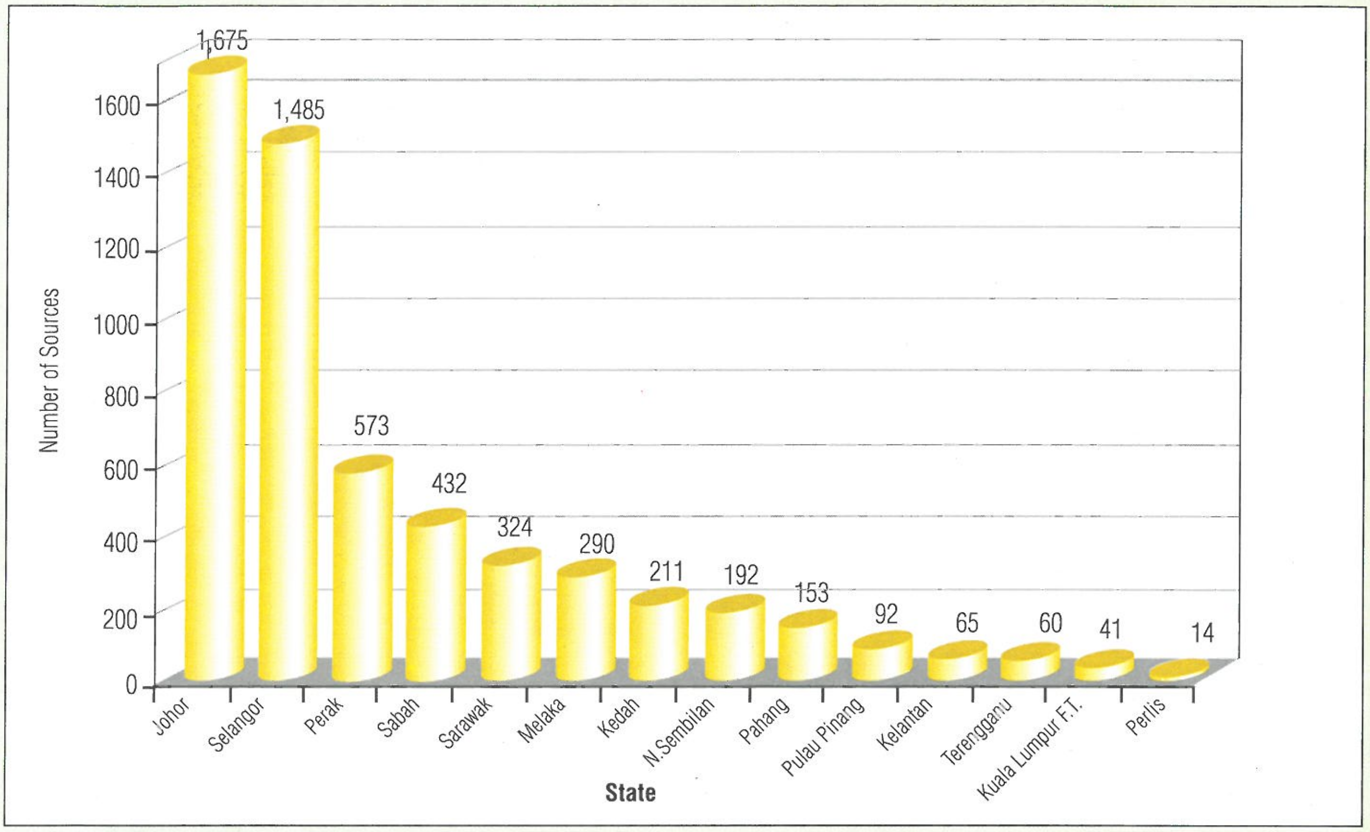


Figure 31 Malaysia : Distribution of Industrial Water Pollution Sources (Agro-based and Manufacturing Industries) By State, 2002

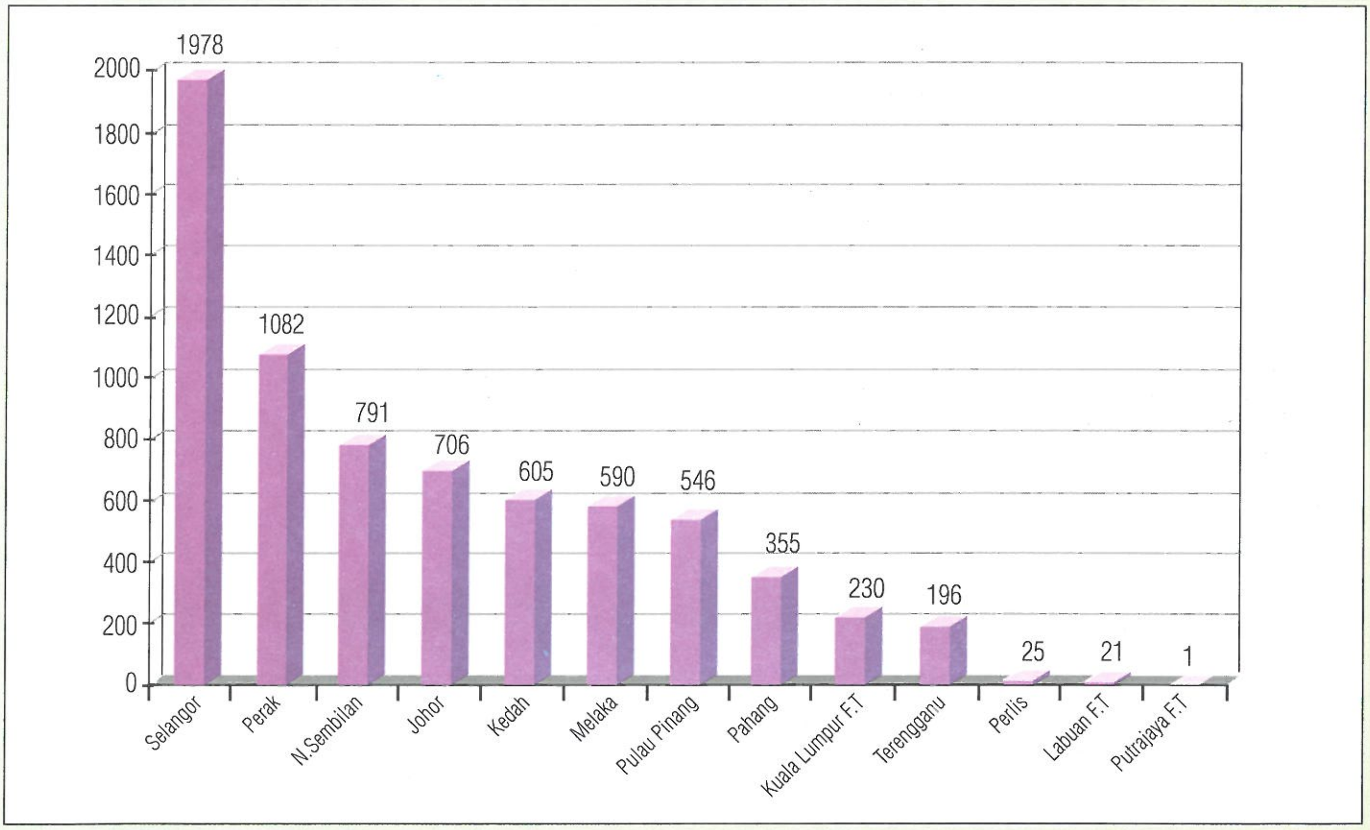


Figure 32 Malaysia : Distribution of Sewage Treatment Plants by State, 2002
(Source : Indah Water Konsortium (IWK) Sdn. Bhd)

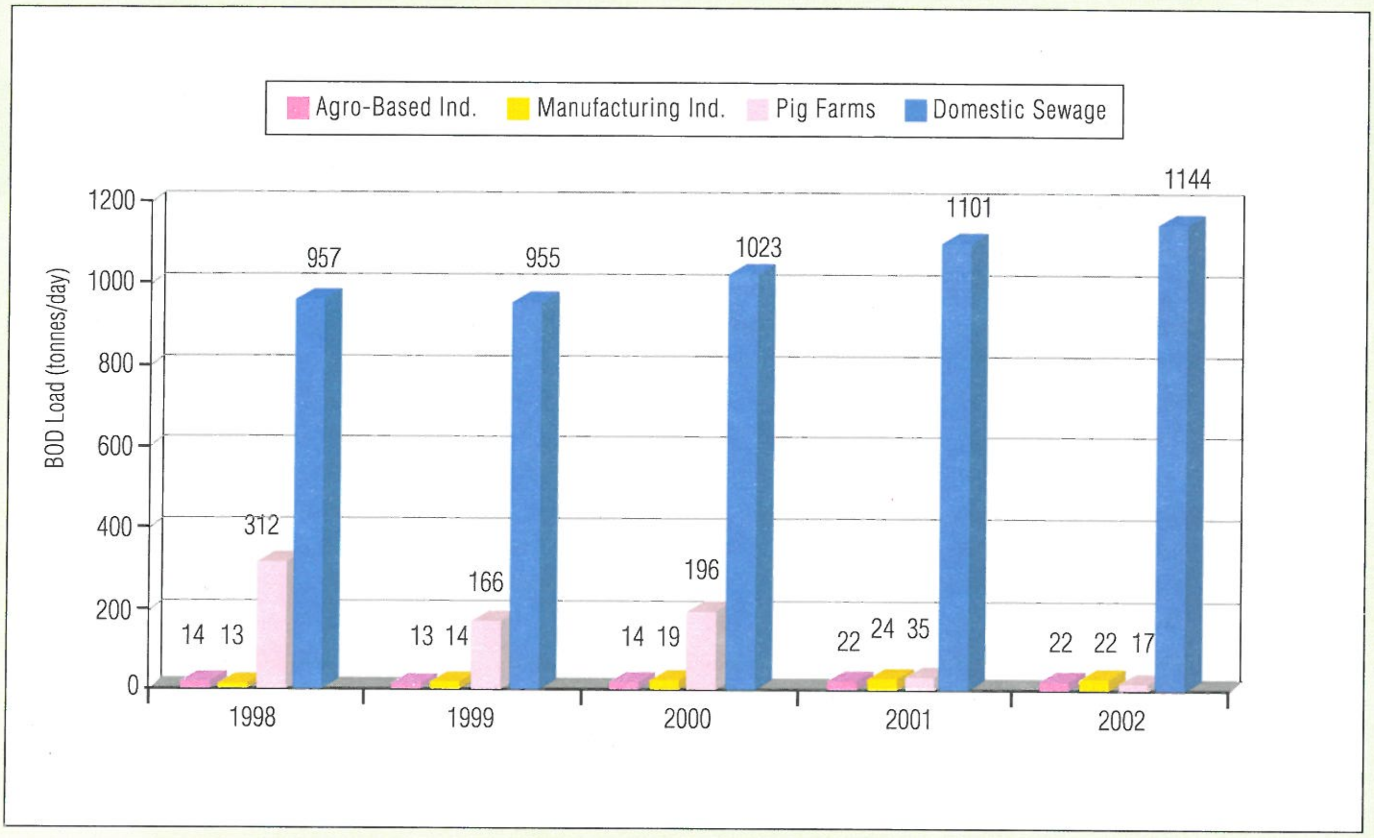


Figure 33 Malaysia : Estimated BOD Load by Major Sector, 1998 - 2002

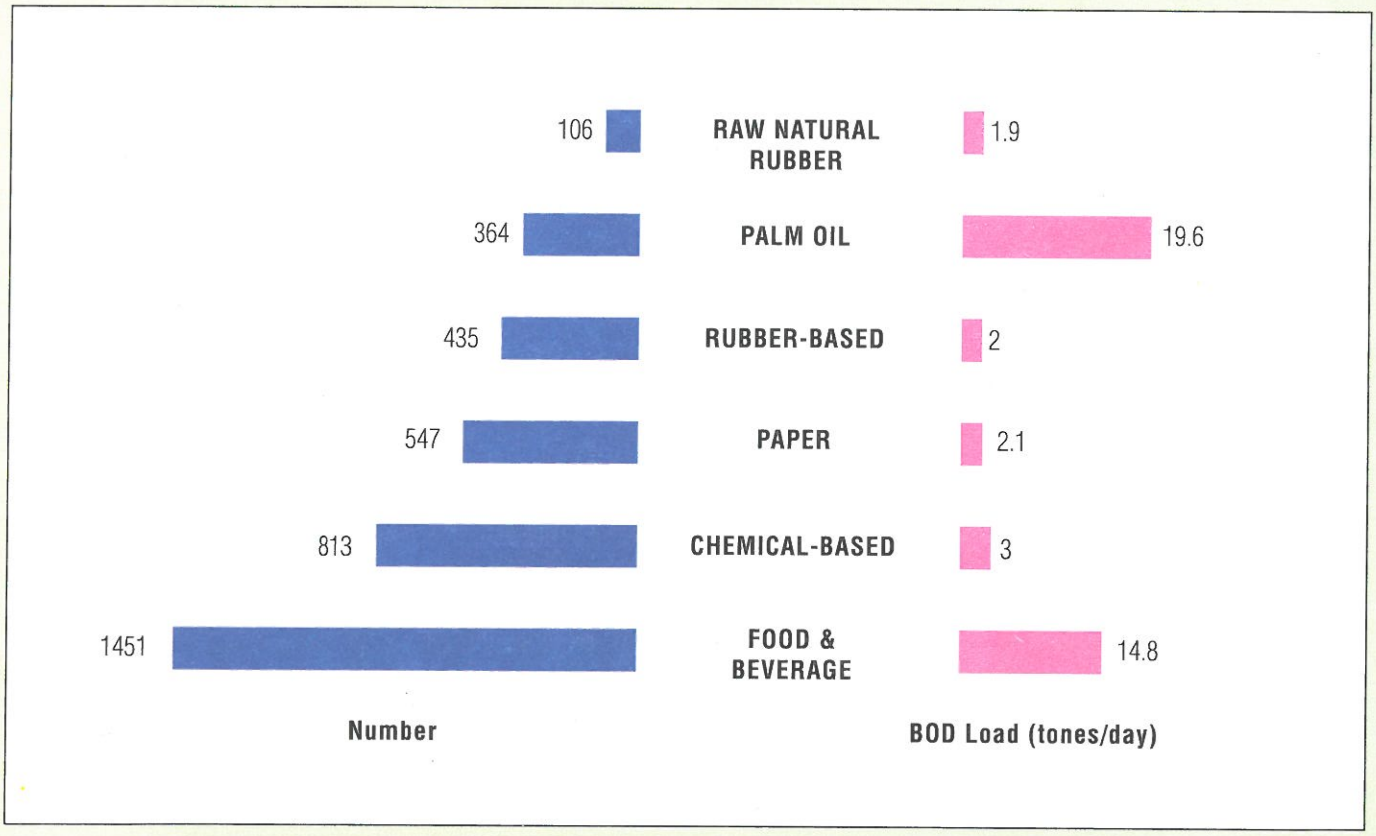


Figure 34 Malaysia : Estimated Organic Pollution Load (BOD) by Types of Industry, 2002

Air Pollution Sources

As in previous years, emissions from mobile and stationary sources as well as open burning activities remained the most significant sources of air pollution. Emissions from a vehicular population of 12,021,939 (a 6.4% increase over that of 2001) were the principal contributors of air pollution (Figure 35). 2,551,552 (21.2%) vehicles were registered in the Federal Territories of Kuala Lumpur and Labuan, followed by Johor (1,670,360) (13.9%) and Selangor (1,465,403) (12.2%), while Perlis had the least number of registered vehicles (46,906) (0.4%).

The total number of stationary air pollution sources identified in 2002 increased to 14,414 a 1.9% increment compared to 2001 (14,137) (Figure 36). Selangor reported the highest number of stationary sources (2,599,18%), followed by Sarawak (2,011, 14%).

Air Pollution Load

The estimated combined air emission load for 2002 was about 2,959,132 mt of carbon monoxide; 158,894 mt of hydrocarbons; 241,405 mt of oxides of nitrogen; 219,766 mt of sulphur dioxide and 77,414 mt of particulate matter. Emissions from mobile sources contributed 80.4% of the total load, followed by emissions from stationary sources, such as industrial fuel consumption (9%); industrial processes (1.2%); power stations (8.8%); domestic fuel (0.2 %) and open burning at solid waste dumping sites (0.4%)(Figure 37). 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 2002.

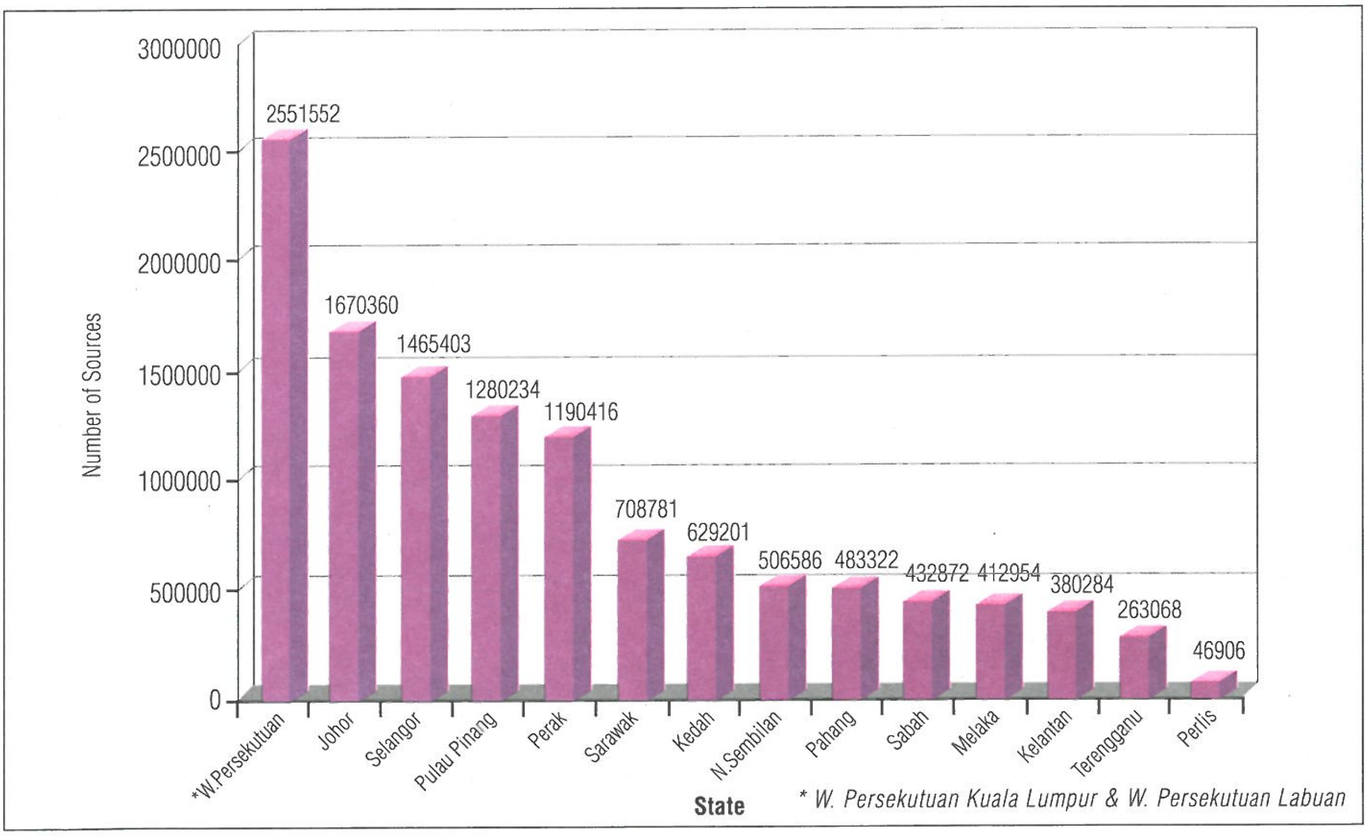


Figure 35 Malaysia : Number of Mobile Sources by State, 2002
(Sources : Road Transport Department, Malaysia)

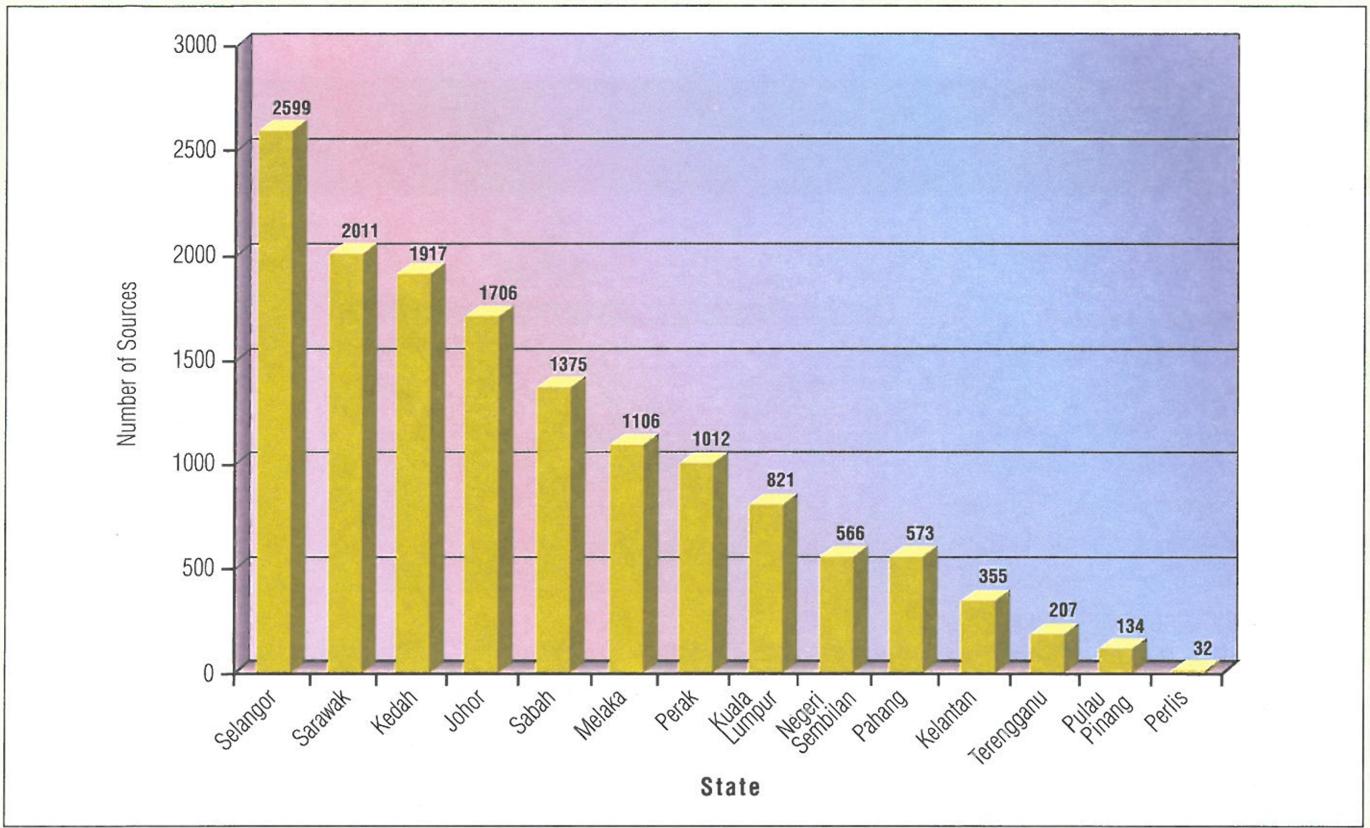


Figure 36 Malaysia : Distribution of Industrial Air Pollution Sources by State, 2002

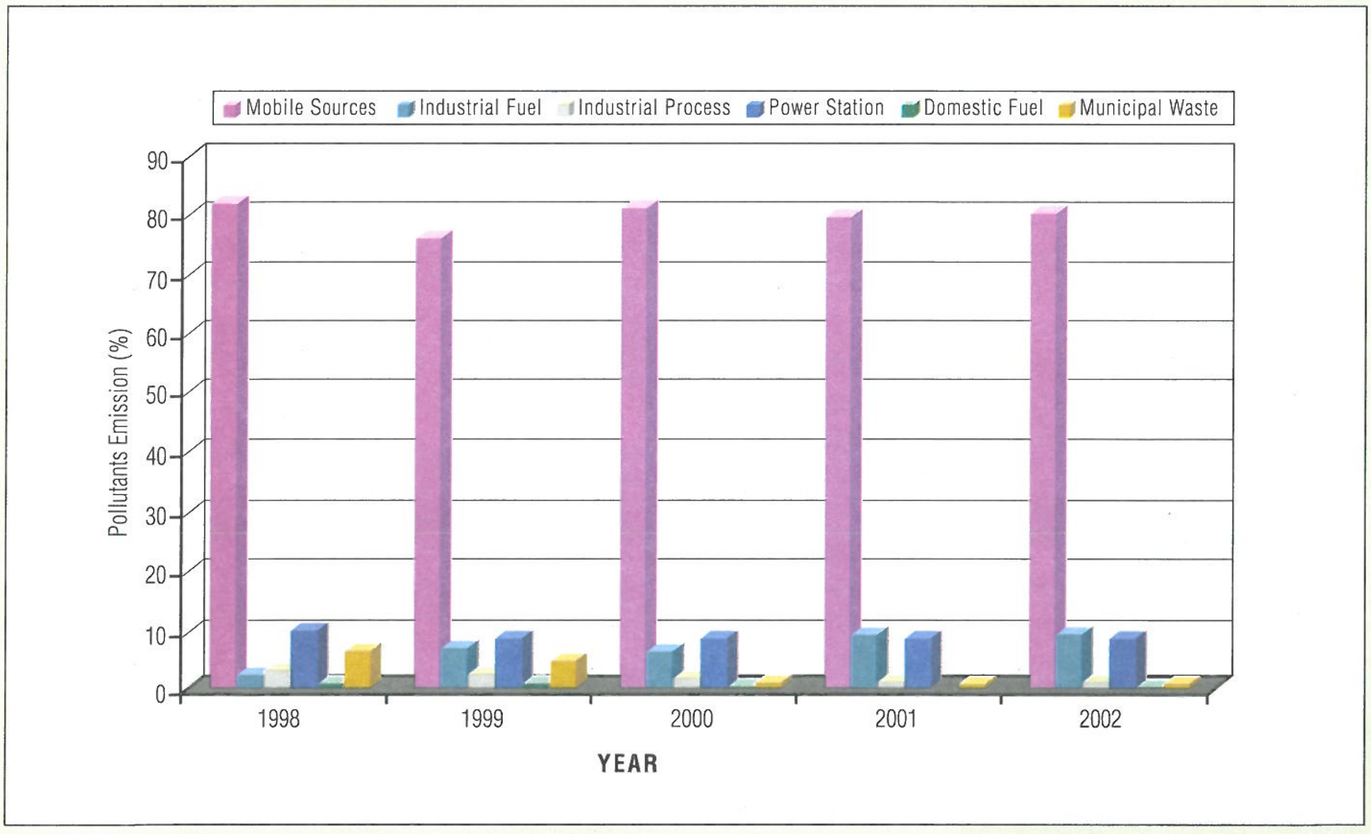


Figure 37 Malaysia : Air Pollutant Emissions by Sources, 1998-2002

Scheduled Waste Inventory

A total of 363,017 tonnes of scheduled wastes were generated by 4,079 waste generators based on notifications received by DOE in 2002. Dross/slag/clinker, mineral sludge and heavy metal sludge made up the main categories of wastes produced in the country. The total amount of wastes handled in 2002 (including 53,037 tonnes on-site stored wastes since 2001) was 416,054 tonnes (Table 11). The breakdown according to waste categories and industry types is given in Figures 38 and 39 respectively.

Of the total wastes accumulated, 85,797 tonnes (20.62 %) were treated and disposed at the Kualiti Alam Treatment Disposal Facility; 17,779 tonnes (4.27%) of clinical wastes were incinerated at licenced off-site facilities; 3,110 tonnes (0.75%) were exported for recovery purposes; 204,666 tonnes (49.19.%) of scheduled wastes were recovered at off-site local facilities and an estimated 104,702 tonnes (25.17%) were treated and stored on-site at waste generators' premises (Table 11). Six land farms and 35 on-site waste incinerators were licenced by DOE to allow for on-site treatment and incineration respectively. The on-site facilities handled an estimated 15,458 tonnes (3.72%) of the total wastes produced in the country.

Photo 16 : Scheduled Waste Treatment Plant (DOE Photo Library)

Table 11: Handling of Scheduled Wastes, 2002

Facility	Tonnes	Percentage (%)
Kualiti Alam Facility	85,797	20.62
Export to foreign recovery facilities	3,110	0.75
Delivered to local off-site recovery facilities	204,666	49.19
Off-site clinical waste incinerators	17,779	4.27
On-site treatment	15,458	3.72
On-site storage	36,037	21.45
On-site storage (accumulated from 2001)	(53,037)	
Total	**416,054**	**100**

The Basel Convention on Control of Transboundry Movement of Hazardous Wastes and Their Disposal

In 2002, 8 Written Approvals were issued for the import of 70,763 tonnes of wastes for use as raw materials. The wastes comprised of spent fluid cracking catalyst (6,878 tonnes, 9.7%), granulated blast furnace slag (29,940 tonnes, 42.3%) and copper slag (33,945 tonnes, 48.0%). Figure 40 illustrates the quantity of wastes imported over the past five years (1998-2002).

The catalysts and furnace slag were used as raw materials in cement manufacturing plants and the copper slag was used in sand blasting operations.

A total of 3,110 tonnes of scheduled wastes were exported. The exported wastes were derived from 43 waste generators and comprised of cadmium nickel oxide sludges (67 tonnes, 2.2%); copper oxide sludges (142 tonnes, 4.6%); spent industrial catalysts (1365 tonnes, 43.9%) and other metal hydroxide sludges (1537 tonnes, 49.4%). The wastes were exported for treatment and recovery in other countries as shown in Table 12. The quantity and type of wastes exported between 1998 and 2002 is shown in Figure 41.

Table 12 Malaysia: Quantity of Scheduled Wastes Exported (Tonnes), 1998- 2002

Country	1998	1999	2000	2001	2002
Australia	638.00	280.00	69.00	-	315.00
Germany	-	80.00	470.00	159.00	128.00
Holland	1500.00	1266.00	1234.00	487.00	569.58
Italy	-	-	-	107.00	44.10
Japan	740.00	1103.00	1530.00	68.00	1,034.96
Finland	-	-	-	-	100.00
France	150.00	80.00	108.00	-	66.61
Philippines	-	1073.00	-	532.00	
Singapore	-	27.00	500.00	-	170.00
South Africa	-	45.00	-	-	
South Korea	-	23.00	-	-	
Sweden	60.00	102.00	203.00	27.00	149.00
Switzerland	-	-	10.00	-	
USA	610.00	1107.00	753.00	1295.00	532.90
Total	**3698.00**	**5186.00**	**4878.00**	**2675.00**	**3,110.15**

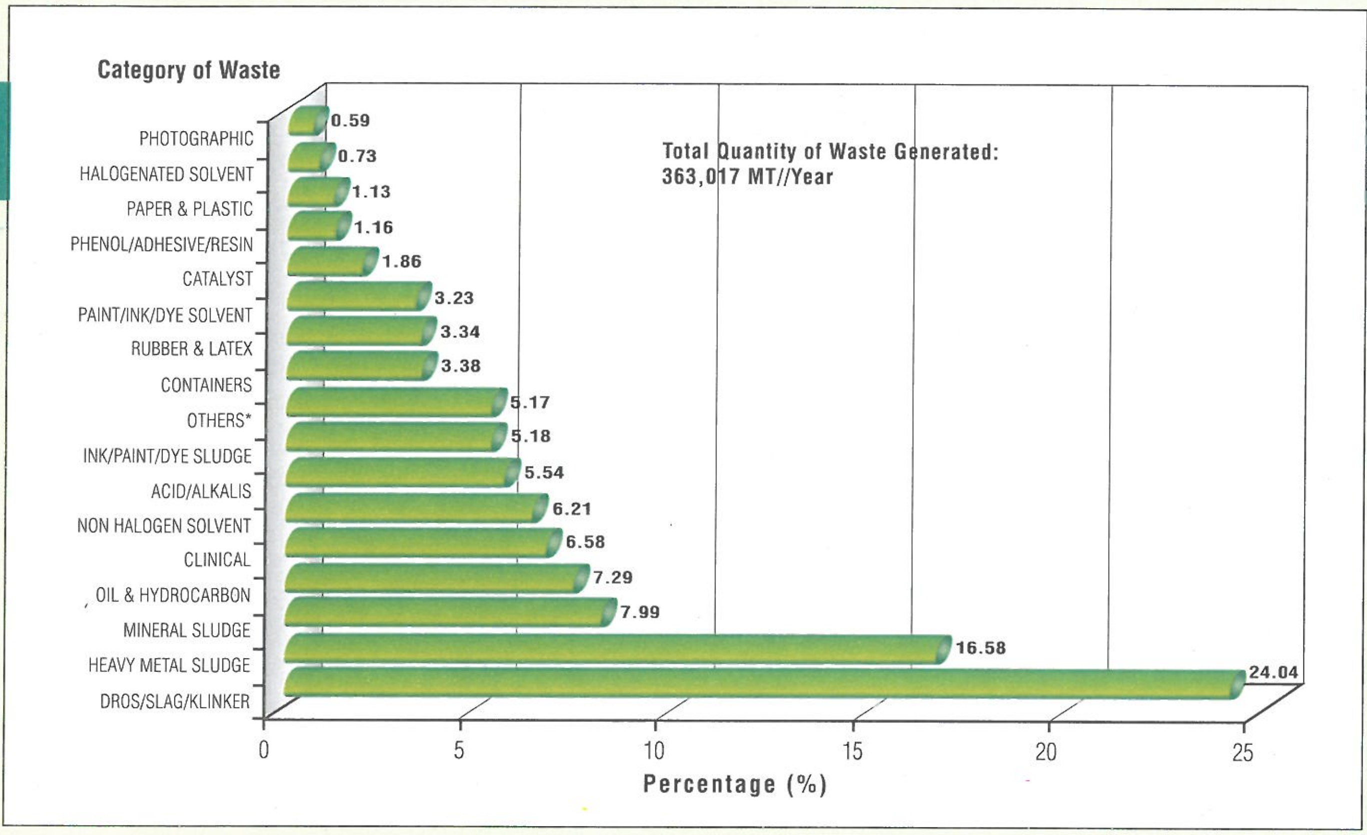


Figure 38 Malaysia : Quantity of Scheduled Wastes Generated by Waste Category, 2002

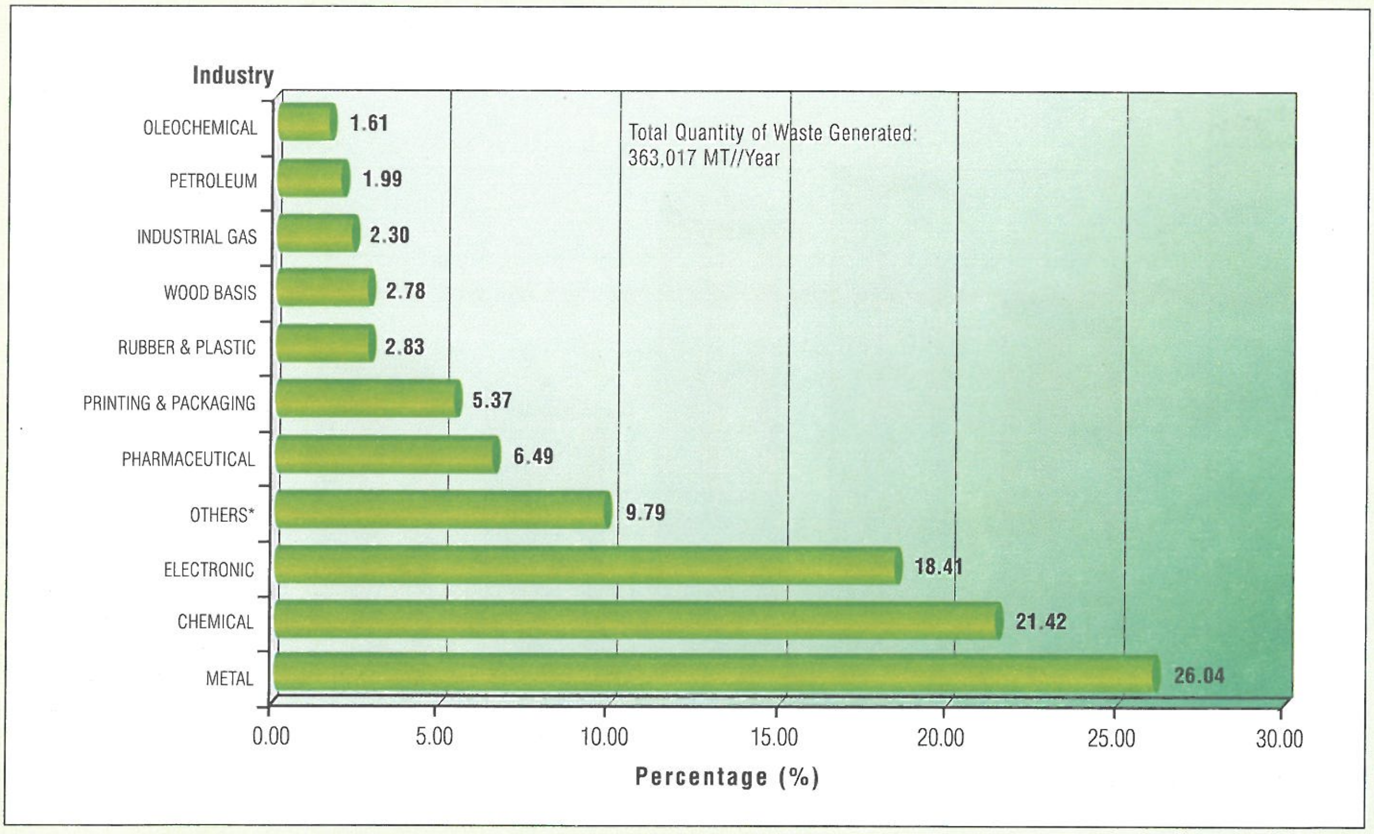


Figure 39 Malaysia : Quantity of Scheduled Wastes Generated by Industries, 2002

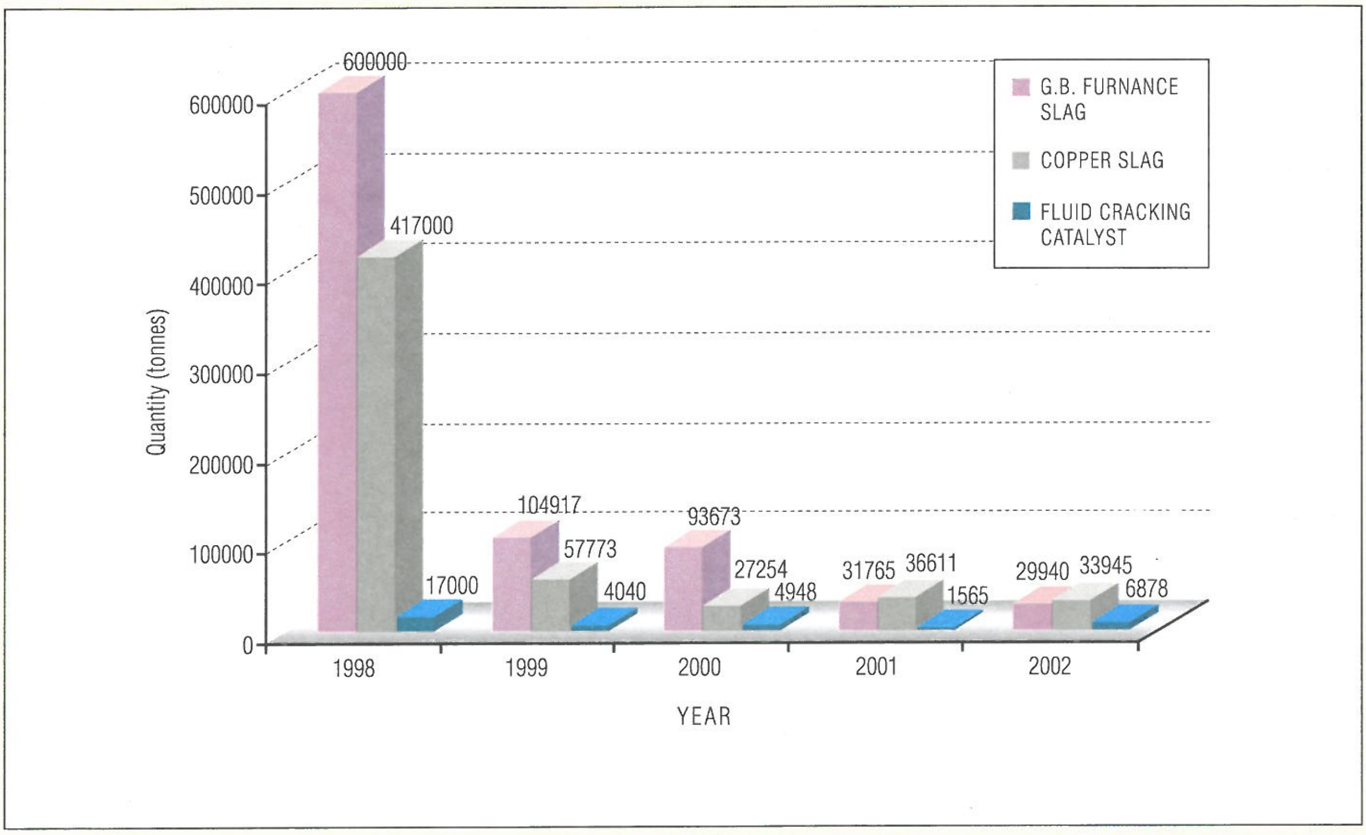


Figure 40 Malaysia : Quantity and Type of Wastes Imported (tonnes), 1998-2002

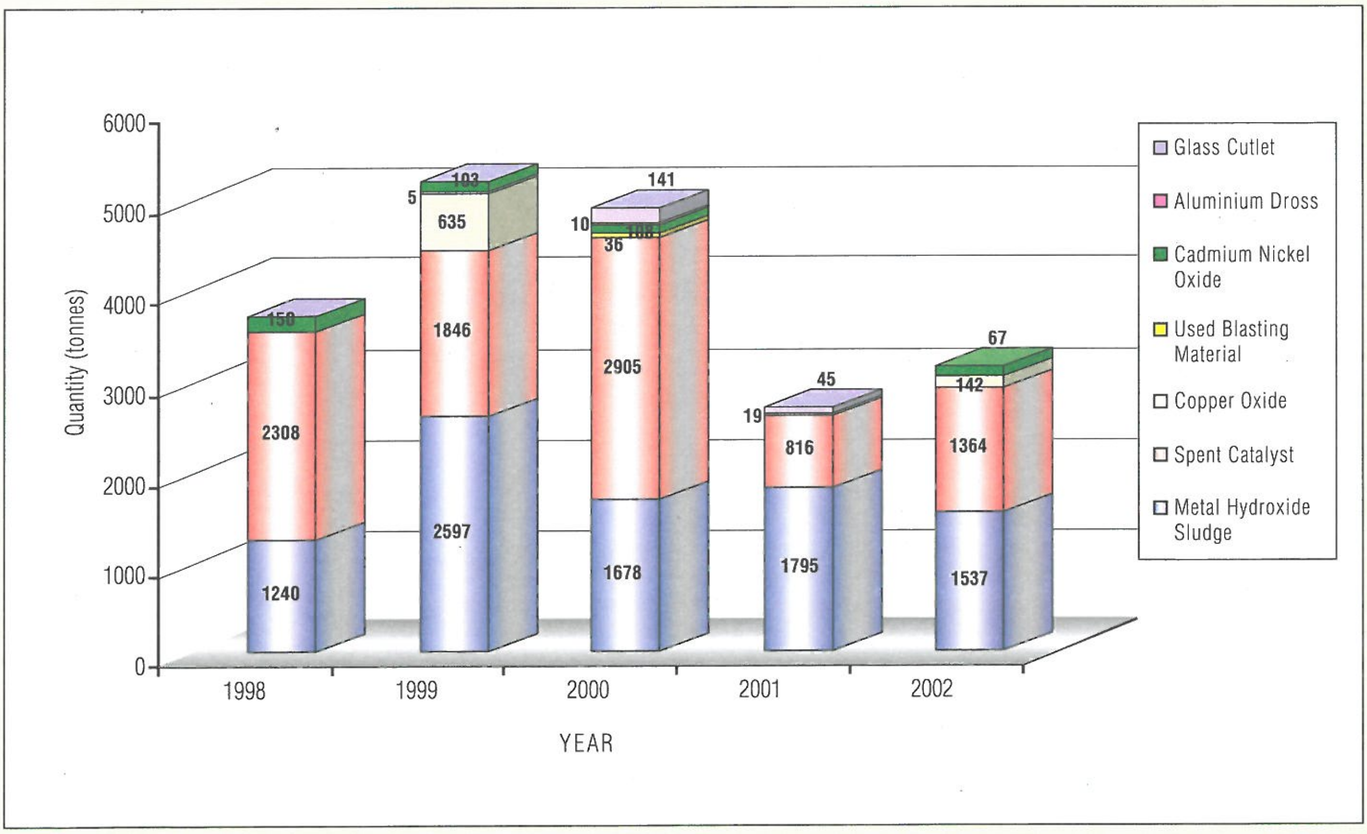


Figure 41 Malaysia : Quantity and Type of Wastes Exported (tonnes), 1998-2002

INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETERS	UNIT	CLASS				
		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	N	-	-	-	L
Mg	mg/l	A	-	-	-	E
Na	mg/l	T	-	-	3 SAR	V
K	mg/l	U	-	-	-	E
Fe	mg/l	R	1	1	1 (Leaf) 5(Others)	L
Pb	mg/l	A	0.05	0.02* (0.01)	5	S
Mn	mg/l	L	0.1	0.1	0.2	
Hg	mg/l		0.001	0.004 (0.0001)	0.002	A
Ni	mg/l	L	0.05	0.9*	0.2	B
Se	mg/l	E	0.01	0.25 (0.04)	0.02	O
Ag	mg/l	V	0.05	0.0002	-	V
Sn	mg/l	E	-	0.004	-	E
U	mg/l	L	-	-	-	
Zn	mg/l	S	5	0.4 *	2	IV
B	mg/l		1	- (3.4)	0.8	
Cl	mg/l		200	-	80	
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	-	-	↓
CCE	ug/l		500	-	-	-
MBAS/BAS	ug/l		500	5000 (200)	-	-
O & G (Mineral)	ug/l		40 ; N	N	-	-
O & G (Emulsified edible)	ug/l		7000 ; N	N	-	-
PCB	ug/l		0.1	6 (0.05)	-	-
Phenol	ug/l		10	-	-	-
Aldrin/Dieldrin	ug/l		0.02	0.2 (0.01)	-	-
BHC	ug/l		2	9 (0.1)	-	-
Chlordane	ug/l		0.08	2 (0.02)	-	-
t - DDT	ug/l	↓	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				

* = At hardness 50 mg/l CaCO3

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

N = Free from visible film sheen, discoloration and deposits

INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETERS	UNIT	CLASS					
		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)	°C	-	Normal +2°C		Normal +2°C	-	-
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, No objectionable odour; 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 II - sensitive aquatic species

CLASS IIB : Recreational use with body contact

CLASS III : Water Supply III - extensive treatment required
Fishery III - common, of economic value, and tolerant species; livestock drinking

CLASS IV : Irrigation

CLASS V : None of the above

MALAYSIA : DOE WATER QUALITY INDEX CLASSIFICATION

PARAMETERS	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

Malaysia : DOE 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