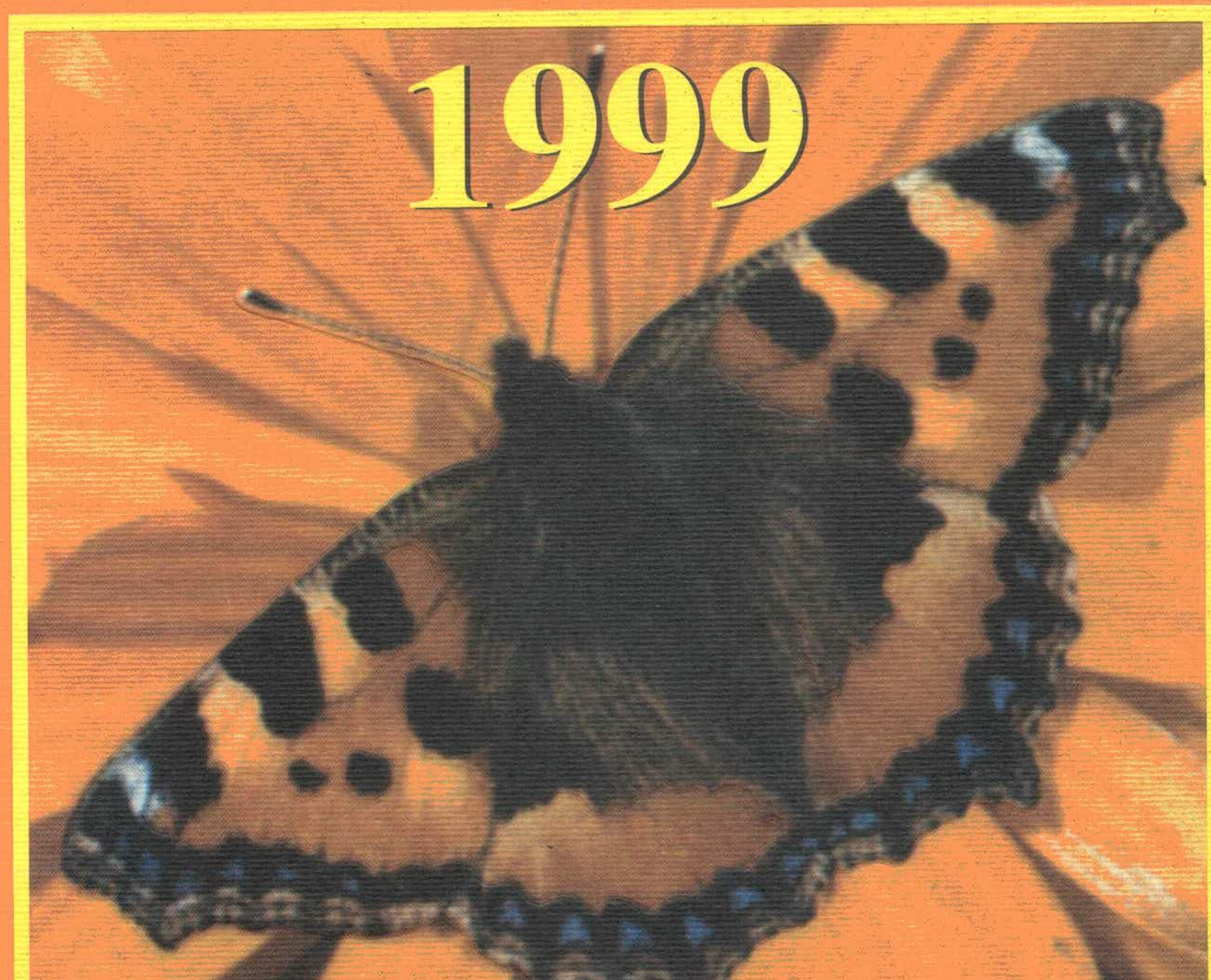
MALAYSIA

Environmental Quality Report



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

MALAYSIA Environmental Quality Report

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Department of Environment, Malaysia

DEPARTMENT OF ENVIRONMENT, MALAYSIA

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CONTENTS

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

FOREWORD

As required under Section 3(1) (i) of the Environmental Quality Act 1974, I hereby submit the 1999 Environmental Quality Report.

The style and dynamics of environmental quality reporting is continuously evolving in attempting to bring about a balanced and credible perspective of the state of the environment in a particular locality. In the Malaysian situation, the Environmental Quality Report has become an important and indispensable source of environmental information for the community, although its coverage has been somewhat limited by the mandate provided by the Act.

For 1999, we have taken the unprecedented step to publish in separate volume a departmental Annual Report for 1999 and an Environmental Quality Report; the former to showcase activities and programmes implemented for the year, and the latter to attempt to provide a broader perspective besides conveying important messages on the state of the environment. As knowledge gaps are identified and resolved, we hope to gradually expand our reporting to a system perspective and from an auditing viewpoint. In the longer term, it may be possible to shift the emphasis towards monitoring human/environment interactions rather than merely the biophysical environment.

Until then, it is hoped that the present coverage will suffice to stimulate thinking, eliminate complacency and heighten awareness such that environmental concerns will be translated into concrete actions to improve the quality of the living environment for now and the future.

'ALAM SEKITAR DIHARGAI KESEJAHTERAAN DINIKMATI'

With Best Wishes

HAJAH ROSNANI IBARAHIM
DIRECTOR-GENERAL OF ENVIRONMENTAL QUALITY
MALAYSIA

30 September 2000

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

AIR QUALITY

Air Quality Monitoring

Monitoring of air quality is based on actual measurements of pollutant concentrations in the ambient air, at selected monitoring sites throughout the country. In 1999, 5 new Continuous Air Quality Monitoring (CAQM) stations were set up in addition to the existing 39 stations. A total of 44 CAQM stations are strategically located throughout the country **(Map 1, 2)**. These stations continuously monitor the presence of pollutants in the air emitted from various sources such as motor vehicles, industries, open burning, etc.

Monitoring air quality

Photo 1: Clear Skyline of Kuala Lumpur City *(DOE Photo Library)*

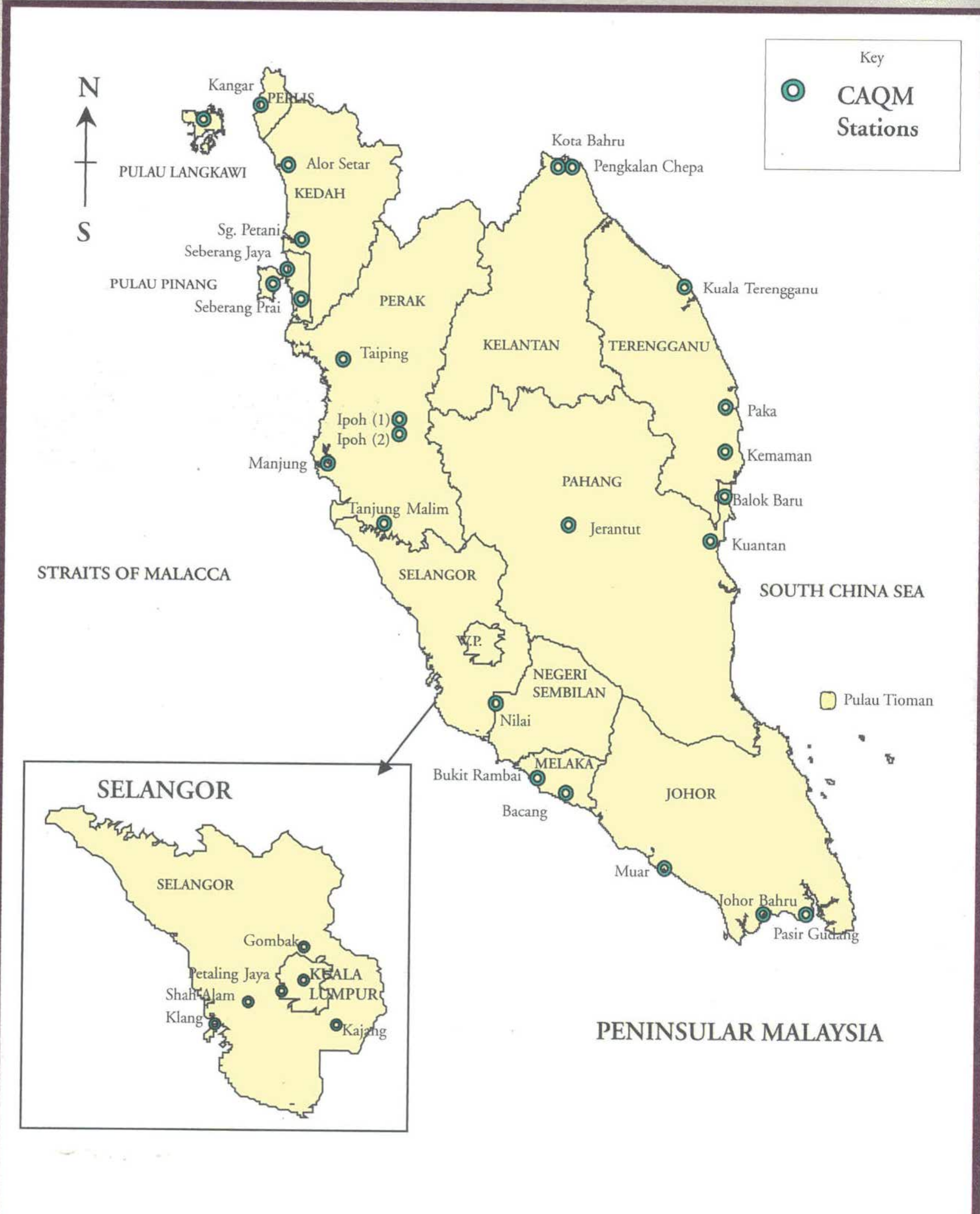
Air Quality Status in 1999

The air quality status for Malaysia is reported in terms of Air Pollutant Index (API). The air quality at all the 44 stations in 1999 was between good and moderate most of the time, except for a few 'unhealthy' days in the year.

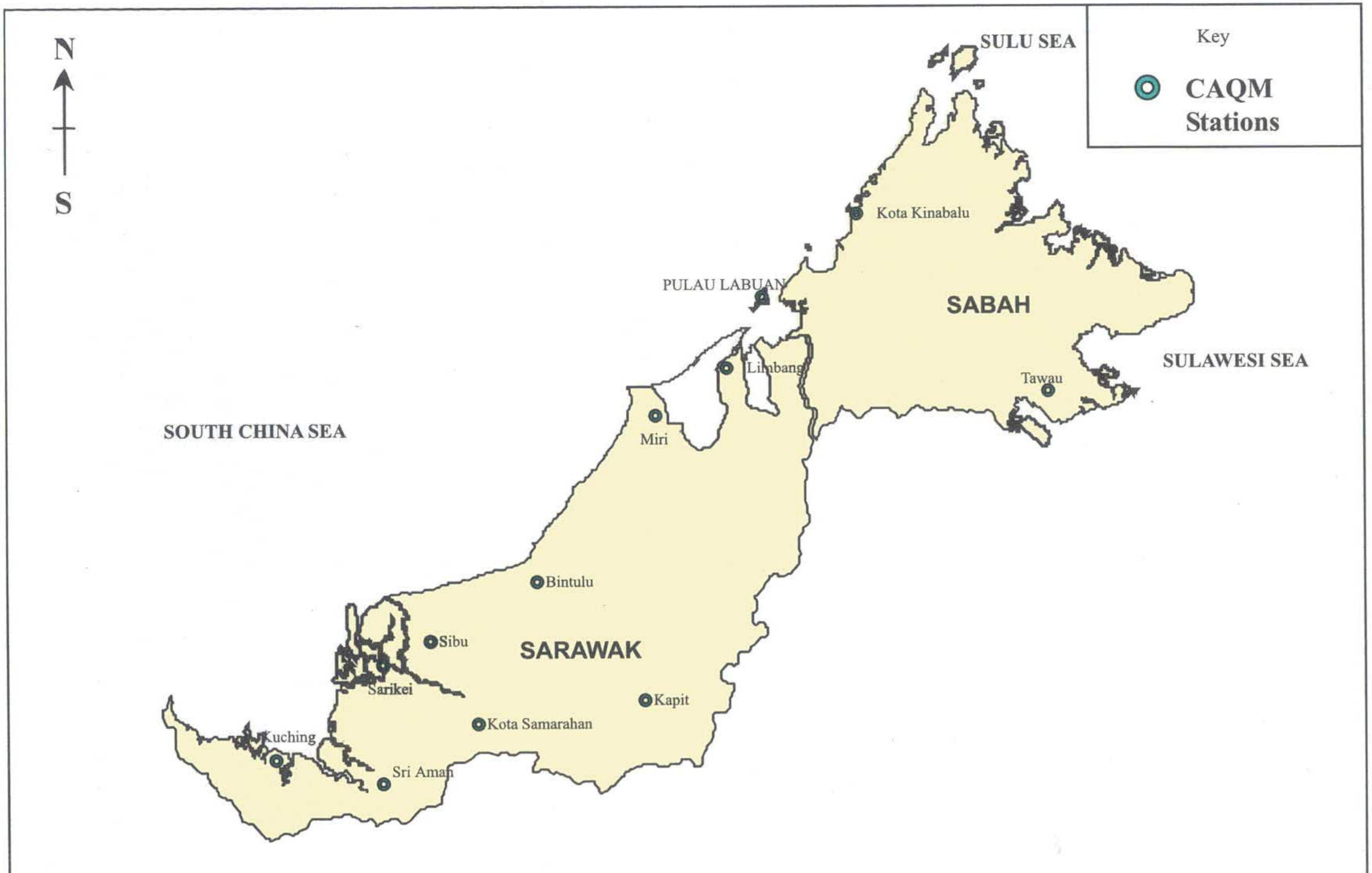
The Klang Valley, being the most densely populated area, experienced moderate air quality most of the time throughout 1999, **(Figure 1).** However 'unhealthy' air quality conditions occasionally recorded in the Klang Valley were mainly due to the presence of high levels of ozone, formed by the reaction of nitrogen oxides (NOx) and volatile organic compounds (VOCs) emitted from motor vehicles and industrial sources in the presence of heat and sunlight, normally occuring between 2 pm to 5 pm.

In the northern part of the west coast of Peninsular Malaysia, involving Perlis, Kedah including Langkawi, Pulau Pinang and Perak, the overall air quality ranged between good and moderate most of the time except for the Prai area which was unhealthy for 67 days of the year.

The air quality for Prai was good 20 percent of the time, 62 percent of the time moderate and 18 percent of the time unhealthy. The main pollutant of concern in that area was sulphur dioxide (SO_2) mainly from industrial activities in the vicinity of the monitoring station.



Map 1 Peninsular Malaysia: Location of Continuous Air Quality Monitoring Stations (CAQM), 1999



Map 2 East Malaysia: Location of Continuous Air Quality Monitoring Stations (CAQM), 1999

CAI/MFY/ami/east-map/17022000

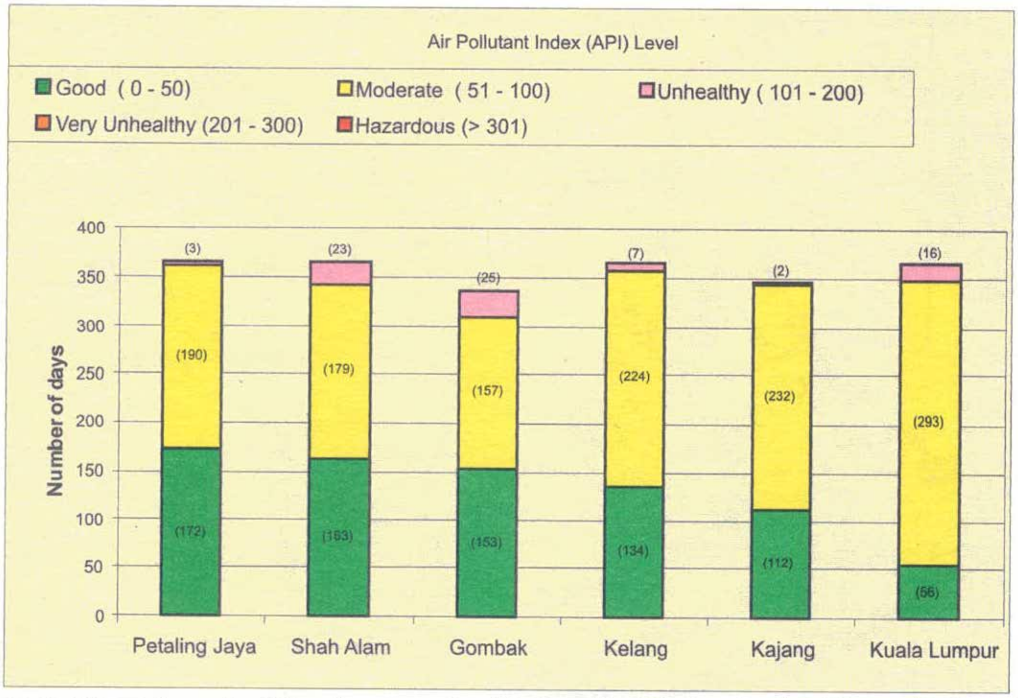


Figure 1 Department of Environment: Air Quality Status in the Klang Valley 1999

( ) - number of days

The air quality for Nilai, Negeri Sembilan, was unhealthy for 10 days in 1999 due to the high level of Particulate Matter (PM10) particularly during the dry season. **Figure 2** describes the overall air quality status for the West Coast of Peninsular Malaysia.

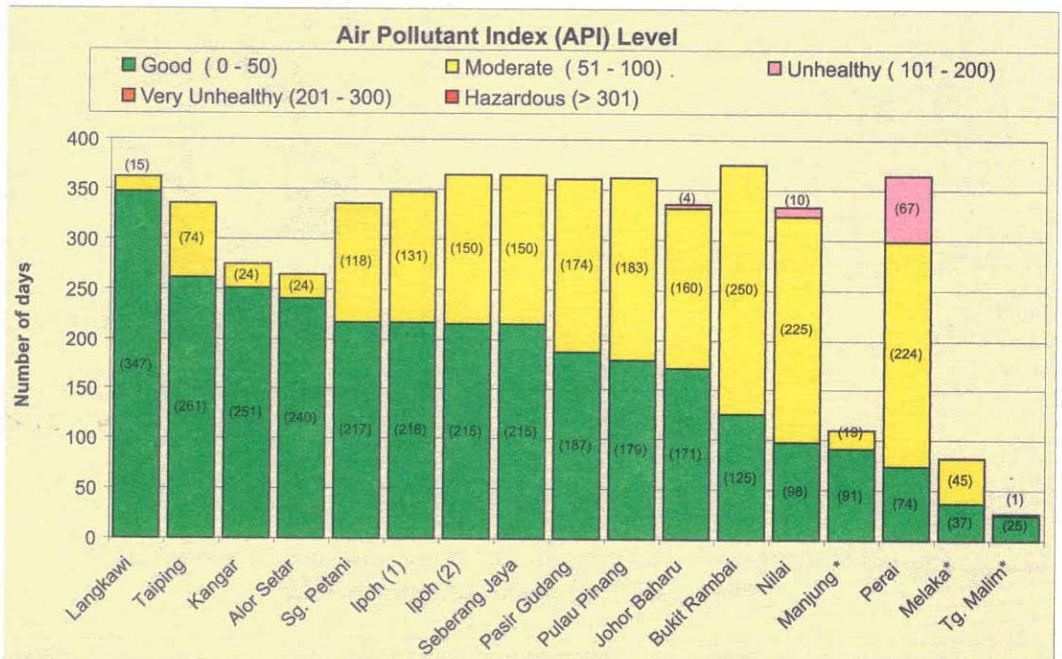


Figure 2 Department of Environment: Air Quality Status of West Coast Peninsular Malaysia

*new installation ( ) - number of days

However in the East Coast of Peninsular Malaysia the air quality was good most of the time. Areas such as Paka, Kota Bahru and Pengkalan Chepa experienced good air quality more than 90% of the time, while the air quality in other stations was good more than 60% of the time throughout 1999 **(Figure 3)**.

In Sabah and Sarawak, the air quality in the 12 stations was good more than 70 % of the time. (**Figure 4)**

Air Quality Trend

Each year data on air pollutant concentrations from all monitoring stations throughout the country are collated and analysed. Six principal pollutants namely Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Sulphur Dioxide (SO_2) and Particulate Matter (PM10) are monitored continuously while Lead (Pb) concentrations are measured once every six days. The air quality trend is then derived by averaging direct measurements of air pollutant concentration from these monitoring stations on a yearly basis.

Trend in Particulate Matter (PM10) levels

Particulate matter is the general term used to describe respirable particles less than 10μ in size, originating from stationary, mobile as well as from natural sources. The non-natural sources are fuel combustion from motor vehicles, power generation plants, industrial premises and open burning activities. In addition, over the last several years between July to September each year, significant amount of fine particulate matter would be transported by the south-westerly winds from a neighbouring country due to uncontrolled biomass burning activities.

Accumulation of this pollutant in the respiratory system is associated with numerous health effects related to respiratory diseases and decreased lung function. Sensitive groups including the elderly, individuals with

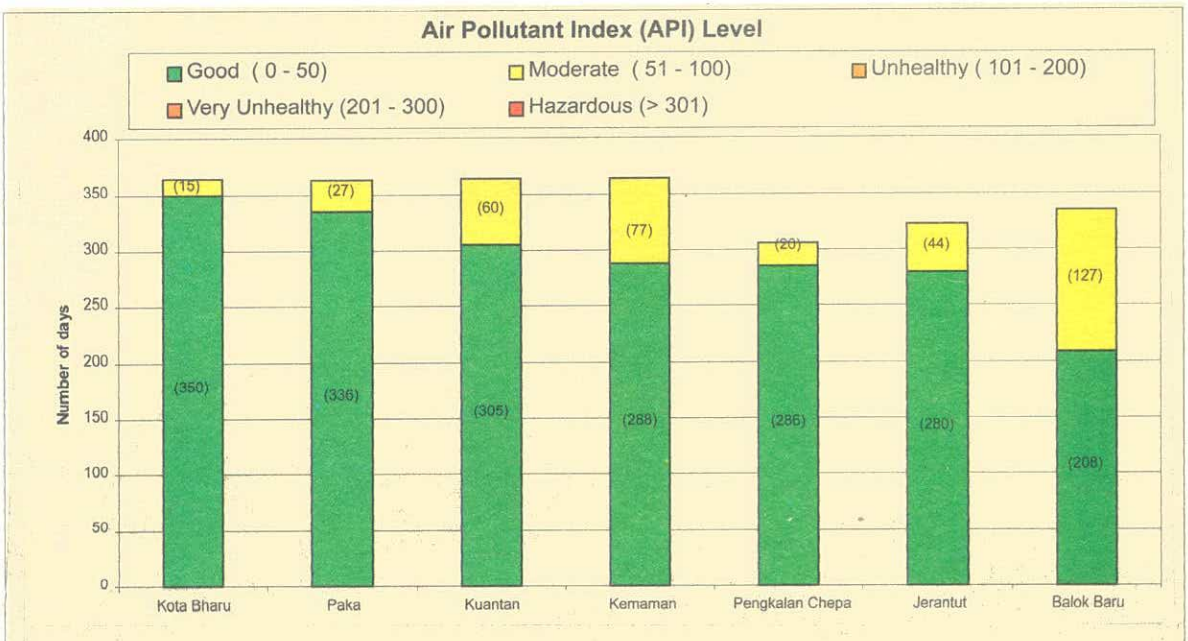


Figure 3 Department of Environment: Air Quality Status of East Coast Peninsular Malaysia, 1999

( ) - number of days

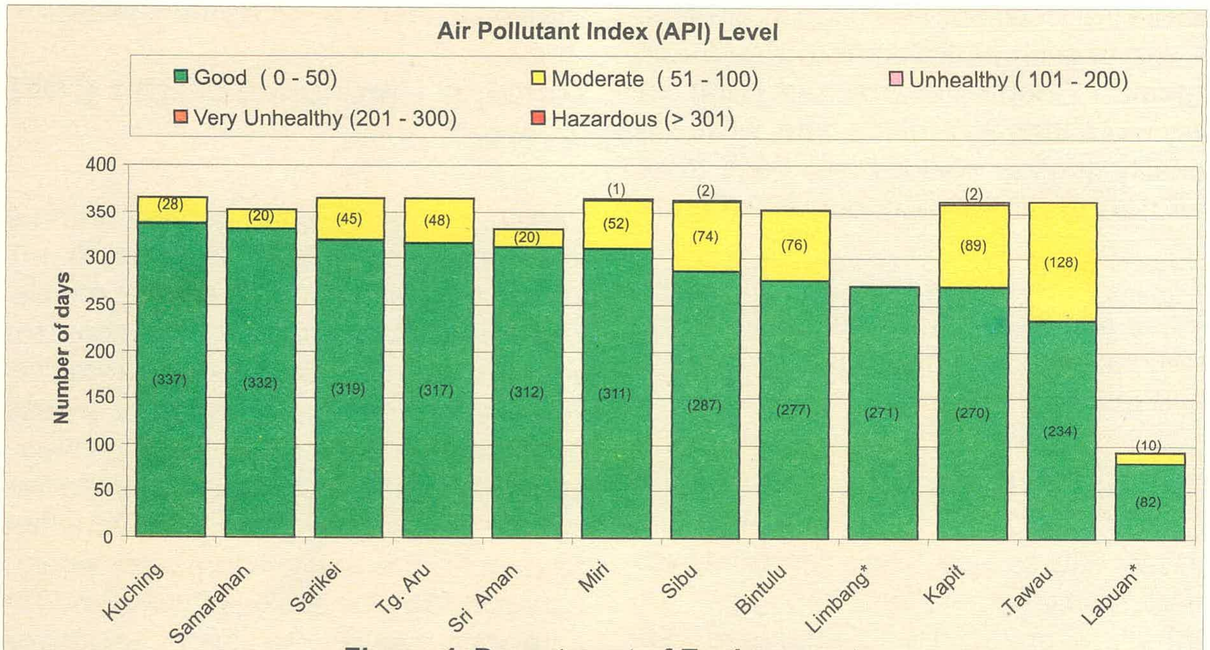


Figure 4 Department of Environment: Air Quality Status in Sabah and Sarawak, 1999

*new installation

( ) - number of days

Photo 2: Open Burning detected during Air Surveillance *(DOE Photo Library)*

Photo 3: Illegal Dumping Site (DOE Photo Library)

Photo 4: Illegal Open Burning at illegal Dumping Site (DOE Photo Library)

asthma, cardiopulmonary diseases and children appear to be at greater risk. High level of PM10 in the atmosphere is also a major cause of reduced visibility, which results in more intense hazy conditions in the country especially during the dry season.

PM10 remained the prevalent pollutant in many areas throughout the country. However, the annual average levels of PM10 concentration in the ambient air between 1996 to 1999 (**Figure 5**), were below the Recommended Malaysian Guideline of 50 $\mu g/m^3$, except during the unprecedented 1997 haze episode. **Figure 5(a)** describes the breakdown of annual average PM10 levels at various landuse categories where monitoring stations were located.

Trend in Sulphur Dioxide (SO_2) levels

Sulphur Dioxide is a colourless, pungent, irritating, water-soluble and reactive gas. These gases are formed when fuel containing sulphur (eg. oil and coal) is burned during the combustion process mainly from industrial activities. High concentrations of SO_2 in the atmosphere increase the risk of adverse asthmatic attacks, irritates respiratory system, cause harm to plant life, and cause corrosion of iron and steel and buildings.

The annual average levels of sulphur dioxide in the ambient air between 1996 to 1999 **(Figure 6)** were well below the Recommended Malaysian Guideline (0.04 ppm). **Figure 6(a)** shows the annual average levels of sulphur dioxide at different landuse categories where monitoring stations were located. Higher levels of SO_2 were recorded in industrial areas as compared to the urban and suburban centres.

Trends in Nitrogen Dioxide (NO_2) levels

Nitrogen dioxide (NO_2) is a reddish brown,

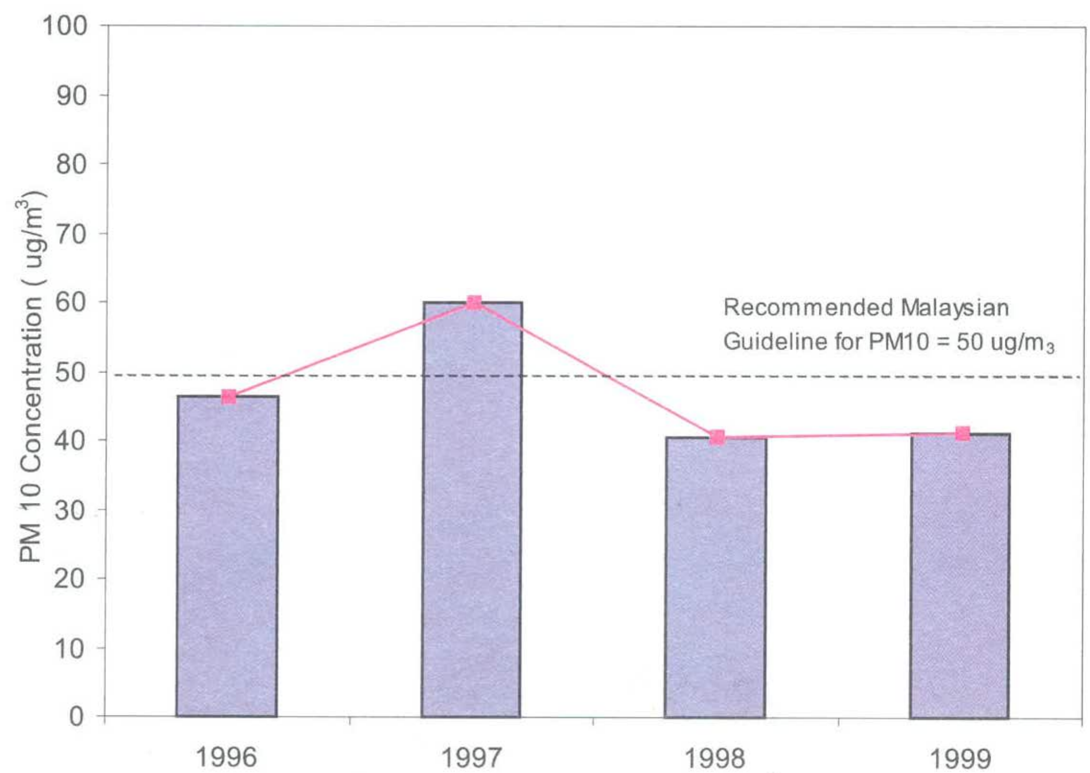


Figure 5 Malaysia: Annual Average Concentration of Particulate Matter (PM10), 1996-1999

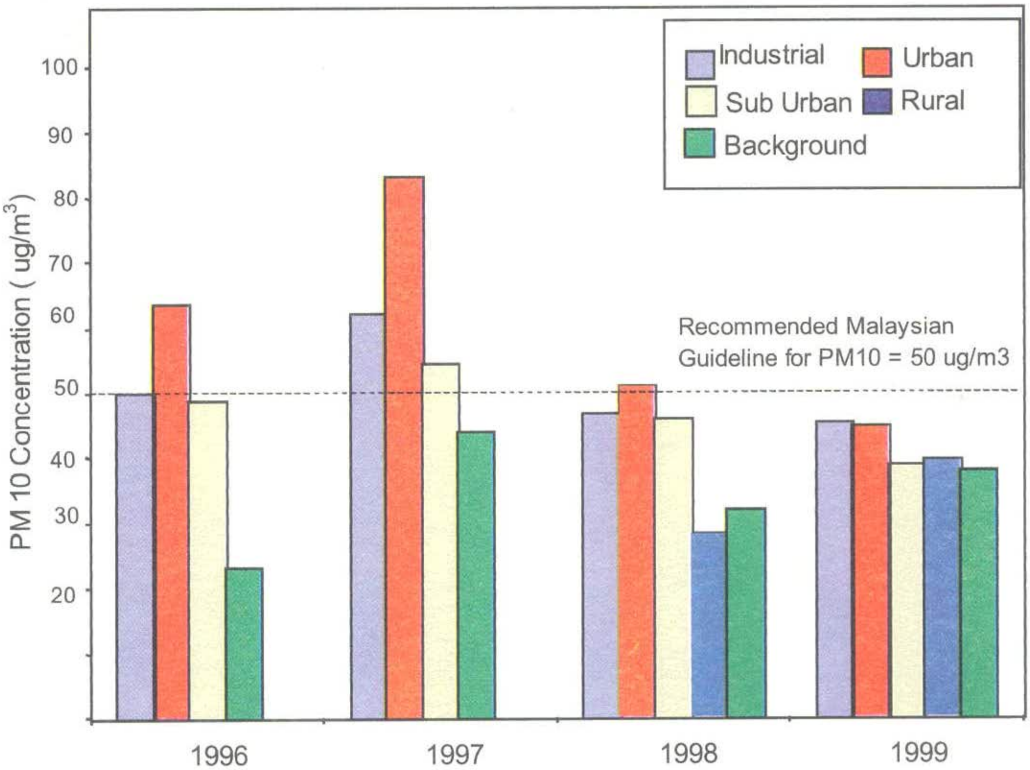


Figure 5(a) Malaysia: Annual Average Concentration of Particulate Matter (by Landuse, 1996-1999)

highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). The major sources of NO_2 are high temperature combustion processes such as those occurring in automobiles and power plants. Short term exposure to NO_2 may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illness and increases respiratory illness in children. Long term exposure may lead to increased susceptibility to respiratory infection and other lung diseases.

For the period between 1996-1999, the annual average concentration of NO_2 in ambient air **(Figure 7, Figure 7(a))** were well below the Recommended Malaysian Guideline (0.17 ppm).

Trend in Ground Ozone (O_3) levels

Ground level 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. The precursor pollutants that cause formation of ozone are emitted mainly from automobiles and industrial activities. Exposures to high levels of ambient ozone have been linked to a number of health effects. Repeated exposures to ozone can increase more susceptibility to respiratory infections, lung inflammation, and aggravate pre-existing respiratory ailments such as asthma.

As indicated in **Figure 8**, the annual average daily maximum 1 hour concentration of ozone in the ambient air measured between 1996 to 1999, were below the Recommended Malaysian Guideline (0.1 ppm). **Figure 8(a)** describes the breakdown of ozone concentration at various landuse categories for the period 1996 – 1999 where monitoring stations were located. Higher levels of Ozone were recorded in the urban areas due to the presence of precursor ozone gases namely NOx emitted mainly from motor vehicles within urban areas.

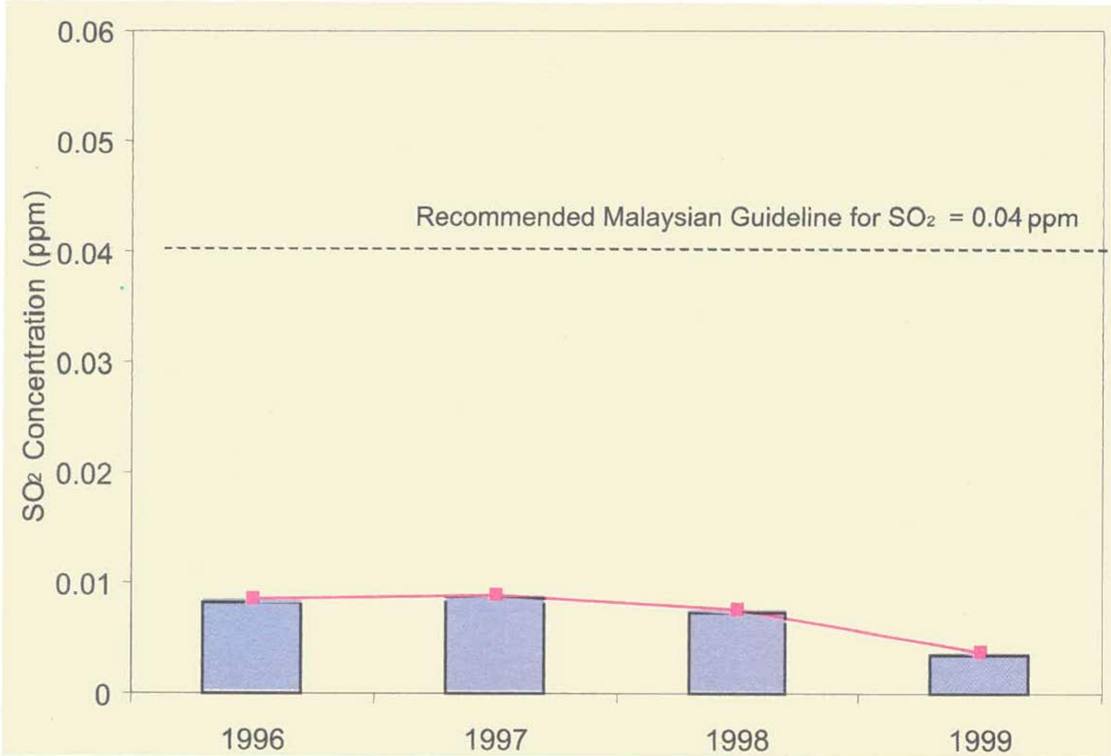


Figure 6 Malaysia: Annual Average Concentration of Sulphur Dioxide (SO_2), 1996-1999

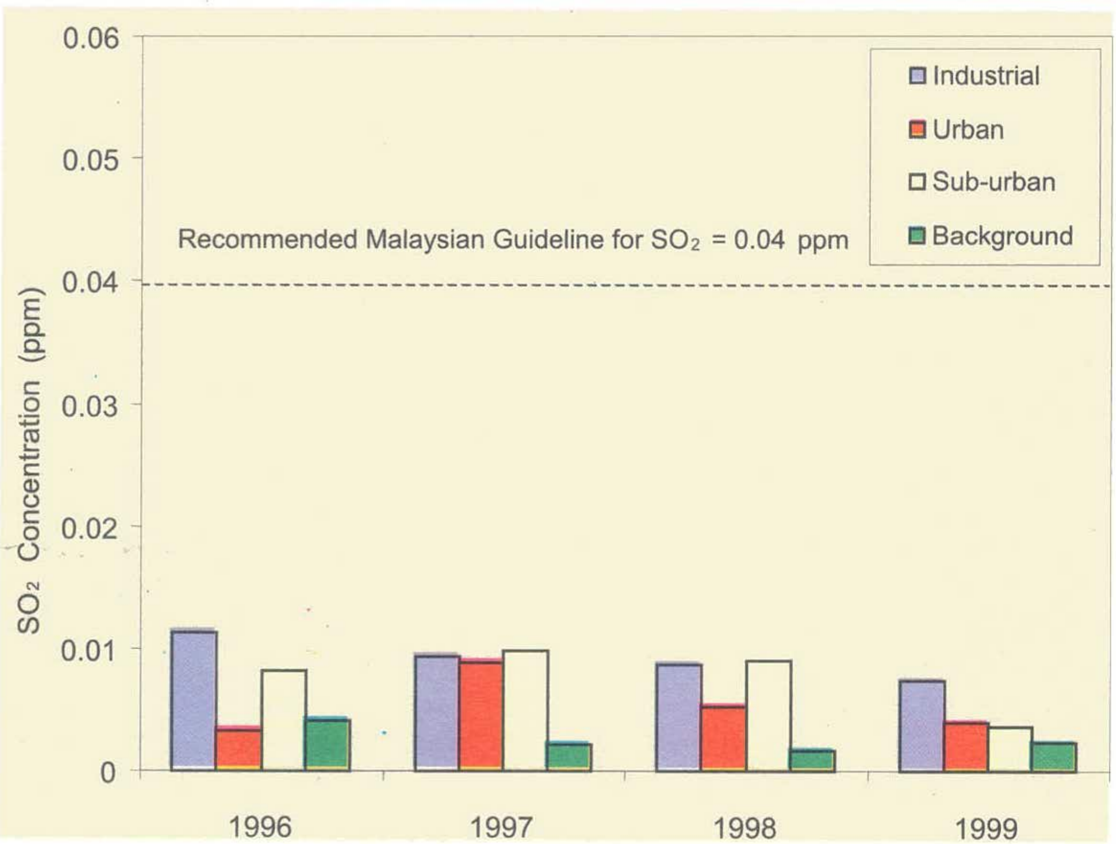


Figure 6(a) Malaysia: Annual Average Concentration of Sulphur Dioxide (SO_2) by Landuse, 1996-1999

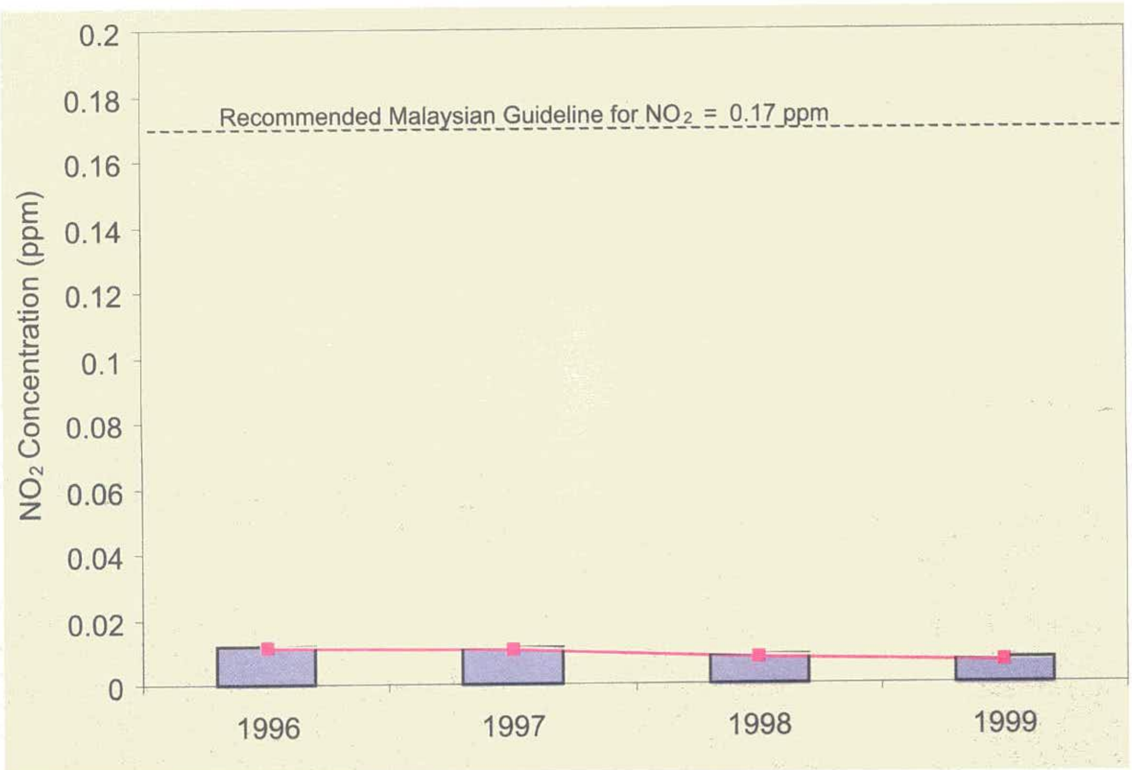


Figure 7 Malaysia: Annual Average Concentration of Nitrogen Dioxide (NO_2), 1996-1999

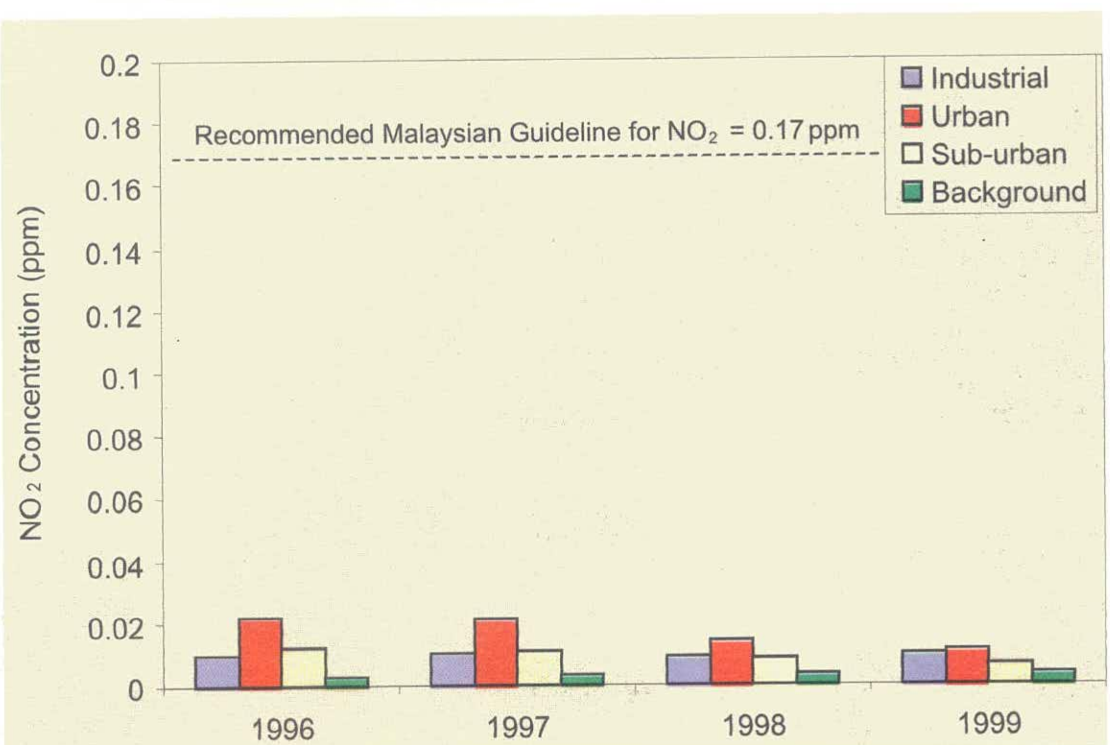


Figure 7(a) Malaysia: Annual Average Concentration of Nitrogen Dioxide (NO_2) by Landuse, 1996-1999

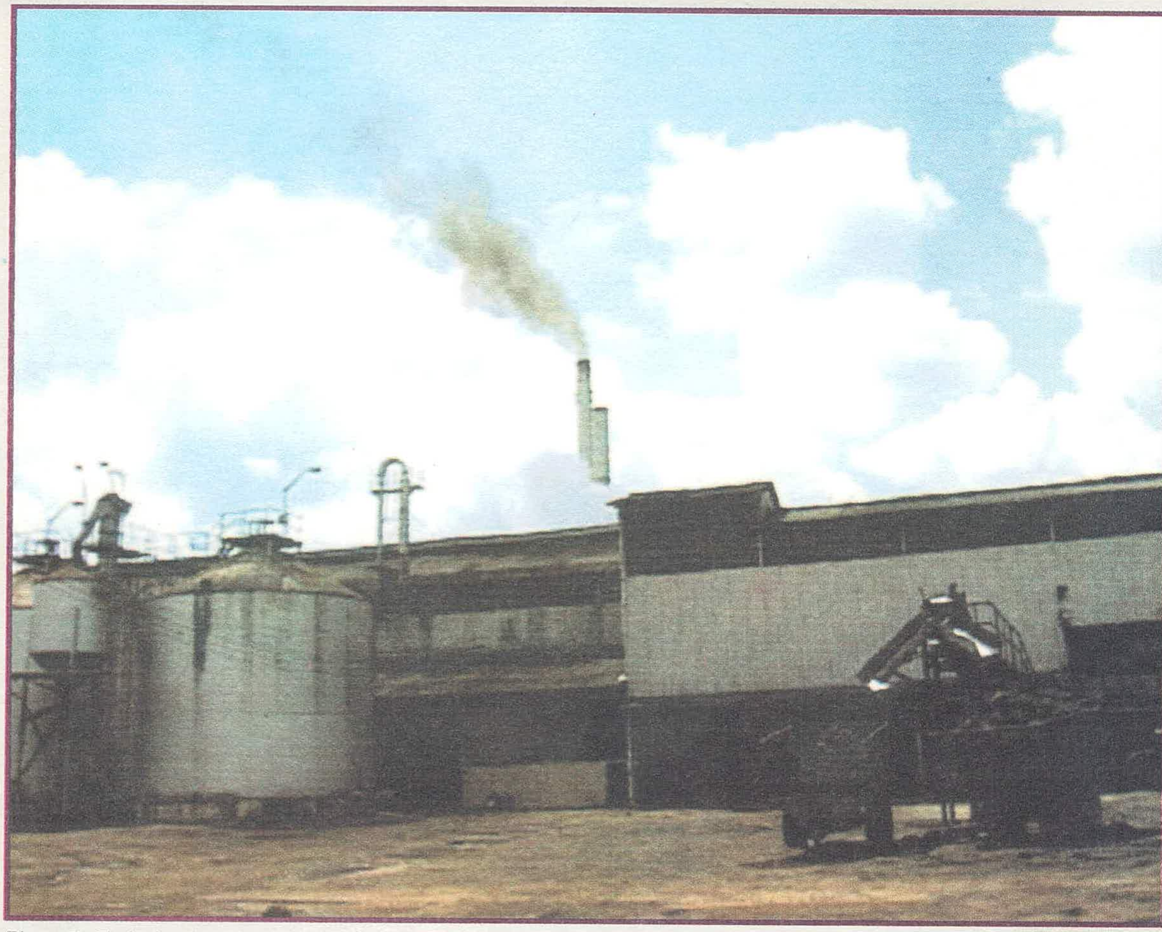
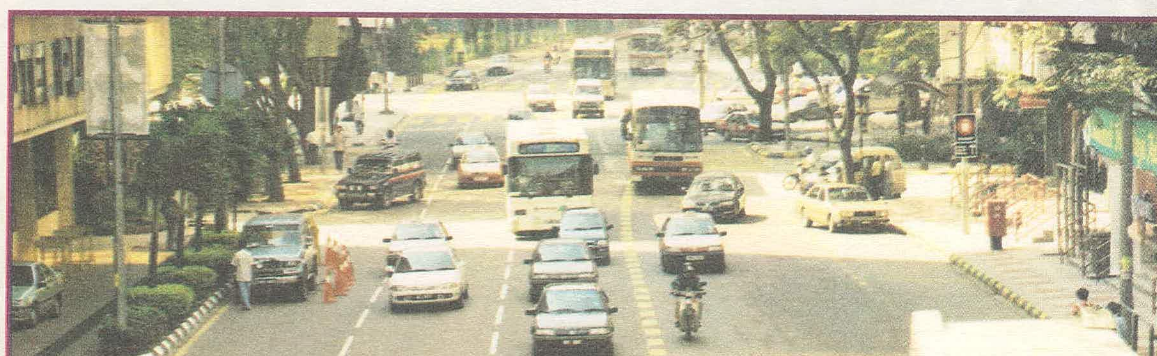


Photo 5: Emission from Industrial Premises *(DOE Photo Library)*



Air Polution Measurement

Photo 6: Urban Motor Vehicle Air Pollution *(DOE Photo Library)*

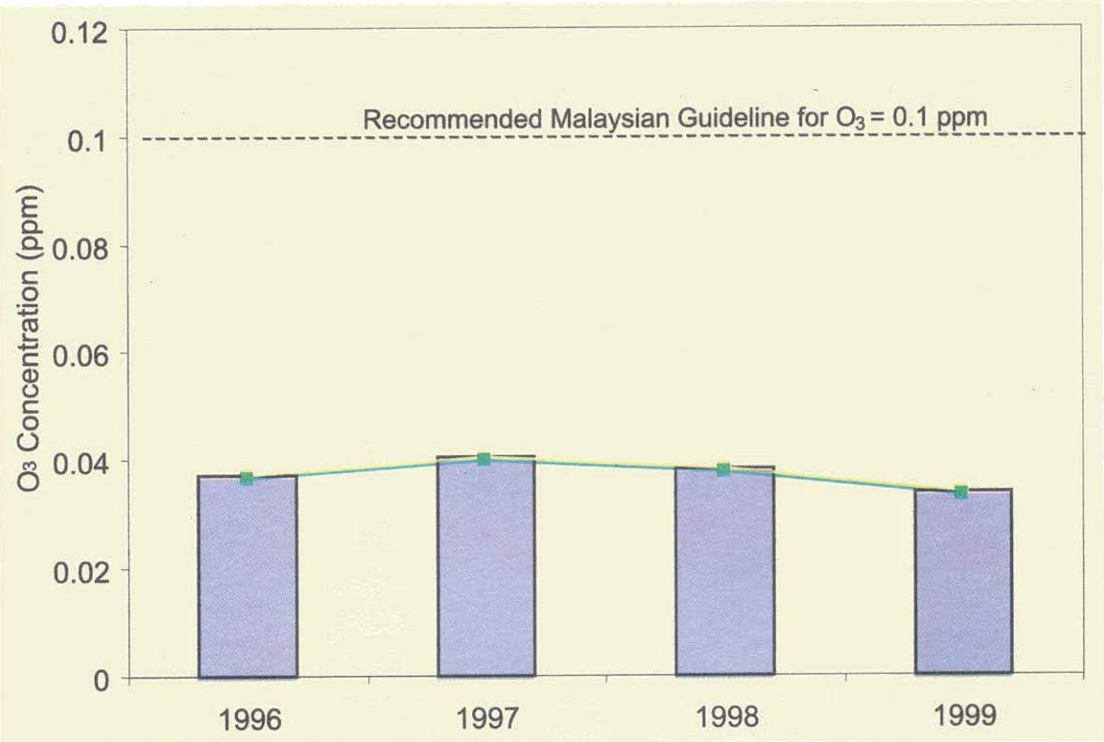


Figure 8 Malaysia: Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3), 1996-1999

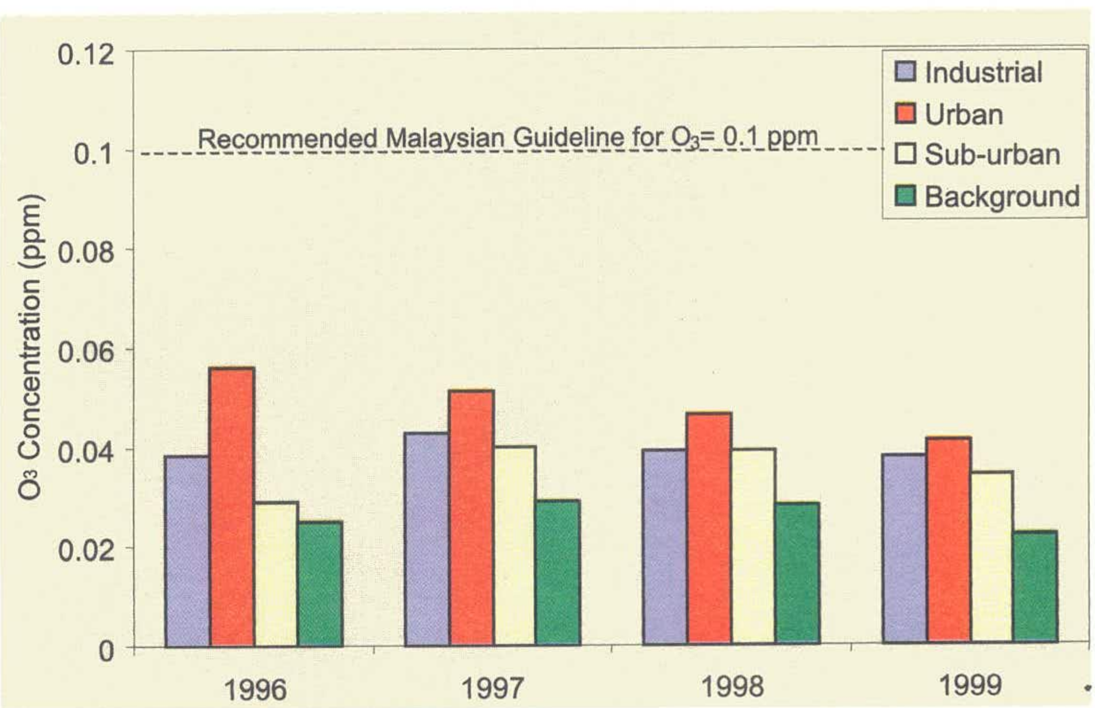


Figure 8(a) Malaysia: Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3) by Landuse 1996-1999

Trend in Carbon Monoxide (CO) levels

Carbon monoxide is a colorless, odorless and at high concentrations, a poisonous gas. Carbon monoxide is formed when the 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 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 between 1996 to 1999, were below the Recommended Malaysian Guideline for Ambient Air (9 ppm) **(Figure 9)**. Higher CO levels were normally recorded in urban areas due to motor vehicle emissions. **Figure 9(a)** shows CO concentrations at various landuse categories where monitoring stations were located.

Trend in Lead (Pb) levels

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 deficiency and lowered IQ.

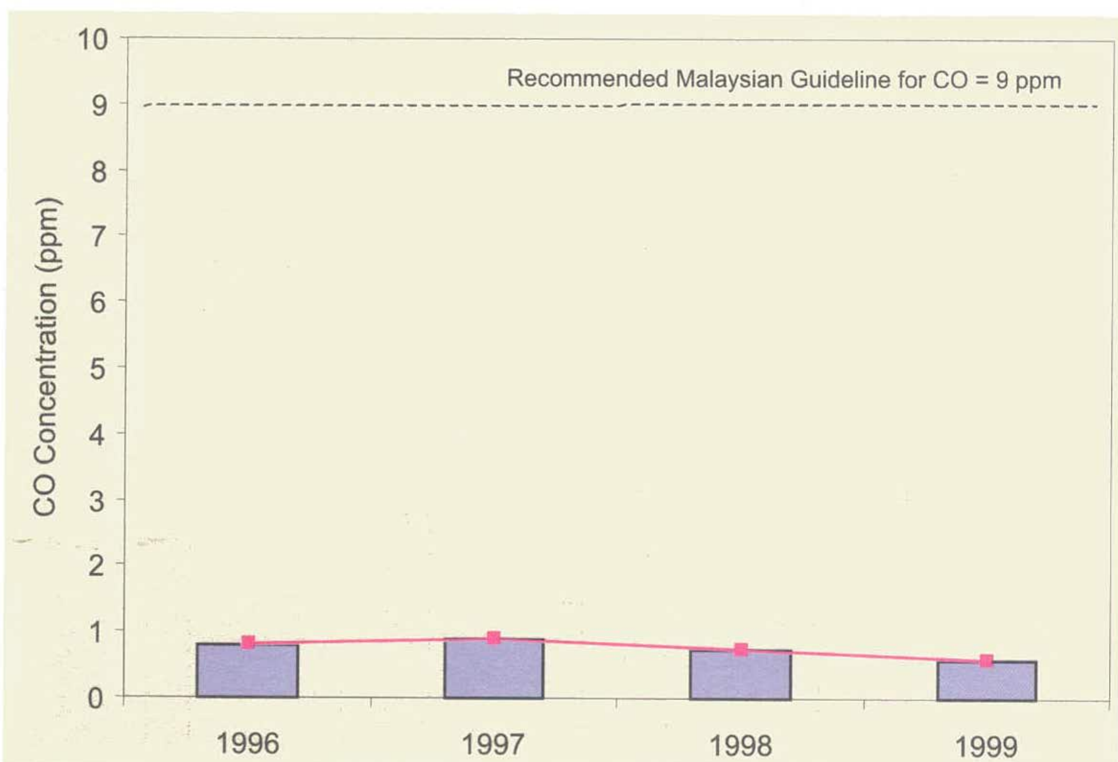


Figure 9 Malaysia: Annual 8-Hourly Average Concentration of Carbon Monoxide (CO), 1996-1999

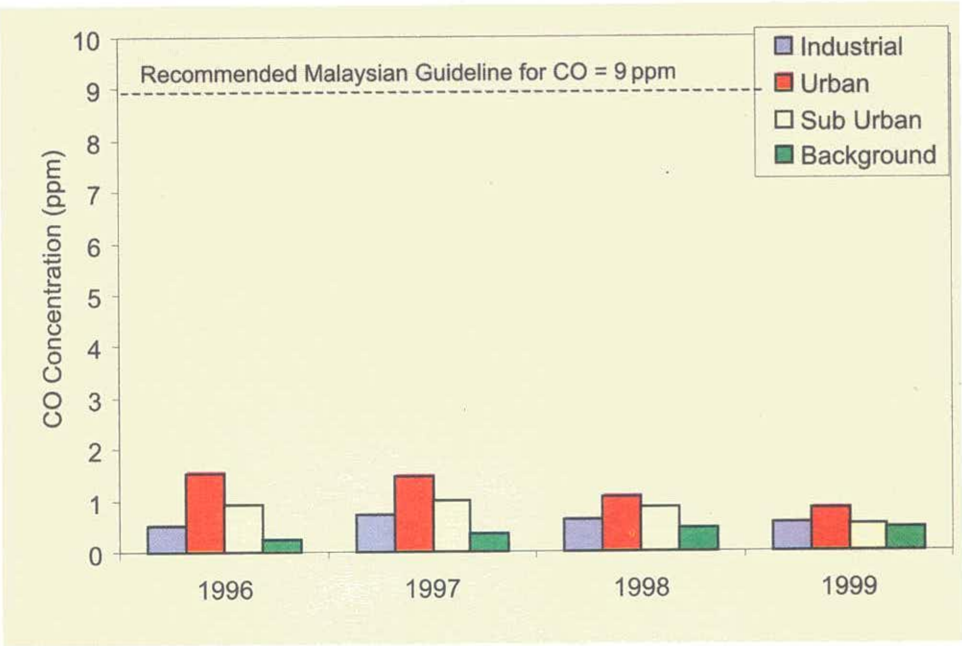


Figure 9(a) Malaysia: Annual Average 8-Hourly Concentration of Carbon Monoxide (CO) by Landuse, 1996-1999

In the past, motor vehicles had been the main source of Lead (Pb) emission into the atmosphere. Lead levels in the atmosphere were high in the Eighties. However, as a result of government efforts in promoting the use of unleaded petrol since 1991, atmospheric lead levels had declined significantly. In 1999, the average level of lead monitored in the Klang Valley further reduced to 0.04µg/m^3 from 0.05µg/m^3 in 1998. **(Figure 10)**

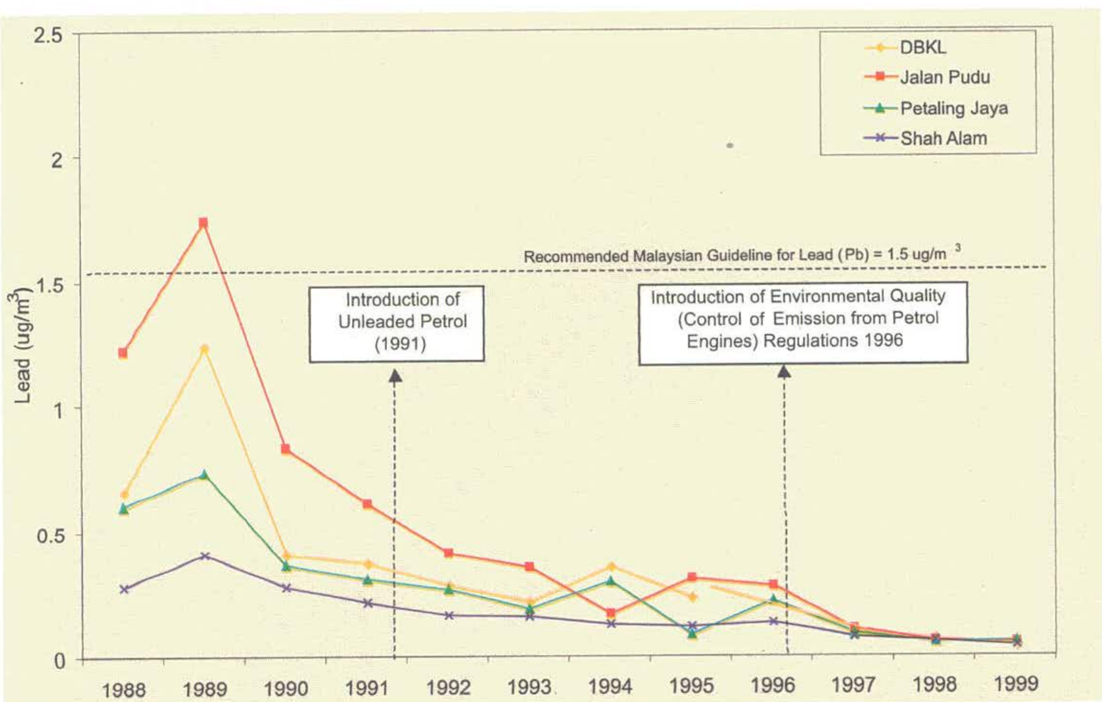


Figure 10 Malaysia: Ambient Lead Concentrations in the Klang Valley, 1988-1999

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

NOISE MONITORING

NOISE MONITORING

Noise monitoring carried out in 1999 concentrated principally in assessing the levels of noise exposure to sensitive noise receivers at premises such as schools and hospitals. Monitoring had been conducted at several schools and hospital premises in Kuala Lumpur, Selangor and Negeri Sembilan. Data obtained from the monitoring program were then assessed against the values recommended by the World Health Organization (WHO)

The recorded noise levels measured at selected school premises within Kuala Lumpur, Selangor and Negeri Sembilan were found to be in the range of **56.4 dB(A)** to **68.5 dB(A)** between 7am to 10pm. This indicated that the noise level exposure of school children during the daytime exceeded the limit of 55dB(A), recommended by the World Health Organization (WHO) for day time exposure. On the whole, Sekolah Kebangsaan Batu in Kuala Lumpur recorded the highest noise level as compared to schools in other areas. High noise levels within Kuala Lumpur were mainly contributed by traffic sources **(Figure 11)**.

Similarly measurements carried out at selected hospital premises also recorded noise levels that exceeded the limit recommended by the World Health Organization (WHO). The noise levels measured were found to be in the range of **58.0 dB(A)** to **68.1dB(A)** during day time (7.00 am to 10.00 pm) and **53.9 dB(A)** to **65.8 dB(A)** at nighttime (10.00 pm to 7.00 am) as compared to 55dB(A) daytime and 45dB(A) nighttime set by WHO. The Kuala Lumpur General Hospital recorded the highest noise level **(Figure 12).**

Noise Level Measurement *Photo 7: Major Urban Noise Sources* *(DOE Photo Library)*

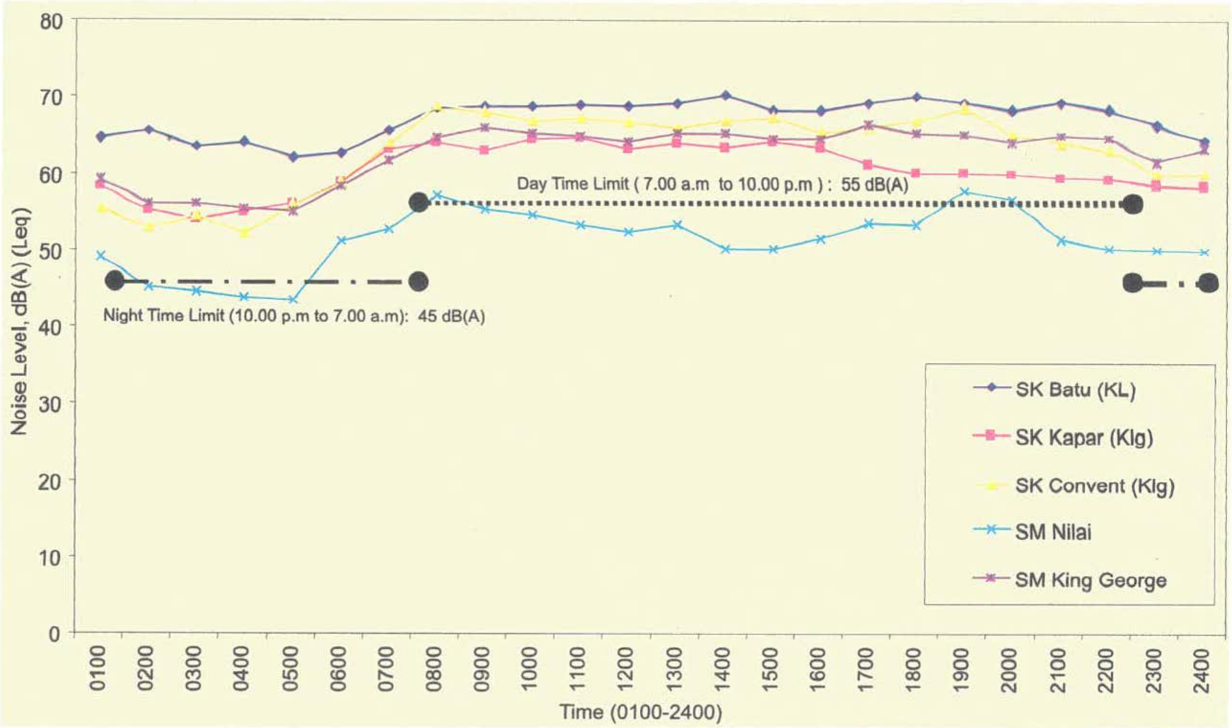


Figure 11 Department of Environment: Profile of noise levels measured at selected school premises, 1999

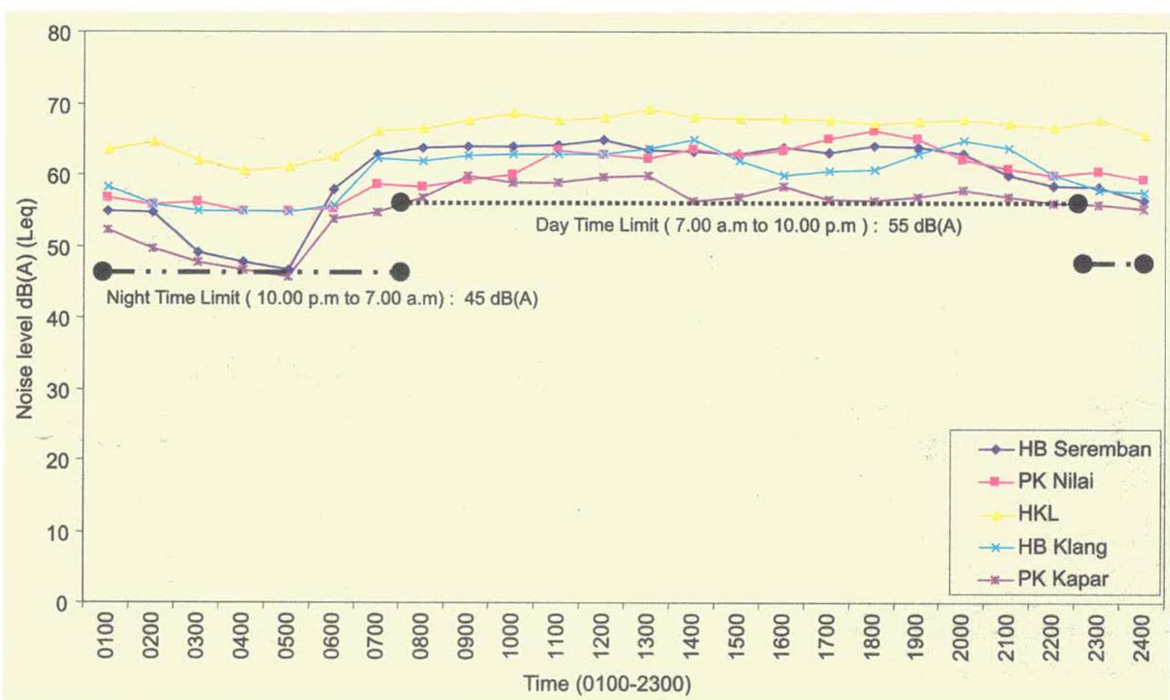


Figure 12 Department of Environment: Profile of noise levels measured at selected hospital premises, 1999

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

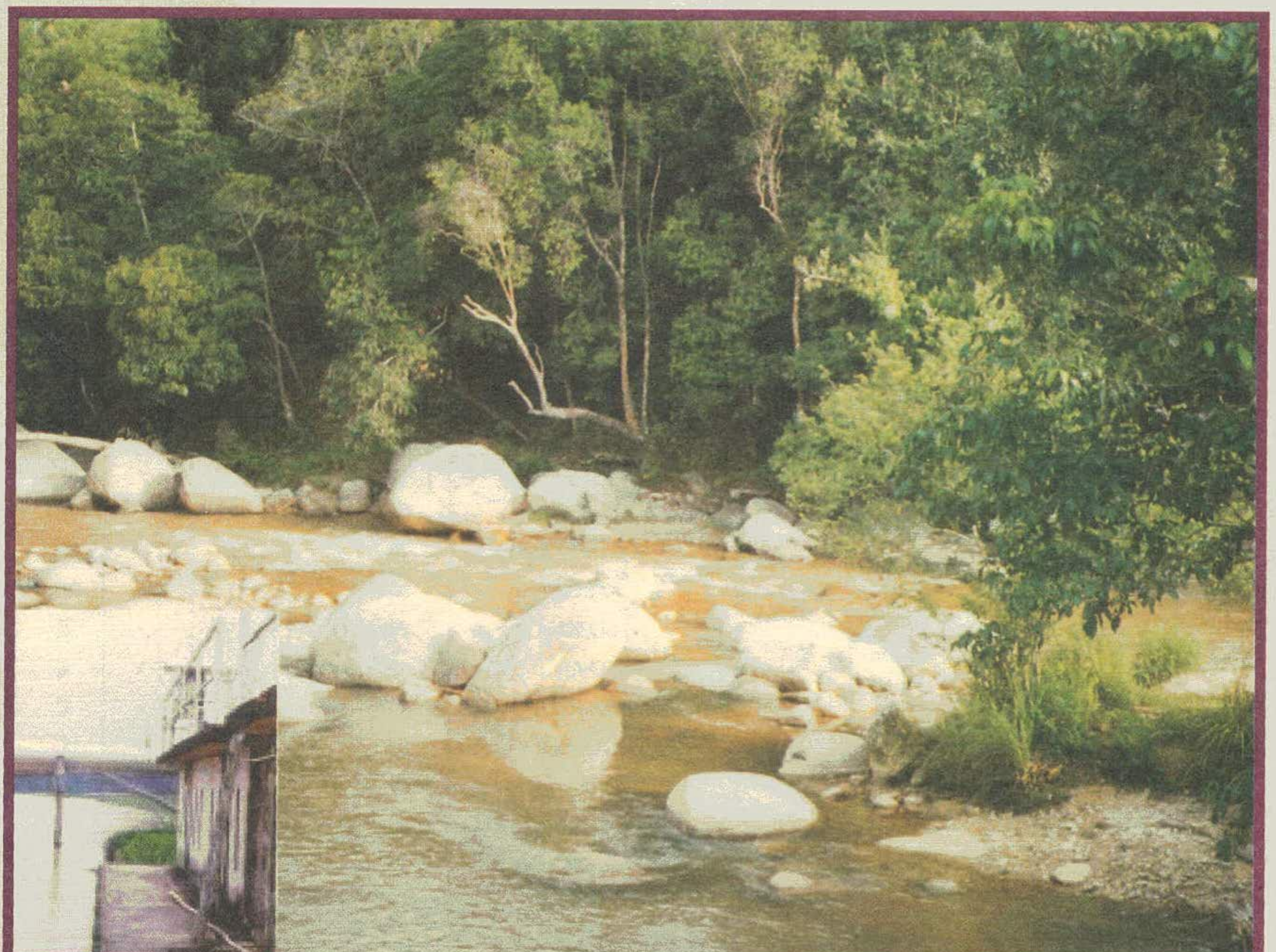
RIVER WATER QUALITY

Introduction

Monitoring of river water quality in Malaysia has been conducted by DOE since 1978, primarily to establish the status of water quality, detect water quality changes and identify pollution sources. This involves routine monitoring at predetermined stations, in-situ and laboratory analysis, and data interpretation in terms of their physico-chemical and biological characteristics. River water quality appraisal is based on Water Quality Index (WQI) involving parameters such as Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammoniacal Nitrogen (NH_3N), Suspended Solids (SS) and pH. The WQI serves as a basis for assessment of a water course in relation to pollution categorization and designated classes of beneficial uses in accordance with the Proposed Interim National Water Quality Standards for Malaysia (INWQS). (ANNEX)

River Water Quality Status

In 1999, a total of 902 stations located within 120 river basins were monitored. Out of these 902 monitoring stations, 335 (37%) were found to be clean, 442 (49%) slightly polluted and 125 (14%) polluted, (**Table 1.0(a), (b), (c)**). Stations located upstream were generally clean, while those downstream were either slightly polluted or polluted. Out of these 902 river monitoring stations, the water quality at 867 stations (96%) based on specific parameters were within Class I to Class III of the Proposed Interim National Water Quality Standards for Malaysia (INWQS) indicating suitability for domestic water supply.



River Monitoring Station *Photo 8: Clear, Clean River* *(DOE Photo Library)*

Table 1.0(a) Malaysia: Status of Water Quality within the Clean River Basins, 1999

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLAS
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
KEDAH	01PL	MELAKA	90	3	KISAP	89	1	-	-	C	II
					MELAKA	86	1	-	-	C	II
					PETANG	94	1	-	-	C	I
	03	KEDAH	81	6	KEDAH	62	-	1	-	SP	III
					PADANG TERAP	83	3	-	-	C	II
					PEDU	89	1	-	-	C	II
					TEKAI	87	1	-	-	C	II
	05	MUDA	83	9	JERUNG	75	1	1	-	SP	III
					KETIL	88	1	-	-	C	II
					MUDA	84	3	1	-	C	II
					TAWAR	88	2	-	-	C	II
PERAK	09	KURAU	81	5	ARA	91	1	-	-	C	II
					KURAU	78	2	2	-	SP	II
	10T	TEMERLOH	88	2	TEMERLOH	88	2	-	-	C	II
	11	BRUAS	82	4	BRUAS	77	1	1	-	SP	II
					ROTAN	86	2	-	-	C	II
SELANGOR	16	SELANGOR	81	9	BATANG KALI	88	1	-	-	C	II
					KANCHING	82	1	-	-	C	II
					KERLING	90	1	-	-	C	II
					SELANGOR	80	2	2	-	SP	II
					SEMBAH	60	-	1	-	SP	III
					SERENDAH	83	1	-	-	C	II
JOHOR	31A	MERSING	91	1	MERSING	91	1	-	-	C	II
	31B	JEMALUANG	83	2	JEMALUANG	83	2	-	-	C	II
PAHANG	32AE	ANAK ENDAU	81	2	ANAK ENDAU	81	1	1	-	C	II
	35L	LEPAR	82	10	ANAK SG. LEPAR	64	-	1	-	SP	III
					CHINI	69	-	1	-	SP	III
					T. PAYA BUNGOR	75	-	1	-	SP	III
					TASIK CHINI	80	-	1	-	SP	II
					BERKAPOR	86	2	-	-	C	II
					LEPAR	88	3	-	-	C	II
					BELAYAR	90	1	-	-	C	II
	35M	MENTIGA	82	2	MENTIGA	82	1	1	-	C	II
	35P	PAHANG	82	51	KUNDANG	74	-	1	-	SP	III
					TEKAL	75	-	1	-	SP	III
					BILUT	76	-	1	-	SP	III
					PERTANG	77	-	2	-	SP	II
					JELAI	78	1	1	-	SP	II
					TANGLIR	78	-	1	-	SP	II

Table 1.0(a) Malaysia: Status of Water Quality within the Clean River Basins, 1999 (continued)

STATE	RIVER BASIN CODE	RIVER BASIN NAME	RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION CLEAN	NO. OF STATION SLIGHTLY POLLUTED	NO. OF STATION POLLUTED	RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
					KELAU	79	-	2	-	SP	II
					SEMANTAN	79	1	2	-	SP	II
					SIAM	79	-	1	-	SP	II
					BATU	80	-	1	-	SP	II
					JENGKA	80	1	1	-	SP	II
					KERTAM	81	1	-	-	C	II
					TEKAM	81	2	-	-	C	II
					PAHANG	81	8	1	-	C	II
					BENTONG	81	2	2	-	C	II
					KOYAN	82	1	-	-	C	II
					PERTING	83	1	-	-	C	II
PAHANG					LIPIS	83	3	-	-	C	II
					MARAN	83	1	1	-	C	II
					TELEMONG	85	2	-	-	C	II
					LUIT	85	1	-	-	C	II
					BENUS	85	2	-	-	C	II
					JEMPOL	85	2	-	-	C	II
					TERAS	86	1	-	-	C	II
					TELANG	88	1	-	-	C	II
					TERANUM	89	1	-	-	C	II
					PENJURING	91	1	-	-	C	II
TERENGGANU	40	PAKA	82	10	PAKA	80	2	2	-	SP	II
					BESUL	83	2	1	-	C	II
					RASAU	82	1	-	-	C	II
					RENGAT	88	2	-	-	C	II
	41	DUNGUN	83	4	DUNGUN	90	2	-	-	C	II
					TELEMBOH	77	1	1	-	SP	II
	43	TERENGGANU	82	9	PUEH	75	1	1	-	SP	III
					TERENGGANU	80	1	1	-	SP	II
					NERUS	85	3	-	-	C	II
					BERANG	85	2	-	-	C	II
	44	SETIU	84	3	TARONG	83	2	-	-	C	II
					SETIU	88	1	-	-	C	II
	46	BESUT	86	4	JERTIH	81	1	1	-	C	II
					BESUT	91	2	-	-	C	II
KELANTAN	48	KELANTAN	87	38	PENGKALAN CHEPA	71	-	1	-	SP	III
					PENGKALAN DATU	79	-	3	-	SP	II
					PERTOK	81	2	0	-	C	II

Table 1.0(a) Malaysia: Status of Water Quality within the Clean River Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED	*	
					BELATOP	87	2	-	-	C	II
					CHIKU	85	2	-	-	C	II
					KELANTAN	86	4	-	-	C	II
					BEROK	87	2	-	-	C	II
					BETIS	87	1	-	-	C	II
					KERAK	87	2	-	-	C	II
					GALAS	88	1	-	-	C	II
					RELAI	89	2	-	-	C	II
					BER	93	1	-	-	C	II
					PERGAU	89	2	-	-	C	II
					PEHI	91	2	-	-	C	II
					NAL	90	3	-	-	C	II
					KELESA	90	2	-	-	C	II
					ARING	92	2	-	-	C	II
					KETIL	94	2	-	-	C	I
					KERILLA	93	2	-	-	C	I
	49	GOLOK	89	4	TASIK GARU	88	2	-	-	C	II
					GOLOK	89	2	-	-	C	II
SARAWAK	53	LUPAR	81	7	LUPAR	77	1	2	-	SP	II
					SETERAP	78	-	1	-	SP	II
					AI	83	1	-	-	C	II
					SEKERANG	86	1	-	-	C	II
					UNDUP	89	1	-	-	C	II
	69	TRUSAN	81	1	TRUSAN	81	1	-	-	C	II
	70	LAWAS	81	2	LAWAS	81	2	-	-	C	II
SABAH	71	MENGALONG	83	3	MENGALONG	80	-	1	-	SP	II
					LAKUTAN	82	1	-	-	C	II
					LINGKUNGAN	86	1	-	-	C	II
	72	PADAS	84	7	PADAS	78	1	2	-	SP	III
					PANGATAN	86	1	-	-	C	II
					BUNSIT	86	1	-	-	C	II
					TANDULU	89	1	-	-	C	II
					LIAWAN	89	1	-	-	C	II
	73	MEMBAKUT	83	1	MEMBAKUT	83	1	-	-	C	II
	75	PAPAR	82	2	PAPAR	82	1	1	-	C	II
	77	DAMIT/TUARAN	87	6	DAMIT	86	2	-	-	C	II
					SONG SAI	86	1	-	-	C	II
					TUARAN	88	3	-	-	C	II
	78	KADAMAIAN	86	3	TEMPASUK	90	2	-	-	C	II

Table 1.0(a) Malaysia: Status of Water Quality within the Clean River Basins, 1999 (continued)

STATE	RIVER BASIN CODE	RIVER BASIN NAME	RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION CLEAN	NO. OF STATION SLIGHTLY POLLUTED	NO. OF STATION POLLUTED	RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
					TENGHILAN	77	-	1	-	SP	III
	80	BENGKOKA	84	1	BENGKOKA	83	1	-	-	C	II
	83	SUGUT	87	6	LOHAN	84	2	-	-	C	II
					MERALI	89	1	-	-	C	II
					BONGKUD	87	1	-	-	C	II
					SUGUT	88	2	-	-	C	II
	84	LABOK/LIWAGU	81	8	KINIPIR	83	2	-	-	C	II
					LIWAGU	81	1	1	-	C	II
					MALIAU	85	1	-	-	C	II
					SAPI	78	-	2	-	SP	II
					SUALONG	80	-	1	-	SP	II
	91	TAWAU	83	5	BALUNG	84	1	-	-	C	II
					TAWAU	82	2	1	-	C	II
					APAS	83	1	-	-	C	II
	93	UMAS-UMAS	83	1	UMAS-UMAS	83	1	-	-	C	II
	94	BRANTIAN	81	1	BRANTIAN	81	1	-	-	C	II
TOTAL	35			232			175	57	0		

NOTE:

1. WQI DERIVED BASED ON 6 MAJOR PARAMETERS NAMELY BOD, COD, SS, PH, DO AND NH3-N
2. RIVER WATER QUALITY STATUS IS REPRESENTED BY C : CLEAN, SP : SLIGHTLY POLLUTED AND P : POLLUTED
3. RIVER CLASS IS BASED ON INWQS

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
PERLIS	01	PERLIS	79	10	ARAU	67	-	1	-	SP	III
					JARUM	81	1	-	-	C	II
					JERNIH	86	2	0	-	C	II
					KOK MAK	82	1	-	-	C	II
					NGULANG	82	1	-	-	C	II
					PERALIT	86	1	-	-	C	II
					PERLIS	68	-	1	-	SP	III
					SERAI	79	-	1	-	SP	II
					TASOH	73	-	1	-	SP	III
KEDAH	04	MERBOK	63	10	BAKAR ARANG	53	-	-	1	P	III
					BATU	36	-	-	1	P	IV
					BONGKOK	67	-	1	-	SP	III
					BUKIT MERAH	73	-	1	-	SP	III
					KOROK	43	-	-	1	P	IV
					MERBOK	64	-	1	-	SP	III
					PETANI	63	-	1	-	SP	III
					TOK PAWANG	82	1	1	-	C	II
					TUPAH	70	-	1	-	SP	III
PULAU PINANG	06P	PERAI	62	22	AIR MELINTAS	43	-	-	1	P	IV
					JARAK	67	-	5	1	SP	III
					KELADI	66	-	1	-	SP	III
					KEREH	55	-	-	4	P	III
					KUBANG SEMANG	65	-	2	-	SP	III
					KULIM	83	2	1	-	C	II
					PERAI	65	-	2	-	SP	III
					SELUANG	40	-	-	1	P	IV
					SELUANG BAWAH	42	-	-	2	P	IV
PERAK	08	KERIAN	71	10	KECHIL	64	1	-	2	SP	III
					KERIAN	74	-	4	-	SP	III
					SELAMA	68	-	2	-	SP	III
					SERDANG	83	1	-	-	C	II
	10	SEPETANG	75	10	BATU TEGUH	76	-	2	-	SP	III
					JANA	91	1	-	-	C	II
					LARUT	72	-	1	-	SP	III
					LIDIN	71	-	1	-	SP	III
					MALAI	65	-	1	-	SP	III
					SEPETANG	76	1	2	-	SP	III
					TUPAI	78	-	1	-	SP	II
	12	RAJA HITAM	65	4	DERHAKA	63	-	2	-	SP	III

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
					RAJA HITAM	67	-	2	-	SP	III
	12W	WANGI/	70	6	DERALIK	66	-	1	1	SP	III
		DERALIK			MANJONG	77	-	2	-	SP	II
					WANGI	66	-	2	-	SP	III
	13	PERAK	75	53	SEROKAI	43	-	-	2	P	IV
					PINJI	56	-	1	1	P	III
					PARI	63	-	1	1	SP	III
					KINTA	63	-	3	3	SP	III
					TUMBOH	71	-	1	-	SP	III
					CUAR	75	1	1	-	SP	III
					SUNGKAI MATI	75	-	2	-	SP	III
					RAIA	75	-	2	-	SP	III
					KLIAN BARU	75	1	1	-	SP	III
					KERDAH	75	-	2	-	SP	III
					KUANG	76	-	1	-	SP	III
					BIDOR	76	1	2	-	SP	III
					SELUANG	78	-	1	-	SP	II
					KEPAYANG	79	1	1	-	SP	II
					BATANG PADANG	81	2	1	-	C	II
					PELUS	81	2	-	-	C	II
					PERAK	81	6	2	-	C	II
					KAMPAR	82	2	-	-	C	II
					SUNGKAI	83	2	-	-	C	II
					KANGSAR	84	1	1	-	C	II
					KLAH	85	2	-	-	C	II
					CHENDERIANG	87	2	-	-	C	II
SELANGOR	14	BERNAM	75	10	BERNAM	70	2	2	2	SP	III
					SLIM	78	-	2	-	SP	II
					TEROLAK	87	2	-	-	C	II
	15	TENGI	75	2	TENGI	75	1	1	-	SP	III
	19	LANGAT	69	22	LIMAU MANIS	40	-	-	1	P	IV
					BATANG BENAR	47	-	-	1	P	IV
					BATANG LABU	61	-	1	-	SP	III
					LANGAT	65	1	4	2	SP	III
					CHUAU	73	2	1	1	SP	III
					RINCHING	74	-	1	-	SP	III
					ANAK CHUAU	75	-	3	-	SP	III
					SEMENYIH	82	1	2	-	C	II
					LUI	89	1	-	-	C	II

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
NEG. SEMBILAN	21	LINGGI	72	15	BATANG PENAR	58	-	-	1	P	III
					LINGGI	66	-	5	1	SP	III
					SIMIN	68	-	1	-	SP	III
					KEPAYONG	68	-	1	-	SP	III
					TEMIANG	77	-	1	-	SP	II
					REMBAU	78	-	2	-	SP	II
					CHEMBONG	79	-	1	-	SP	II
					KUNDUR BESAR	84	1	-	-	C	II
					PEDAS	88	1	-	-	C	II
MELAKA	22	MELAKA	68	11	PUTAT	53	-	-	1	P	III
					MELAKA	64	-	4	2	SP	III
					BTG. MELAKA	72	-	2	-	SP	III
					TAMPIN	79	-	1	-	SP	II
					DURIAN TUNGGAL	85	1	-	-	C	II
	23	DUYONG	67	3	DUYONG	67	1	1	1	SP	III
	24	KESANG	74	8	CHOHONG	87	2	-	-	C	II
					KESANG	76	1	2	-	SP	III
					MERLIMAU	62	-	2	1	SP	III
JOHOR	25	MUAR	72	43	KELAMAH	58	-	1	1	P	III
					SENARUT	58	-	1	1	P	III
					SEROM	60	-	1	-	SP	III
					TENANG	62	-	2	-	SP	III
					MERBUDU	65	-	1	-	SP	III
					SPG. LOI	67	-	2	-	SP	III
					MERLIMAU	68	-	1	-	SP	III
					GEMENCHEH	71	-	3	-	SP	III
					MUAR	72	2	14	-	SP	III
					LABIS	76	-	4	-	SP	III
					PALONG	76	-	4	-	SP	III
					SEGAMAT	82	1	-	-	C	II
					P. MENKUANG	90	1	-	-	C	II
					JUASSEH	86	2	-	-	C	II
					TEMARONG	87	1	-	-	C	II
	26	BATU PAHAT	74	23	SIMPANG KANAN	62	-	1	1	SP	III
					BATU PAHAT	62	-	1	-	SP	III
					SIMPANG KIRI	64	-	2	1	SP	III
					SEMBERONG	65	-	2	-	SP	III
					AMRAN	74	-	2	-	SP	III
					BERLIAN	74	-	2	-	SP	III

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
					LENIK	78	-	1	-	SP	II
					BEKOK	79	2	2	-	SP	II
					CHAAH	80	1	1	-	SP	II
					MEREK	86	2	-	-	C	II
					MERPO	89	2	-	-	C	II
	27B	BENUT	71	7	BENUT	68	1	2	1	SP	III
					PT. HAJI YASSIN	70	-	2	-	SP	III
					ULU BENUT	86	1	-	-	C	II
	28A	PONTIAN BESAR	67	5	AIR HITAM	70	-	1	-	SP	III
					AYER MERAH	53	-	-	1	P	III
					PONTIAN BESAR	70	1	1	1	SP	III
	28B	PONTIAN KECIL	75	2	PONTIAN KECIL	75	1	1	-	SP	III
	28C	SKUDAI	68	8	SKUDAI	68	1	6	1	SP	III
	28D	TEBRAU	68	5	PLENTONG	54	-	-	1	P	III
					TEBRAU	72	-	3	1	SP	III
	28F	DANGA	60	2	DANGA	60	-	1	1	SP	III
	29	JOHOR	76	44	BKT. BESAR	62	1	-	1	SP	III
					SENING	63	1	-	1	SP	III
					ANAK SG. SAYONG	66	2	-	1	SP	III
					SANTI	69	-	1	-	SP	III
					SERAI	72	1	1	-	SP	III
					TIRAM	73	2	-	2	SP	III
JOHOR	29	JOHOR			BERANGAN	74	1	1	-	SP	III
					LEBAM	74	-	2	-	SP	III
					SAYONG	77	2	2	-	SP	II
					TEMON	78	1	1	-	SP	II
					SEBOL	79	1	1	-	SP	II
					CHEMANGAR	79	-	1	-	SP	II
					JOHOR	80	1	3	-	SP	II
					SEMENCHU	80	1	1	-	SP	II
					REMIS	82	2	-	-	C	II
					PENGGELI	83	2	-	-	C	II
					LINGGIU	84	1	-	-	C	II
					LAYAU KIRI	85	2	-	-	C	II
					LAYANG	85	1	-	-	C	II
					SEMANGER	88	1	-	-	C	II
					TELOR	89	2	-	-	C	II
	30A	SEDILI BESAR	78	13	MUPUR	68	-	1	-	SP	III
					TEMUBOR KANAN	76	1	1	-	SP	III

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
					SEDILI BESAR	76	1	4	-	SP	III
					DOHOL	79	-	1	-	SP	II
					SEMANGGOT KIRI	82	1	-	-	C	II
					AMBAT	84	2	-	-	C	II
					SEMANGGOT KANAN	87	1	-	-	C	II
	30B	SEDILI KECIL	64	5	ANAK SEDILI KECIL	28	-	-	1	P	V
					BAHAN	73	-	2	-	SP	III
					SEDILI KECIL	73	-	2	-	SP	III
	30C	PALOI	79	2	PALOI	79	-	2	-	SP	II
	32	ENDAU	75	29	PAMOL	46	-	-	1	P	IV
					LENGA	62	-	2	-	SP	III
					SINGOL	67	1	-	1	SP	III
					JEBONG	72	-	1	-	SP	III
					MELANTAI	74	1	1	-	SP	III
					MENGKIBOL	73	1	2	-	SP	III
					DENGAR	77	1	1	-	SP	II
					SEMBERONG	78	1	4	-	SP	II
					MAMAI	79	1	1	-	SP	II
					ENDAU	80	-	1	-	SP	II
					LENGGOR	81	1	1	-	C	II
					TAMOK	82	1	1	-	C	II
					A.S. SEMBERONG	83	1	1	-	C	II
					PALOH	85	2	-	-	C	II
PAHANG	32/33	PONTIAN	75	3	PONTIAN	79	1	1	-	SP	II
					SEPAYANG	68	-	1	-	SP	III
	33	ROMPIN	80	18	BAKAR	57	-	-	1	P	III
					REKOH	68	-	1	-	SP	III
					KEPASING	77	-	1	-	SP	II
					KERATONG	78	-	4	-	SP	II
					ROMPIN	79	1	3	-	SP	II
	33	ROMPIN			AUR	83	1	-	-	C	II
					JERAM	86	1	-	-	C	II
					PUKIN	88	3	-	-	C	II
					JEKATIH	89	2	-	-	C	II
	34	BEBAR	78	8	MERCHONG	63	-	1	-	SP	III
					BEBAR	68	-	1	-	SP	III
					MERBA	75	-	1	-	SP	III
					TEMIANG	82	1	1	-	C	II
					KELAYAT	85	1	-	-	C	II

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
					SERAI	85	2	-	-	C	II
	35	SERTING	68	7	MOKEK	69	-	2	-	SP	III
					SERTING	68	-	4	1	SP	III
	35B	BERA	74	5	BERA	73	-	3	-	SP	III
					TASIK BERA	73	-	1	-	SP	III
					TRIANG	77	-	1	-	SP	II
	35CH	BERTAM	78	10	TELOM	69	-	2	-	SP	III
					TRINGKAP	73	-	1	-	SP	III
					BERTAM	76	1	1	-	SP	III
					HABU	78	-	1	-	SP	II
					RINGLET	78	-	1	-	SP	II
					LENGGOK	85	1	-	-	C	II
					TERLA	86	1	-	-	C	II
					BURUNG	86	1	-	-	C	II
	36	KUANTAN	77	11	GALING BESAR	47	-	-	1	P	IV
					GALING KECIL	58	-	-	1	P	III
					PINANG	70	-	1	-	SP	III
					RIAU	76	-	1	-	SP	III
					CHARU	83	1	-	-	C	II
					BELAT	84	1	-	-	C	II
					KUANTAN	86	3	1	-	C	II
					KENAU	87	1	-	-	C	II
	37	BALOK/ TONGGOK	70	5	BALOK	65	-	2	-	SP	III
					TONGGOK	73	-	3	-	SP	III
	37A	CERATING	73	1	CERATING	73	-	1	-	SP	III
TERENGGANU	38	KEMAMAN	80	10	RANSAN	71	1	-	1	SP	III
					NERAM	79	1	1	-	SP	II
					PERASING	80	1	1	-	SP	II
					CHERUL	85	2	-	-	C	II
					KEMAMAN	88	2	-	-	C	II
	39C	CHUKAI	72	5	RUANG	66	-	2	-	SP	III
					CHUKAI	75	-	1	-	SP	III
					IBOK	77	-	2	-	SP	II
	39K	KERTIH	79	1	KERTIH	79	-	1	-	SP	II
	42I	IBAI	68	3	IBAI	68	-	3	-	SP	III
	42M	MARANG	74	5	KERAK	72	-	2	-	SP	III
					MARANG	75	-	1	-	SP	III
					TEMALA	75	-	2	-	SP	III

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
KELANTAN	47K	KEMASIN	77	1	KEMASIN	77	-	1	-	SP	II
	47S	SEMERAK	74	2	SEMERAK	74	-	2	-	SP	III
SARAWAK	50	KAYAN	76	4	KAYAN	72	0	3	-	SP	III
					SEMATAN	88	1	-	-	C	II
	51	SARAWAK	72	15	MAONG KIRI	45	-	-	1	P	IV
					TABUAN	68	-	1	-	SP	III
					KUAP	68	-	2	-	SP	III
					SEMENGGOH	70	-	2	-	SP	III
					SANTUBONG	73	-	1	-	SP	III
					SARAWAK KANAN	75	-	1	-	SP	III
	51	SARAWAK			SARAWAK	77	1	5	-	SP	II
					SARAWAK KIRI	82	1	-	-	C	II
	51BS	SAMARAHAN	72	2	SAMARAHAN	72	-	2	-	SP	III
	52	SADONG	77	6	KARANGAN	77	-	1	-	SP	II
					SADONG	74	1	2	-	SP	III
					TARAT	83	2	-	-	C	II
	54	SARIBAS	77	2	RIMBAS	85	1	-	-	C	II
					SARIBAS	68	-	1	-	SP	III
	55	KERIAN	70	3	KERIAN	68	-	2	-	SP	III
					SEBLAK	74	-	1	-	SP	III
	56	RAJANG	77	18	RAJANG	75	-	14	-	SP	III
					SARIKEI	76	-	1	-	SP	II
					MERADONG	83	1	-	-	C	II
					JULAU	85	1	-	-	C	II
					BINATANG	86	1	-	-	C	II
	57	OYA	71	3	OYA	71	-	3	-	SP	III
	58	MUKAH	70	4	MUKAH	70	-	4	-	SP	III
	59	BALINGIAN	74	2	BALINGIAN	74	-	2	-	SP	III
	60	TATAU	78	1	TATAU	78	-	1	-	SP	II
	61	KEMENA	76	3	KEMENA	75	-	2	-	SP	III
					SIBIU	77	-	1	-	SP	III
	62	SIMILAJAU	79	1	SIMILAJAU	79	-	1	-	SP	II
	63	SUAI	74	1	SUAI	74	-	1	-	SP	III
	64	NIAH	68	5	NIAH	77	-	2	-	SP	II
					SEKALOH	62	-	1	2	SP	III
	65	SIBUTI	75	6	KABULOH	67	-	2	-	SP	III
					SIBUTI	78	-	2	-	SP	II
					SATAP	82	1	-	-	C	II
					KEJAPIL	80	-	1	-	SP	II

Table 1.0(b) Malaysia: Status of Water Quality within the Slightly Polluted Basins, 1999 (continued)

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI[1]	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
	66	MIRI/LUTONG	63	4	LUTONG	64	-	2	-	SP	III
					MIRI	62	-	2	-	SP	III
	67	BARAM	64	4	BARAM	64	-	4	-	SP	III
	68	LIMBANG	77	5	LIMBANG	77	-	5	-	SP	II
SABAH	76	MOYOG	80	11	LIKAS	61	-	1	-	SP	III
					TELIPOK	70	-	2	-	SP	III
					INANAM	83	1	2	-	C	II
					MENGGATAL	85	2	-	-	C	II
	76	MOYOG			MOYOG	85	3	-	-	C	II
	79	BINGKONGAN	77	3	MENGGARIS	54	-	-	1	P	III
					TANDEK	79	-	1	-	SP	II
					BANDAU	87	1	-	-	C	II
	85	KAYA	79	1	MOUNAD	79	-	1	-	SP	II
	86	KINABATANGAN	76	4	TENEGANG BESAR	74	-	1	-	SP	III
					KOYAH	77	-	1	-	SP	II
	86	KINABATANGAN			KINABATANGAN	77	1	1	-	SP	II
	87	SEGAMA	78	1	SEGAMA	78	-	1	-	SP	II
	88	SILABUKAN	75	2	SILABUKAN	75	-	2	-	SP	III
	89	TINGKAYU	72	1	TINGKAYU	72	-	1	-	SP	III
	90	KALUMPANG	79	5	PANG BURONG 2	67	-	1	-	SP	III
					PANG BURONG 1	72	-	1	-	SP	III
					KALUMPANG	84	2	-	-	C	II
					INTAN	85	1	-	-	C	II
	95	KALABAKAN	78	2	KALABAKAN	78	-	2	-	SP	II
TOTAL	72			598			166	368	64		

NOTE:

1. WQI DERIVED BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, PH, DO, NH3-N
2. RIVER WATER QUALITY STATUS: C : CLEAN, SP : SLIGHTLY POLLUTED AND P : POLLUTED
3. RIVER CLASS IS BASED ON INWQS

Table 1.0(c) Malaysia: Status of River within the Polluted River Basins, 1999

STATE	RIVER BASIN		RIVER BASIN OVERALL WQI	TOTAL NUMBER OF STATIONS	RIVER	RIVER OVERALL WQI[1]	NO. OF STATION			RIVER WATER QUALITY STATUS[2]	RIVER CLASS[3]
	CODE	NAME					CLEAN	SLIGHTLY POLLUTED	POLLUTED		
PULAU PINANG	06J	JURU	46	8	ARA	50	-	-	1	P	IV
					JURU	45	-	-	1	P	IV
					KILANG UBI	45	-	-	2	P	IV
					PASIR	37	-	-	1	P	IV
					RAMBAI	48	-	1	2	P	IV
	06PP	PINANG	41	7	AIR ITAM	50	-	-	1	P	IV
					DONDANG	42	-	-	3	P	IV
					JELUTONG	25	-	-	1	P	V
					KLUANG	47	-	-	1	P	IV
					PINANG	38	-	-	1	P	IV
	07	JEJAWI	56	5	CEMPEDAK	43	-	-	1	P	IV
					JAWI	61	1	-	2	SP	III
					JUNJONG	57	-	-	1	P	III
SELANGOR	17	BULOH	58	5	BULOH	58	-	2	3	P	III
	18	KLANG	51	24	PENCALA	29	-	-	1	P	V
					KEROH	44	-	-	1	P	IV
					KERAYONG	46	-	-	1	P	IV
					JINJANG	46	-	-	1	P	IV
					KLANG	50	1	-	9	P	IV
					KUYOH	52	-	-	1	P	IV
					AMPANG	55	-	-	1	P	III
					BATU	55	-	-	2	P	III
					DAMANSARA	58	-	1	2	P	III
					GOMBAK	68	1	2	-	SP	III
	20	SEPANG	57	3	SEPANG	57	-	1	2	P	III
NEGERI SEMBILAN	20J	LUKUT	59	1	LUKUT	59	-	-	1	P	III
JOHOR	27A	AIR BALOI	57	3	AIR BALOI	57	-	-	3	P	III
	28	SEGGET	45	5	SEGGET	45	-	-	5	P	IV
	28E	KEMPAS	42	2	KEMPAS	42	-	-	2	P	IV
	28G	RAMBAH	57	2	RAMBAH	57	-	-	2	P	III
	29B	TUKANG BATU	46	5	TUKANG BATU	28	-	-	1	P	V
					BULUH	35	-	-	1	P	IV
					PEREMBI	42	-	-	1	P	IV
					LATOH	61	-	1	-	SP	III
					MASAI	62	-	1	-	SP	III
TERENGGANU	42L	LANDAS	53	2	LANDAS	53	-	1	1	P	III
TOTAL	13			72			3	10	59		

NOTE:
1. WQI DERIVED BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, PH, DO, NH3-N
2. RIVER WATER QUALITY STATUS: C : CLEAN, SP : SLIGHTLY POLLUTED AND P : POLLUTED
3. RIVER CLASS IS BASED ON INWQS

In terms of water quality on the basis of river basins, 35 river basins (29%) were clean compared to 33 river basins in 1998; 72 (60%) slightly polluted compared to 71 in 1998; and 13 (11%) polluted compared to 16 in 1998. The 13 polluted river basins were Sungai Lukut in Negeri Sembilan; Sungai Landas in Terengganu; Sungai Buloh, Sungai Sepang and Sungai Kelang in Selangor; Sungai Jejawi, Sungai Juru and Sungai Pinang in Pulau Pinang; and Sungai Rambah, Sungai Air Baloi, Sungai Tukang Batu, Sungai Segget and Sungai Kempas in Johor. Three river basins that had improved in terms of their status from polluted to slightly polluted were Sungai Merbok (Kedah), Sungai Balok (Pahang) and Sungai Miri (Sarawak). Of the 36 rivers within the 13 polluted river basins, 14 rivers (39%) were under Class III while the remaining 22 rivers (61%) fell under Class IV and Class V of the INWQS **(Table 1.0 (c))**.

Figure 13 illustrates the status of river water quality in relation to the major pollution sources, whereby 28% of river basins were polluted by ammoniacal nitrogen (NH_3-N) from sewage that include livestock farming and domestic sewage; 26% by biochemical oxygen demand (BOD) due to sewage and discharges from agro-based and manufacturing industries, while 38% by suspended solids (SS) due to earthworks and land-clearing activities. The corresponding figures in 1998 were 43%, 21% and 34% for NH_3-N, BOD and SS respectively. The relatively significant improvement in terms of NH_3-N could be attributed to the reduction of waste discharges following the closure of many pig farms after the *Japanese Encephalitis* /Nipah virus outbreak in 1999.

Out of the 902 monitoring stations, 318 stations were selected for comparative monitoring of the impact of effluent discharges from palm oil mills directly into watercourses (upstream and downstream). Of the 179 downstream stations, 103 stations (58%) had no appreciable impact, while the water quality at 76 stations (42%) deteriorated in terms of BOD.

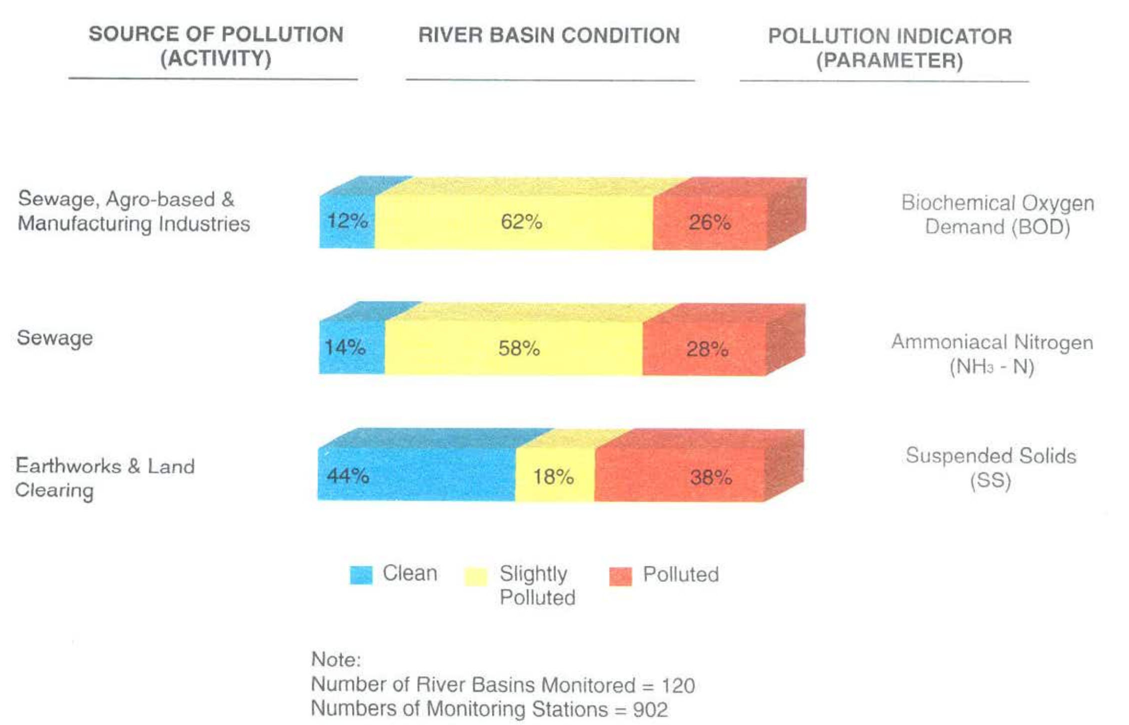


Figure 13 Malaysia: Status of River Water Quality Based on Activity, 1999

Photo 9: Industrial Effluent Discharge (DOE Photo Library)

Photo 10: Extensive Land Clearing for Development (DOE Photo Library)

Photo 11: River water with high level of Suspended Solids resulting from uncontrolled land activities *(DOE Photo Library)*

Based on data available in 1999, 696 sewage treatment plants were located upstream of water intake points and were subject to Standard A of the Environmental Quality (Sewage and Industrial Effluents) Regulations 1979. Out of the 696 plants, 57 plants (8%) were visited in 1999 and 794 effluent samples were taken to determine compliance status in relation to pH, COD, BOD_5, oil and grease and SS. The results showed that only 41 samples (5%) complied fully with the prescribed limits and those were taken from 23 sewage treatment plants in Perak, 7 in Negeri Sembilan, 3 in Pahang, 2 in Kedah and 2 in Selangor. Thus it could generally be concluded that a lot more improvement and refurbishment works need to be implemented to bring about regulatory compliance by all sewage treatment plants.

In terms of heavy metal contamination, out of the 5,274 river water samples analysed for heavy metals, only 7% of the samples exceeded the Class III (INWQS) standards for Cadmium (Cd), 2% for Zinc (Zn), 1% for Lead (Pb) and 0.2% for Chromium (Cr). However, Sungai Kempas in Johor was heavily affected by the presence of heavy metals due to industrial effluent discharges from the Tampoi Industrial Zone and its adjacent areas. Out of 24 samples taken from Sungai Kempas in 1999, 96% of the samples exceeded the Class III levels for Iron (Fe), 87% for Zn, 42% for Cd, 33% for Pb and 8% for Cr.

Figure 14 and 14(a) show river water quality trend between 1990 and 1999. Overall, the general noticeable trend over the 10-year period was a reduction in the number of clean rivers. Under the Eighth Malaysia Plan, DOE has initiated an action programme for improvement of water quality of selected rivers to be implemented over a period of at least 10 years. This proposed programme will compliment on-going and future river clean-up activities of other agencies at the federal and state levels.

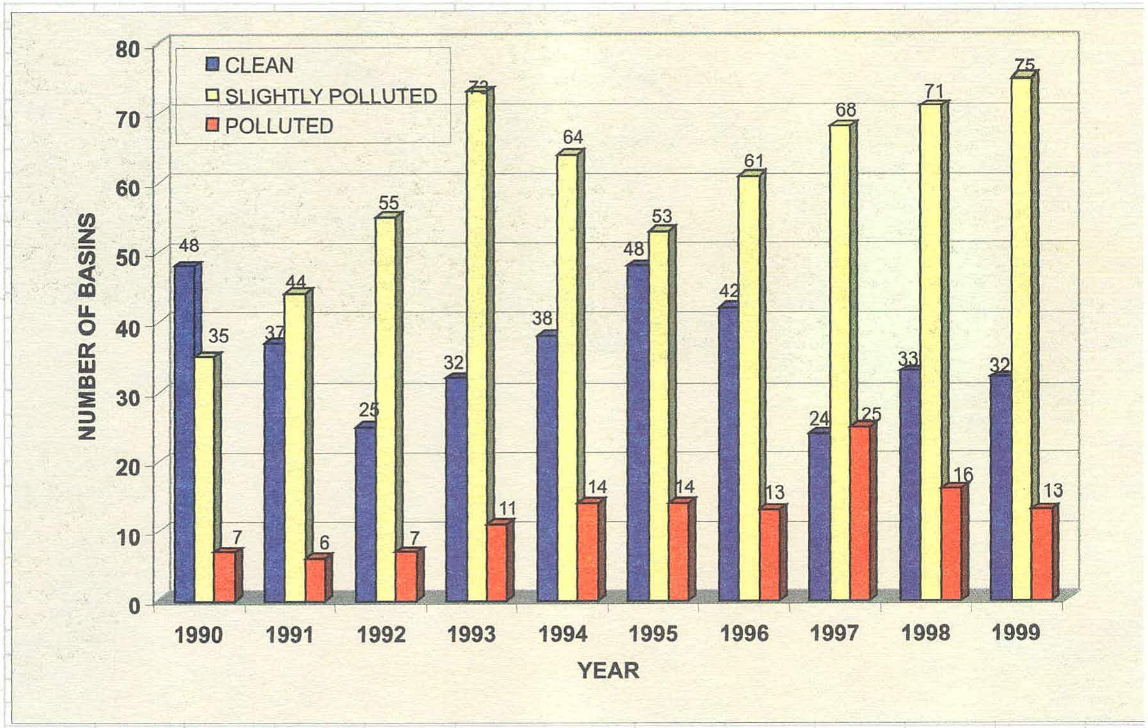


Figure 14 Malaysia: Trend of Water Quality Status of River Basins, 1990-1999

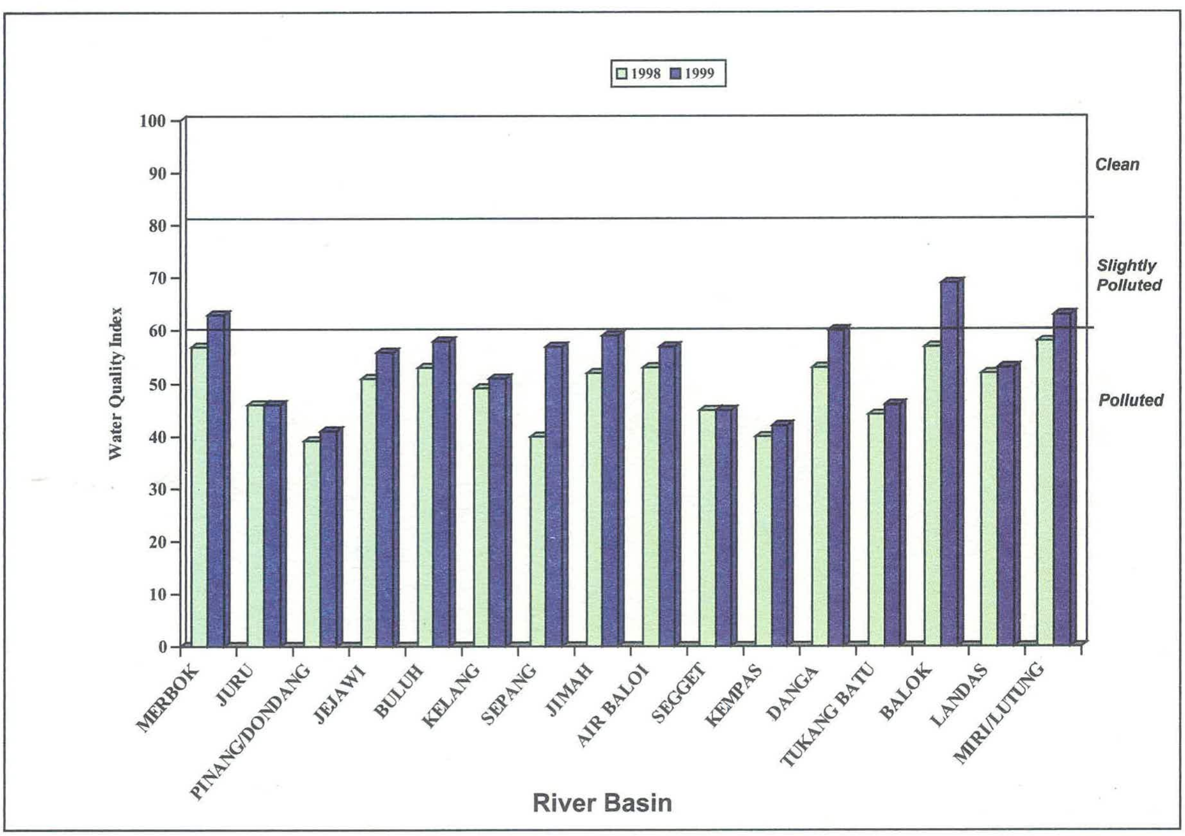


Figure 14(a) Malaysia: Water Quality Status Of Polluted River Basins, 1998-1999

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

GROUND WATER QUALITY

Introduction

Groundwater is expected to become an important source of water for domestic and industrial uses particularly in areas facing surface water shortages. However, groundwater sources are vulnerable to contamination. Groundwater quality can also be influenced by soil and subsurface geological formations which affect the chemical composition and constituent concentration of groundwater. **Map 3** shows the hydrogeological map of Peninsular Malaysia and their groundwater potential.

DOE initiated groundwater monitoring in 1997 and by 1999, 61 monitoring wells at 41 sites in Peninsular Malaysia had been established (**Map 4**). Monitoring sites were identified based on major categories of land use, namely industrial areas, golf courses, animal burial areas, rural areas, urban/suburban areas, agricultural areas and landfills.

Groundwater Quality Status

Groundwater monitoring was intensified in 1999 and 119 samples were collected from 61 monitoring wells in Peninsular Malaysia. The parameters monitored were volatile organic compounds (VOC), pesticides, heavy metals, anions, bacteria, phenolic compounds, radioactivity, total hardness, total dissolved solids (TDS), pH, temperature, electrical conductivity and dissolved oxygen. Preliminary results showed that the level of some parameters exceeded the benchmark values for raw water quality under the National Guidelines for Drinking Water Quality (1990) (**Table 2**).

Photo 12: Groundwater Monitoring Station *(DOE Photo Library)*

Map 3 Peninsular Malaysia: Hydrogeological map

Map 4: Peninsular Malaysia: Location of Groundwater Quality Monitoring Wells, 1999

Table 2 Malaysia: National Guidelines for Drinking Water Quality

CHEMICAL	SYMBOL	BENCHMARK
SULPHATE	SO_4	400 mg/l
HARDNESS	$CaCO_3$	500 mg/l
NITRATE	NO_3	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

In general, high iron (Fe) levels had been observed ranging between 36% to 75% exceeding the benchmark for agricultural, industrial, landfill, golf course and urban/ suburban landuse categories (**Figure 15**). The high values could also be attributed to the naturally-occurring ferum constituent in the soil.

Mercury levels were recorded exceeding benchmark values for agricultural (10%), landfill (6%) and industrial sites (15%), while for arsenic, the level exceeding benchmark values for agricultural, landfill and industrial sites were respectively 9%, 27% and 11%

Phenolic compounds exceeding benchmark

values at landfills (8%), industrial sites (10%) and golf courses (11%) were detected. Nitrate levels exceeding the benchmark were detected at agricultural areas (8%), landfill sites (8%), industrial sites (50%). The occurrence of high nitrate levels could be due to fertiliser use and sewage seepage into the soil.

The groundwater quality located at all 19 industrial sites monitored were found to be more contaminated than those in other sites, in terms of percentage exceeding benchmark values (**Figure 16**).

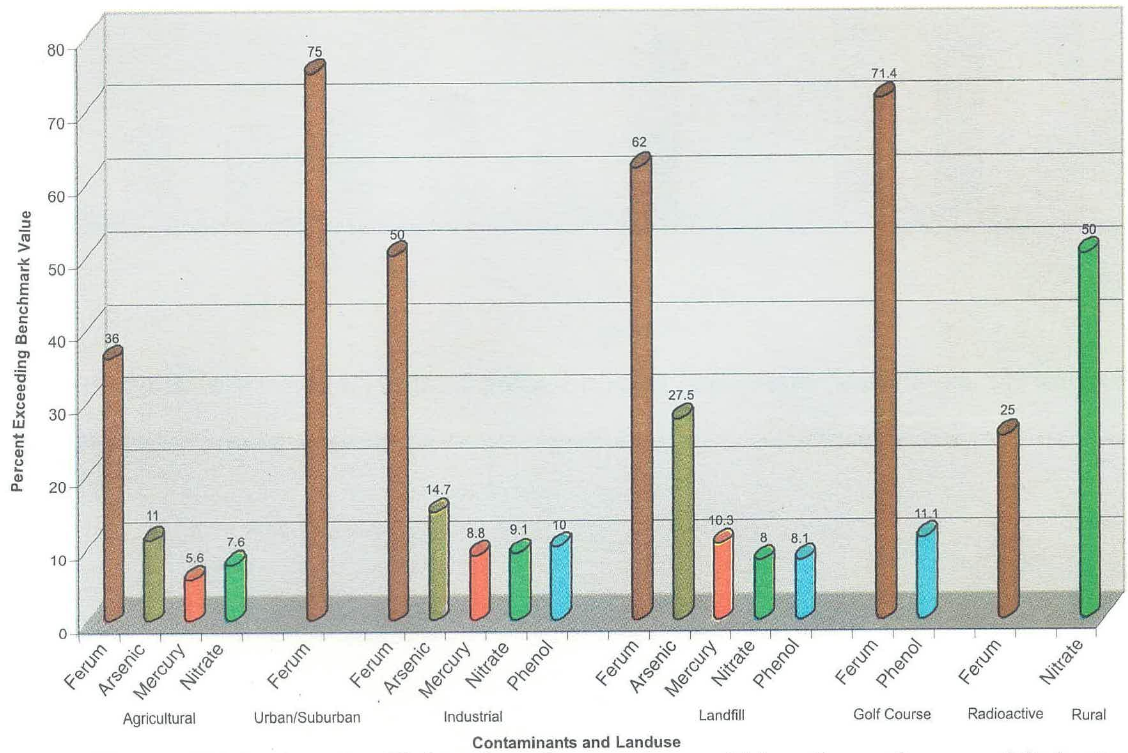


Figure 15 Peninsular Malaysia: Percentage of Non-Compliance of Selected Contaminants by Landuse, 1999

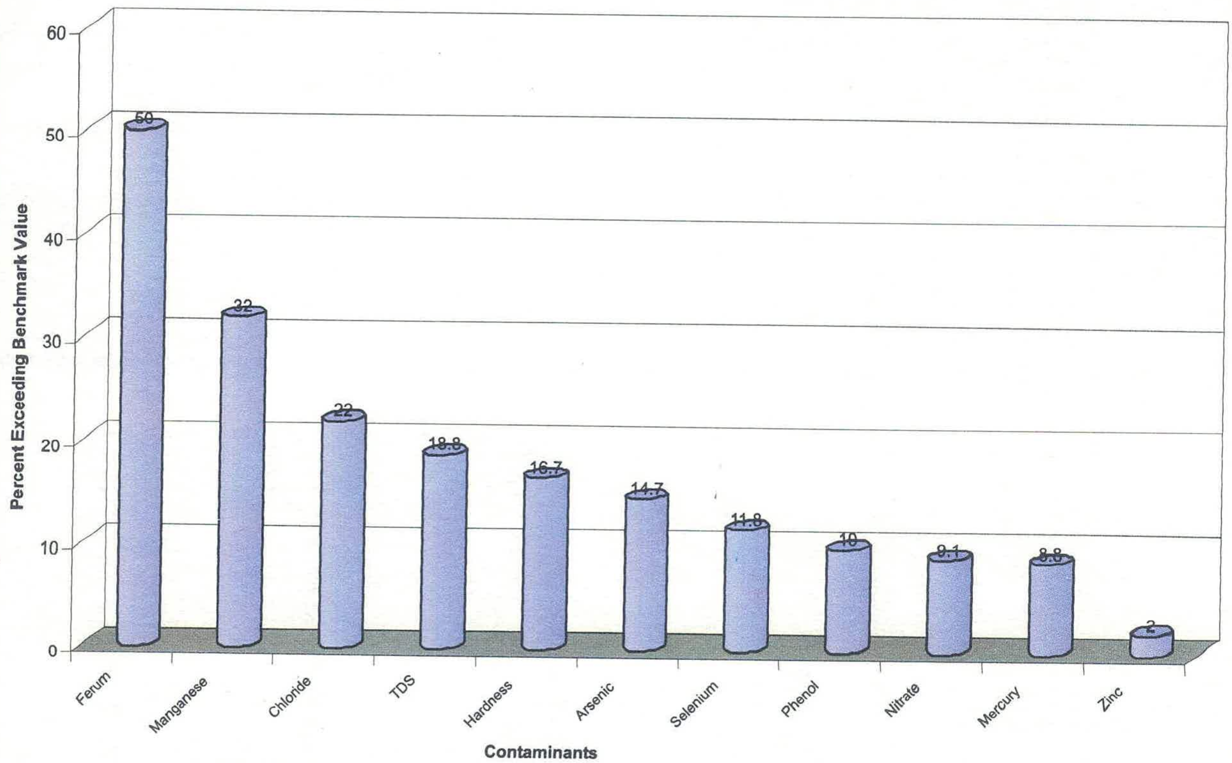


Figure 16: Peninsular Malaysia: Groundwater Quality At Industrial Sites, 1999

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

MARINE ENVIRONMENTAL QUALITY

Marine Water Quality Status

In 1999, a total of 1,184 samples were collected from 237 marine monitoring stations, compared to 836 samples from 231 monitoring stations in 1998. As in previous years, the main contaminants of the coastal waters in all States were total suspended solids (TSS), oil and grease (OG) and *Escherichia coli* (*E. coli*) (**Figure 17**).

Of the 1,184 samples analyzed, 71 % of samples for total suspended solids, 50 % for oil and grease and 49 % for *E. coli* exceeded the Proposed Interim Marine Standards (**Table 3**). On the whole marine water quality in 1999 had improved for oil and grease and total suspended solids but worsened for *E. coli* as compared to the previous year.

Contamination by suspended solids were highest in the coastal waters off Melaka, Perak and Negeri Sembilan. All samples collected showed levels exceedingthe interim standard of 50 mg/l for total suspended solids (TSS). Estuaries with high level of suspended solids included Kuala Sg. Lukut in Negri Sembilan, Kuala Sg. Merlimau and Kuala Sg. Sebatu in Melaka and Kuala Sg.Sepetang and Kuala Sg. Gula in Perak. Coastal reclamation and intensive clearing of land areas for development such as construction of hotels and resorts along the coast brought about erosion and siltation of coastal waters resulting in high levels of TSS.

Oil and grease contamination were detected in all samples in the coastal waters off Kedah/ Perlis, Pulau Pinang and Pulau Langkawi, while no oil and grease contamination was detected in Sabah. The increasing levels of oil and grease in the marine environment could be attributed to discharges of ballast water and bilges from vessels, bunkering, tanker cleaning activities, leakages and indiscriminate disposal of waste oil from fishing vessels and other marine crafts.

With respect to *E.coli*, levels exceeding 100 MPN/100 ml were observed at Pantai Gertak

Table 3 Malaysia : Interim Standards for Marine Water Quality

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	0.05
Cadmium	Cd	mg/l	0.005
Chromium (total)	Cr	mg/l	0.1
Cooper	Cu	mg/l	0.01
Lead	Pb	mg/l	0.05
Mercury	Hg	mg/l	0.0005
Nickel	Ni	mg/l	0.1

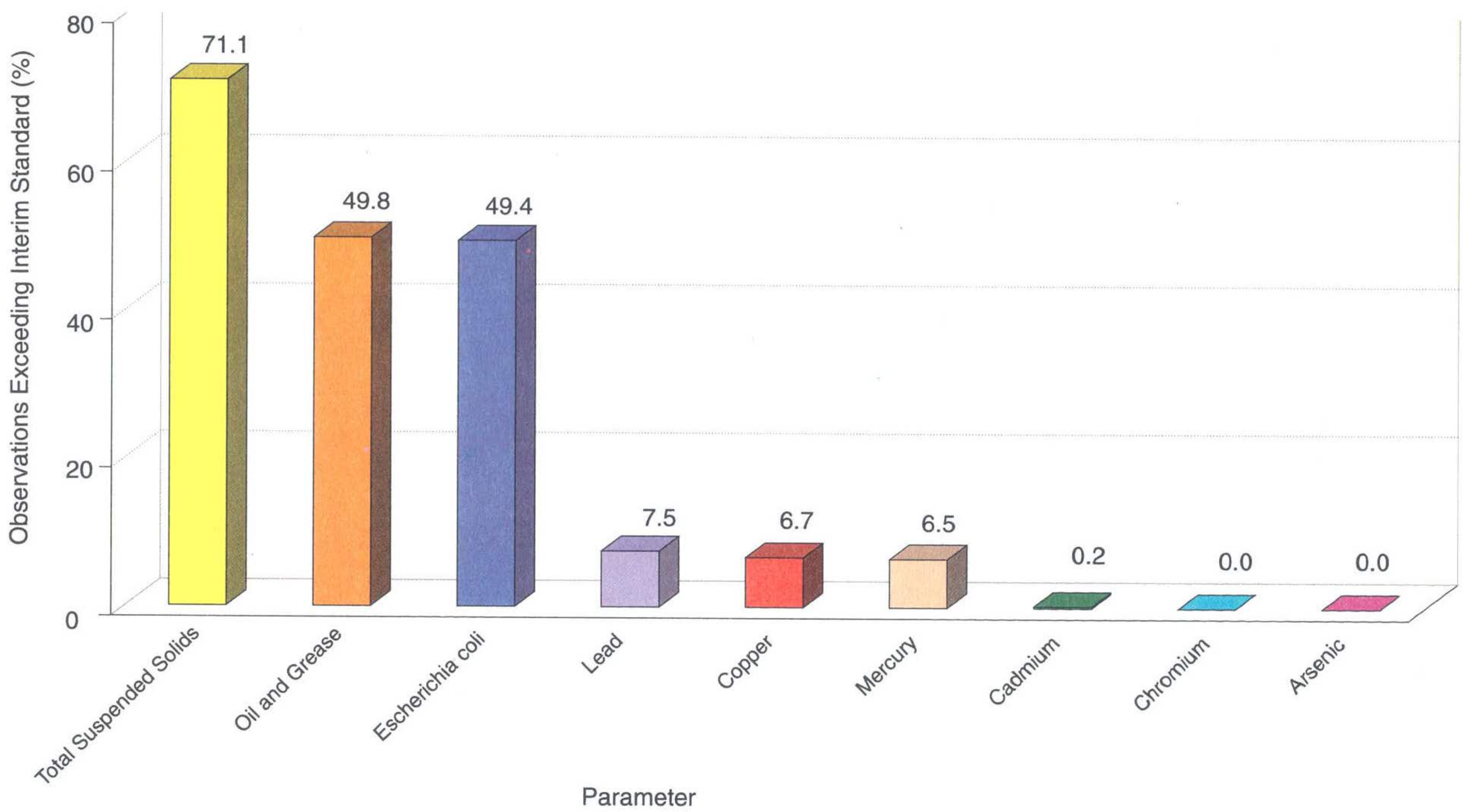


Figure 17 Malaysia: Status of Marine Water Quality, 1999

Sanggul, Pantai Teluk Tempoyak, Kuala Sg. Juru and Kuala Sg. Pinang in Penang; Kuala Sg. Sepetang and Kuala Sg. Tg. Piandang in Perak; and Pantai Morib, Kuala Sg. Tengi and Kuala Sg. Selangor in Selangor. The presence of *E.coli* in coastal waters was principally attributed to discharges of partially treated or untreated domestic sewage and animal wastes.

As for heavy metal pollution, copper (Cu) levels exceeding the interim standard of 0.1 mg/l were recorded in the coastal waters off Sarawak, Penang, Langkawi, Kedah/Perlis and Sabah; mercury (Hg) levels exceeding the interim standard of 0.001 mg/l were observed in the coastal waters of all States, except Kelantan, Sarawak, Terengganu and Langkawi; lead (Pb) exceeding the interim standard of 0.1 mg/l were found in 50% of samples collected off Perak and 22% collected off Sarawak. Chromium and arsenic levels were found to be within the interim standards.

Marine monitoring studies conducted throughout the country revealed that discharges associated with partially treated and untreated industrial wastes and from other land-based sources greatly influenced the level of heavy metal contaminants in the marine water. This was particularly true for industrial areas situated close to the sea such as in Manjung and Lumut (Perak), Bayan Lepas (Penang) and Kuching (Sarawak) where high levels of copper and lead were detected.

Island Marine Water Quality

In 1999, 736 samples were collected from 85 monitoring stations established around 71 islands within Malaysia (**Table 4**), which had been categorised as Marine Park Islands (38), Resort Islands (25), Development Islands (3) and Protected Islands (5). Rapid development

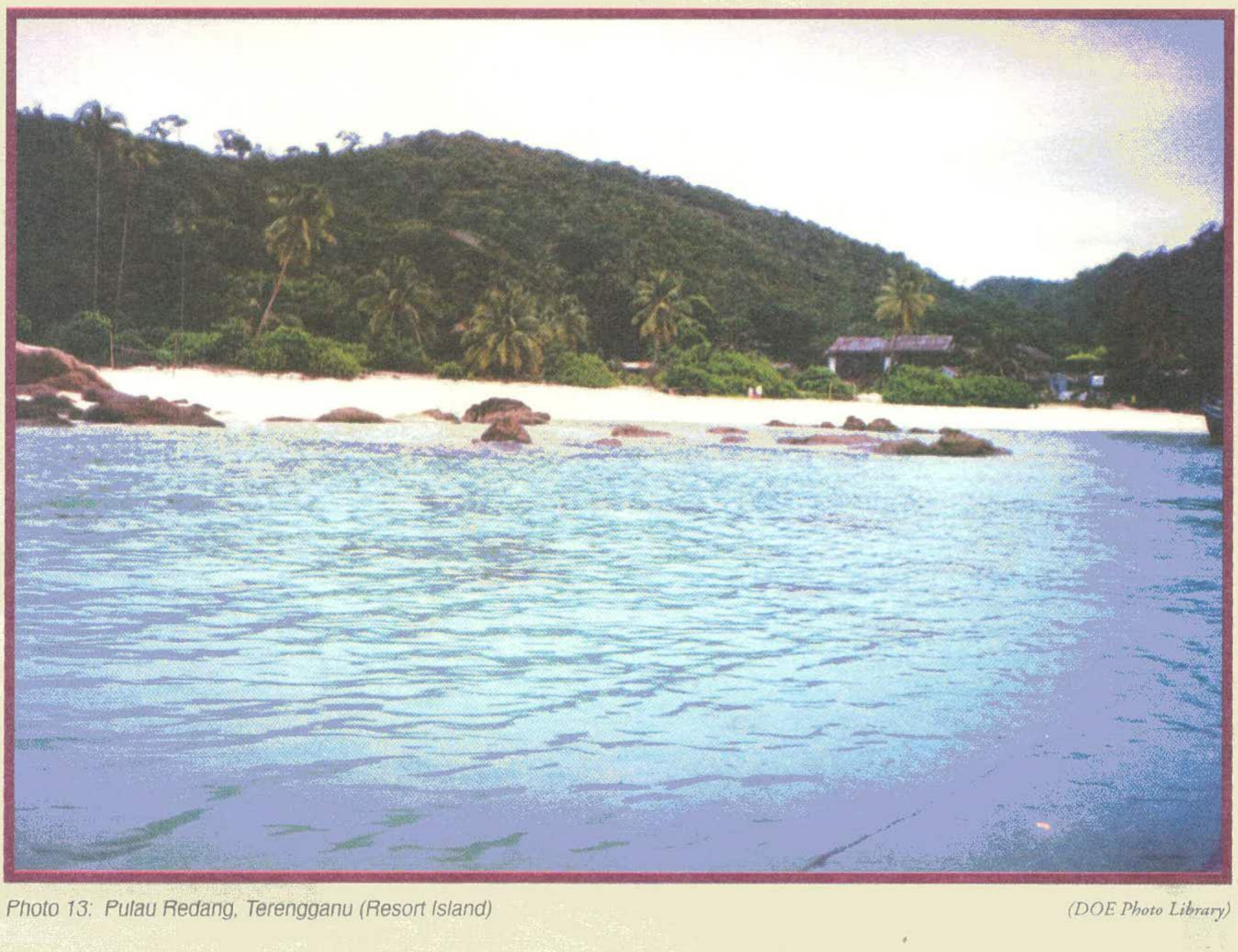


Photo 13: Pulau Redang, Terengganu (Resort Island) *(DOE Photo Library)*

Photo 14: Marine Water Quality Sampling at Pulau Redang, Terengganu *(DOE Photo Library)*

activities and animal husbandry wastes on those islands could be the contributing sources for presence of high levels of *E.coli*. The rapid growth and expansion of major urban centres had also compounded the problem of providing adequate sewage treatment facilities on these islands. Several Resort Islands at Penang, Terengganu and Selangor and the Marine Park Islands of Kedah and Sabah recorded a much lower level of *E. coli* contamination exceeding interim standards (14.5% and 1.5% respectively) compared to Development Islands. The occurrence of *E.coli* exceeding the interim standards at some Resort and Marine Park islands would be attributed to the lack of suitable and efficient waste treatment facilities (**Figure 18**).

The percentage of samples for total suspended solids exceeding interim standards at Pulau Pinang, (categorised as a Development Island (with stations at Gertak Sanggol and Teluk Bahang) was 9.7%, which was relatively higher compared to the other categories. Construction activities for resorts, hotels, housing development and associated infrastructure such as roads and jetties had been identified to contribute to siltation of coastal water around Pulau Pinang.

Oil and grease contamination was relatively low compared to levels off the mainland. Levels exceeding the interim standard were found in 2 % of samples from the Resort Islands of Pulau Sembilan (Perak), Pulau Rimau (Penang) and Pulau Mabul and Pulau Sipadan (Sabah); 1.5% of samples from Development Islands (Pulau Langkawi and Pulau Labuan); and 1 % of samples from the Marine Park Islands of Pulau Segantang,

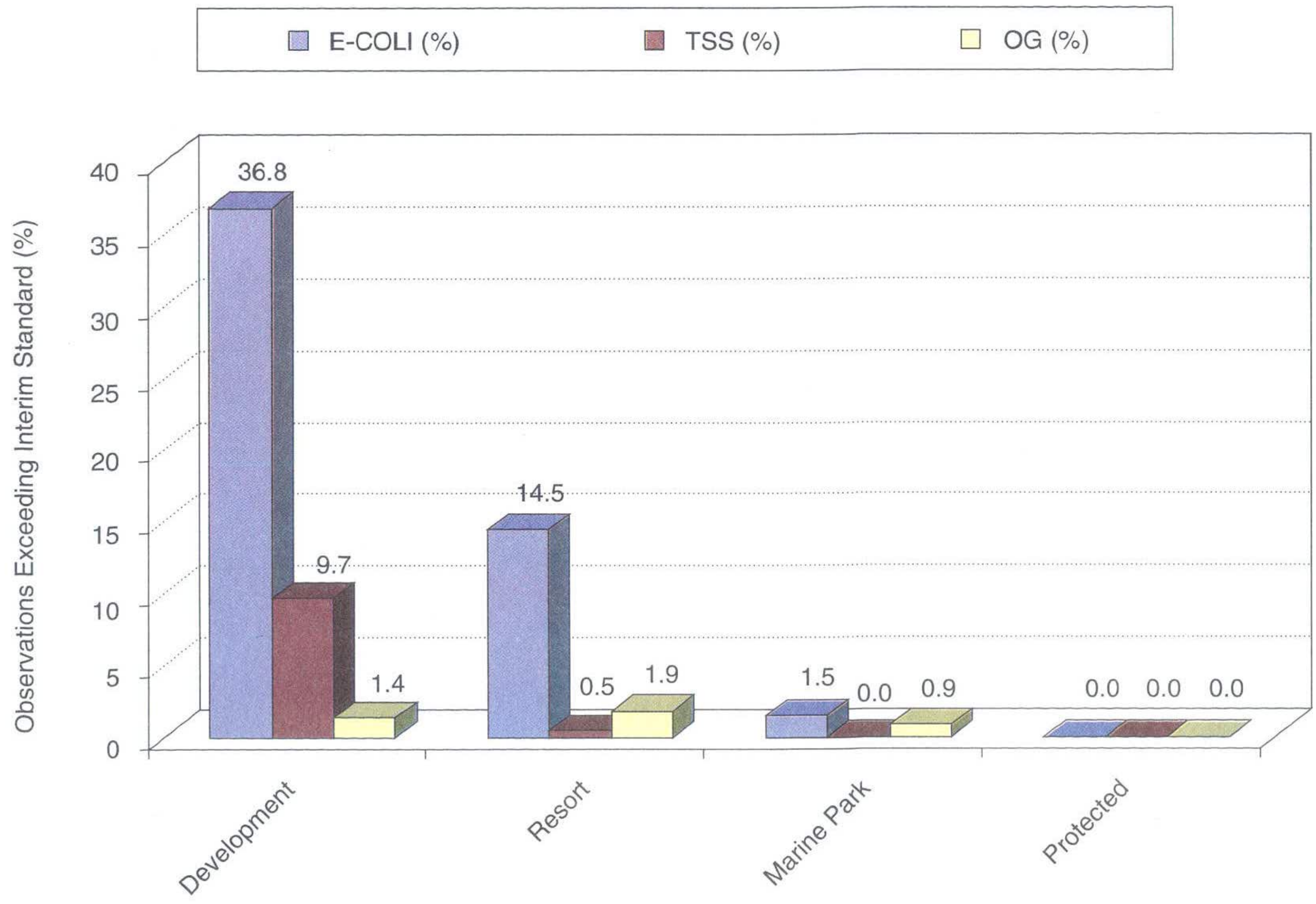


Figure 18 Malaysia: Status of Island Marine Water Quality, 1999

Table 4 Department of Environment: Island Marine Water Quality Monitoring, 1999

NO	STATE	ISLAND	CATEGORY	NO. OF STATIONS
1.	KEDAH	Langkawi	Development	4
		Singa Besar	Resort	1
		Dayang Bunting	Resort	1
		Payar	Marine Park	1
		Kaca	Marine Park	1
		Lembu	Marine Park	1
		Segantang	Marine Park	1
2.	PERAK	Pangkor	Resort	2
		Pangkor Laut	Resort	1
		Sembilan	Resort	1
3.	PULAU PINANG	Pulau Pinang	Development	4
		Aman	Resort	1
		Jerejak	Resort	1
		Gedong	Resort	1
		Kendi	Resort	1
		Rimau	Resort	1
4.	SELANGOR	Ketam	Resort	1
		Angsa	Resort	1
		Lumut	Resort	1
5.	MELAKA	Besar	Resort	1
		Upeh	Resort	1
6.	PAHANG	Tioman	Marine Park	2
		Tulai	Marine Park	1
		Chebeh	Marine Park	1
		Labas	Marine Park	1
		Sepui	Marine Park	1
		Seri Bulat	Marine Park	1
		Sembilan	Marine Park	1
		Tokong Berhala	Marine Park	1

Table 4 Department of Environment: Island Marine Water Quality Monitoring, 1999

NO	STATE	ISLAND	CATEGORY	NO. OF STATIONS
		But	Marine Park	1
7.	JOHOR	Setindan	Resort	1
		Harimau	Marine Park	1
		Mensirip	Marine Park	1
		Gual	Marine Park	1
		Rawa	Marine Park	1
		Pemanggil	Marine Park	1
		Hujung	Marine Park	1
		Tengah	Marine Park	1
		Hujung Tengah	Resort	1
		Dayang	Resort	1
		Aur	Marine Park	1
		Besar	Marine Park	1
		Tinggi	Marine Park	1
		Mentinggi	Marine Park	1
		Sibu	Marine Park	1
		Sibu Hujung	Marine Park	1
8.	TERENGGANU	Gumia	Resort	1
		Kapas	Marine Park	1
		Tenggol	Protected	1
		Nyireh	Protected	1
		Bidong	Resort	1
		Duyong	Resort	1
		Susu Dara	Marine Park	1
		Perhentian Besar	Marine Park	2
		Redang	Marine Park	2
		Perhentian Kecil	Marine Park	1
		Lang Tengah	Marine Park	1
		Pinang	Marine Park	1

Table 4 Department of Environment: Island Marine Water Quality Monitoring, 1999

NO	STATE	ISLAND	CATEGORY	NO. OF STATIONS
		Ekor Tebu	Marine Park	1
		Lima	Marine Park	1
9.	SABAH	Gaya	Resort	1
		Layang-Layang	Resort	1
		Ligitan	Resort	1
		Sipadan	Resort	2
	(Labuan)	Labuan	Development	4
		Kuraman	Marine Park	1
		Rusukan Kecil	Marine Park	1
		Rusukan Besar	Marine Park	1
10.	SARAWAK	Satang Besar	Protected	1
		Talang-Talang Kecil	Protected	1
		Talang-Talang Besar	Protected	1
	TOTAL	**71 Island**		**85**

	Category	No. of Islands	No. of stations
i.	Resort Island	25	27
ii.	Marine Park Island	38	41
iii.	Protected Island	5	5
iv.	Development Island	3	12

Kedah and Pulau But and Pulau Sembilang in Pahang.The likely sources of oil contamination were discharges from fishing boats and marine pleasure crafts plying the islands.

All the five Protected Islands were found to be free from contamination by *E.coli*, total suspended solid and oil and grease. No heavy metals contamination was found at all the marine monitoring stations around Protected Islands.

Tarball

In 1999, several beaches in the States of Johor, Perak, Pahang, Melaka and Terengganu were affected by oil pollution in the form of tarballs (**Table 5)** believed to be due to intentional or accidental discharges of oil sludges or oily wastes from marine vessels and fishermen boats. Tarballs were also sighted on the beaches of Pulau Pangkor (Perak), Pulau Payar (Pulau Langkawi) and Pulau Tioman (Pahang).

Table 5 Malaysia: Beaches affected by Tarball, 1999

STATE	STATION	STATION NO.	SAMPLING DATE	TAR BALL (g/m strip)
Johor	Desaru Beach, Kota Tinggi	1542914	15 Feb 99	95.0
	Desaru Beach, Kota Tinggi	1542914	5 Apr 99	523.0
	Desaru Beach, Kota Tinggi	1542914	14 Oct 99	67.0
	Teluk Mahkota Beach, Kota Tinggi	1841911	24 Feb 99	85.0
	Teluk Mahkota Beach, Kota Tinggi	1841911	21 Apr 99	267.7
	Sri Pantai Beach, Mersing	2339960	24 Feb 99	1990.0
	Sri Pantai Beach, Mersing	2339960	21 Apr 99	574.0
	Sri Pantai Beach, Mersing	2339960	8 Jun 99	197.3
	Sri Pantai Beach, Mersing	2339960	19 Oct 99	158.0
	Teluk Gorek Beach, Mersing	2538958	24 Feb 99	1780.0
	Teluk Gorek Beach, Mersing	2538958	21 Apr 99	436.5
	Teluk Gorek Beach, Mersing	2538958	8 Jun 99	586.5
	Air Papan Beach, Mersing	2538959	24 Feb 99	1780.0
	Air Papan Beach, Mersing	2538959	21 Apr 99	592.9
	Air Papan Beach, Mersing	2538959	8 Jun 99	436.9
	Tanjung Setapa Beach, Kota Tinggi	1341961	10 Mar 99	1790.0
	Tanjung Leman Beach, Mersing	2140964	17 Mar 99	1255.0
	Tanjung Leman Beach, Mersing	2140964	17 Nov 99	46.0
Melaka	Telok Gong Beach	2320902	26 Apr 99	120.0
	Telok Gong Beach	2320902	24 Jun 99	25.0
	Rombang Beach	2221906	26 Apr 99	250.0
	Rombang Beach	2221906	24 Jun 99	20.0
	Besar Island	2123911	28 Apr 99	20.0
	Besar Island	2123911	22 Jun 99	90.0
	Kundur Beach	2221908	24 Jun 99	25.0
Terengganu	Rantau Abang Beach	4833917	3 May 99	11.6
	Rantau Abang Beach	4833917	11 Aug 99	4.5
	Rantau Abang Beach	4833917	6 Oct 99	11.7

Table 5 Malaysia: Beaches affected by Tarball, 1999

STATE	STATION	STATION NO.	SAMPLING DATE	TAR BALL (g/m strip)
Terengganu	Selatan Tioxide Final Discharge	4234952	4 May 99	12.3
	Selatan Tioxide Final Discharge	4234952	10 Aug 99	24.5
	Selatan Tioxide Final Discharge	4234952	5 Oct 99	4.9
	Tioxide Final Discharge	4234951	4 May 99	10.4
	Tioxide Final Discharge	4234951	10 Aug 99	46.7
	Tioxide Final Discharge	4234951	5 Oct 99	1.5
	Utara Tioxide Final Discharge	4234950	4 May 99	55.1
	Utara Tioxide Final Discharge	4234950	10 Aug 99	2
	Utara Tioxide Final Discharge	4234950	5 Oct 99	4.9
Pahang	Tanjung Gelang Beach	3934916	13 Apr 99	22.3
	Tanjung Gelang Beach	3934916	1 June 99	110.6
	Kuala Api-Api Beach	3334917	14 Apr 99	110
	Kuala Api-Api Beach	3334917	2 June 99	198.7
	Tanjung Batu Beach	3334915	14 Apr 99	16.3
Perak	Teluk Gedung Beach	4205929	21 June 99	17.5
	Pasir Bogak Beach	4205908	21 June 99	296.5
	Island			
Perak	Puteri Dewi Beach (P. Pangkor)		8 June 99	216
	Puteri Dewi Beach (P. Pangkor)		20 Sept 99	38.2
	Pasir Bogak Beach (P. Pangkor)		7 June 99	898.5
Kedah	Payar Island		15 June 99	70.3
	Tanjung Rhu Beach (P.Langkawi)		15 June 99	89.3
Pahang	Tioman Island (Kg. Salang)		9 Sept 99	14.49

MALAYSIA ENVIRONMENTAL QUALITY REPORT 1999

POLLUTION SOURCES INVENTORY

INVENTORY OF WATER POLLUTION SOURCES

In 1999, it was estimated that there were about 13,378 effluent-related pollution sources from four sectors, namely agro-based industries, manufacturing industries, pig rearing and population sewage **(Figure 19)**. Population sewage facilities accounted for 6,081 sources (45.5%) followed by manufacturing industries (5,843, 43.7%), pig rearing activities (983, 7.3%) and agro-based industries (471, 3.5%).

Based on DOE inventory compilation in 1999, a total of 6,314 agro-based and manufacturing industries were identified. **(Figure 20)** Out of the 16 types of manufacturing industries classified, the main sources in term of numbers were food and beverage industries with 1,424 sources constituting 22.6% of the total number, followed by chemical-based (687, 10.9%), metal fabrication industrial sources (568, 9%), crude palm oil mills (337, 5.3%) and raw natural rubber factories (134, 2%). Selangor, Johor and Perak made up more than 57% of the total number of sources. **(Figure 21).**

The *Japanese Encephalitis/Nipah* outbreaks in 1999 resulted in a significant reduction in the standing pig population (SPP) and the total number of pig farms in Malaysia. At the end of December 1999, total SPP was reduced from 2.8 million in 1998 to 1.3 million and the number of farms was reduced from 2,235 in 1998 to 983 in 1999. These pig farms were concentrated mainly in 3 States: Pulau Pinang (326, 33.2%), Perak (190, 19.3%) and Selangor (136, 14%). BOD load was also reduced from 312.4 mt/day in 1998 to 166 mt/day in 1999.

The number of sewage treatment facilities identified in 1999 had increased to 6,081 from 5,665 in 1998. Selangor had the highest number of sewage treatment facilities (1,620, 27%), followed by Perak (963, 16%), Negeri Sembilan (651, 11%) and Johor (605, 10%). **(Figure 22).**

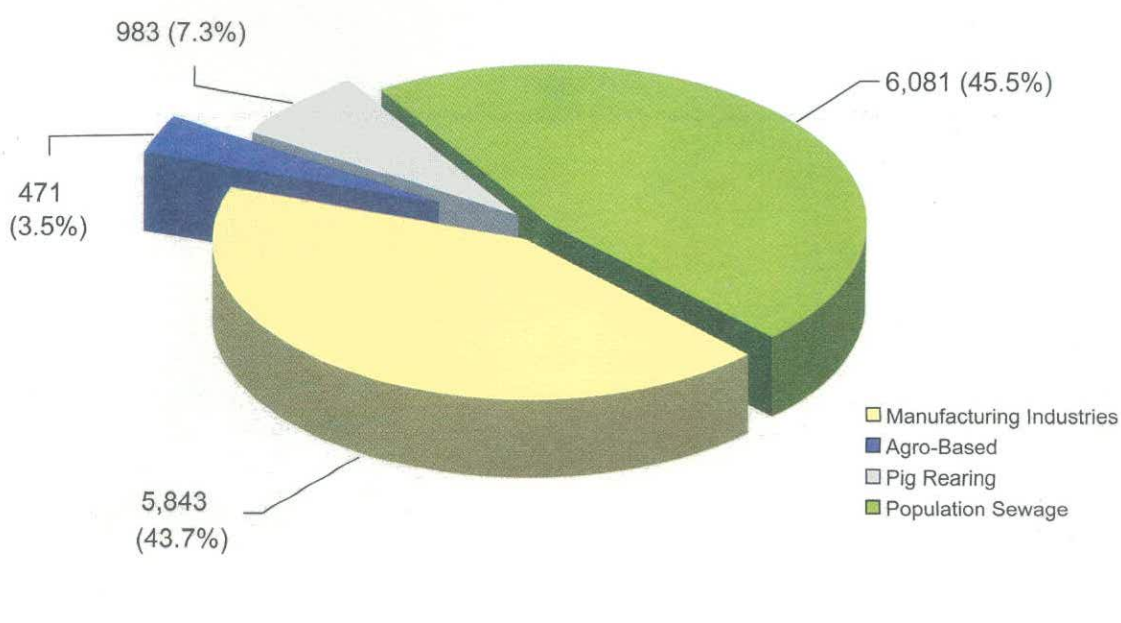


Figure 19 Department of Environment: Water Pollution By Sources, 1999

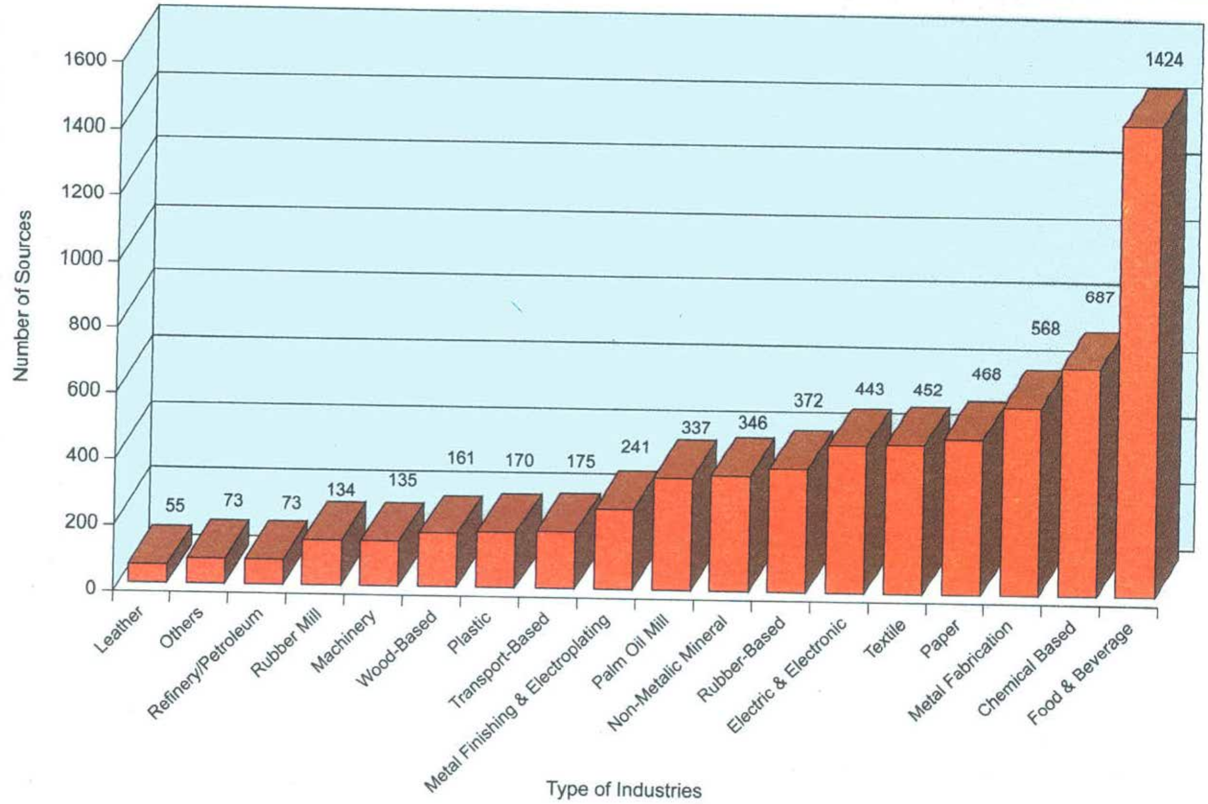


Figure 20 Department of Environment: Industrial Water Pollution Sources (Agro-Based and Manufacturing Industries), 1999

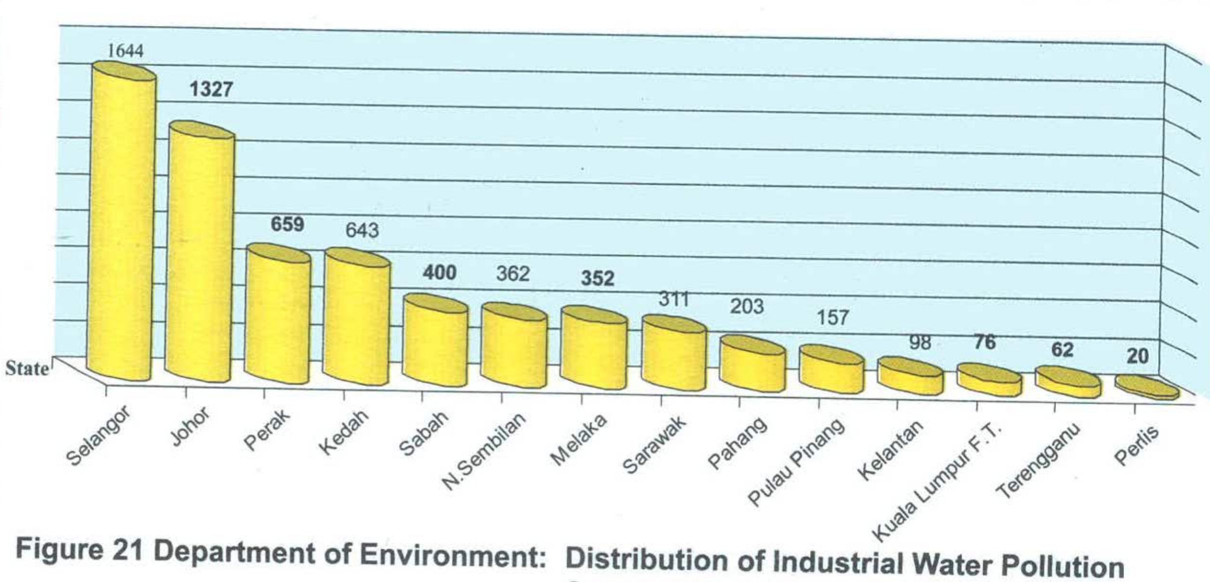


Figure 21 Department of Environment: Distribution of Industrial Water Pollution Sources (Agro-Based and Manufacturing Industries) By State, 1999

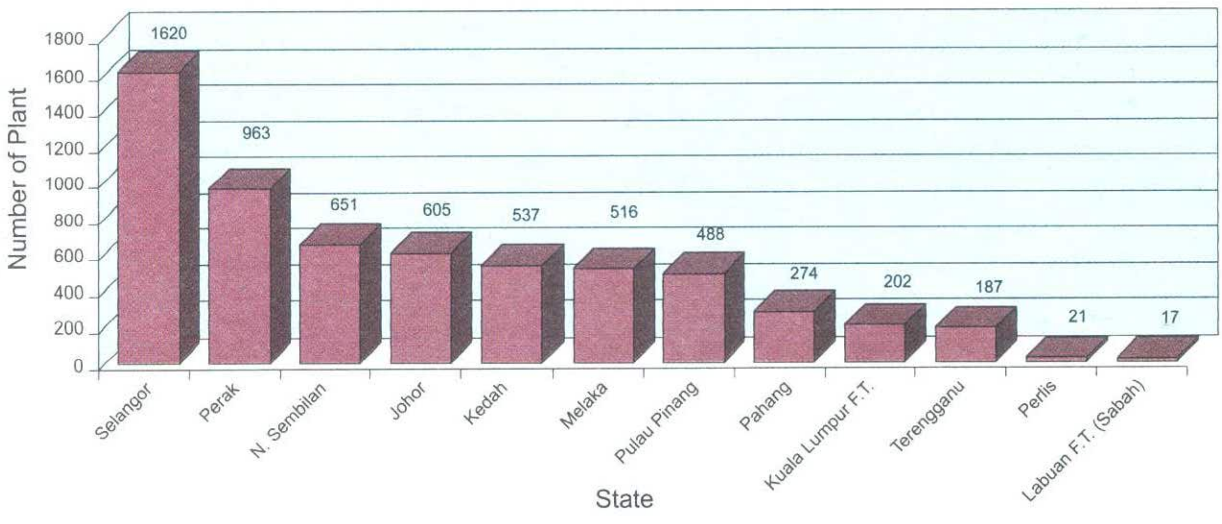


Figure 22 Malaysia: Distribution of Sewage Treatment Facilities By State, 1999

(Source: Indah Water Consortium)

BOD Pollution Load

Population sewage (treated, partially treated and untreated) remained the principal contributor of organic pollution load with a total estimated biochemical oxygen demand (BOD) of 995 metric tonnes per day, followed by pig rearing (BOD, 166 mt/day), manufacturing industries (BOD, 14 mt/day) based on 3,099 premises with treatment systems visited in 1999; and licensed agro-based industries (BOD, 13.6 mt/day). **(Figure 23).**

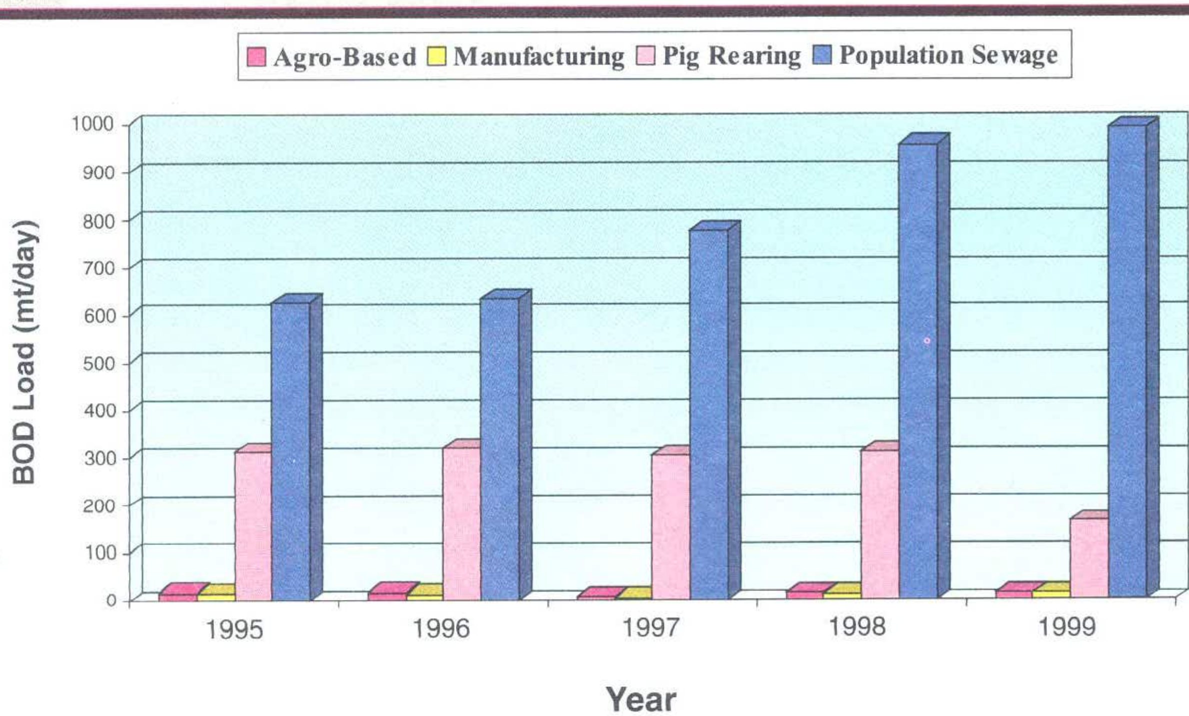


Figure 23 Malaysia: Estimated BOD Load from Major Sources, 1995-1999

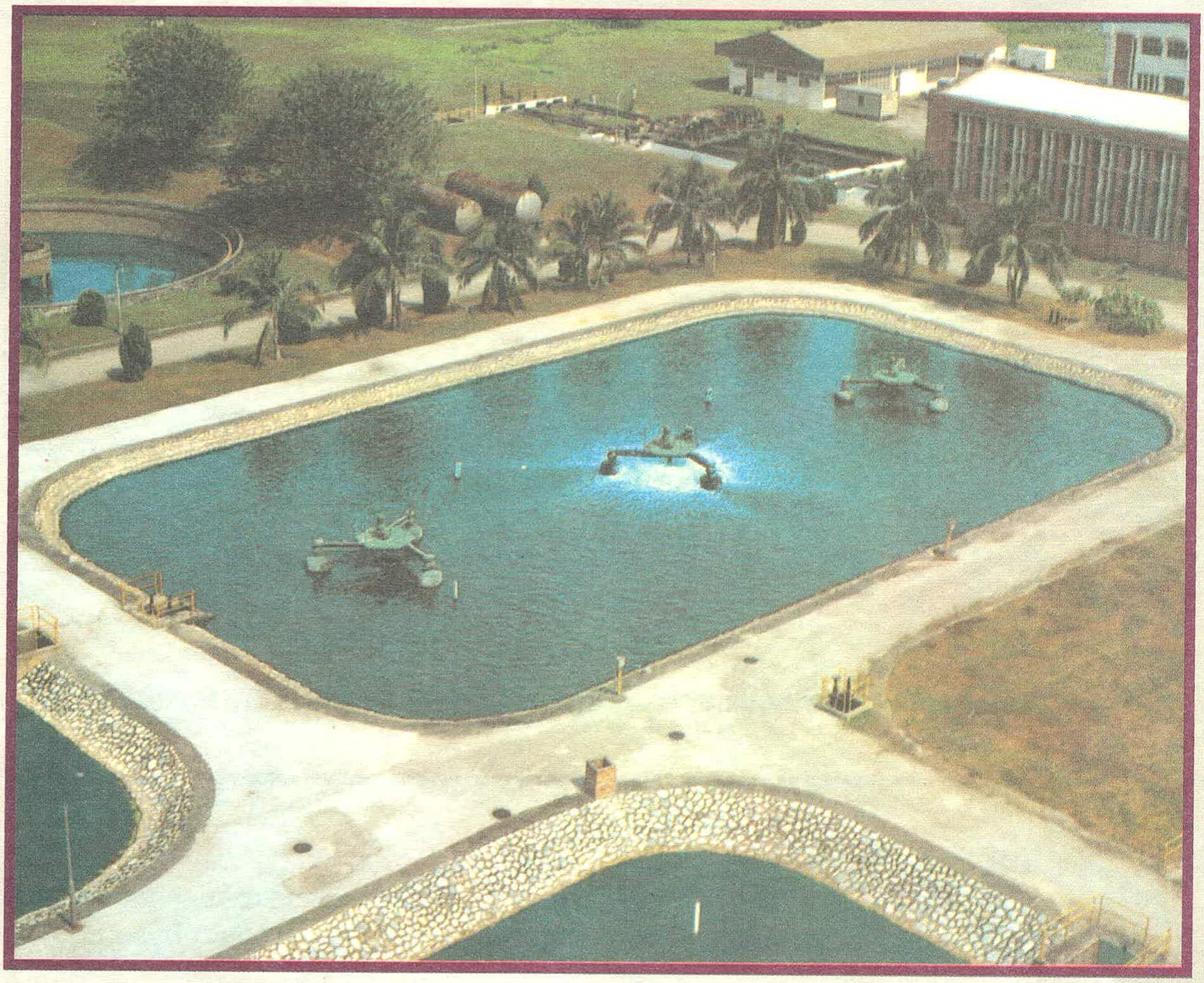


Photo 14: Centralised Sewage Treatment Plant

(Indah Water Consortium)

Air Pollution Sources

Emissions from mobile sources, stationary sources and open burning activities remained the most significant sources of air pollution in 1999. Emissions from a motor vehicular population of 9,929,951 were the principal contributors of air pollution (**Figure 24**), of which 2,001,406 (20%) vehicles were found in the Federal Territory of Kuala Lumpur, followed by Johor (1,383,339, 14%), Selangor (1,228,782, 12%), Pulau Pinang (1,047,076, 11%) and Perak (1,025,122, 10%). Perlis recorded the least number of registered vehicles (38,833, 0.4%).

The number of stationary air pollution sources identified in 1999 were 14,257, an increase of 18.3% compared to 12,056 sources in 1998. Johor had the highest number of stationary air pollution sources (3,359, 24%), followed by Selangor (2,119, 15%) and Sarawak (1,868, 13%). **(Figure 25)**.

Air Pollution Load

In 1999, the air emission load emitted into the atmosphere made up of 1,925,344 metric tonnes (mt) of carbon monoxide, 141,097 mt of hydrocarbons, 302,678 mt of oxides of nitrogen, 40,126 mt of sulphur dioxide and 19,277 mt of particulate matter. Emissions from mobile sources were the most significant contributors of air pollution (76.3%), followed by emissions from power stations (8.7%), industrial fuel consumption (7%), open burning at solid waste dumping sites (4.7%), industrial processes (2.4%) and domestic fuel consumption (0.9%). (**Figure 26**). Mobile air pollution sources in Kuala Lumpur, Johor, Selangor, Pulau Pinang and Perak accounted for more than half of the total air pollution loading into the atmosphere in 1999.

Photo 15: Communal Sewage Septic Tank (Indah Water Consortium)

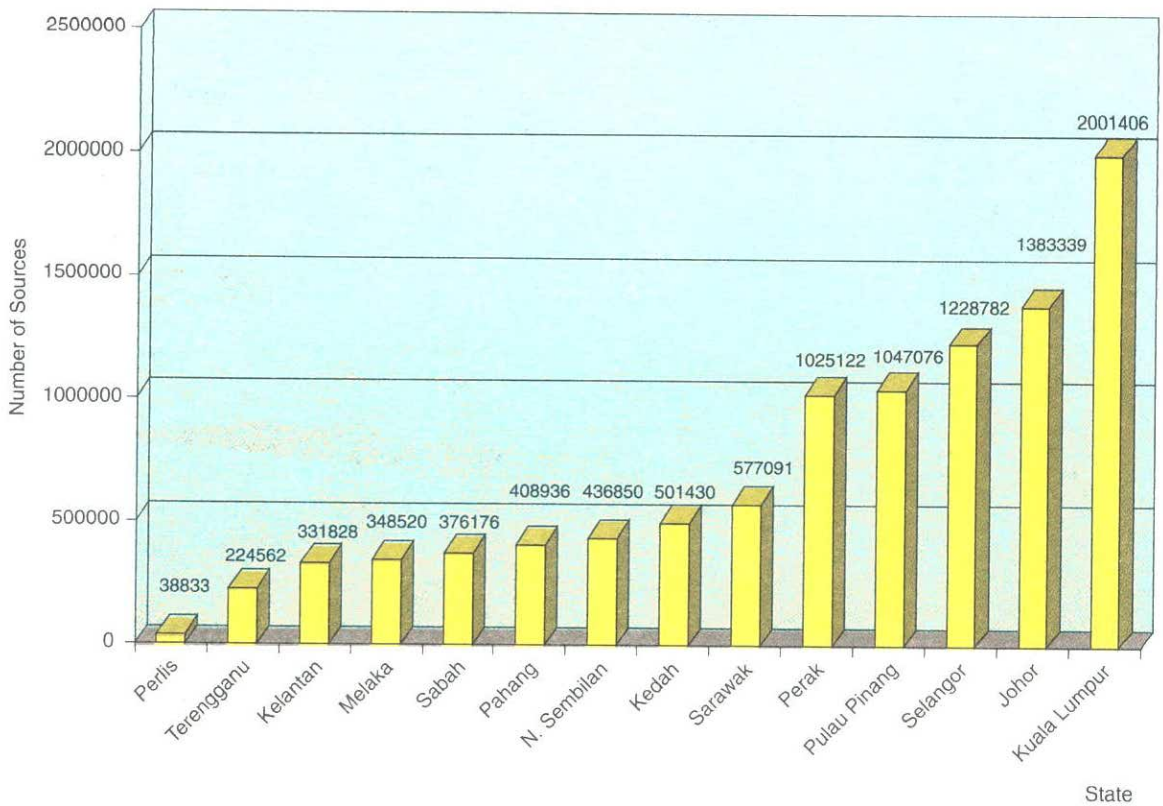


Figure 24 Malaysia: Number of Mobile Sources By State, 1999
(Source: Road Transport Department)

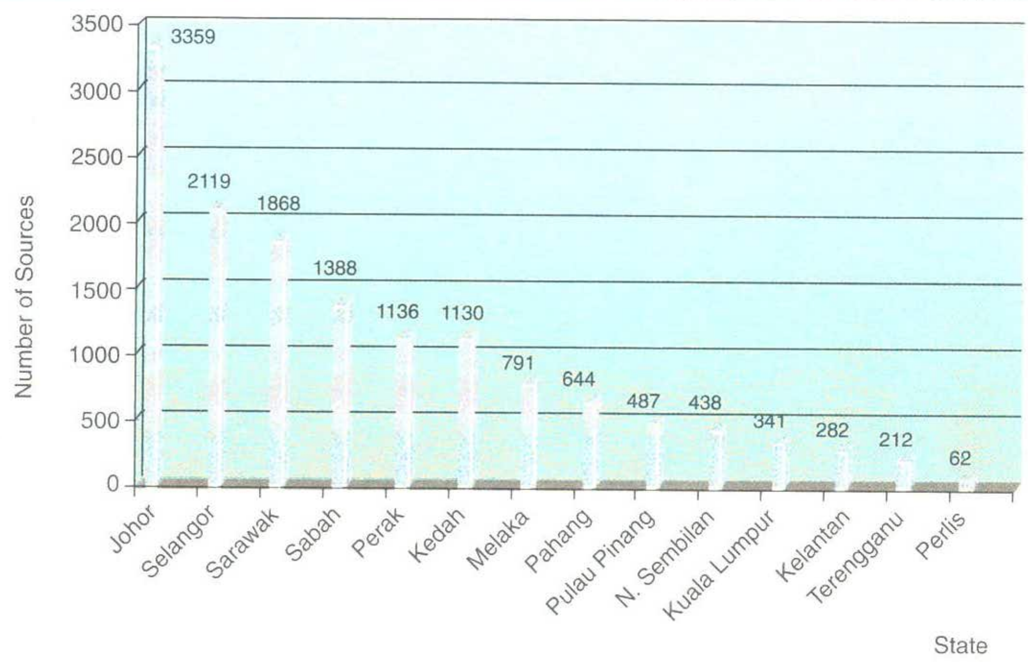


Figure 25 Department of Environment: Distribution of Industrial Air Pollution Sources By State, 1999

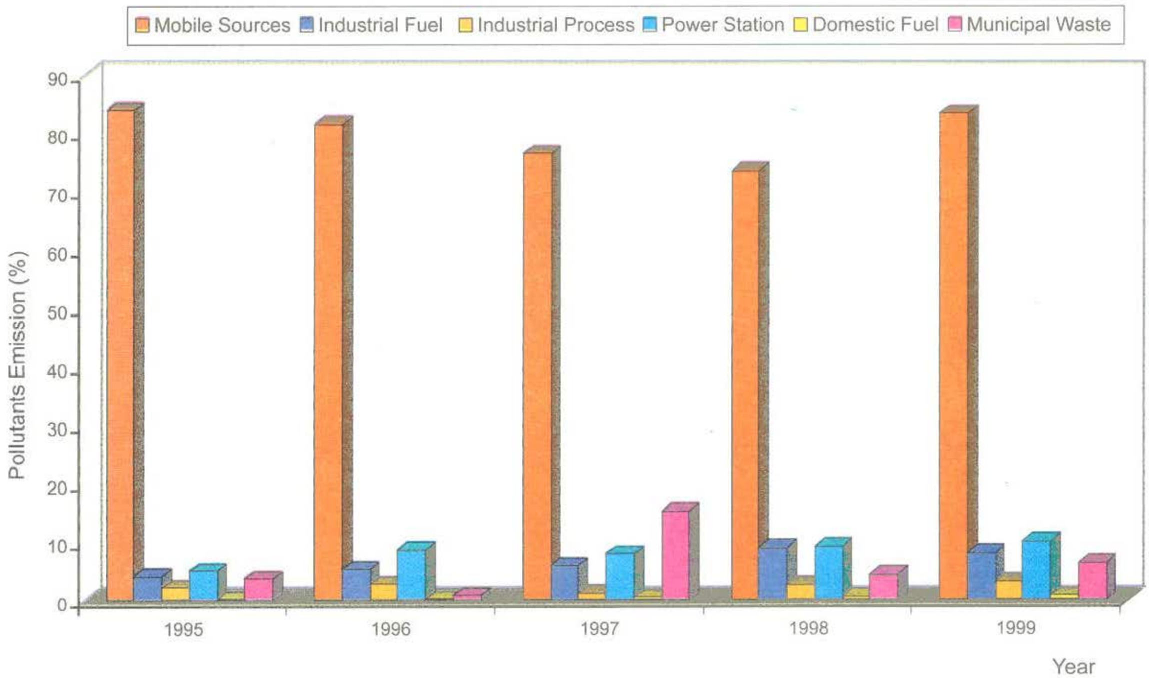


Figure 26 Malaysia: Estimated Air Pollution Load By Major Sources, 1995-1999

Inventory of Scheduled Wastes

A total of 3450 waste generators notified their waste generation in 1999 which amounted to 378,611 metric tonnes generated by industries. These wastes were grouped into 19 main categories as shown in **Figure 27**. Dross and slag from metal-based industries accounted for the largest quantity of wastes produced in the country (**Figure 28**). Of the 378,611 tonnes of wastes generated by industries and 4,571 tonnes clinical wastes, 70,479 tonnes (18.4%) were delivered to Kualiti Alam Sdn. Bhd. (KA) (**Table 6**), 4,571 tonnes (1.2%) were sent for destruction at clinical incinerators managed by FMS, Radicare and Tongkah; 5,186 tonnes (1.4%) were exported for recovery; 189,306 tonnes (49.4%) were recovered at off-site recovery facilities and an estimated 113,640 tonnes (29.6%) were still kept inside factory premises. (**Table 7**)

The Basel Convention on Transboundary Movement of Hazardous Wastes and Their Disposal

In accordance with the provisions of the Basel Convention on Transboundary Movement of Hazardous Wastes and their Disposal, a total of 5,185.94 tonnes of scheduled wastes were approved by the DOE to be exported in 1999 for recovery in other countries **(Figure 29)**. The exports comprised mainly of spent industrial catalysts and metal sludges and were made by 22 applicants.

As in previous years, the largests quantity was exported to Japan. Similarly, written permissions were given to 8 applicants to import an estimated quantity of 166,729.67 tonnes, which consisted mainly of catalysts and copper slag. (**Figure 30**)

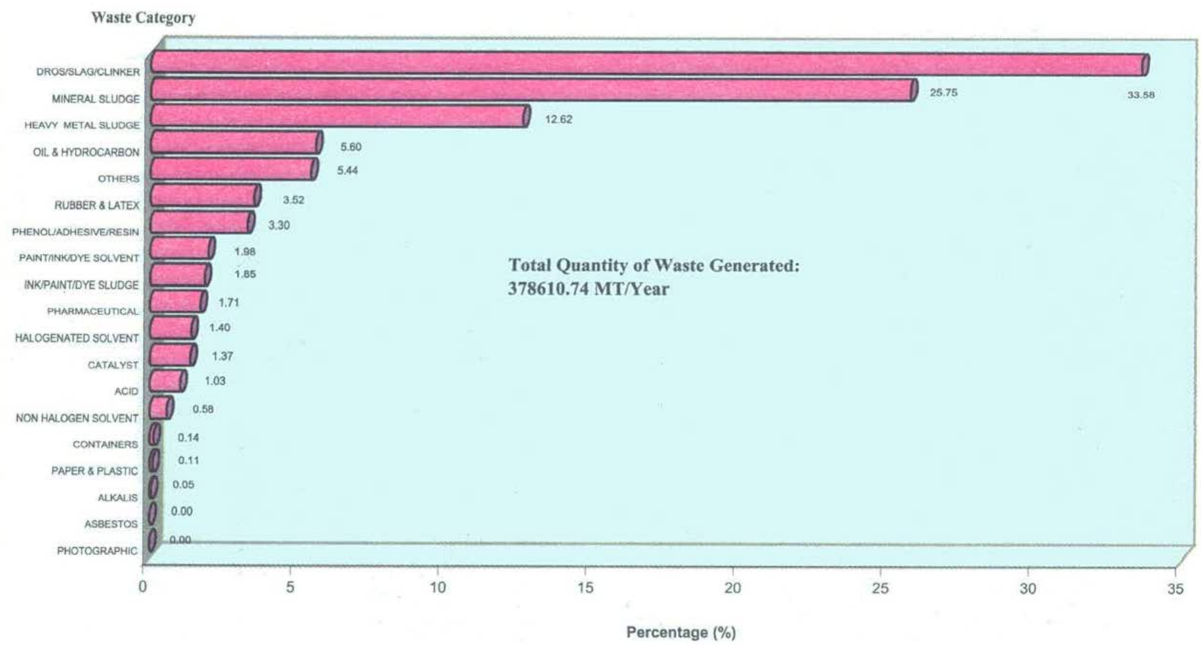


Figure 27 Malaysia/DOE: Quantity of Scheduled Waste Generated by Waste Category, 1999

Photo 16: Integrated Scheduled Wastes Treatment and Disposal Facility, Bukit Nanas, Negeri Sembilan (Kualiti Alam Sdn. Bhd.)

Table 6 Malaysia: Quantity of Scheduled Wastes handled by KUALITI ALAM

STATE	QUANTITY MT/YEAR	
	1998	1999
PERAK	2,833.99	2136.03
SELANGOR	22,025.30	2,3326.42
PAHANG	1,495.71	7,327.33
KELANTAN	1300.53	329.51
W.P. KUALA LUMPUR	182.38	727.03
SABAH	0	64.8
JOHOR	3,212.97	4,380.27
KEDAH	2,719.35	5,328.90
MELAKA	3,848.38	8,110.86
N. SEMBILAN	9,618.64	9,422.41
PULAU PINANG	6,013.48	5,954.58
PERLIS	52.29	130.3
TERENGGANU	306.04	854.17
SARAWAK	1,719.68	2,286.16
W.P. LABUAN	0	99.88
TOTAL	**55,328.74**	**70,478.65**

Photo 17: Illegal Scheduled Wastes Dumping (DOE Photo Library)

Table 7 Malaysia: Quantity of Clinical Wastes handled by Faber Medi-Serve, Radicare & Tongkah Medivest

	FABER MEDI-SERVE SDN. BHD. QUANTITY MT/YEAR		RADICARE (M) SDN. BHD. QUANTITY MT/YEAR		TONGKAH MEDIVEST SDN BHD QUANTITY MT/YEAR	
	1998	1999	1998	1999	1998	1999
PERAK	323.56	343.20	0.00	0.00	10.04	25.97
SELANGOR	0.00	0.00	357.80	391.16	74.88	90.88
PAHANG	0.00	0.00	214.99	217.67	0.00	0.00
KELANTAN	0.00	0.00	176.80	178.05	0.00	0.00
W.P. KUALA LUMPUR	0.00	0.00	754.83	802.81	100.62	117.14
SABAH	340.74	284.78	0.00	0.00	0.00	0.00
JOHOR	0.00	0.00	0.00	0.00	483.44	569.47
KEDAH	257.77	291.23	0.00	0.00	0.00	0.00
MELAKA	0.00	0.00	0.00	0.00	144.63	177.68
N. SEMBILAN	0.00	0.00	0.00	0.00	179.82	215.27
PULAU PINANG	268.64	340.79	0.00	0.00	0.00	3.06
PERLIS	39.98	47.44	0.00	0.00	0.00	0.00
TERENGGANU	0.00	0.00	145.89	145.95	0.00	0.00
SARAWAK	283.12	328.38	0.00	0.00	0.00	0.00
TOTAL 1998 = 4,157.55 MT	**1,513.81**		**1,635.82**		**993.43**	
TOTAL 1999 = 4,570.93		**1,635.82**		**1,735.64**		**1,199.47**

Photo 18: Clean-up of Scheduled Wastes Dumping Site *(DOE Photo Library)*

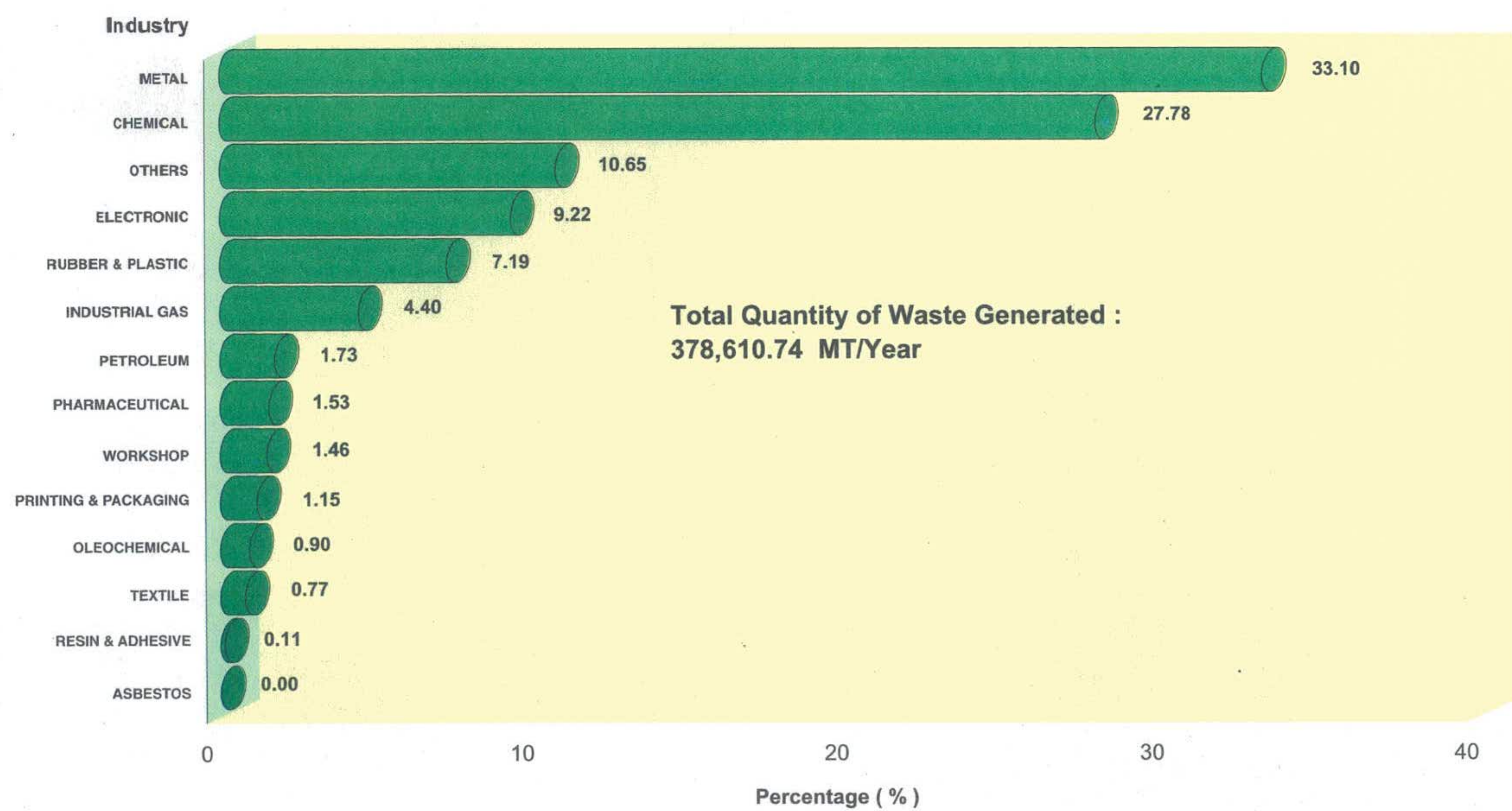


Figure 28 Malaysia: Quantity of Scheduled Wastes Generated by Industries, 1999

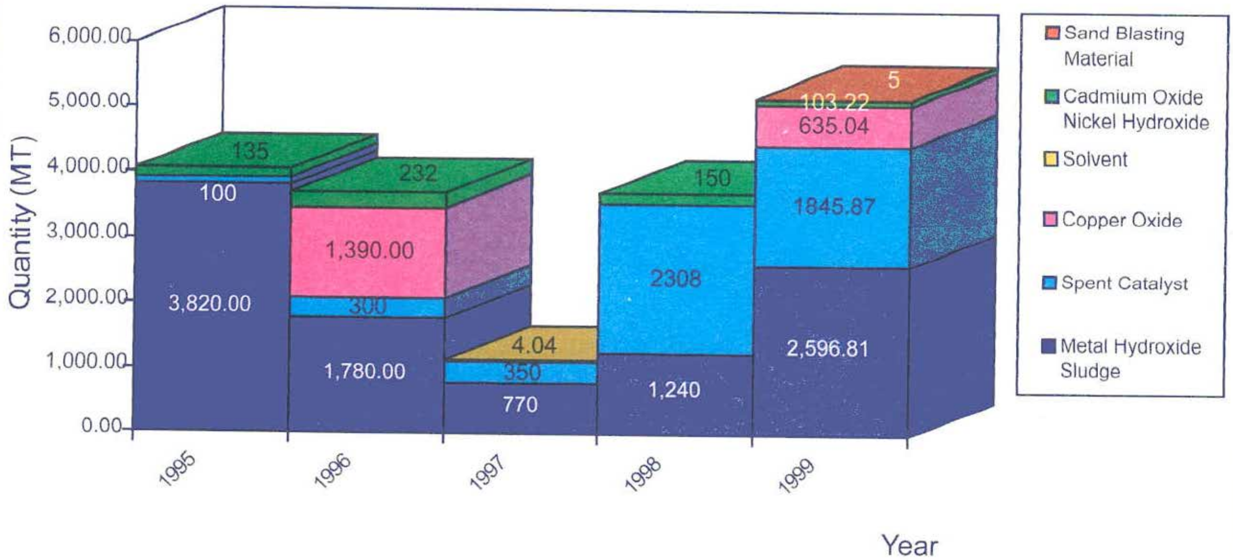


Figure 29 Malaysia: Volume of Wastes Exported, 1995-1999

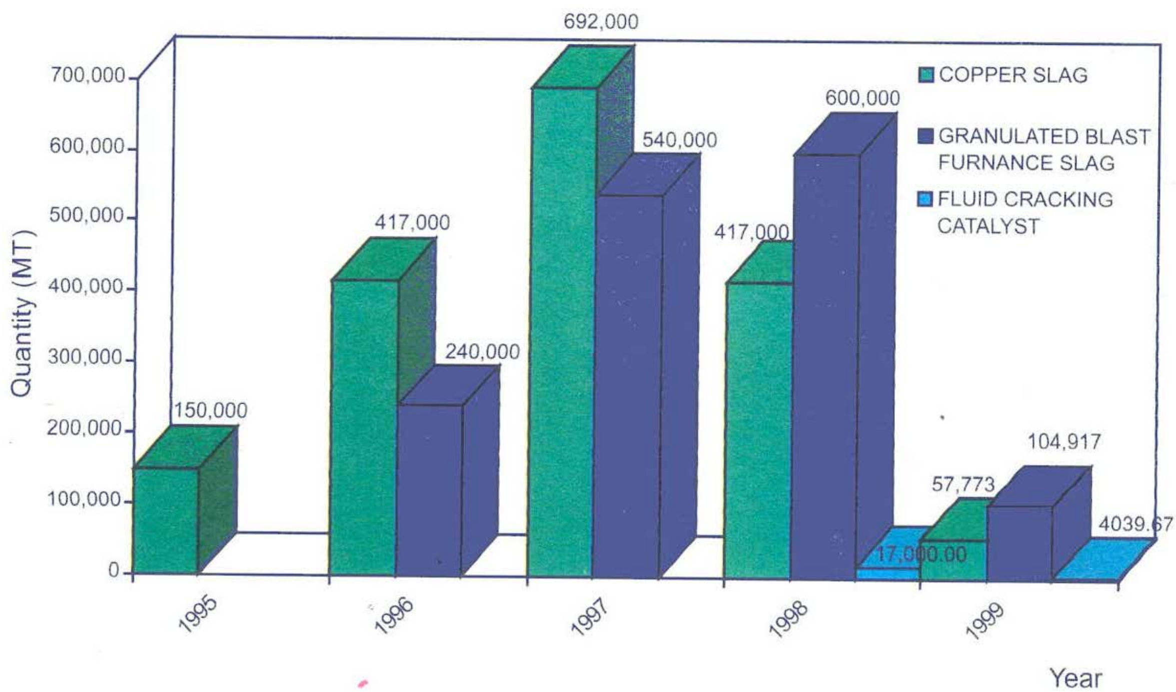


Figure 30 Malaysia: Volume of Waste Imported, 1995-1999

INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETERS	CLASSES					
	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	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l		-	-	3 SAR	
K	mg/l	N	-	-	-	L
Fe	mg/l	A	1	1	1 (Leaf) 5 (Others)	E
Pb		T				V
Mn	mg/l	U	0.05	0.02* (0.01)	5	E
	mg/l	R	0.1	0.1	0.2	L
		A		0.004		S
Hg	mg/l	L	0.001	(0.0001)	0.002	
Ni	mg/l		0.05	0.9*	0.2	A
Se	mg/l	L	0.01	0.25 (0.04)	0.02	B
Ag	mg/l	E	0.05	0.0002	-	O
Sn	mg/l	V	-	0.004	-	V
U	mg/l	E	-	-	-	E
Zn	mg/l	L	5	0.04*	2	
B	mg/l	S	1	-(3.4)	0.8	IV
Cl	mg/l		200	-	80	
Cl_2	mg/l			-(0.02)	-	
CN	mg/l		0.02	0.06 (0.02)	-	
F	mg/l		1.5	10	1	
NO_2	mg/l		0.4	0.4 (0.03)	-	
NO_3	mg/l		7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l		50	-	-	
SO_4	mg/l		250	-	-	
S	mg/l		0.05	-(0.001)	-	
CO_2	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 $CaCO_3$

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

INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETERS	CLASSES					
	UNIT	I	IIA / IIB	II #	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

INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETERS	CLASSES						
	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)	°C	-	Normal +2°C		Normal +2°C	-	-
Turbidity (NTU)	NTU	5	50	50	-	-	-
Faecal Coliform **	counts/100mL	10	100	400	5000 (2000)[a]	5000 (20000)[a]	-
Total Coliform	counts/100mL	100	5000	5000	5000	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 1 : Conservation of natural environment water supply 1 - practically no treatment necessary
Fishery 1 - very sensitive uquatic 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

DOE WATER QUALITY INDEX CLASSES

Parameter	Class	I	II	III	IV	V
Ammoniacal Nitrogen (NH_3-N)	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand (BOD)	mg/l	< 1	1 - 3	3 - 6	6 - 12	> 12
Chemical Oxygen Demand (COD)	mg/l	< 10	10 - 25	25 - 50	50 - 100	> 100
Dissolved Oxygen (DO)	mg/l	> 7	5 - 7	3 - 5	1 - 3	< 1
pH	mg/l	> 7	6 - 7	5.6	< 5	> 5
Suspended Solids (SS)	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300
Water Quality Index (WQI)		**> 92.7**	**76.5 - 92.7**	**51.9 - 76.5**	**31.0 - 51.9**	**< 31.0**

Parameter	Index Range		
	Clean	Slightly Polluted	Very Polluted
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59
Biochemical Oxygen Demand (BOD)	91 - 100	80 - 90	0 - 79
Ammoniacal Nitrogen (NH_3-N)	92 - 100	71 - 91	0 - 70
Suspended Solids (SS)	76 - 100	70 - 75	0 - 69

MALAYSIA ENVIRONMENTAL
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