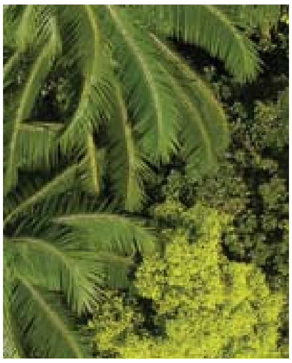
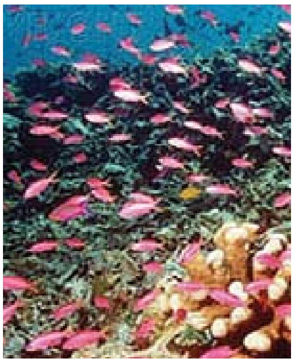
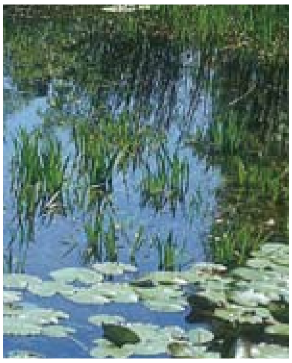
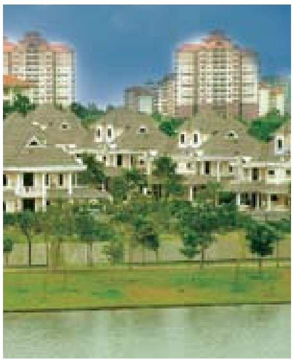
MALAYSIA
ENVIRONMENTAL QUALITY REPORT
2005



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Ministry of Natural Resources and Environment
Malaysia

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Foreword

The Environmental Quality Report 2005 is presented in compliance with Section 3(1)(i) of the Environmental Quality Act 1974.

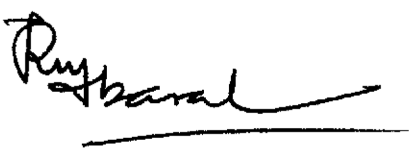
The quality of the environment in 2005 with respect to river and marine water quality remained within normal variations compared to previous years. Following a review of the national monitoring programme, the number of water quality monitoring stations increased to 1085 and river basins increased to 146, of which 80 were classified as clean, 51 slightly polluted and 15 polluted.

Compared to 2004, the overall air quality in 2005 deteriorated due primarily to transboundary pollution and fires at a few areas within the country which necessitated the activation of the National Haze Action Plan.

One key challenge is to find effective ways and means to increase community sensitivity and commitment as well as enhancing its role and responsibility towards safeguarding the environment. Steps taken by the Department of Environment and other similar efforts could not be totally effective if there is no corresponding participation by the general public to respond, or even take the lead, in an environmentally responsible and conscientious manner. There is an urgent need to bring about a paradigm shift of values, systems and attitudes as opposed to greed and selfishness. The environment needs the commitment of everyone from all walks of life to lend their voices and services.

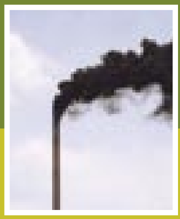
Together, we can make the difference.

With best wishes,



Dato' Hajah Rosnani Ibarahim
Director General of Environmental Quality
Malaysia

27 September 2006



CHAPTER 1

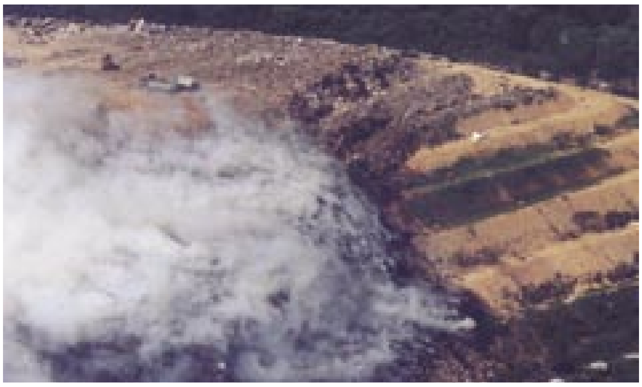
AIR

QUALITY

AIR QUALITY MONITORING

The Department of Environment (DOE) monitors the country's ambient air quality through a network of 51 stations **(Map 1.1,** and **Map 1.2).** These monitoring stations are strategically located in residential, urban and industrial areas to detect any significant change in the air quality which may be harmful to human health and the environment.

The National Air Quality Monitoring Network is also supplemented by manual air quality monitoring stations (High Volume Samplers) located at 25 different sites. At these sites, total suspended particulates, particulate matter (PM_{10}) and several heavy metals such as lead are measured once in every six days.



Aerial Photo of Open Burning at Municipal Solid Waste Disposal Site (DOE Photo Library)

The land and forest fires in the Riau Province of Central Sumatra, Indonesia as reported by the ASEAN Specialised Meteorological Center (ASMC) were the primary cause of transboundary pollution which was aggravated by the stable atmospheric conditions during the period.

AIR QUALITY STATUS

The air quality status for Malaysia is determined according to the Air Pollutant Index (API) as shown in **Table 1.1**. The overall air quality for Malaysia in 2005 deteriorated quite significantly compared to the previous year. There was a significant increase in the number of unhealthy days recorded at various locations in the Klang Valley, the West and East Coast of Peninsular Malaysia and the State of Sarawak.

Table 1.1 Malaysia : Air Pollutant Index (API)

API	AIR QUALITY STATUS
0 – 50	Good
51 – 100	Moderate
101 – 200	Unhealthy
201 – 300	Very Unhealthy
> 300	Hazardous

During the dry season between February and March 2005, some areas in the Klang Valley experienced short periods of slight to moderate haze due to peatland fires in several areas in the State of Selangor. Following the prolonged dry season in the region, coupled with the direct influence of south-westerly wind, several parts of the country experienced short-term mild to severe haze episodes from mid-May until mid-October 2005.

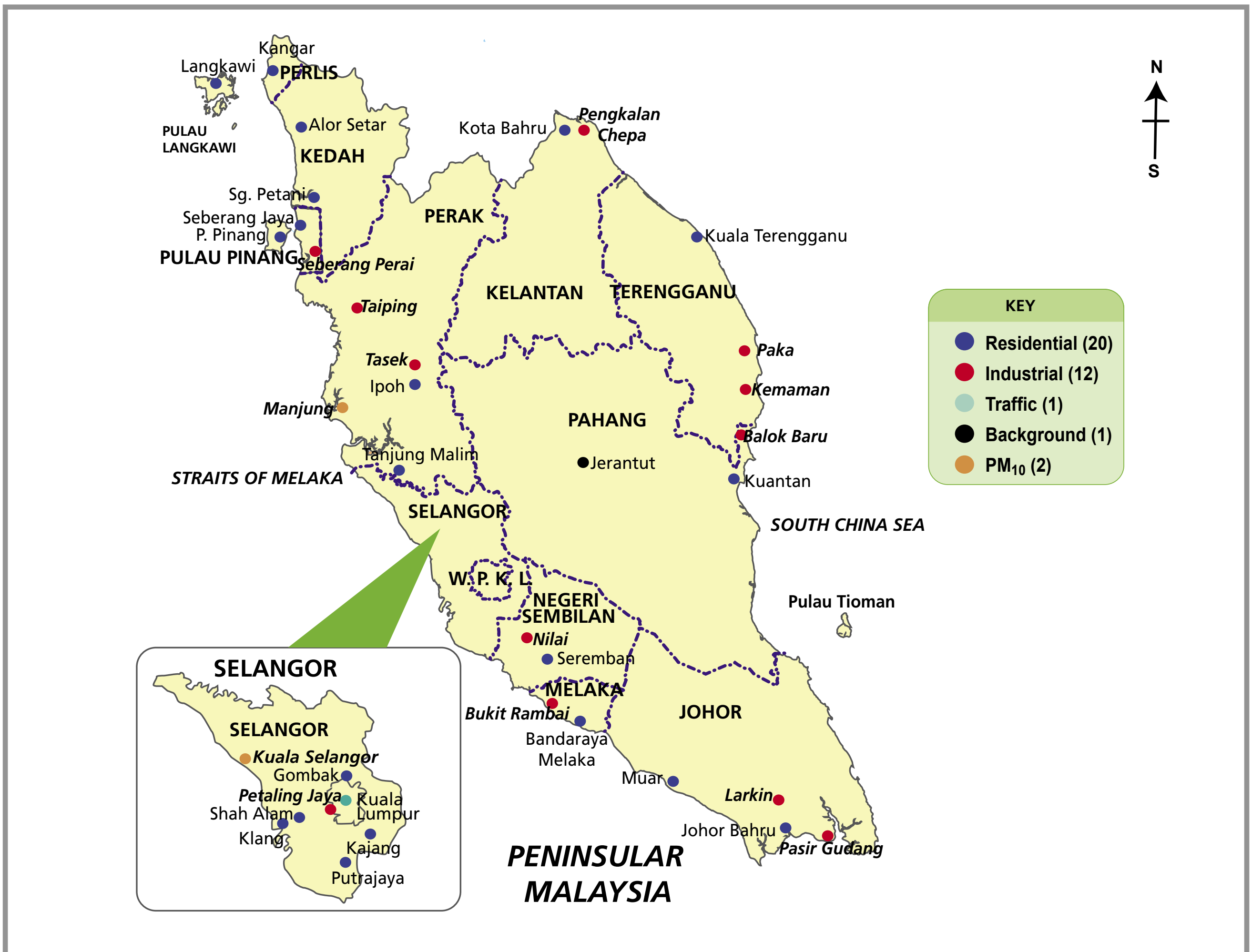
Between 1 August 2005 and 15 August 2005, the central, eastern and northern parts of Peninsular Malaysia experienced severe haze. The hazy conditions in the Klang Valley and surrounding areas were more severe in intensity than that of September 1997 in Peninsular Malaysia. It reached its peak on 11 August 2005 when a haze emergency was declared in two areas in the Klang Valley, namely Pelabuhan Klang and Kuala Selangor when the Air Pollutant Index (API) in both areas exceeded 500. The emergency declaration was lifted on 13 August 2005 after the API readings in both areas dropped below the hazardous level and the visibility improved.

Apart from these haze episodes, there were no other serious air pollution incidences in 2005. As in the previous year Particulate Matter (PM_{10}) and ground level Ozone remained the prevailing pollutants in 2005.

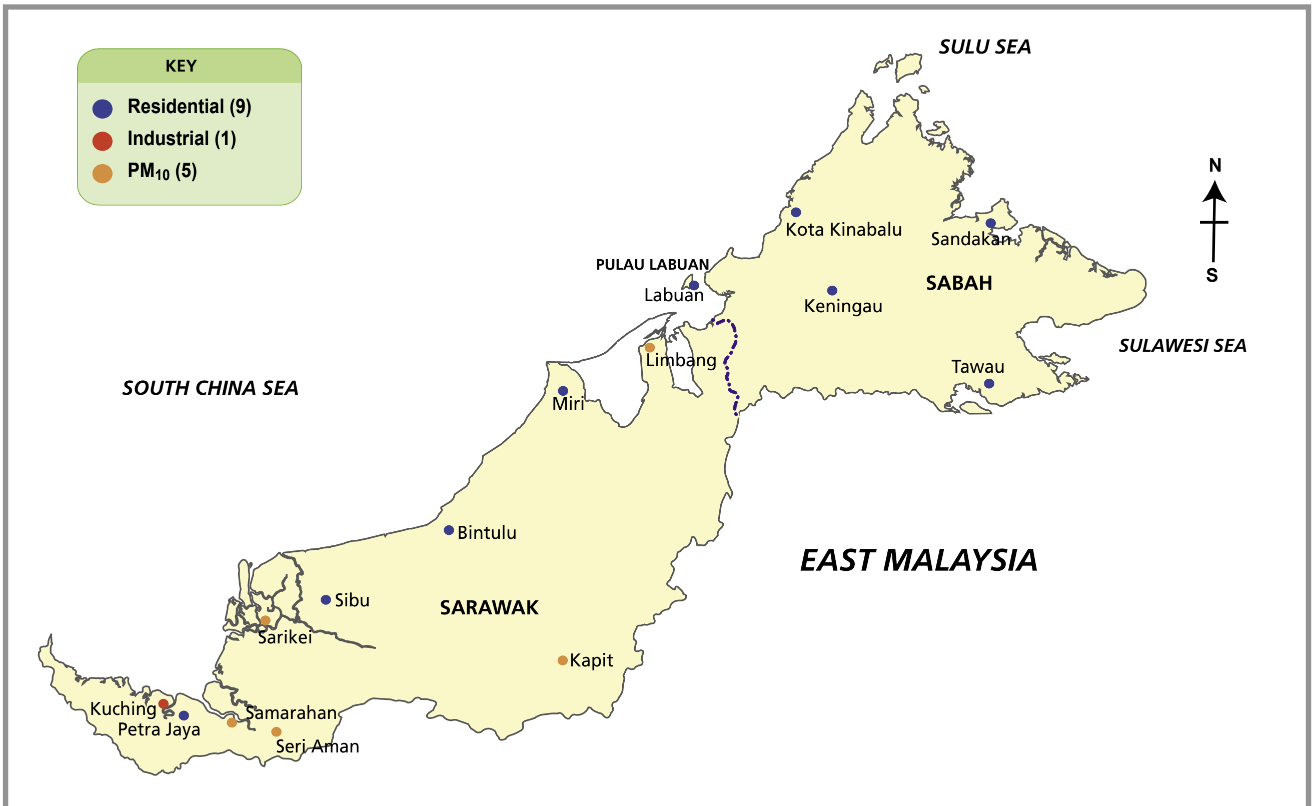
Air Quality Status in the West Coast

Klang Valley

The Klang Valley is more prone to air pollution than other areas due to its geographical position, large-scale industrial and commercial activities, densely populated areas and high vehicular traffic. The prevailing winds in the Klang Valley are generally weak resulting in stable atmospheric conditions which cause pollutants in the air to stagnate.



Map 1.1 Malaysia : Location of Continuous Air Quality Monitoring Stations, Peninsular Malaysia, 2005



Map 1.2 Malaysia : Location of Continuous Air Quality Monitoring Stations, East Malaysia, 2005

In 2005, the air quality in the Klang Valley was good 21 percent of the time, 69 percent moderate and the remaining 10 percent at an unhealthy level. PM_{10} was the predominant pollutant in the dry season during the south-westerly monsoon. The highest number of unhealthy days were recorded in Kuala Lumpur (67 days) **(Figure 1.1)**. The overall air quality status in the Klang Valley is shown in **Figure 1.2**

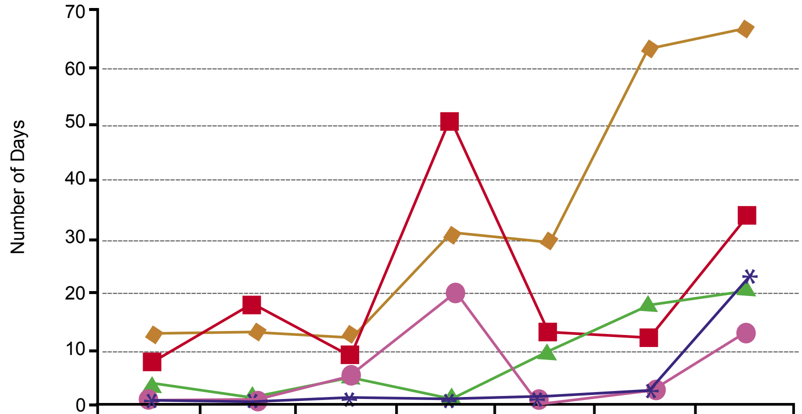
Mobile Source Air Pollution (DOE Photo Library)

Northern Region

In the northern region of the West Coast of Peninsular Malaysia, comprising the States of Perlis, Kedah (including Langkawi), Pulau Pinang and Perak, the overall air quality was between good and moderate most of the time. More than 30 percent of the time good air quality was recorded in Langkawi, Pulau Pinang (USM), Taiping and Alor Setar, while in Kangar good air quality was experienced only three percent of the time and moderate air quality for the rest of the time. Sungai Petani experienced 30 percent of the time good air quality, 69 percent moderate and the remaining two percent unhealthy mainly due to high levels of PM_{10} caused by transboundary pollution.

Air quality stations in Seberang Prai recorded moderate air quality 73 percent of the time and three percent at unhealthy status. PM_{10} was the main pollutant detected due to industrial activities, motor vehicle emissions and transboundary pollution which occurred during the south-west monsoon.

In Perak, Taiping experienced more moderate air quality days in 2005 compared to 2004. The air quality stations in Tanjung Malim, Ipoh, Tasek and Manjung recorded several unhealthy days mainly due to high PM_{10} caused by transboundary pollution.



	1999	2000	2001	2002	2003	2004	2005
Kuala Lumpur	12	12	11	30	28	63	67
Klang	7	17	7	50	12	11	33
Petaling Jaya	3	0	4	0	9	17	20
Kuala Selangor	0	0	8	21	0	2	13
Putrajaya	0	0	0	0	1	1	22

Figure 1.1 Malaysia : Number of Unhealthy Days, Klang Valley, 1999 - 2005

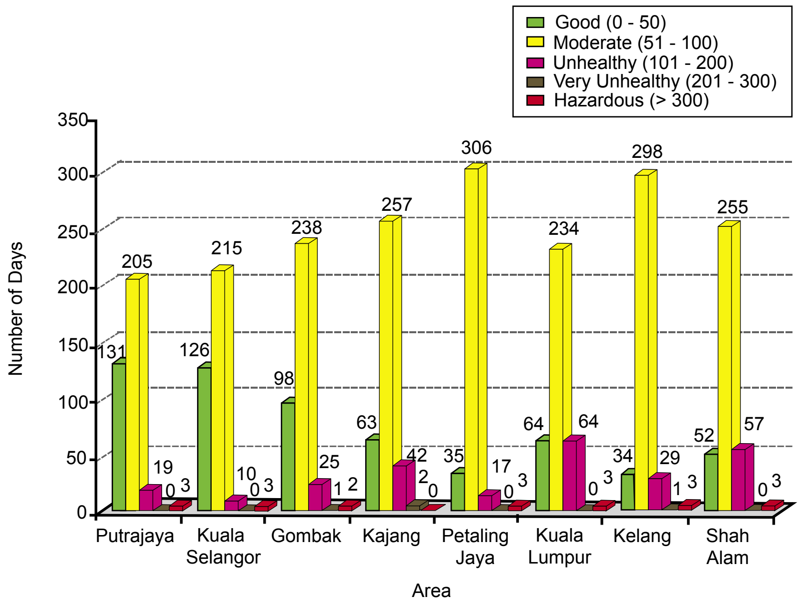


Figure 1.2 Malaysia : Klang Valley Air Quality Status, 2005

Southern Region

Similarly, the status of air quality in 2005 observed in the southern region of the West Coast of Peninsular Malaysia, which includes the States of Negeri Sembilan, Melaka and Johor, was between good to moderate most of the time, with the exception of a few unhealthy days. In Negeri Sembilan, the air quality station in Seremban recorded 69 percent moderate air quality days, 28 percent good air quality days and 3 percent unhealthy air quality days. In Nilai, the air quality was moderate for 84 percent of the time, 11 percent good and 5 percent unhealthy. In Bandaraya Melaka, the air quality was moderate for more than 71 percent of the time, while in Bukit Rambai the air quality was moderate 94 percent of the time. Both areas recorded several unhealthy air quality days mainly due to transboundary pollution during the south-west monsoon. All four stations in Johor recorded less than 70 percent good air quality days and several unhealthy days in 2005. PM_{10} was the predominant pollutant causing unhealthy days in these areas. **Figure 1.3** shows the overall air quality status for the West Coast of Peninsular Malaysia.

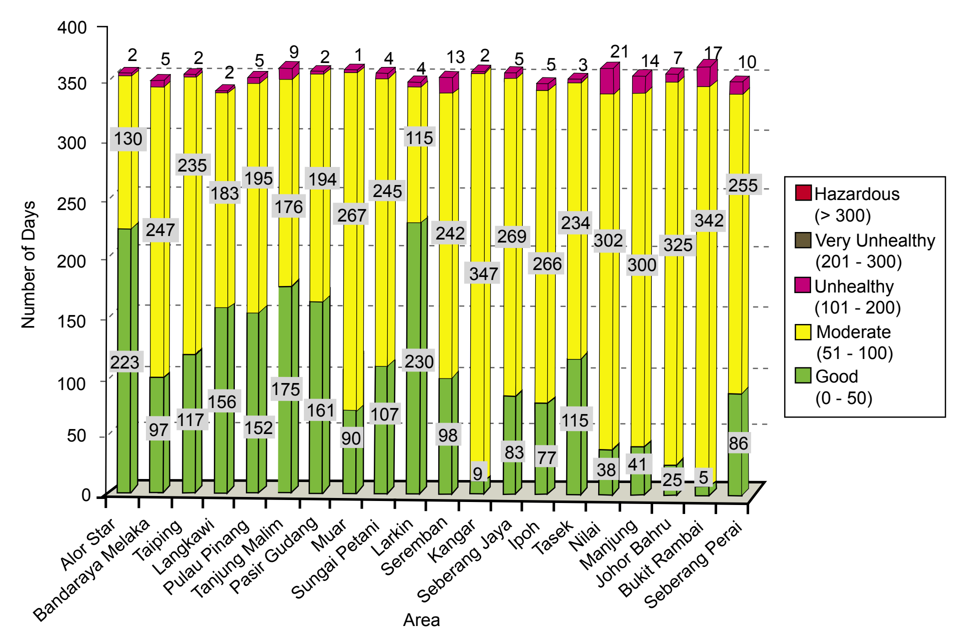


Figure 1.3 Malaysia :
Air Quality Status, West Coast Peninsular Malaysia, 2005

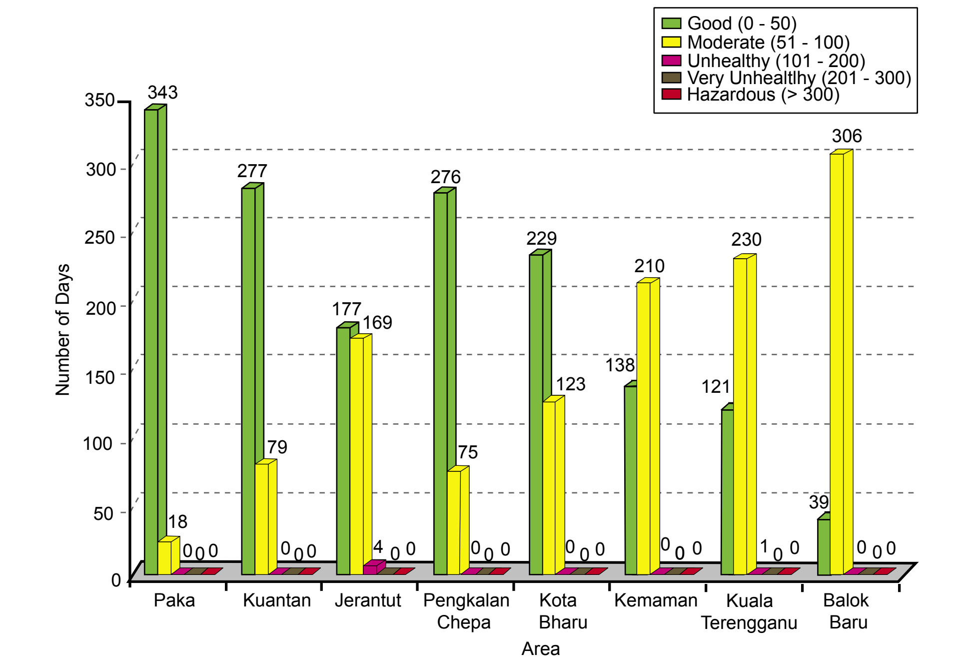


Figure 1.4 Malaysia : Air Quality Status, East Coast Peninsular Malaysia, 2005

Air Quality Status in the East Coast

The air quality in the East Coast of Peninsular Malaysia remained good most of the time in 2005. Areas such as Kuantan, Kota Bahru, Jerantut, Paka and Pengkalan Chepa experienced good air quality for more than 50 percent of the time, while Kemaman, Kuala Terengganu and Balok Baru experienced more moderate air quality than good air quality in 2005. Four unhealthy days were recorded in Jerantut and one day in Kuala Terengganu due to high levels of PM_{10} and ozone. The overall air quality status in the East Coast is shown in **Figure 1.4.**

Air Quality Status in Sabah, Labuan and Sarawak

The air quality in Sandakan, Kota Kinabalu and Keningau in Sabah was good for more than 75 percent of the time, while Tawau recorded more moderate air quality than good air quality days. No unhealthy conditions were recorded at all the locations in Sabah. In Labuan, the air quality was good 85 percent of the time and moderate for the remaining 15 percent.

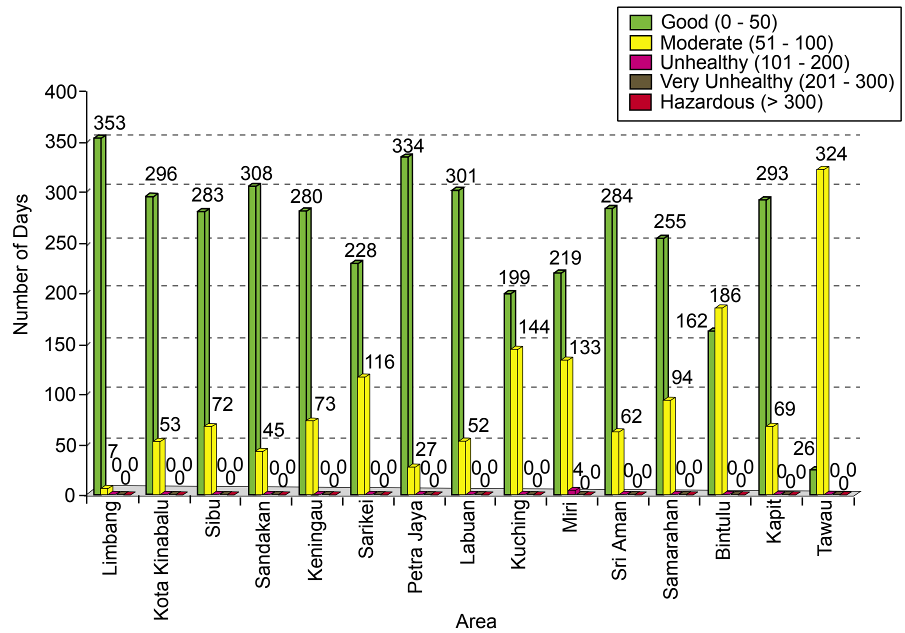


Figure 1.5 Malaysia : Air Quality Status in Sabah and Sarawak, 2005

Most stations in Sarawak experienced more than 70 percent good air quality days in 2005 **(Figure 1.5).** Miri recorded four unhealthy air quality days due to high concentrations of PM_{10} from transboundary pollution.

AIR QUALITY TREND

Six criteria pollutants, namely Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Sulphur Dioxide (SO_2) and Particulate Matter (PM_{10}) were monitored continuously at 51 locations, while lead (Pb) concentration was measured once in every six days at two locations. The air quality trend for the period 1997 to 2005 was computed by averaging direct measurements from the monitoring sites on a yearly basis and cross-reference with the Malaysian Ambient Air Quality Guidelines shown in **Table 1.2.**

Table 1.2 Malaysia : Ambient Air Quality Guidelines

Pollutant	Averaging Time	Malaysia Guidelines	
		ppm	(µg/m³)
Ozone	1 Hour 8 Hour	0.10 0.06	200 120
Carbon Monoxide**	1 Hour 8 Hour	30.0 9.0	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 (PM_{10})	24 Hour 12 Month		150 50
Total Suspended Particulate (TSP)	24 Hour 12 Month		260 90
Lead	3 Month		1.5

Note :
**(mg/m³)

Particulate Matter (PM_{10})

Particulate Matter is the general term used to describe respirable particles of less than 10 microns in size. They may be from motor vehicle exhaust, heat and power generation, industrial processes and open burning activities. Particulate matter may also form in the atmosphere by the transformation of precursor emissions such as SO_2 and NO_X (to form Sulphates and Nitrates). In addition, significant amount of fine particulates can also arise from uncontrolled biomass burning activities either within or from outside the country (transboundary pollution).

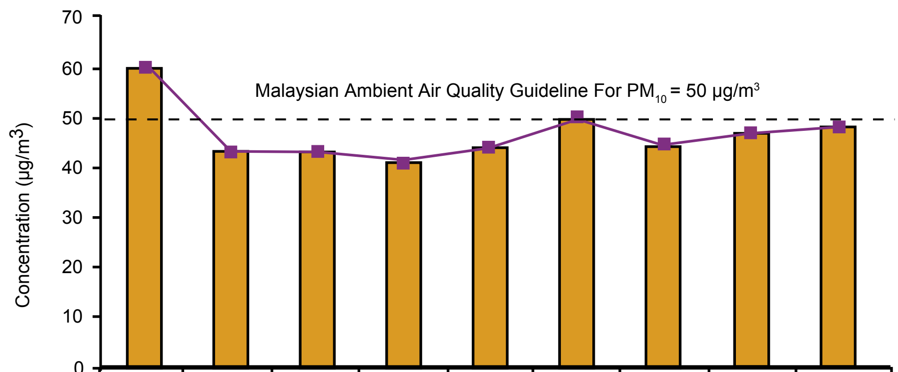
PM_{10} can cause eye and throat irritation, and its accumulation in the respiratory system is associated with numerous respiratory problems such as decreased lung function. High levels of particulate matter can also pose health risk to sensitive groups such as children, the elderly and individuals with asthma or cardiopulmonary diseases.

Particulate matter (PM_{10}) can also cause undesirable impact on the environment. The presence of high levels of PM_{10} in the atmosphere is a major cause of reduced visibility, resulting in hazy conditions especially during the dry season. Other environmental impacts can occur when particulate matter is deposited onto soil, plants, water or other materials. Depending on the chemical composition of these substances, when particulate matter is deposited in sufficient quantities, it may change the nutrient balance and acidity in soil, interfere with plant metabolism and change the composition of materials.

long-term exposure to high concentrations of SO_2 include respiratory illnesses, alterations in lung function and aggravation of existing cardiovascular diseases.

There are also environmental concerns associated with high concentrations of SO_2. Sulphur dioxide along with NO_X is a major precursor of acidic deposition, which contributes to the acidification of soils, lakes and streams resulting in adverse impact on the ecosystem. Sulphur dioxide can also be harmful to plant life and accelerates the corrosion of buildings and monuments.

PM_{10} continues to be the prevalent pollutant in many areas in Malaysia. The annual average levels of PM_{10} concentration in the ambient air between 1997 and 2005 were just below the Malaysian Ambient Air Quality Guideline for PM_{10} except in 1997 which was due to severe haze episodes. However, in 2005 the annual average value of PM_{10} concentration increased by 2 percent compared to 2004 **(Figure 1.6).** The breakdown of the annual average levels of PM_{10} for various categories of land use is shown in **Figure 1.6(a).**

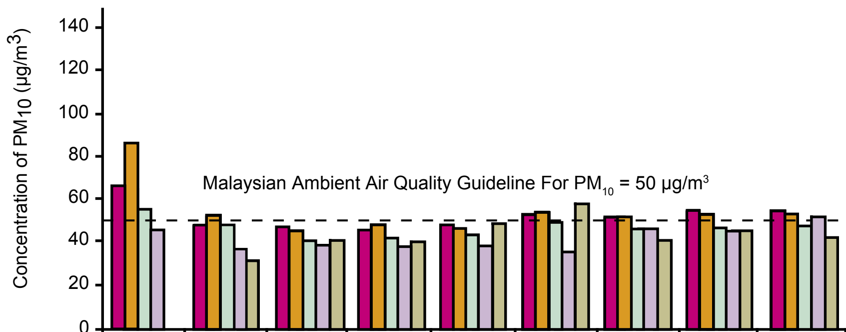


	1997	1998	1999	2000	2001	2002	2003	2004	2005
Concentration (µg/m3)	60	41	41	40	44	50	44	48	49
Number of Sites	27	37	45	50	50	50	51	51	51

Figure 1.6 Malaysia :
Annual Average Concentration of Particulate Matter (PM_{10}), 1997 - 2005

Sulphur Dioxide (SO_2)

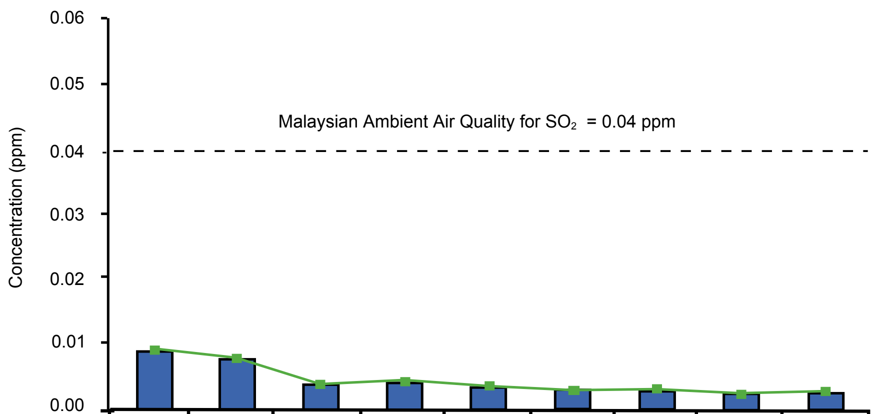
Sulphur dioxide is a colourless, pungent, irritating, water-soluble reactive gas. This gas is formed during the combustion process of fuel containing sulphur (e.g. oil and coal) mainly from industrial activities. High concentrations of SO_2 in the atmosphere increase the risk of adverse symptoms in asthmatic patients and irritate the respiratory system. Other effects associated with



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial	62	47	45	45	47	54	50	55	53
Urban	83	51	45	46	46	55	50	52	52
Sub Urban	54	46	39	39	42	49	42	44	46
Background	44	32	38	31	36	35	42	44	50
Rural	0	28	40	38	48	58	35	44	39

Figure 1.6 (a) Malaysia :
Annual Average Concentration of Particulate Matter (PM_{10})
by Land Use, 1997 - 2005

The annual average levels of SO_2 in the ambient air between 1997 and 2005 **(Figure 1.7)** were well below the Malaysian Ambient Air Quality Guideline. **Figure 1.7(a)** shows the annual average concentrations of sulphur dioxide for different categories of land use. The concentrations of SO_2 were consistently higher in industrial areas where the main emission sources were located. Compared to 1997, there had been a noticeable drop in SO_2 level in 2005 (75%). This could be attributed to measures taken to promote the use of cleaner fuel such as natural gas for industrial combustion processes and vehicles.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Concentration (ppm)	0.0086	0.0074	0.0035	0.0038	0.0030	0.0029	0.0026	0.0023	0.0024
Number of Sites	27	33	39	43	43	43	44	44	44

Figure 1.7 Malaysia :
Annual Average Concentration of Sulphur Dioxide (SO_2), 1997 - 2005

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial	0.0093	0.0087	0.0073	0.0064	0.0057	0.0058	0.0050	0.0042	0.0034
Urban	0.0089	0.0052	0.0039	0.0037	0.0030	0.0027	0.0026	0.0029	0.0025
Sub Urban	0.0097	0.0090	0.0036	0.0038	0.0024	0.0020	0.0018	0.0015	0.0016
Background	0.0022	0.0017	0.0022	0.0013	0.0009	0.0009	0.0010	0.0006	0.0009

Figure 1.7 (a) Malaysia :
Annual Average Concentration of Sulphur Dioxide (SO_2) by Land Use,1997 - 2005

Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitrogen monoxide (NO). Nitrogen oxides (NO_X) is the term used to describe the total sum of NO, NO_2 and other oxides of nitrogen. The major sources of man-made NO_X emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. Most of the NO_X (95%) from combustion processes are emitted as NO and the rest as NO_2. Nitrogen monoxide (NO) is readily converted to NO_2 in the environment. Short term exposure to NO_2 may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses and increases respiratory illness in children. Long term exposure may increase susceptibility to respiratory infection and cause alteration in lung function. Nitrogen oxides also react in the air to form ground-level ozone and fine particle pollution, both of which are associated with adverse health impacts.

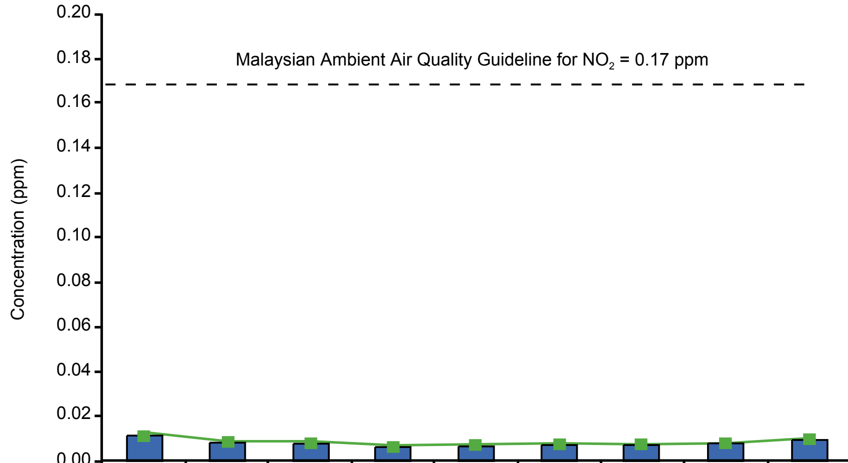
Nitrogen oxides contribute to a wide range of environmental effects, including the formation of acid rain and potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication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

For the period 1997 to 2005, the annual average concentrations of NO_2 in the ambient air in Malaysia as shown in **Figure 1.8** and **Figure 1.8(a)** were well below the Malaysian Ambient Air Quality Guideline. In 2005, the NO_2 concentration increased by two percent compared to 2004. Nitrogen dioxide concentrations were high in urban and industrial areas mainly due to emissions from automobiles and combustion processes.

Ground Level Ozone (O_3)

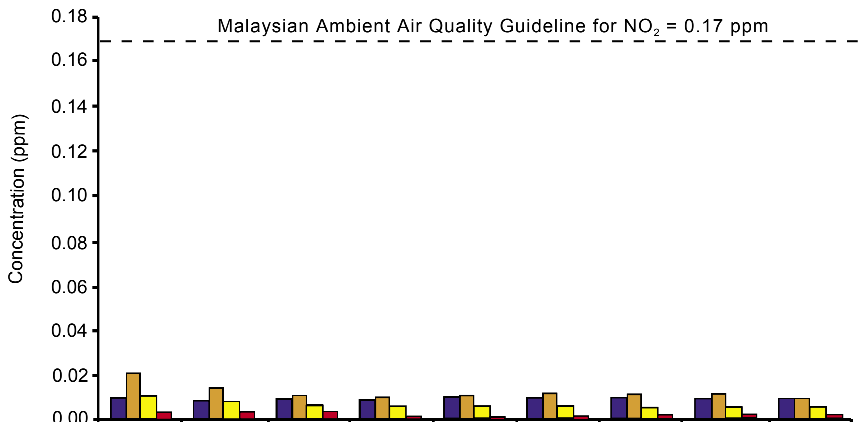
Ozone is not emitted directly into the air but is formed by the reaction of Volatile Organic Compounds (VOCs) and NO_x in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually in the warm sunny urban atmosphere. VOCs are emitted from various sources, including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

Exposure to high concentrations of ground-level ozone has been linked to numerous health effects. Repeated exposures to ozone can make people more susceptible to respiratory infections resulting in 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 increase plant susceptibility to diseases, pests, and other environmental stresses. In long lived species, these effects may become evident only after several years or decades. Thus, ozone has the potential for long-term effect on forest ecosystems.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Concentration (ppm)	0.0113	0.0086	0.0074	0.0068	0.0073	0.0078	0.0078	0.0079	0.0095
Number of Sites	13	27	33	39	43	43	43	44	44

Figure 1.8 Malaysia :
Annual Average Concentration of Nitrogen Dioxide (NO_2), 1997 - 2005



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial	0.0100	0.0089	0.0096	0.0093	0.0105	0.0106	0.0104	0.0105	0.0105
Urban	0.0210	0.0141	0.0112	0.0104	0.0113	0.0122	0.0123	0.0122	0.0106
Sub Urban	0.0108	0.0084	0.0062	0.0062	0.0062	0.0065	0.0066	0.0068	0.0069
Background	0.0033	0.0031	0.0030	0.0014	0.0013	0.0018	0.0017	0.0020	0.0026

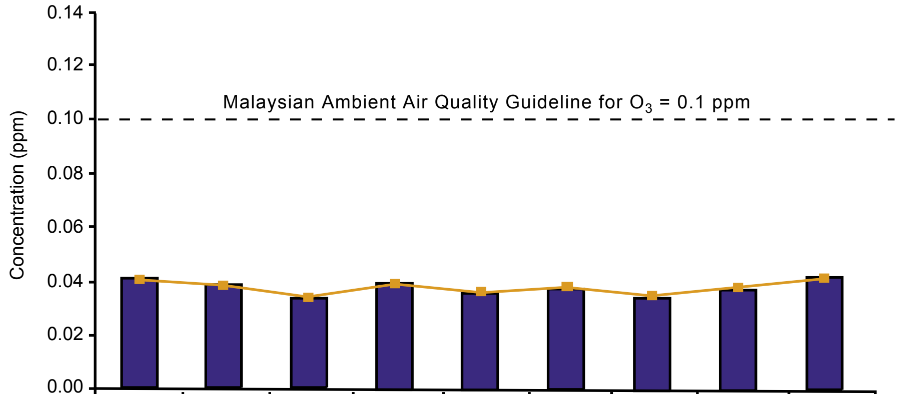
Figure 1.8 (a) Malaysia :
Annual Average Concentration of Nitrogen Dioxide (NO_2)
by Land Use,1997 - 2005

Figure 1.9 shows the annual average daily maximum one-hour ozone concentrations in ambient air for 1997 to 2005. There were fluctuations in the trend observed throughout this period. In 2005, the annual average daily maximum one-hour ozone concentrations increased by 63 percent compared to 2004. **Figure 1.9(a)** describes the ozone concentration for various land use categories between 1997 and 2005. Higher levels of ozone were consistently recorded in urban areas, due to the presence of the precursor ozone (i.e. NO_x from motor vehicle emissions).

Carbon Monoxide (CO)

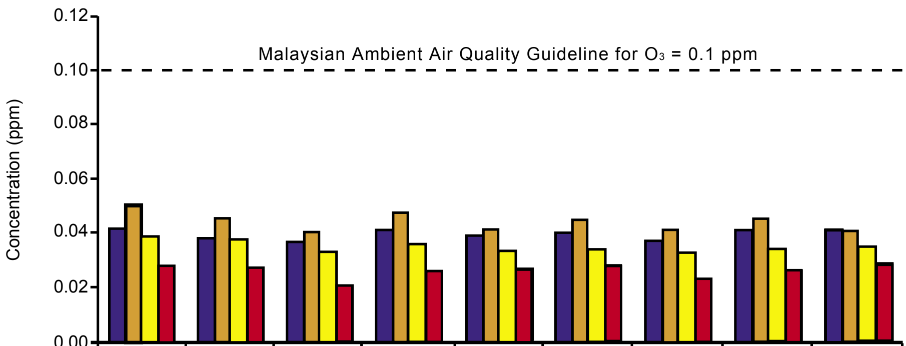
Carbon monoxide is a colourless, odourless and at high concentration, a poisonous gas. Carbon monoxide is formed when the carbon present in fuel is not burnt completely. CO is emitted mainly from motor vehicle exhaust. Other sources of CO emission include industrial processes and open burning activities.

Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to organs and tissues.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Concentration (ppm)	0.041	0.038	0.034	0.039	0.037	0.0382	0.0353	0.0388	0.0421
Number of sites	21	27	35	39	39	39	41	41	41

Figure 1.9 Malaysia :
Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3), 1997 - 2005



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial	0.043	0.039	0.038	0.043	0.0405	0.0413	0.0389	0.0429	0.0431
Urban	0.051	0.046	0.041	0.049	0.0426	0.0461	0.0428	0.0471	0.0428
Sub Urban	0.040	0.039	0.034	0.037	0.0348	0.0355	0.0345	0.0363	0.0373
Background	0.029	0.028	0.022	0.027	0.0279	0.0298	0.0250	0.0287	0.0311

Figure 1.9 (a) Malaysia :
Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3)
by Land Use, 1997 - 2005

The 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 capability and poor learning ability are among the health effects associated with exposure to elevated CO levels.

The annual eight-hourly average concentrations of carbon monoxide throughout the country measured from 1997 to 2005 were well below the Malaysian Ambient Air Quality Guideline **(Figure 1.10)**. The concentration of CO was consistently higher in urban areas where the main sources of emission were motor vehicles. **Figure 1.10(a)** shows CO concentrations for various categories of land use.

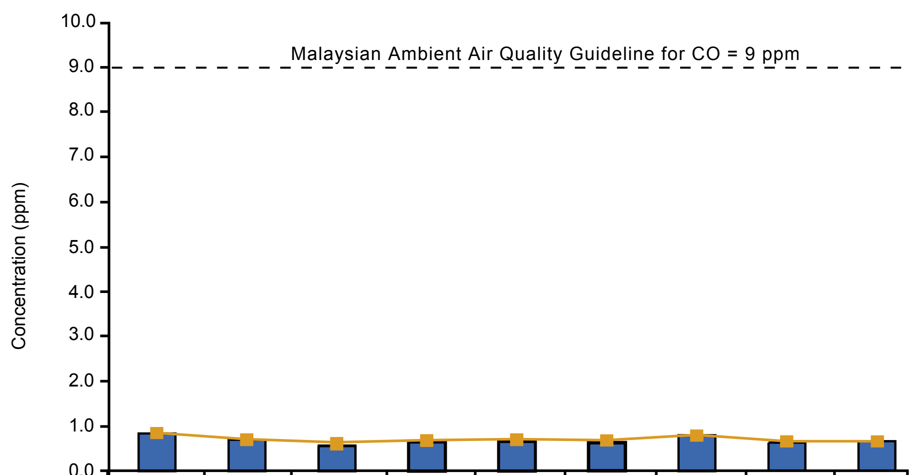
Lead (Pb) Concentration

Excessive exposure to lead (Pb) may cause neurological impairment such as mental retardation and behavioural disorders. Even at low dosage, lead exposure is associated with damage in foetus nervous system and in young children resulting in learning deficiency and lowered IQ.

In the past, motor vehicles were the main sources of Pb emissions into the atmosphere. The Pb levels monitored in the atmosphere were high in the eighties. However, as a result of Government efforts to promote the use of unleaded petrol since 1991 and the total phase out of leaded petrol in 1998, the Pb level in the atmosphere had declined significantly. In 2005, the average level of atmospheric Pb monitored in the Klang Valley was lower than previous years **(Figure 1.11).**

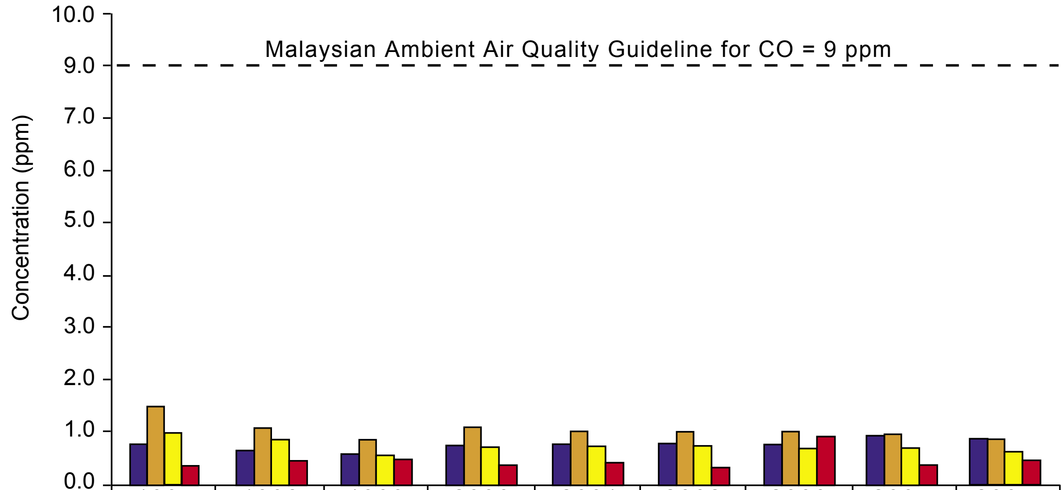
Clear Day in Kuala Lumpur City (DOE Photo Library)

Hazy Day in Kuala Lumpur City (DOE Photo Library)



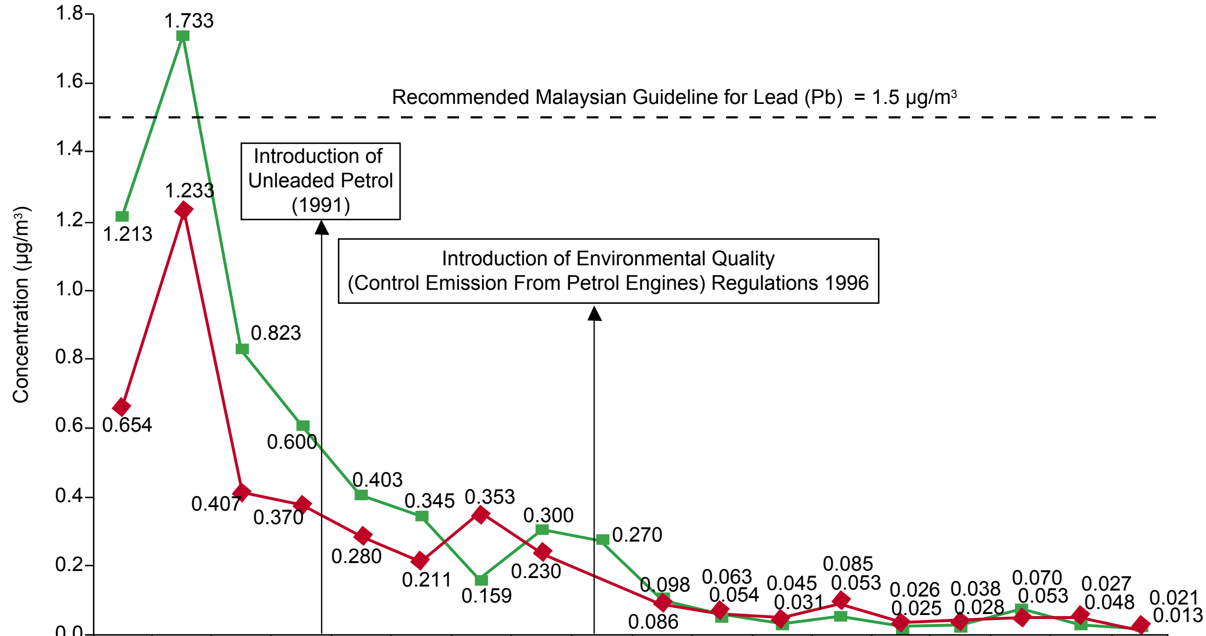
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Concentration (ppm)	0.876	0.744	0.586	0.712	0.7213	0.6995	0.8325	0.7389	0.7918
Number of sites	21	27	35	39	39	39	41	41	41

Figure 1.10 Malaysia :
Annual Average Concentration of Carbon Monoxide (CO),1997 - 2005



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial	0.7260	0.6270	0.5550	0.7390	0.7614	0.7676	0.7405	0.9442	0.8734
Urban	1.4750	1.0670	0.8220	1.0710	1.0091	0.9934	0.9981	0.9632	0.8636
Sub Urban	0.9750	0.8450	0.5200	0.6890	0.7169	0.7187	0.6768	0.6784	0.6335
Background	0.3300	0.4360	0.4480	0.3470	0.3978	0.3182	0.9145	0.3700	0.4582

Figure 1.10 (a) Malaysia :
Annual Average Concentration of Carbon Monoxide (CO) by Land Use,1997 - 2005



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
DBKL	0.654	1.233	0.407	0.370	0.280	0.211	0.353	0.230		0.086	0.063	0.045	0.085	0.026	0.038	0.053	0.048	0.013
Jalan Pudu	1.213	1.733	0.823	0.600	0.403	0.345	0.159	0.300	0.270	0.098	0.054	0.031	0.053	0.025	0.028	0.070	0.027	0.021

Figure 1.11 Malaysia : Air Quality Trend : Ambient Lead Concentration in Klang Valley, 1988 - 2005

CHAPTER 2

NOISE

MONITORING

NOISE MONITORING PROGRAMME

Ambient noise level measurements in 2005 were conducted in residential areas close to industrial and traffic activities. The data obtained were analysed based on methods recommended in the Planning Guidelines for Environmental Noise Limits and Control. The L_{Aeq} calculated represented the existing noise levels in those areas. The L_{Aeq} for 24 hours, daytime (7:00 a.m. to 10:00 p.m.) and night time (10:00 p.m. to 7:00 a.m.), were plotted as in **Figure 2.1** and **Figure 2.2.** The readings indicated that noise levels from commercial centres were the highest among all other noise sources. Planning Guidelines for Environmental Noise Limits and Control serves as a useful reference to determine the recommended noise level limits for any new development (e.g. **Schedule 1,2**).

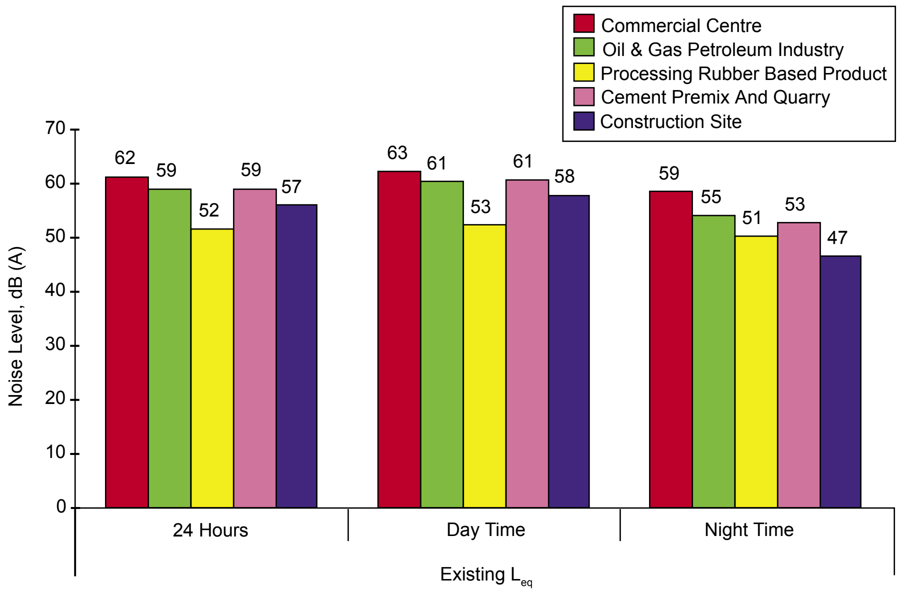


Figure 2.1 DOE : Comparison of Noise Data for Various Activities

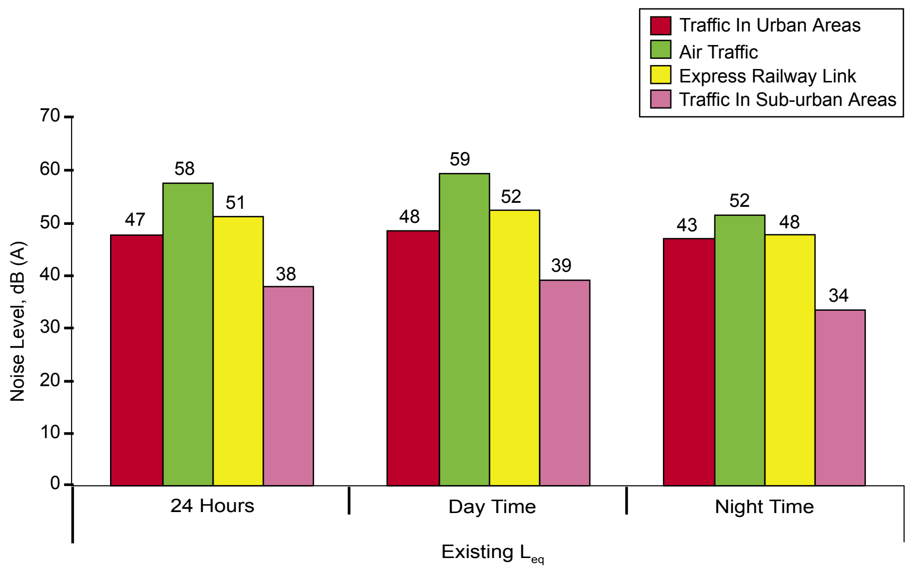


Figure 2.2 DOE : Comparison of Noise Data for Various Traffic Mode

Motorcycle: Kerbside Noise Enforcement Campaign (DOE Photo Library)

SCHEDULE 1

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) OF RECEIVING LAND USE
FOR PLANNING AND NEW DEVELOPMENT

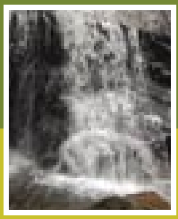
Receiving Land Use Category	**Day Time 7:00 a.m. – 10:00 p.m.**	**Night Time 10:00 p.m. – 7:00 a.m.**
Noise Sensitive Areas, Low Density Residential, Institutional (School or Hospital) and Worship Areas	50 dBA	40 dBA
Suburban Residential (Medium Density) Areas, Public Spaces, Parks and Recreational Areas	55 dBA	45 dBA
Urban Residential (High Density) Areas and Designated Mixed Development Areas (Residential - Commercial)	60 dBA	50 dBA
Commercial Business Areas	65 dBA	55 dBA
Designated Industrial Areas	70 dBA	60 dBA

SCHEDULE 2

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) OF NEW DEVELOPMENT (ROADS, RAILS AND INDUSTRIAL) IN AREAS OF EXISTING HIGH ENVIRONMENTAL NOISE CLIMATE

Receiving Land Use Category	**Day Time 7:00 a.m. – 10:00 p.m.**	**Night Time 10:00 p.m. – 7:00 a.m.**
Noise Sensitive Areas and Low Density Residential Areas	L_{90} + 10 dBA	L_{90} + 5 dBA
Suburban and Urban Residential Areas	L_{90} + 10 dBA	L_{90} + 5 dBA
Commercial and Business Areas	L_{90} + 10 dBA	L_{90} + 10 dBA
Industrial Areas	L_{90} + 10 dBA	L_{90} + 10 dBA

Note :
L_{90} is the measured ninety percentile sound level for the respective time period of the existing areas of interest in the absence of the proposed new development.



CHAPTER 3

RIVER WATER QUALITY

RIVER WATER QUALITY MONITORING

The Department of Environment (DOE) river water quality monitoring programme which began in 1978 was initially geared to establish baselines and detect water quality changes. In recent years, it had been extended to provide information for identification of pollution sources. Water samples are collected at regular intervals from designated stations for in-situ and laboratory analysis to determine their physical, chemical and biological characteristics. The Water Quality Index (WQI) used to evaluate the status of river water quality consists of parameters such as Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammoniacal Nitrogen (NH_3-N), 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 Sampling (DOE Photo Library)

Clean River (DOE Photo Library)

In 2004 a thorough review of river basins and water quality monitoring stations was carried out, taking into consideration criteria such as location of monitoring stations upstream, midstream and downstream of the river basin; location of stations at tributaries; landuse pattern; river basins with estuaries; and river basins not previously monitored. After the review, some stations were terminated, some relocated and new stations were also established. Following this revision, the number of river basins monitored in 2005 increased from 120 to 146 and the number of stations increased from 926 to 1085.

RIVER WATER QUALITY STATUS

In 2005, a total of 1,085 water quality monitoring stations located within 146 river basins were monitored by DOE (**Map 3.1, 3.2 and 3.3**). Out of these 1,085 monitoring stations, 504 (46.5%) were classified as clean; 467 (43%) slightly polluted; and 114 (10.5%) polluted (**Table 3.2, 3.3 and 3.4**). Stations located upstream were generally clean, while those downstream were either slightly polluted or polluted. In terms of river basin water quality, 80 river basins (54.7%) were clean, 51 (34.9%) slightly polluted, and 15 (10.3%) polluted (**Figure 3.1**).

Polluted River : Discharge from Textile Industry
(DOE Photo Library)

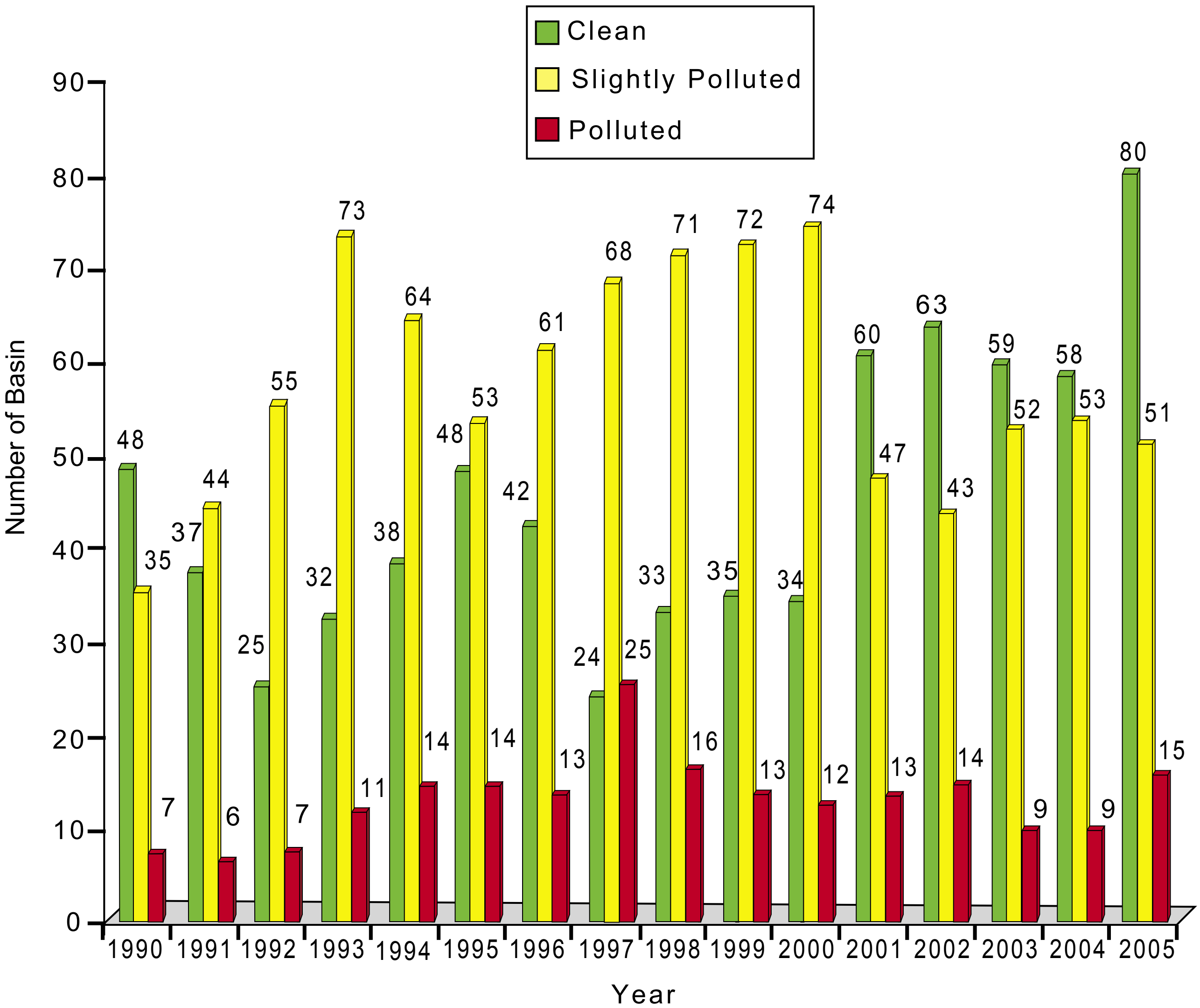
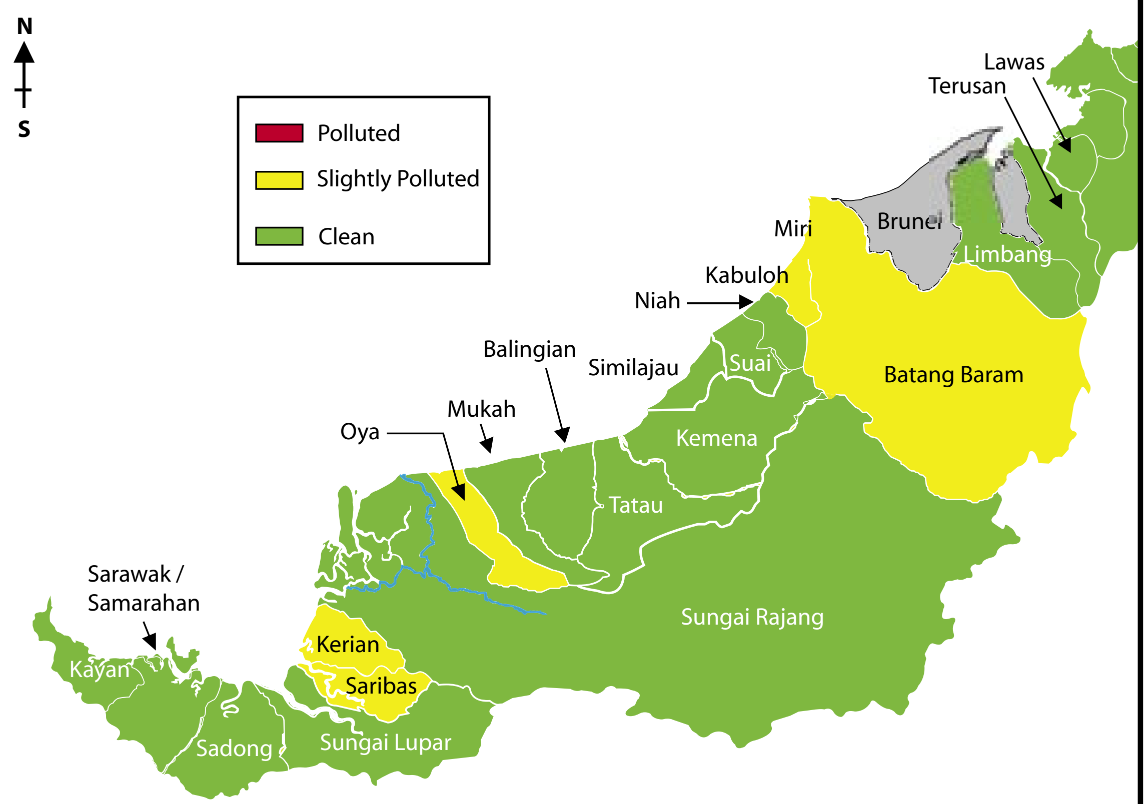
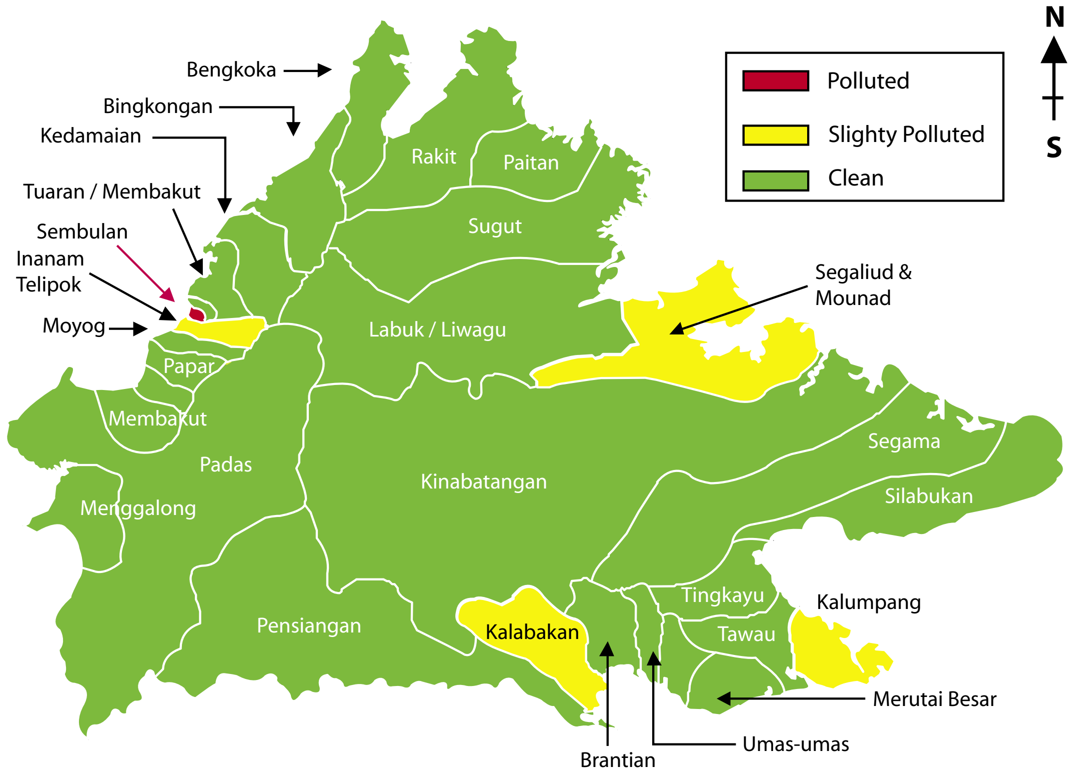


Figure 3.1 Malaysia : River Basins Water Quality Trend,1990 - 2005

Map 3.1 Malaysia : Water Quality Status for River Basins of Peninsular Malaysia, 2005



Map 3.2 Malaysia : Water Quality Status for River Basins of Sarawak, 2005



Map 3.3 Malaysia : Water Quality Status for River Basins of Sabah, 2005

Polluted River : Cement Slurry from Construction Site
(DOE Photo Library)

Polluted River : Construction Work Along River Bank
(DOE Photo Library)

Cumulative water quality data compiled from 15 continuous water quality monitoring stations are presented in **Figures 3.2, 3.3, 3.4 and 3.5**. Based on the 90-percentile value, low dissolved oxygen levels were most frequent in Sungai Perai (41.9% saturation), followed by Sungai Klang (44.6% saturation) and Sungai Putat (46.2% saturation) (**Figure 3.2**). High ammonium levels were recorded more frequently in Sungai Putat (8.8 mg/l), followed by Sungai Klang (8.5 mg/l) and Sungai Linggi (4.2 mg/l) (**Figure 3.3**). High turbidity was most frequently detected in Sungai Langat (928.3 NTU), followed by Sungai Selangor (751.1 NTU) and Sungai Klang (682.5 NTU) (**Figure 3.4**). Meanwhile pH value of 6.5 was recorded at Sungai Terengganu, pH 6.6 at Sungai Selangor and pH 6.8 at Sungai Skudai (**Figure 3.5)**.

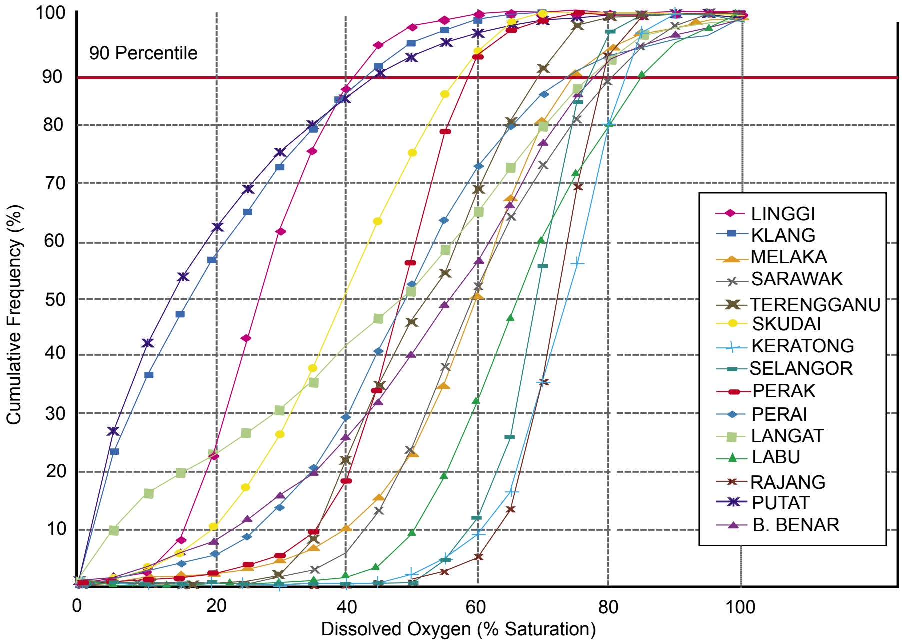


Figure 3.2 : Comparison of Cumulative Frequency for 15 CWQM Stations - Dissolved Oxygen : 1 January - 31 December 2005

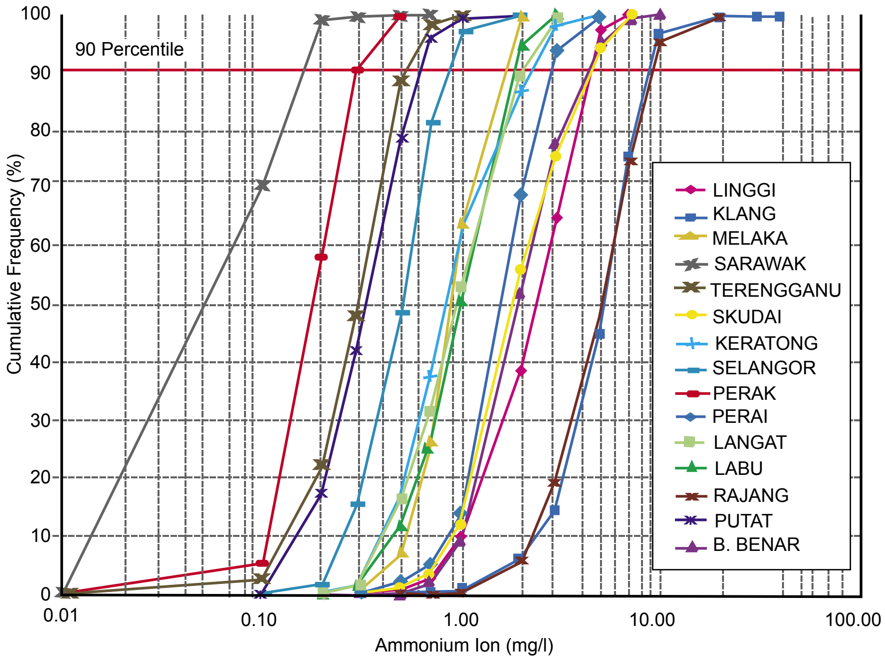


Figure 3.3 : Comparison of Cumulative Frequency for 15 CWQM Stations - Ammonium Ion Concentration : 1 January - 31 December 2005

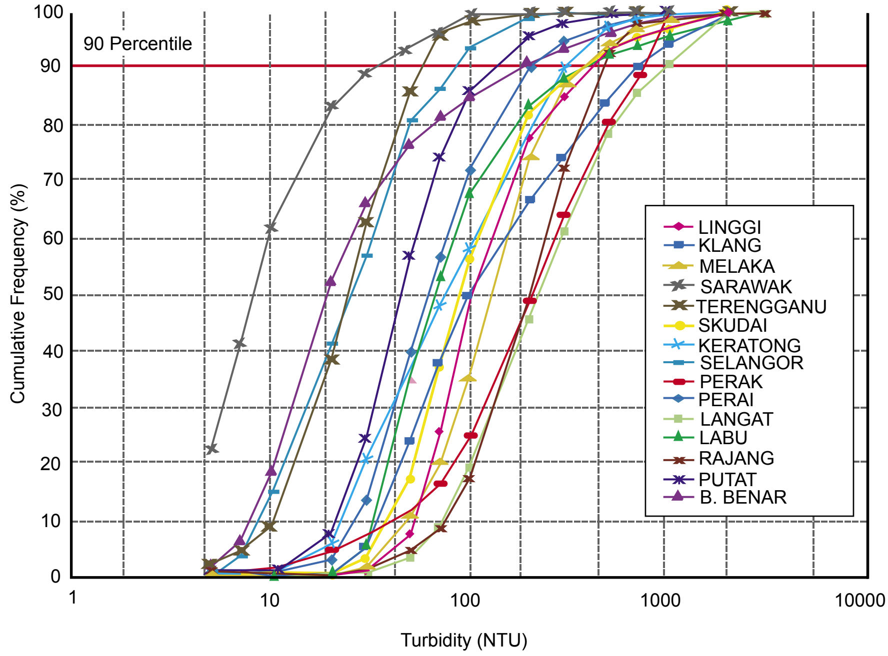


Figure 3.4 : Comparison of Cumulative Frequency for 15 CWQM Stations - Turbidity : 1 January - 31 December 2005

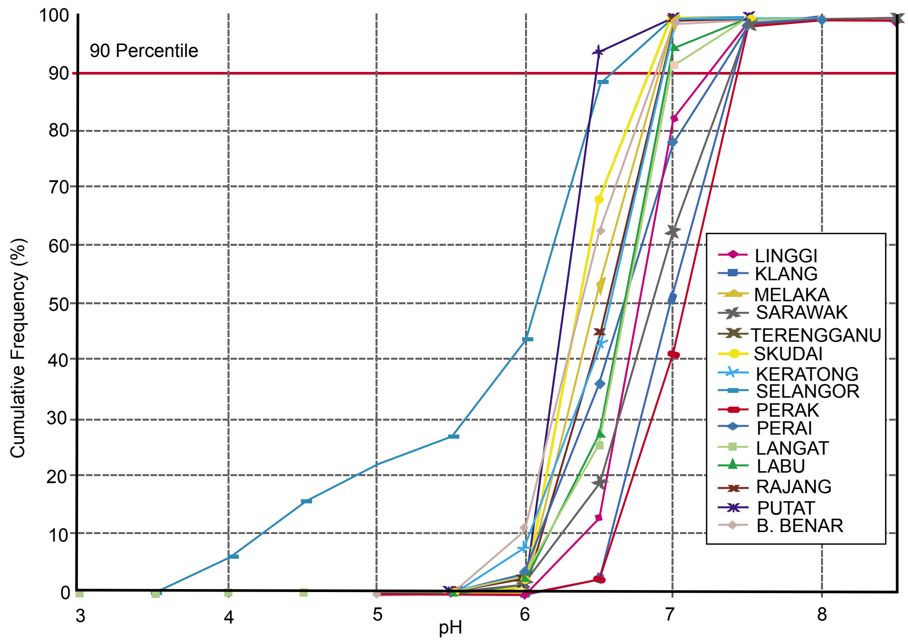


Figure 3.5 : Comparison of Cumulative Frequency for 15 CWQM Stations - pH Level : 1 January - 31 December 2005

Continuous monitoring is vital for early detection of pollution influx. Over the years, a number of pollution incidences had been observed at several continuous monitoring stations. For the period of January to December 2005, twenty two (22) incidences of distinctive pollution influx were observed (**Table 3.1**).

RIVER WATER POLLUTION SOURCES

Figures 3.6, 3.7 and 3.8 illustrate the status of river water quality in relation to the major pollution sources. Based on Biochemical Oxygen Demand (BOD), 28 river basins were categorized as polluted; 41 river basins slightly polluted and 77 river basins clean (**Figure 3.6**). High BOD was

Table 3.1 Malaysia : Pollution Influx Observed at Six Continuous Water Quality Stations

Station	Date	Parameter	Pollution Sources
Sungai Melaka	8 Jan `05	NH_4 : 1.24 mg/l Turbidity : 185.5 NTU	Sewage/earthworks
Sungai Langat	3 Feb `05	NH_4 : 2.97 mg/l pH : 6.96	Sewage/latex based industry
Sungai Batang Benar	9 Feb `05	NH_4 : 6.4 mg/l	Sewage/latex based industry
Sungai Batang Benar	26 Feb `05	NH_4 : 6.85 mg/l	Sewage/latex based industry
Sungai Batang Benar	4 Mar `05	NH_4 : 8.03 mg/l	Sewage/latex based industry
Sungai Batang Benar	21 Mar `05	NH_4 : 7.58 mg/l DO : 0.28 mg/l	Sewage/latex based industry
Sungai Batang Benar	22 Mar `05	NH_4 : 10.91 mg/l DO : 0.37 mg/l	Sewage/latex based industry
Sungai Batang Benar	11 Apr `05	NH_4 : 3.09 mg/l DO : 1.55 mg/l	Sewage/latex based industry
Sungai Batang Benar	12 Apr `05	NH_4 : 2.48 mg/l DO : 2.82 mg/l	Sewage/latex based industry
Sungai Batang Benar	15 Apr `05	NH_4 : 2.05 mg/l DO : 3.45 mg/l	Sewage/latex based industry
Sungai Labu	25 Apr `05	NH_4 : 2.89 mg/l DO : 0.26 mg/l	Sewage/latex based industry
Sungai Labu	19 May `05	NH_4 : 3.69 mg/l	Sewage
Sungai Batang Benar	24 May `05	NH_4 : 4.47 mg/l	Sewage/latex based industry
Sungai Skudai	24 Jun `05	NH_4 : 8.48 mg/l DO : 0.25 mg/l	Sewage/latex based industry
Sungai Keratong	7 Jul `05	NH_4 : 4.65 mg/l	Sewage/industrial discharge
Sungai Batang Benar	10 Jul `05	NH_4 : 8.11 mg/l	Sewage/industrial discharge
Sungai Batang Benar	3 Aug `05	NH_4 : 7.59 mg/l DO : 0.39 mg/l	Sewage/industrial discharge
Sungai Batang Benar	22 Oct `05	NH_4 : 8.51 mg/l	Sewage/latex based industry
Sungai Skudai	9 Nov `05	NH_4 : 3.65 mg/l	Sewage/industrial discharge
Sungai Batang Benar	16 Nov `05	NH_4 : 4.86 mg/l DO : 0.04 mg/l	Sewage/industrial discharge
Sungai Skudai	15 Dec `05	NH_4 : 3.61 mg/l	Sewage/industrial discharge
Sungai Skudai	16 Dec `05	NH_4 : 3.40 mg/l	Sewage/industrial discharge
Sungai Skudai	17 Dec `05	NH_4 : 4.48 mg/l	Sewage/industrial discharge

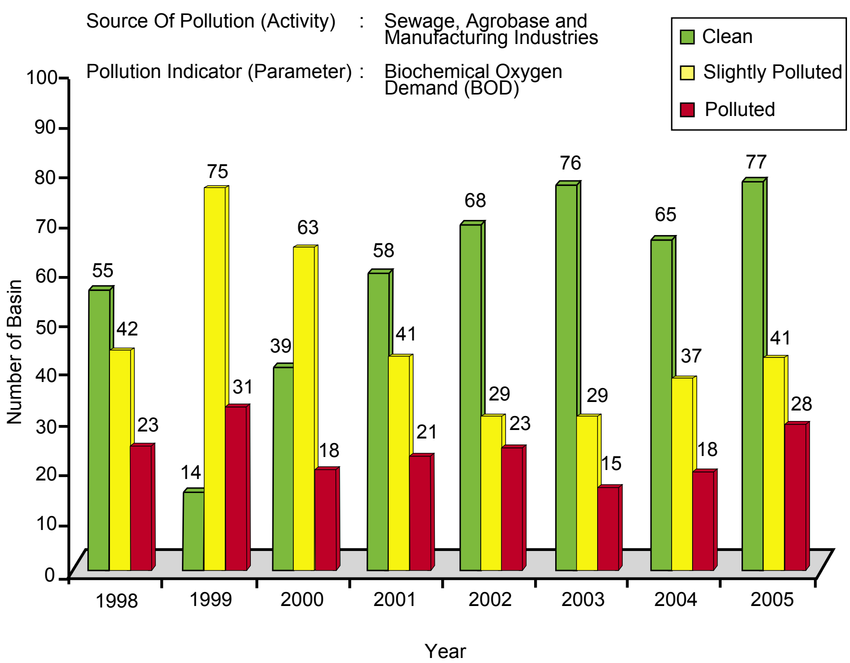


Figure 3.6 :
River Basins Water Quality Trend Based on BOD Sub-Index, 1998 - 2005

contributed by untreated or partially treated sewage and discharges from agro-based and manufacturing industries. Based on Ammoniacal Nitrogen (NH_3-N), 43 river basins were categorized as polluted; 54 river basins slightly polluted and 49 river basins clean (**Figure 3.7**). The main source of Ammoniacal Nitrogen (NH_3-N) was sewage which included livestock farming and domestic sewage. Meanwhile, 34 river basins were categorized as polluted by Suspended Solids (SS), 22 basins slightly polluted and 90 clean (**Figure 3.8**). Earthworks and land clearing activities were the main sources of SS pollution.

Analysis of heavy metals in 5,828 water samples revealed that almost all samples complied with Class III, National Water Quality Standards for arsenic (As), mercury (Hg), cadmium (Cd), chromium (Cr), lead (Pb), and zinc (Zn), except iron (Fe) 85 % compliance and zinc (Zn) 99 % compliance.

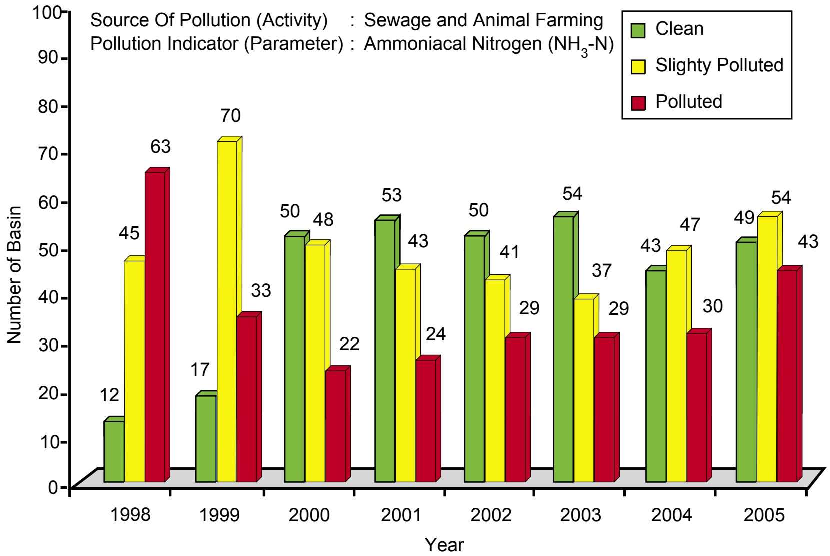


Figure 3.7 :
River Basins Water Quality Trend Based on NH_3-N Sub-Index, 1998 - 2005

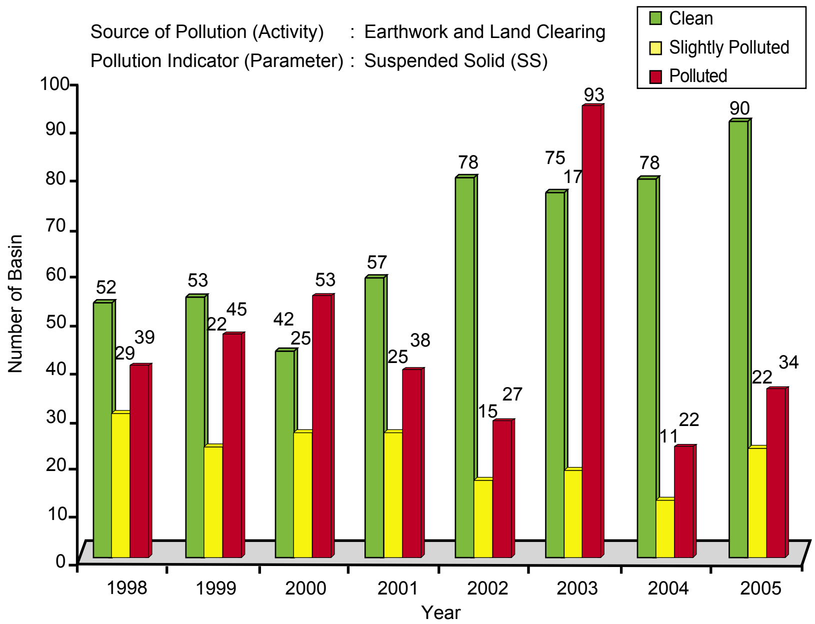


Figure 3.8 :
River Basins Water Quality Trend Based on SS Sub-Index, 1998 - 2005

The trend for river water quality (1990 to 2005) is as shown in **Figure 3.1**. In 2005, the number of polluted river basins were 15, slightly polluted basins 51 and the number of clean river basins 80. Of the 15 polluted river basins, 9 were previously already polluted thus remaining unchanged; 3 deteriorated from slightly polluted in 2004 to polluted in 2005; and 3 were new river basins identified after the review. The 3 river basins where water quality deteriorated were Sungai Merbok, Kedah (WQI 59)(WQI 65 in 2004); Sungai Air Baloi, Johor (WQI 59) (WQI 67 in 2004); and Sungai Tebrau, Johor (WQI 57) (WQI 68 in 2004). The other newly identified polluted river basins were Sungai Bayan Lepas, Pulau Pinang (WQI 58), Sungai Merlimau, Melaka (WQI 58) and Sungai Sembulan, Sabah (WQI 59).

Table 3.2 Malaysia : Water Quality Status of Clean River Basins, 2005

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	01PLA	KISAP	1	90 (92)	KISAP	1	90	C	II
	01PLC	MELAKA	2	87 (82)	MELAKA	1	82	C	II
					PETANG	1	93	C	I
	03	KEDAH	9	81 (79)	JANING	1	88	C	II
					KEDAH	1	64	SP	III
					PADANG TERAP	4	82	C	II
					PEDU	1	91	C	II
					PENDANG	1	76	SP	III
					TEKAI	1	82	C	II
KEDAH/ P.PINANG	05	MUDA	13	81 (84)	CHEPIR	1	84	C	II
					JERUNG	2	65	SP	III
					KARANGAN	1	81	C	II
					KETIL	2	88	C	II
					MUDA	4	86	C	II
					PEGANG	1	91	C	II
					SEDIM	1	81	C	II
					TAWAR	1	73	SP	III
PERAK	09	KURAU	6	83 (82)	ARA	1	91	C	II
					KURAU	5	79	SP	II
	11	BERUAS	6	87 (86)	BRUAS	3	85	C	II
					DANDANG	1	90	C	II
					ROTAN	2	89	C	II
PERAK/ SELANGOR	14	BERNAM	13	85 (79)	BERNAM	7	81	C	II
					INKI	1	91	C	II
					SLIM	2	88	C	II
					TEROLAK	3	90	C	II
SELANGOR	15	TENGI	3	84 (78)	TENGI	3	84	C	II
JOHOR	29	JOHOR	39	81 (81)	ANAK SG. SAYONG	2	65	SP	III
					BELITONG	1	79	SP	II
					BERANGAN	1	72	SP	III
					BKT. BESAR	2	65	SP	III
					CHEMANGAR	1	78	SP	II
					JOHOR	5	84	C	II
					LAYANG	1	91	C	II
					LAYAU KIRI	1	88	C	II
					LEBAM	1	83	C	II
					LINGGIU	1	89	C	II
					PANTI	1	83	C	II
					PAPAN	1	87	C	II
					PELEPAH	1	92	C	II
					PENGGELI	1	91	C	II
					REMIS	1	86	C	II
					SANTI	1	87	C	II
					SAYONG	5	86	C	II
					SEBOL	1	78	SP	II
					SELUYUT	1	87	C	II
					SEMANGER	1	89	C	II
					SEMENCHU	1	87	C	II
					SENING	1	77	SP	II
					SERAI	1	60	SP	III
					TELOR	1	91	C	II
					TEMON	1	87	C	II
					TIRAM	4	71	SP	III
	30C	PALOI	1	88 (80)	PALOI	1	88	C	II
	31A	MERSING	2	83 (90)	MERSING	2	83	C	II
	31B	JEMALUANG	2	82 (84)	JEMALUANG	2	82	C	II
PAHANG	32A	PONTIAN	2	89 (80)	PONTIAN	1	89	C	II
					SEPAYANG	1	62	SP	III
	32AE	ANAK ENDAU	2	85 (86)	ANAK ENDAU	2	85	C	II
	33	ROMPIN	17	85 (85)	AUR	1	88	C	II
					BAKAR	1	61	SP	III
					JEKATIH	2	88	C	II
					JERAM	1	86	C	II
					KEPASING	1	74	SP	III
					KERATONG	3	84	C	II
					PUKIN	3	89	C	II
					REKOH	1	74	SP	III
					ROMPIN	4	84	C	II
	34B	BEBAR	6	85 (-)	BEBAR	2	80	SP	II
					MERBA	1	87	C	II
					SERAI	2	85	C	II
					TEMIANG	1	86	C	II
	34M	MERCHONG	2	81 (-)	KELAYAT	1	87	C	II

Table 3.2 Malaysia : Water Quality Status of Clean River Basins, 2005 (Continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PAHANG					MERCHONG	1	76	SP	III
	35P	PAHANG	93	87 (88)	ANAK SG. LEPAR	1	74	SP	III
					BATU	1	53	P	III
					BELAYAR	1	93	C	I
					BENTONG	4	84	C	II
					BENUS	2	88	C	II
					BERA	3	83	C	II
					BERKAPOR	1	83	C	II
					BERTAM	3	85	C	II
					BILUT	1	85	C	II
					BURUNG	1	93	C	II
					CHINI	1	77	SP	II
					HABU	1	83	C	II
					JELAI	2	88	C	II
					JEMPOL	2	89	C	II
					JENGKA	2	78	SP	II
					KELAU	2	90	C	II
					KERTAM	1	84	C	II
					KOYAN	1	88	C	II
					KUNDANG	1	84	C	II
					LENGGOK	1	93	C	I
					LEPAR	3	89	C	II
					LIPIS	3	91	C	II
					LUIT	1	89	C	II
					MARAN	1	88	C	II
					MENTIGA	2	83	C	II
					MOKEK	1	83	C	II
					PAHANG	8	88	C	II
					PENJURING	1	92	C	II
					PERTANG	2	87	C	II
					PERTING	1	88	C	II
					RINGLET	1	85	C	II
					SEMANTAN	3	88	C	II
					SERTING	5	79	SP	II
					SIAM	1	91	C	II
					T. PAYA BUNGOR	1	85	C	II
					TAHAN	1	90	C	II
					TANGLIR	1	84	C	II
					TASIK BERA	1	88	C	II
					TASIK CHINI	10	92	C	II
					TEKAL	1	84	C	II
					TEKAM	2	87	C	II
					TELANG	1	89	C	II
					TELEMONG	1	91	C	II
					TELOM	2	91	C	II
					TEMBELING	1	87	C	II
					TERANUM	1	92	C	II
					TERAS	1	91	C	II
					TERLA	1	93	C	I
					TRIANG	2	84	C	II
					TRINGKAP	1	90	C	II
	37C	CHERATING	1	83 (82)	CHERATING	1	83	C	II
TERENGGANU	38	KEMAMAN	9	88 (79)	CHERUL	2	86	C	II
					KEMAMAN	3	87	C	II
					NERAM	1	83	C	II
					PERASING	1	88	C	II
					RANSAN	2	74	SP	III
	39K	KERTIH	2	87 (86)	KERTIH	2	87	C	II
	40	PAKA	6	87 (85)	BESUL	1	89	C	II
					PAKA	2	88	C	II
					RASAU	2	81	C	II
					RENGAT	1	76	SP	III
	41	DUNGUN	5	88 (87)	DUNGUN	4	89	C	II
					TELEMBOH	1	82	C	II
	42I	IBAI	3	83 (75)	IBAI	3	83	C	II
	42M	MARANG	3	82 (84)	KERAK	1	77	SP	II
					MARANG	1	87	C	II
					TEMALA	1	86	C	II
	43	TERENGGANU	12	85 (85)	BERANG	2	91	C	II
					NERUS	4	83	C	II
					PUEH	2	82	C	II
					TELEMONG	1	91	C	II
					TERENGGANU	3	85	C	II

Table 3.2 Malaysia : Water Quality Status of Clean River Basins, 2005 (Continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
TERENGGANU	44	SETIU	5	85	(88)	SETIU	4	84	C	II
						TAROM	1	81	C	II
	46	BESUT	4	90	(88)	BESUT	3	90	C	II
						JERTIH	1	89	C	II
	47A	MERANG	1	84	(-)	MERANG	1	84	C	II
	47B	KLUANG	1	83	(-)	KLUANG	1	83	C	II
KELANTAN	47K	KEMASIN	2	82	(84)	KEMASIN	2	82	C	II
	48	KELANTAN	45	87	(87)	ARING	1	87	C	II
						BELATOP	2	84	C	II
						BER	1	91	C	II
						BEROK	4	84	C	II
						BETIS	1	88	C	II
						CHIKU	1	85	C	II
						GALAS	5	85	C	II
						KELANTAN	3	84	C	II
						KELESA	1	89	C	II
						KERAK	1	88	C	II
						KERILLA	2	89	C	II
						KETIL	1	90	C	II
						LEBIR	4	86	C	II
						NAL	3	89	C	II
						NENGGIRI	3	85	C	II
						PEHI	1	87	C	II
						PERGAU	6	89	C	II
						PERTOK	1	83	C	II
						RELAI	2	87	C	II
						SOKOR	1	86	C	II
						TUANG	1	89	C	II
	48PD	PENGKALAN DATU	3	85	(-)	PENGKALAN DATU	3	85	C	II
	49	GOLOK	7	88	(87)	GOLOK	5	87	C	II
						LANAS	1	90	C	II
						TASIK GARU	1	88	C	II
SARAWAK	50	KAYAN	4	86	(84)	KAYAN	3	86	C	II
						SEMATAN	1	90	C	II
	50S	SEMUNSAM	1	89	(-)	SEMUNSAM	1	89	C	II
	51	SARAWAK	16	82	(79)	KELANTAN	1	46	P	IV
						KUAP	2	83	C	II
						MAONG KIRI	1	60	SP	III
						SANTUBONG	1	86	C	II
						SARAWAK	5	86	C	II
						SARAWAK KANAN	2	85	C	II
						SARAWAK KIRI	1	88	C	II
						SEMADANG	1	91	C	II
						SEMENGGOH	1	69	SP	III
						TABUAN	1	84	C	II
	51BS	SAMARAHAN	2	81	(77)	SAMARAHAN	2	81	C	II
	52	SADONG	7	83	(81)	KARANGAN	2	80	SP	II
						SADONG	4	83	C	II
						TARAT	1	89	C	II
	53	LUPAR	8	83	(80)	AI	2	88	C	II
						LUPAR	3	78	SP	II
						SEKERANG	1	85	C	II
						SETERAP	1	81	C	II
						UNDUP	1	85	C	II
	56	RAJANG	19	82	(83)	BALOI	1	82	C	II
						BINATANG	1	87	C	II
						JULAU	1	86	C	II
						KANOWIT	1	89	C	II
						MERADONG	1	82	C	II
						RAJANG	12	81	C	II
						SALIM	1	81	C	II
						SARIKEI	1	86	C	II
	58	MUKAH	4	81	(75)	MUKAH	4	81	C	II
	59	BALINGIAN	2	83	(78)	BALINGIAN	2	83	C	II
	60	TATAU	1	82	(85)	TATAU	1	82	C	II
	61	KEMENA	5	81	(80)	KEMENA	4	82	C	II
						SIBIU	1	81	C	II
	62	SIMILAJAU	2	84	(82)	SIMILAJAU	2	84	C	II
	63	SUAI	1	83	(82)	SUAI	1	83	C	II
	64	NIAH	4	83	(77)	NIAH	2	85	C	II
						SEKALOH	2	70	SP	III
	68	LIMBANG	5	85	(81)	LIMBANG	5	85	C	II
	69	TRUSAN	1	89	(86)	TRUSAN	1	89	C	II

Table 3.2 Malaysia : Water Quality Status of Clean River Basins, 2005 (Continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SARAWAK	70	LAWAS	3	85	(87)	LAWAS	3	85	C	II
SABAH	71L	LAKUTAN	1	87	(-)	LAKUTAN	1	87	C	II
	71LG	LINGKUNGAN	2	89	(-)	BUKAU	1	89	C	II
						LINGKUNGAN	1	89	C	II
	71MG	MENGGALONG	2	86	(90)	MENGGALONG	2	86	C	II
	72	PADAS	10	86	(90)	ANSIP	1	88	C	II
						BUNSIT	1	92	C	II
						LIAWAN	1	91	C	II
						PADAS	3	85	C	II
						PANGATAN	1	84	C	II
						PEGALAN	2	81	C	II
						TANDULU	1	94	C	I
	72BW	BONGAWAN	1	82	(-)	BONGAWAN	1	82	C	II
	72KM	KIMANIS	1	82	(-)	KIMANIS	1	82	C	II
	73	MEMBAKUT	1	83	(91)	MEMBAKUT	1	83	C	II
	74	PAPAR	3	89	(92)	PAPAR	3	89	C	II
	76	MOYOG	4	91	(79)	MOYOG	4	91	C	II
	77	DAMIT/TUARAN	5	90	(90)	DAMIT	2	89	C	II
						SONG SAI	1	91	C	II
						TUARAN	2	91	C	II
	78	KEDAMAIAN	4	90	(90)	KEDAMAIAN	1	92	C	II
						TEMPASUK	2	90	C	II
						WARIU	1	91	C	II
	78T	TENGHILAN	1	91	(-)	TENGHILAN	1	91	C	II
	79	BINGKONGAN	6	87	(64)	BANDAU	1	90	C	II
						BINGKONGAN	2	93	C	II
						MENGGARIS	2	79	SP	II
						TANDEK	1	86	C	II
	80	BENGKOKA	2	89	(91)	BENGKOKA	2	89	C	II
	83	SUGUT	6	92	(91)	BONGKUD	1	93	C	I
						LOHAN	1	93	C	I
						MERALI	1	89	C	II
						SUGUT	3	92	C	II
	83P	PAITAN	1	82	(-)	PAITAN	1	82	C	II
	84	LABOK	7	89	(88)	KINIPIR	2	90	C	II
						LABOK	1	87	C	II
						LIWAGU	2	89	C	II
						MALIAU	1	92	C	II
						TUNGUD	1	89	C	II
	84SP	SAPI	4	86	(-)	SAPI	3	83	C	II
						SUALONG	1	94	C	I
	86	KINABATANGAN	10	84	(81)	KARAMUAK	1	88	C	II
						KINABATANGAN	2	86	C	II
						KOYAH	1	83	C	II
						LEEPANG	1	83	C	II
						MENANGGUL	1	82	C	II
						PIN	1	78	SP	II
						TAKALA	1	80	SP	II
						TENEGANG BESAR	2	86	C	II
	87	SEGAMA	3	87	(85)	SEGAMA	3	87	C	II
	88	SILABUKAN	2	81	(81)	SILABUKAN	2	81	C	II
	88T	TUNGKU	2	82	(-)	TUNGKU	2	82	C	II
	89	TINGKAYU	2	86	(85)	TINGKAYU	2	86	C	II
	91	APAS	1	89	(-)	APAS	1	89	C	II
	91B	BALUNG	1	82	(-)	BALUNG	1	82	C	II
	92	TAWAU	4	88	84	TAWAU	4	88	C	II
	93	UMAS-UMAS	1	84	82	UMAS-UMAS	1	84	C	II
	94	BRANTIAN	1	86	81	BRANTIAN	1	86	C	II
	96	MEROTAI	3	85	(-)	MEROTAI	3	85	C	II

Notes :

1. WQI based on 6 major parameters : BOD, COD, SS, pH, DO and NH_3-N
2. River water quality status : C = Clean, SP = Slightly polluted and P = Polluted
3. River class based on NWQS
4. ( ) = Overall WQI for 2005
5. Overall WQI for river basin is calculated by averaging WQI from all sampling stations in each river basin

Table 3.3 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2005

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PERLIS	01	PERLIS	12	78	(78)	ARAU	1	62	SP	III
						JARUM	1	81	C	II
						JERNIH	2	77	SP	II
						KOK MAK	1	72	SP	III
						NGULANG	1	76	SP	III
						PELARIT	1	89	C	II
						PERALIT	1	87	C	II
						PERLIS	1	65	SP	III
						SERAI	1	78	SP	II
						TASOH	1	79	SP	II
						WANG KELIAN	1	93	C	I
KEDAH	01PLB	KUAH	1	65	(-)	KUAH	1	65	SP	III
	06P	PERAI	20	60	(63)	AIR MELINTAS	1	39	P	IV
						JARAK	5	68	SP	III
						KARANGAN	1	91	C	II
						KELADI	1	70	SP	III
						KEREH	2	50	P	IV
						KUBANG SEMANG	1	41	P	IV
						KULIM	3	82	C	II
						PERAI	2	60	SP	III
						PERTAMA	1	53	P	III
						SELUANG	1	50	P	IV
						SELUANG BAWAH	2	52	P	IV
P.PINANG	06K	KLUANG	4	72	(-)	ARA	2	74	SP	III
						KLUANG	1	72	SP	III
						RELAU	1	70	SP	III
P.PINANG/ PERAK	08	KERIAN	9	74	(76)	KECHIL	2	79	SP	II
						KERIAN	4	81	C	II
						SELAMA	2	62	SP	III
						SERDANG	1	56	P	III
PERAK	10	SEPETANG	15	79	(75)	BATU TEGUH	4	79	SP	II
						JANA	1	87	C	II
						LARUT	1	60	SP	III
						LIDIN	1	54	P	III
						LIMAU	1	88	C	II
						MALAI	1	61	SP	III
						SEPETANG	2	72	SP	III
						TEMERLOH	2	89	C	II
						TRONG	1	93	C	II
						TUPAI	1	81	C	II
	12	RAJA HITAM/ MANJONG	8	70	(73)	DERHAKA	2	59	P	III
						MANJONG	2	84	C	II
						NYIOR	1	92	C	II
						RAJA HITAM	3	54	P	III
	12W	DERALIK/WANGI	4	76	(69)	DERALIK	2	72	SP	III
						WANGI	2	62	SP	III
	13	PERAK	60	75	(81)	BATANG PADANG	4	86	C	II
						BIDOR	3	83	C	II
						CHENDERIANG	2	84	C	II
						CHEPOR	1	93	C	I
						CUAR	1	90	C	II
						KAMPAR	2	85	C	II
						KANGSAR	2	83	C	II
						KEPAYANG	2	66	SP	III
						KERDAH	2	67	SP	III
						KINJANG	1	93	C	I
						KINTA	8	67	SP	III
						KLAH	2	83	C	II
						KLIAN BARU	2	71	SP	III
						KUANG	1	83	C	II
						NYAMOK	1	43	P	IV
						PARI	2	58	P	III
						PELUS	3	89	C	II
						PERAK	8	85	C	II
						PINJI	2	57	P	III
						RAIA	2	86	C	II
						SELUANG	1	58	P	III
						SEROKAI	2	49	P	IV
						SINTANG	1	47	P	IV
						SUNGKAI	2	85	C	II
						SUNGKAI MATI	2	65	SP	III
						TUMBOH	1	68	SP	III

Table 3.3 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2005 (Continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SELANGOR	16	SELANGOR	15	80 (85)	BATANG KALI	1	92	C	II
					KANCING	1	87	C	II
					KERLING	1	91	C	II
					KUNDANG	1	58	P	III
					RAWANG	1	66	SP	III
					SELANGOR	8	81	C	II
					SEMBAH	1	68	SP	III
					SERENDAH	1	89	C	II
	19	LANGAT	28	74 (70)	ANAK CHUAU	1	84	C	II
					BALAK	1	60	SP	III
					BATANG BENAR	2	54	P	III
					BATANG LABU	2	74	SP	III
					BATANG NILAI	2	54	P	III
					BERANANG	1	80	SP	II
					BUAN	1	63	SP	III
					CHUAU	2	88	C	II
					JIJAN	1	86	C	II
					LANGAT	8	67	SP	III
					LIMAU MANIS	1	56	P	III
					LUI	1	92	C	II
					PAJAM	1	77	SP	II
					RINCHING	1	70	SP	III
					SEMENYIH	3	85	C	II
	20	SEPANG	4	67 (72)	RAMBAI	1	41	P	IV
					SEPANG	3	76	SP	III
N.SEMBILAN	20J	LUKUT	1	79 (75)	LUKUT	1	79	SP	II
	21	LINGGI	21	73 (77)	BATANG PENAR	3	67	SP	III
					CHEMBONG	1	85	C	II
					KAYU ARA	1	69	SP	III
					KEPAYONG	1	64	SP	III
					KUNDUR BESAR	1	89	C	II
					LINGGI	6	70	SP	III
					PAROI	1	70	SP	III
					PEDAS	1	88	C	II
					REMBAU	2	86	C	II
					SENAWANG	1	67	SP	III
					SIMIN	1	66	SP	III
					TEMIANG	2	58	P	III
MELAKA	22	MELAKA	21	71 (73)	BTG.MELAKA	2	88	C	II
					DURIAN TUNGGAL	1	78	SP	II
					KEMUNTING	1	80	SP	II
					KERU	1	89	C	II
					MELAKA	9	68	SP	III
					PUTAT	2	54	P	III
					REMBIA	2	64	SP	III
					TAMPIN	3	79	SP	II
	23	DUYONG	4	72 (76)	DUYONG	3	71	SP	III
					GAPAM	1	91	C	II
	24	KESANG	7	76 (-)	CHIN-CHIN	1	59	P	III
					CHOHONG	2	86	C	II
					KESANG	3	77	SP	II
					TANGKAK	1	59	P	III
	24B/T	TUANG/BARU	2	70 (-)	BARU	1	70	SP	III
					TUANG	1	57	P	III
	24L	LINGGI	3	77 (-)	SIMPANG EMPAT	1	74	SP	III
					SIPUT	2	79	SP	II
	24SM	SRI MELAKA	2	62 (-)	AYER SALAK	1	61	SP	III
					SRI MELAKA	1	63	SP	III
JOHOR/ N.SEMBILAN	25	MUAR	40	79 (81)	AIR PANAS	1	92	C	II
					GEMAS	1	74	SP	III
					GEMENCHEH	2	88	C	II
					JUASEH	1	87	C	II
					KELAMAH	1	65	SP	III
					LABIS	3	75	SP	III
					MEDA	1	81	C	II
					MERBUDU	1	83	C	II
					MERLIMAU	1	63	SP	III
					MUAR	16	84	C	II
					P. MENKUANG	1	88	C	II
					PALONG	4	83	C	II
					SARANG BUAYA	1	67	SP	III
					SEGAMAT	1	87	C	II

Table 3.3 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2005 (Continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
JOHOR/ N.SEMBILAN						SENARUT	1	50	P	IV
						SEROM	1	69	SP	III
						SPG. LOI	1	76	SP	III
						TEMARONG (N.S)	1	78	SP	II
						TENANG	1	74	SP	III
JOHOR	26	BATU PAHAT	20	72	(75)	AMRAN	1	75	SP	III
						BANTANG	1	93	C	II
						BATU PAHAT	1	62	SP	III
						BEKOK	5	75	SP	III
						BERLIAN	1	75	SP	III
						CHAAH	1	83	C	II
						LENIK	1	79	SP	II
						MEREK	1	83	C	II
						MERPO	1	76	SP	III
						SEMBERONG	2	59	P	III
						SIMPANG KANAN	2	52	P	III
						SIMPANG KIRI	3	64	SP	III
	27B	BENUT	4	72	(74)	BENUT	4	59	P	III
	28A	PONTIAN BESAR	7	68	(68)	AIR HITAM	1	67	SP	III
						AYER MERAH	1	45	P	IV
						KELAPA SAWIT	1	67	SP	III
						PONTIAN BESAR	4	74	SP	III
	28B	PONTIAN KECIL	2	80	(75)	PONTIAN KECIL	2	80	SP	II
	28C	SKUDAI	11	64	(65)	MELANA	2	60	SP	III
						SKUDAI	9	64	SP	III
	28G	RAMBAH	2	69	(70)	RAMBAH	2	69	SP	III
	29S	SANGLANG	1	63	(-)	SANGLANG	1	63	SP	III
	30	PULAI	3	74	(-)	CHOH	1	60	SP	III
						PULAI	2	82	C	II
	30A	SEDILI BESAR	12	78	(83)	AMBAT	1	86	C	II
						DOHOL	1	84	C	II
						MUPUR	1	53	P	III
						PASIR PANJANG	1	67	SP	III
						SEDILI BESAR	5	79	SP	II
						SEMANGGOT KANAN	1	87	C	II
						SEMANGGOT KIRI	1	86	C	II
						TEMUBOR KANAN	1	85	C	II
	30B	SEDILI KECIL	6	74	(71)	ANAK SEDILI KECIL	1	53	P	III
						BAHAN	2	81	C	II
						SEDILI KECIL	3	81	C	II
	31C	KIM-KIM	2	71	(-)	KIM-KIM	2	71	SP	III
	32	ENDAU	25	78	(78)	A.S. SEMBERONG	1	81	C	II
						DENGAR	1	82	C	II
						ENDAU	2	88	C	II
						JASIN	1	94	C	I
						JEBONG	1	60	SP	III
						KAHANG	1	87	C	II
						LENGA	1	59	P	III
						LENGGOR	1	84	C	II
						MAMAI	1	82	C	II
						MELANTAI	1	67	SP	III
						MENGKIBOL	3	70	SP	III
						PALOH	1	85	C	II
						PAMOL	1	37	P	IV
						SELAI	1	92	C	II
						SEMBERONG	6	79	SP	II
						SINGOL	1	75	SP	III
						TAMOK	1	89	C	II
PAHANG	36	KUANTAN	15	80	(79)	BELAT	1	82	C	II
						CHARU	1	85	C	II
						GALING BESAR	1	39	P	IV
						GALING KECIL	1	51	P	IV
						KENAU	1	88	C	II
						KUANTAN	5	86	C	II
						PANDAN	1	78	SP	II
						PINANG	1	85	C	II
						REMAN	1	77	SP	II
						RIAU	1	84	C	II
						TALAM	1	88	C	II
	37B	BALOK/TONGGOK	6	76	(81)	BALOK	2	75	SP	III
						PANJANG	1	64	SP	III
						TONGGOK	2	82	C	II
						YIOR	1	63	SP	III

Table 3.3 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2005 (Continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
TERENGGANU	39C	CHUKAI	6	73 (78)	BUNGKUS	1	76	SP	III
					CHUKAI	1	87	C	II
					IBOK	2	83	C	II
					RUANG	2	59	P	III
	42L	LANDAS	2	79 (71)	LANDAS	1	64	SP	III
					MERCHANG	1	71	SP	III
KELANTAN	47S	SEMERAK	3	77 (78)	SEMERAK	3	77	SP	II
	48PC	PENGKALAN CHEPA	6	67 (-)	ALOR B	1	56	P	III
					ALOR LINTAH	1	52	P	III
					KELADI	1	66	SP	III
					PENGKALAN CHEPA	3	76	SP	III
SARAWAK	54	SARIBAS	4	77 (80)	LAYAR	2	78	SP	II
					RIMBAS	1	85	C	II
					SARIBAS	1	72	SP	III
	55	KERIAN	3	77 (79)	KERIAN	2	76	SP	III
					SEBLAK	1	79	SP	II
	57	OYA	3	79 (75)	OYA	3	79	SP	II
	65	KABULOH	6	77 (81)	KABULOH	2	63	SP	III
					KEJAPIL	1	87	C	II
					SATAP	1	84	C	II
					SIBUTI	2	83	C	II
	66	MIRI/LUTONG	7	72 (68)	ADONG	1	70	SP	III
					DALAM	1	58	P	III
					LUTONG	2	76	SP	III
					MIRI	2	73	SP	III
					PADANG LIKU	1	82	C	II
	67	BARAM	5	80 (76)	BARAM	4	80	SP	II
					TUTOH	1	83	C	II
SABAH	76	INANAM	8	77 (-)	DARAU	1	72	SP	III
					INANAM	3	81	C	II
					LIKAS	2	65	SP	III
					MENGGATAL	2	86	C	II
	76	TELIPOK	2	67 (-)	TELIPOK	2	67	SP	III
	85	MOUNAD	2	69 (79)	MOUNAD	2	69	SP	III
	85A	SEGALIUD	2	78 (-)	SEGALIUD	2	78	SP	II
	90	KALUMPANG	6	73 (70)	INTAN	1	83	C	II
					KALUMPANG	3	86	C	II
					PANG BURONG 1	1	49	P	IV
					PANG BURONG 2	1	54	P	III
	95	KALABAKAN	3	78 (78)	KALABAKAN	3	78	SP	II

Notes :

1. WQI based on 6 major parameters : BOD, COD, SS, pH, DO and NH_3-N
2. River water quality status : C = Clean, SP = Slightly polluted and P = Polluted
3. River class based on NWQS
4. ( ) = Overall WQI for 2005
5. Overall WQI for river basin is calculated by averaging WQI from all sampling stations in each river basin

Table 3.4 Malaysia : Water Quality Status of Polluted River Basins, 2005

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	04	MERBOK	11	59	(65)	BAKAR ARANG	1	53	P	III
						BATU	1	33	P	IV
						BONGKOK	1	62	SP	III
						BUKIT MERAH	1	70	SP	III
						KOROK	1	42	P	IV
						MERBOK	1	72	SP	III
						PETANI	1	46	P	IV
						TOK PAWANG	2	63	SP	III
						TUPAH	2	64	SP	III
P. PINANG	06J	JURU	12	46	(49)	ARA	1	38	P	IV
						PMTG RAWA	1	45	P	IV
						JURU	2	46	P	IV
						KILANG UBI	5	53	P	III
						PASIR	1	42	P	IV
						RAMBAI	2	40	P	IV
	06PP	PINANG	11	44	(-)	AIR ITAM	5	44	P	IV
						AIR TERJUN	1	94	C	I
						DONDANG	3	43	P	IV
						JELUTONG	1	30	P	V
						PINANG	1	39	P	IV
	06T	BAYAN LEPAS	3	58	(-)	BAYAN LEPAS	1	54	P	III
						TIRAM	2	60	SP	III
	07	JEJAWI	7	59	(58)	CEMPEDAK	1	33	P	IV
						JAWI	1	56	P	III
						JUNJUNG	3	57	P	III
						MACHANG BUBUK	1	67	SP	III
						TENGAH	1	58	P	III
SELANGOR	17	BULOH	5	51	(48)	BULOH	5	51	P	IV
WPKL	18	KLANG	31	55	(54)	AMPANG	1	52	P	IV
						BATU	3	58	P	III
						BUNOS	1	48	P	IV
						DAMANSARA	3	52	P	III
						GOMBAK	3	68	SP	III
						JINJANG	2	44	P	IV
						KERAYONG	2	44	P	IV
						KEROH	3	65	SP	III
						KLANG	11	52	P	IV
						KUYOH	1	54	P	III
						PENCALA	1	41	P	IV
MELAKA	24A	MERLIMAU	4	58	(-)	MERLIMAU	4	58	P	III
JOHOR	27A	AIR BALOI	3	59	(67)	AIR BALOI	3	59	P	III
	28	SEGGET	5	47	(50)	SEGGET	5	47	P	IV
	28D	TEBRAU	11	57	(68)	ANAK TEBRAU	3	78	SP	II
						BALA	1	55	P	III
						CAW TEBRAU	1	66	SP	III
						PANDAN	1	56	P	III
						PLENTONG	1	48	P	IV
						SEBULUNG	1	54	P	III
						SENGKUANG	1	40	P	IV
						TAMPOI	1	51	P	IV
						TEBRAU	1	68	SP	III
	28E	KEMPAS	2	56	(45)	KEMPAS	2	56	P	III
	28F	DANGA	2	52	(55)	DANGA	2	52	P	III
	29B	KAW. PASIR GUDANG	5	43	(40)	BULUH	1	37	P	IV
						LATOH	1	54	P	III
						MASAI	1	66	SP	III
						PEREMBI	1	33	P	IV
						TUKANG BATU	1	25	P	V
SABAH	76SB	SEMBULAN	2	59	(-)	SEMBULAN	2	59	P	III

Notes :

1. WQI based on 6 major parameters : BOD, COD, SS, pH, DO and NH_3-N
2. River water quality status : C = Clean, SP = Slightly polluted and P = Polluted
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4. ( ) = Overall WQI for 2005
5. Overall WQI for river basin is calculated by averaging WQI from all sampling stations in each river basin

CHAPTER 4

GROUNDWATER QUALITY

GROUNDWATER QUALITY MONITORING

Recognising the future potential of groundwater as an important alternative source of water, the Department of Environment (DOE) in 1997 initiated the National Groundwater Monitoring Programme. By 2005, 88 monitoring wells had been established at 48 sites in Peninsular Malaysia, 19 wells in Sarawak and 15 wells in Sabah **(Table 4.1)**. The sites were selected and categorized according to the surrounding land use which were agricultural, urban/suburban, rural, industrial, solid waste landfills, golf courses, radioactive landfill, animal burial areas, municipal water supply and ex-mining areas (gold mine). In 2005, monitoring of salt water intrusion was conducted at three monitoring wells; two in Selangor and one in Pahang.

DOE Groundwater Monitoring Well (DOE Photo Library)

Table 4.1 Malaysia :
Distribution of Groundwater Monitoring Wells, 2005

Category	Number of Wells
Agricultural Areas	12
Urban/Suburban Areas	12
Industrial Sites	18
Solid Waste Landfills	27
Golf Courses	7
Radioactive Landfill	1
Rural Areas	5
Ex-mining Areas (Gold Mine)	3
Municipal Water Supply	11
Animal Burial Areas	16
Aquaculture Farms	9
Resorts	1
Total	**122**

Groundwater Monitoring (DOE Photo Library)

GROUNDWATER QUALITY STATUS

In 2005, 250 water samples were taken from these monitoring wells compared to 274 the previous year (2004). The samples were analysed for volatile organic compounds (VOCs), pesticides, heavy metals, anions, bacteria (coliform), phenolic compounds, radioactivity (Gross Alpha and Beta), total hardness, total dissolved solids (TDS), pH, temperature, conductivity and dissolved oxygen (DO). The groundwater quality status was determined based on the National Guidelines for Raw Drinking Water Quality from the Ministry of Health (Revised December 2000) **(Table 4.2)** as the benchmark.

Table 4.2 Malaysia :
National Guidelines for Raw Drinking Water Quality
(Revised December 2000)

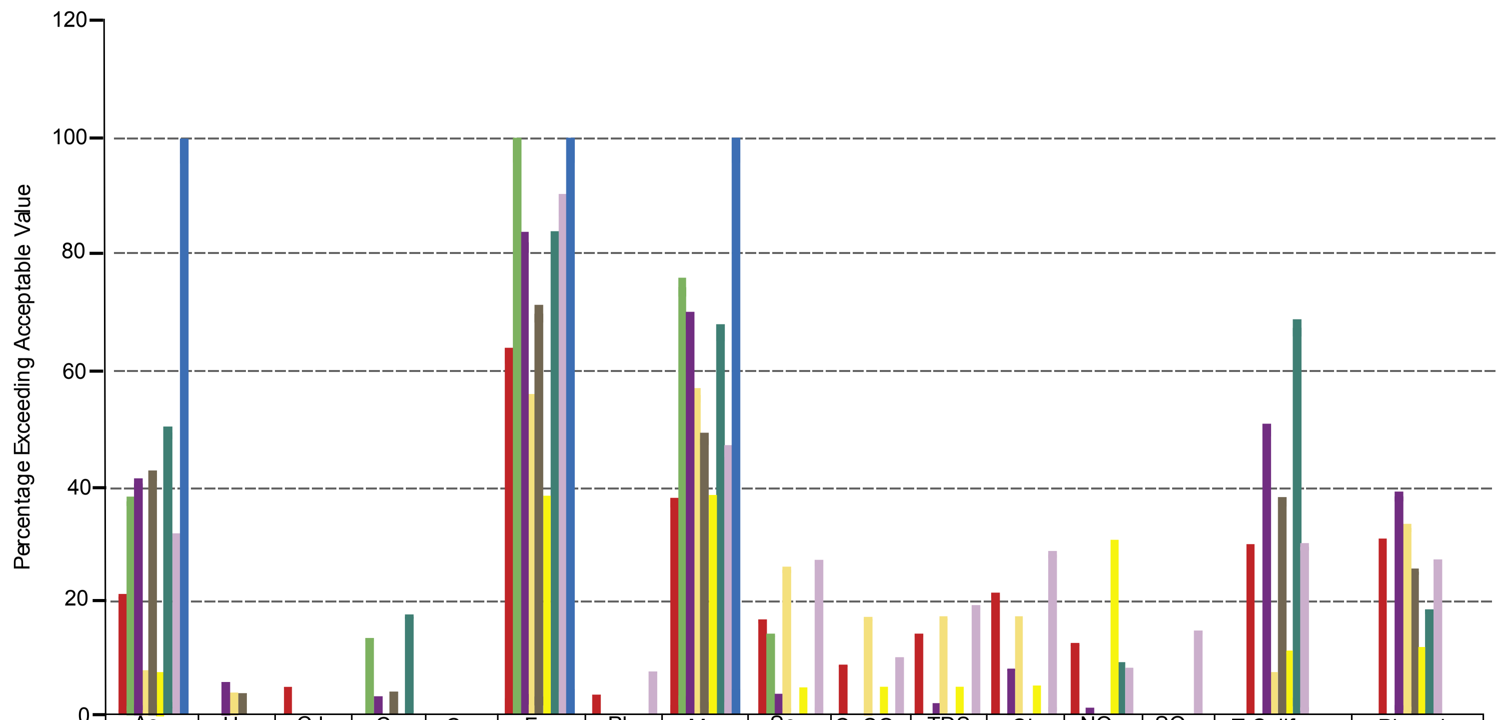
Parameter	Symbol	Benchmark
Sulphate	SO_4	250 mg/l
Hardness	$CaCO_3$	500 mg/l
Nitrate	NO_3	10 mg/l
Coliform	-	Must not be detected in any 100 ml sample
Manganese	Mn	0.1 mg/l
Chromium	Cr	0.05 mg/l
Zinc	Zn	3 mg/l
Arsenic	As	0.01 mg/l
Selenium	Se	0.01 mg/l
Chloride	Cl	250 mg/l
Phenolics	-	0.002 mg/l
TDS	-	1000 mg/l
Iron	Fe	0.3 mg/l
Copper	Cu	1.0 mg/l
Lead	Pb	0.01 mg/l
Cadmium	Cd	0.003 mg/l
Mercury	Hg	0.001 mg/l

Source : Ministry of Health, Malaysia

Potential Groundwater Contamination by Landfill Leachate
(DOE Photo Library)

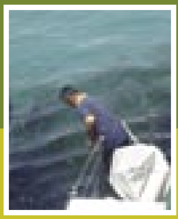
Iron (Fe) levels exceeding the benchmark were recorded in all samples **(Figure 4.1)**. Between 38 percent and 100 percent of the samples taken from all sites showed high levels of iron. The sampling results also showed that between 37 percent and 100 percent of samples taken from all areas recorded manganese (Mn) levels exceeding the benchmark. Between one percent and 29 percent of samples from all areas except in radioactive landfill, ex-mining areas (gold mine), municipal water supply and urban/suburban areas were found to exceed the nitrate benchmark.

Arsenic levels exceeding the benchmark were recorded at radioactive sites (100%), ex-mining areas (50%), solid waste landfill (42%), industrial areas (33%), municipal water supply (38%) and agricultural areas (21%). Other parameters exceeding the acceptable values are shown in **Figure 4.1**.



	As (mg/l)	Hg (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Pb (mg/l)	Mn (mg/l)	Se (mg/l)	$CaCO_3$ (mg/l)	TDS (mg/l)	Cl (mg/l)	NO_3 (mg/l)	SO_4 (mg/l)	T-Coliform (MPN/100ml)	Phenol (mg/l)
Agriculture	21	0	5	0	0	63	3	37	16	8	13	21	11	0	28	29
Municipal Water Supply	38	0	0	13	0	100	0	75	13	0	0	0	0	0	0	0
Landfills	42	6	0	3	0	83	0	69	3	0	1	7	1	0	49	39
Urban/Suburban	8	4	0	0	0	64	0	56	25	16	16	16	0	0	6	33
Golf Courses	44	4	0	4	0	72	0	48	0	0	0	0	0	0	38	24
Rural Areas	8	0	0	0	0	38	0	38	4	4	4	4	29	0	10	10
Ex-Mining	50	0	0	17	0	83	0	67	0	0	0	0	8	0	67	17
Industrial	33	0	0	0	0	89	7	46	26	9	18	27	7	13	28	26
Radioactive Landfills	100	0	0	0	0	100	0	100	0	0	0	0	0	0	0	0

Figure 4.1 Malaysia : Percentage of Non Compliance of Selected Contaminants by Land Use, 2005



CHAPTER 5

MARINE AND

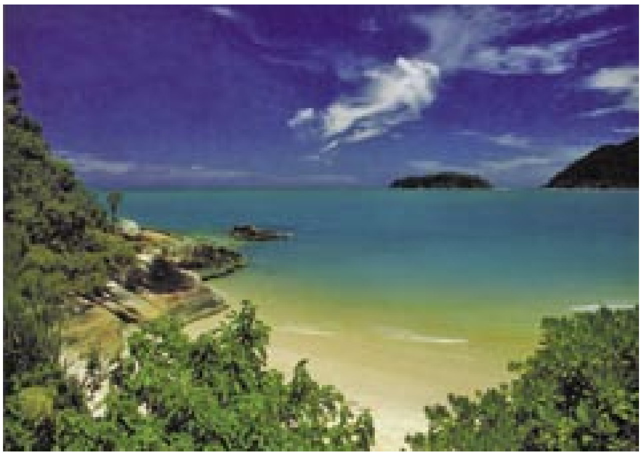
ISLAND MARINE

WATER QUALITY

MARINE WATER QUALITY MONITORING

Marine water quality monitoring plays an important role in the conservation of marine resources which contribute to the stability and diversity of the marine ecosystem. Pollution from land-based sources as well as from the sea can pose threats to these invaluable resources.

The Department of Environment (DOE) started the marine monitoring programme in 1978 for Peninsular Malaysia and in 1985 for Sabah and Sarawak. The programme included in-situ



Pristine Malaysian Beach (DOE Photo Library)

Table 5.1 Malaysia : Marine Environmental Quality Parameters

In-situ Measurement	Unit	Parameter (Laboratory Analysis)	Unit
Temperature	°C	*Escherichia coli (E. coli)*	MPN/100ml
pH	-	Oil and grease (O & G)	mg/l
Dissolved oxygen	% Sat	Total suspended solids (TSS)	mg/l
Dissolved oxygen	mg/l	Arsenic (As)	mg/l
Conductivity	mS/cm	Cadmium (Cd)	mg/l
Salinity	ppt	Total Chromium (Cr)	mg/l
Turbidity	NTU	Cuprum (Cu)	mg/l
Tarball	g/100m	Lead (Pb)	mg/l
		Mercury (Hg)	mg/l

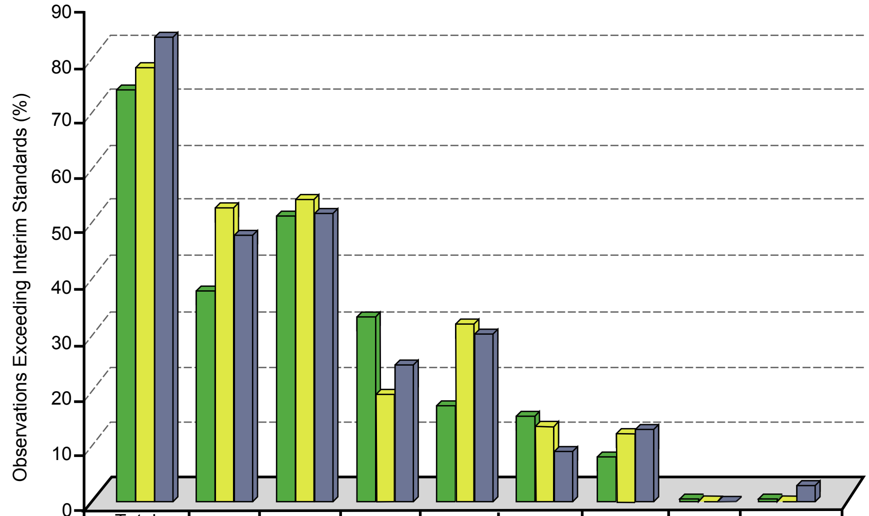
Table 5.2 Malaysia : Interim Marine Water Quality Standards

Parameter (Laboratory Analysis)	Unit	Standards
Escherichia coli (E. coli)	MPN/100ml	100
Oil and grease (O & G)	mg/l	0
Total suspended solids (TSS)	mg/l	50
Arsenic (As)	mg/l	0.1
Cadmium (Cd)	mg/l	0.1
Total chromium (Cr)	mg/l	0.5
Cuprum (Cu)	mg/l	0.1
Lead (Pb)	mg/l	0.1
Mercury (Hg)	mg/l	0.001

measurements and laboratory analyses for parameters as listed in **Table 5.1**. The Interim Marine Water Quality Standards (IMWQS) are as shown in **Table 5.2**.

MARINE WATER QUALITY STATUS

A total of 1,102 samples from 221 monitoring stations were analysed in 2005 **(Table 5.3)**. As in previous years, the main contaminants of the coastal waters of all States that exceeded the Interim Marine Water Quality Standards (IMWQS) were total suspended solids (80.2%), *Escherichia coli* (48.5%) and oil and grease (45.1%). **Figure 5.1** shows the trend of marine water quality contaminants from 2003 to 2005. Overall comparison showed an increase in total suspended solids, cadmium, cuprum and total chromium levels in marine waters and a decrease in oil and grease, *E. coli*, lead and mercury in 2005 compared to the previous year.



	Total Suspended Solids	Oil & Grease	*E. coli*	Cuprum	Lead	Mercury	Cadmium	Arsenic	Total Chromium
2003	72.1	34.7	48.2	30	16.1	12.7	6.7	0.5	0.2
2004	76.9	49.1	50.1	15.9	29.2	10.8	9.1	0	0.1
2005	80.2	45.1	48.5	20.7	27.4	7.6	9.9	0	2.2

Figure 5.1 Malaysia : Marine Water Quality Status, 2003 - 2005

Table 5.3 Malaysia : Status of Marine Water Quality Parameters Exceeding Standards (%), 2005

State	No. of Station	No. of Sample	Total Suspended Solids	Oil & Grease	*E. Coli*	Cadmium	Total Chromium	Mercury	Lead	Arsenic	Cuprum
Perlis	2	24	86.36	36.36	75.00	0.00	4.55	27.27	0.00	0.00	40.91
Pulau Langkawi	7	42	100.00	80.00	25.71	2.86	14.29	11.43	62.86	0.00	45.71
Kedah	3	15	93.33	46.67	22.22	0.00	0.00	6.67	0.00	0.00	73.33
Pulau Pinang	23	174	89.76	46.01	93.43	5.39	0.00	10.18	1.20	0.00	35.93
Perak	13	74	100.00	100.00	77.36	0.00	0.00	NA	37.84	0.00	2.99
Selangor	14	53	96.00	49.02	NA	0.00	0.00	15.09	0.00	0.00	0.00
Negeri Sembilan	13	78	82.05	14.29	78.67	0.00	0.00	2.56	0.00	0.00	0.00
Melaka	9	54	83.00	11.11	61.11	0.00	NA	NA	0.00	NA	0.00
Johor	45	128	80.13	21.05	46.81	0.00	0.00	1.97	48.97	0.00	25.66
Pahang	11	80	8.11	100.00	16.22	1.35	0.00	6.76	0.00	0.00	0.00
Terengganu	19	76	65.79	73.33	59.21	64.47	1.32	1.32	82.89	0.00	36.00
Kelantan	10	40	60.00	82.50	32.50	62.96	0.00	0.00	71.79	0.00	46.15
W.P. Labuan	5	30	96.67	3.33	26.92	0.00	10.00	NA	16.67	NA	3.33
Sabah	26	129	96.00	0.00	12.70	11.81	0.00	NA	33.59	NA	0.00
Sarawak	21	105	66.04	12.38	51.35	0.00	0.92	0.00	55.96	0.00	0.92
Malaysia (Total)	**221**	**1,102**									
Average (%)			**80.21**	**45.07**	**48.52**	**9.92**	**2.22**	**7.57**	**27.45**	**0.00**	**20.73**

Note :
NA : Not available

Table 5.4 Malaysia : Sources of Marine Water Contaminants

Contaminant	Sources
Total suspended solids (TSS)	Agricultural activities, tourism development, coastal reclamation, logging and road construction.
Escherichia coli (E. coli)	Untreated or partially treated domestic and animal wastes.
Oil and grease (O & G)	Discharges from vessels such as tank cleaning, deballasting, bilges and bunkering. Leakages and disposal of engine oil from ferries and boats.
Heavy metals	Industrial development and land-based sources.

Total suspended solids remained a significant contaminant of marine water with 100 percent of samples from Pulau Langkawi and Perak exceeding the IMWQS. Other States recorded levels that exceeded the IMWQS by more than 60 percent, except for Pahang, where the level was only 8 percent (**Table 5.3**).

For oil and grease contamination, Pahang and Perak recorded the highest percentage (100%) exceeding the IMWQS, followed by Kelantan (82.5%) and Langkawi (80%), while Sabah was free from oil and grease contamination *E. coli* contamination was recorded highest in Pulau Pinang (93.4%), followed by Negeri Sembilan (78.7%) and Perak (77%).

Heavy metals pollution was comparatively low with lead (Pb) exceeding the IMWQS by 27.4 percent, followed by cuprum (20.7%), cadmium (9.9%) and mercury (7.6%). Lead contamination was evident in Terengganu (82.9%), Kelantan (71.8%), and Langkawi (62.9%). Meanwhile, total chromium pollution was recorded at 2.2 percent and no arsenic (As) contamination was detected in 2005. **Table 5.4** highlights sources of contamination of marine waters.

Coral Reef Ecosystem (DOE Photo Library)

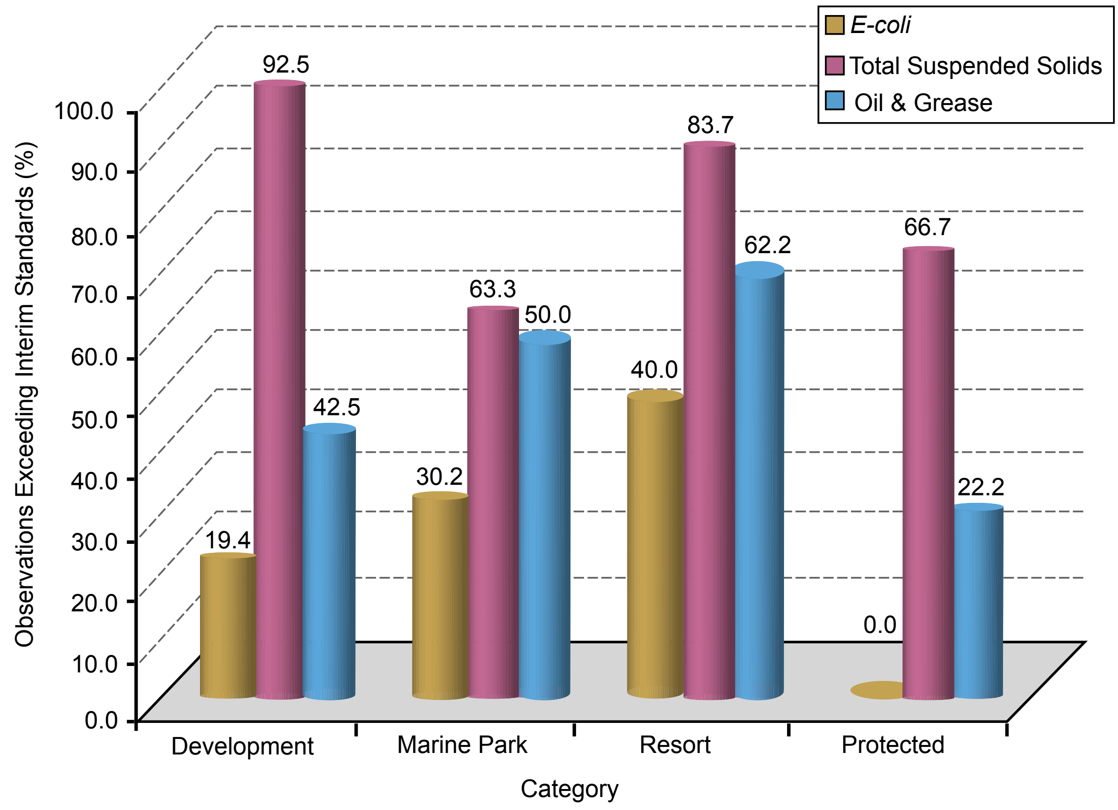


Figure 5.2 Malaysia : Island Marine Water Quality Status, 2005

ISLAND MARINE WATER QUALITY STATUS

The islands monitored are categorised as development islands (12 islands), resort islands (21 islands), marine park islands (25 islands) and protected islands (3 islands). A total of 208 samples were collected and analysed. The major pollutants identified in island marine waters were total suspended solids, *E. coli* and oil and grease. Total suspended solids was the predominant pollutant recorded in development islands, of which 92.5 percent of samples monitored exceeded the interim standards **(Figure 5.2)**. Resort islands recorded *E. coli* and oil and grease exceeding the standards by 40 percent and 62.2 percent respectively. For protected islands, total suspended solids and oil and grease exceeded the standards by 66.7 percent and 22.2 percent respectively and none of *E. coli* samples exceeded the standard.

Potential Oil Pollution Source (DOE Photo Library)

All samples for *E. coli* contamination in Perak waters exceeded the standard of 100MPN/100ml, followed by Terengganu (43.5%) and Labuan (26.1%) **(Figure 5.3).** *E. coli* contamination was not detected for islands in Kedah, Pulau Pinang, Selangor, Melaka, Johor and Sarawak. As for total suspended solids, all samples analysed in Kedah, Perak, Johor and Sabah exceeded the standard. All samples in Kedah and Pahang exceeded the standard for oil and grease.

TARBALL MONITORING

In 2005, there were 133 monitoring stations for tarball. Almost all beaches were found to be free from tarball pollution with the exception of Kuala Sungai Kerteh Tioxide Selatan and Kerteh Tengah Industrial Area in Terengganu (observed on 3 May 2005) and Club Med and Legend Hotel, Pantai Cherating in Pahang (observed on 11 May 2005). The amount of tarballs quantified were 337.7g, 31.6g and 50g per 100m beach strip respectively. Tarball residues on beaches were caused by oily discharges from fishing boats as well as passing vessels.

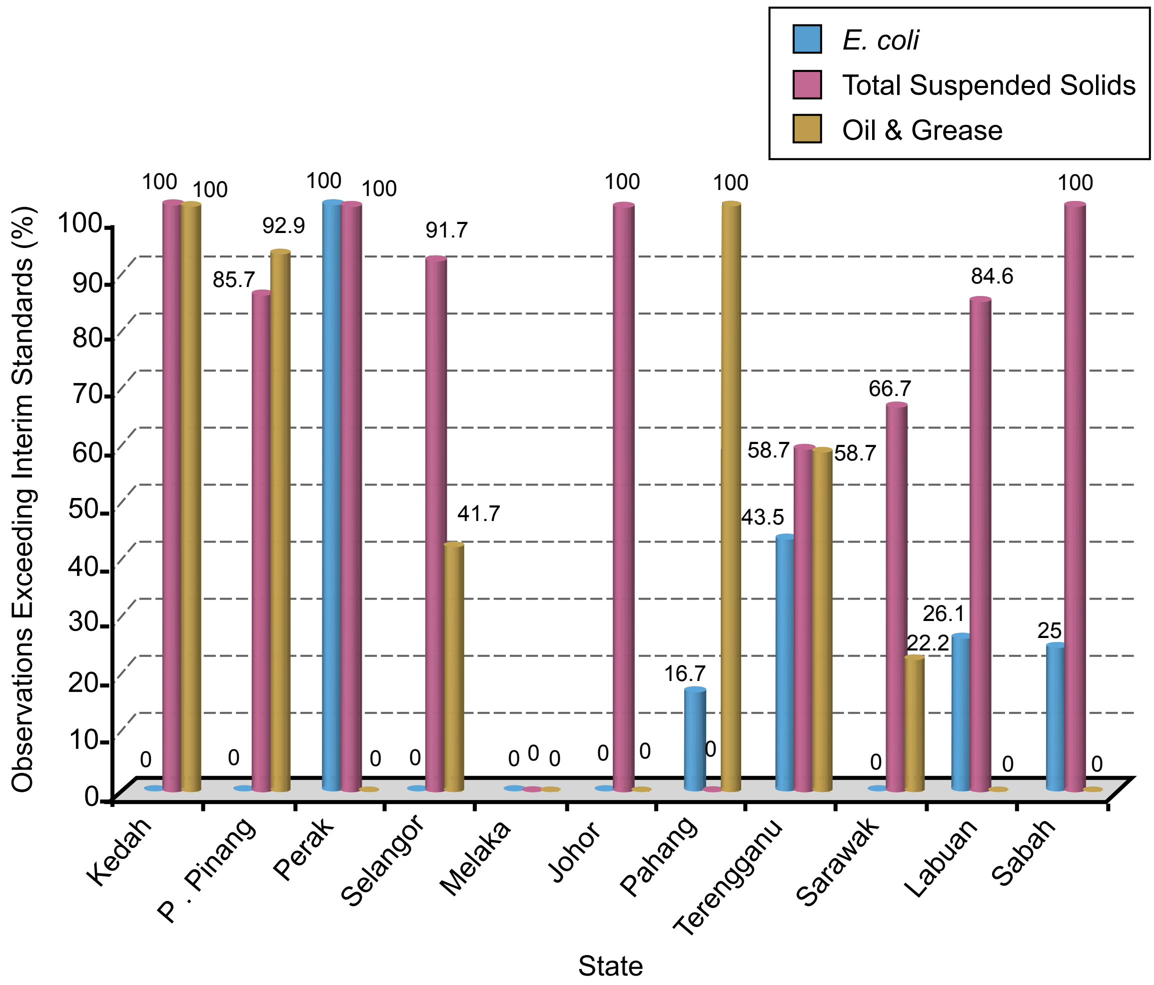
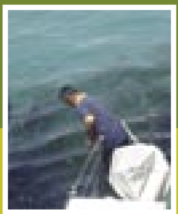


Figure 5.3 Malaysia : Status of Island Marine Water Quality by State, 2005

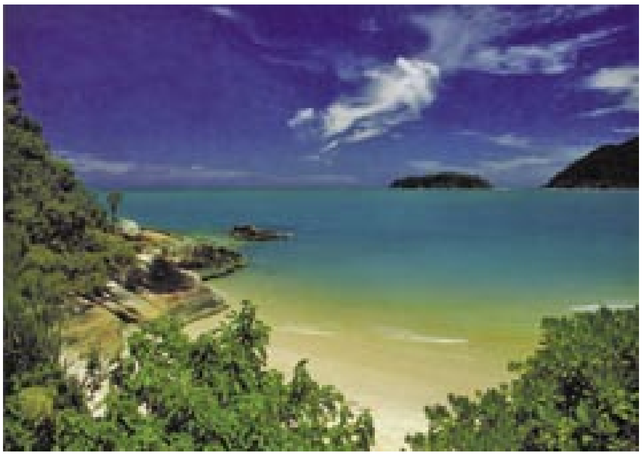


CHAPTER 5

MARINE AND ISLAND MARINE WATER QUALITY

MARINE WATER QUALITY MONITORING

Marine water quality monitoring plays an important role in the conservation of marine resources which contribute to the stability and diversity of the marine ecosystem. Pollution from land-based sources as well as from the sea can pose threats to these invaluable resources.


Pristine Malaysian Beach (DOE Photo Library)

The Department of Environment (DOE) started the marine monitoring programme in 1978 for Peninsular Malaysia and in 1985 for Sabah and Sarawak. The programme included in-situ

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In-situ Measurement	Unit	Parameter (Laboratory Analysis)	Unit
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Dissolved oxygen	mg/l	Arsenic (As)	mg/l
Conductivity	mS/cm	Cadmium (Cd)	mg/l
Salinity	ppt	Total Chromium (Cr)	mg/l
Turbidity	NTU	Cuprum (Cu)	mg/l
Tarball	g/100m	Lead (Pb)	mg/l
		Mercury (Hg)	mg/l

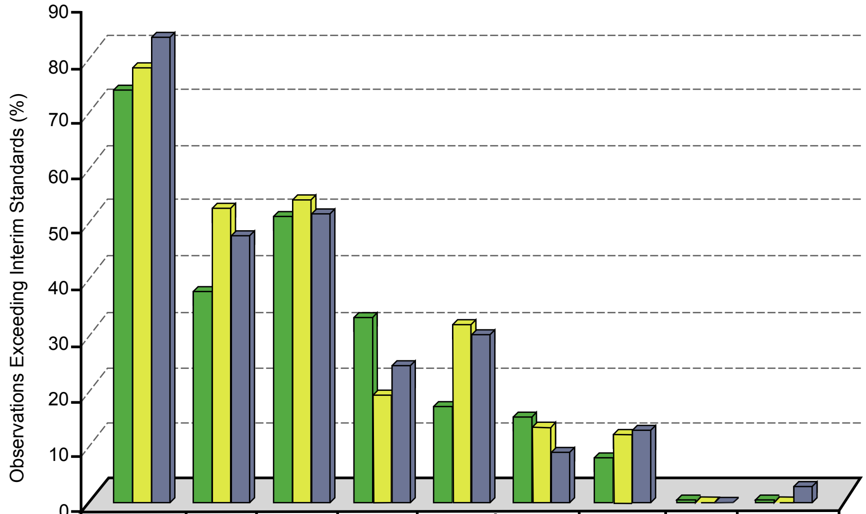
Table 5.2 Malaysia : Interim Marine Water Quality Standards

Parameter (Laboratory Analysis)	Unit	Standards
Escherichia coli (E. coli)	MPN/100ml	100
Oil and grease (O & G)	mg/l	0
Total suspended solids (TSS)	mg/l	50
Arsenic (As)	mg/l	0.1
Cadmium (Cd)	mg/l	0.1
Total chromium (Cr)	mg/l	0.5
Cuprum (Cu)	mg/l	0.1
Lead (Pb)	mg/l	0.1
Mercury (Hg)	mg/l	0.001

measurements and laboratory analyses for parameters as listed in **Table 5.1**. The Interim Marine Water Quality Standards (IMWQS) are as shown in **Table 5.2**.

MARINE WATER QUALITY STATUS

A total of 1,102 samples from 221 monitoring stations were analysed in 2005 **(Table 5.3)**. As in previous years, the main contaminants of the coastal waters of all States that exceeded the Interim Marine Water Quality Standards (IMWQS) were total suspended solids (80.2%), *Escherichia coli* (48.5%) and oil and grease (45.1%). **Figure 5.1** shows the trend of marine water quality contaminants from 2003 to 2005. Overall comparison showed an increase in total suspended solids, cadmium, cuprum and total chromium levels in marine waters and a decrease in oil and grease, *E. coli*, lead and mercury in 2005 compared to the previous year.



	Total Suspended Solids	Oil & Grease	*E. coli*	Cuprum	Lead	Mercury	Cadmium	Arsenic	Total Chromium
2003	72.1	34.7	48.2	30	16.1	12.7	6.7	0.5	0.2
2004	76.9	49.1	50.1	15.9	29.2	10.8	9.1	0	0.1
2005	80.2	45.1	48.5	20.7	27.4	7.6	9.9	0	2.2

Figure 5.1 Malaysia : Marine Water Quality Status, 2003 - 2005

Table 5.3 Malaysia : Status of Marine Water Quality Parameters Exceeding Standards (%), 2005

State	No. of Station	No. of Sample	Total Suspended Solids	Oil & Grease	*E. Coli*	Cadmium	Total Chromium	Mercury	Lead	Arsenic	Cuprum
Perlis	2	24	86.36	36.36	75.00	0.00	4.55	27.27	0.00	0.00	40.91
Pulau Langkawi	7	42	100.00	80.00	25.71	2.86	14.29	11.43	62.86	0.00	45.71
Kedah	3	15	93.33	46.67	22.22	0.00	0.00	6.67	0.00	0.00	73.33
Pulau Pinang	23	174	89.76	46.01	93.43	5.39	0.00	10.18	1.20	0.00	35.93
Perak	13	74	100.00	100.00	77.36	0.00	0.00	NA	37.84	0.00	2.99
Selangor	14	53	96.00	49.02	NA	0.00	0.00	15.09	0.00	0.00	0.00
Negeri Sembilan	13	78	82.05	14.29	78.67	0.00	0.00	2.56	0.00	0.00	0.00
Melaka	9	54	83.00	11.11	61.11	0.00	NA	NA	0.00	NA	0.00
Johor	45	128	80.13	21.05	46.81	0.00	0.00	1.97	48.97	0.00	25.66
Pahang	11	80	8.11	100.00	16.22	1.35	0.00	6.76	0.00	0.00	0.00
Terengganu	19	76	65.79	73.33	59.21	64.47	1.32	1.32	82.89	0.00	36.00
Kelantan	10	40	60.00	82.50	32.50	62.96	0.00	0.00	71.79	0.00	46.15
W.P. Labuan	5	30	96.67	3.33	26.92	0.00	10.00	NA	16.67	NA	3.33
Sabah	26	129	96.00	0.00	12.70	11.81	0.00	NA	33.59	NA	0.00
Sarawak	21	105	66.04	12.38	51.35	0.00	0.92	0.00	55.96	0.00	0.92
Malaysia (Total)	**221**	**1,102**									
Average (%)			**80.21**	**45.07**	**48.52**	**9.92**	**2.22**	**7.57**	**27.45**	**0.00**	**20.73**

Note :
NA : Not available

Table 5.4 Malaysia : Sources of Marine Water Contaminants

Contaminant	Sources
Total suspended solids (TSS)	Agricultural activities, tourism development, coastal reclamation, logging and road construction.
Escherichia coli *(E. coli)*	Untreated or partially treated domestic and animal wastes.
Oil and grease (O & G)	Discharges from vessels such as tank cleaning, deballasting, bilges and bunkering. Leakages and disposal of engine oil from ferries and boats.
Heavy metals	Industrial development and land-based sources.

Total suspended solids remained a significant contaminant of marine water with 100 percent of samples from Pulau Langkawi and Perak exceeding the IMWQS. Other States recorded levels that exceeded the IMWQS by more than 60 percent, except for Pahang, where the level was only 8 percent (**Table 5.3**).

For oil and grease contamination, Pahang and Perak recorded the highest percentage (100%) exceeding the IMWQS, followed by Kelantan (82.5%) and Langkawi (80%), while Sabah was free from oil and grease contamination *E. coli* contamination was recorded highest in Pulau Pinang (93.4%), followed by Negeri Sembilan (78.7%) and Perak (77%).

Heavy metals pollution was comparatively low with lead (Pb) exceeding the IMWQS by 27.4 percent, followed by cuprum (20.7%), cadmium (9.9%) and mercury (7.6%). Lead contamination was evident in Terengganu (82.9%), Kelantan (71.8%), and Langkawi (62.9%). Meanwhile, total chromium pollution was recorded at 2.2 percent and no arsenic (As) contamination was detected in 2005. **Table 5.4** highlights sources of contamination of marine waters.

Coral Reef Ecosystem (DOE Photo Library)

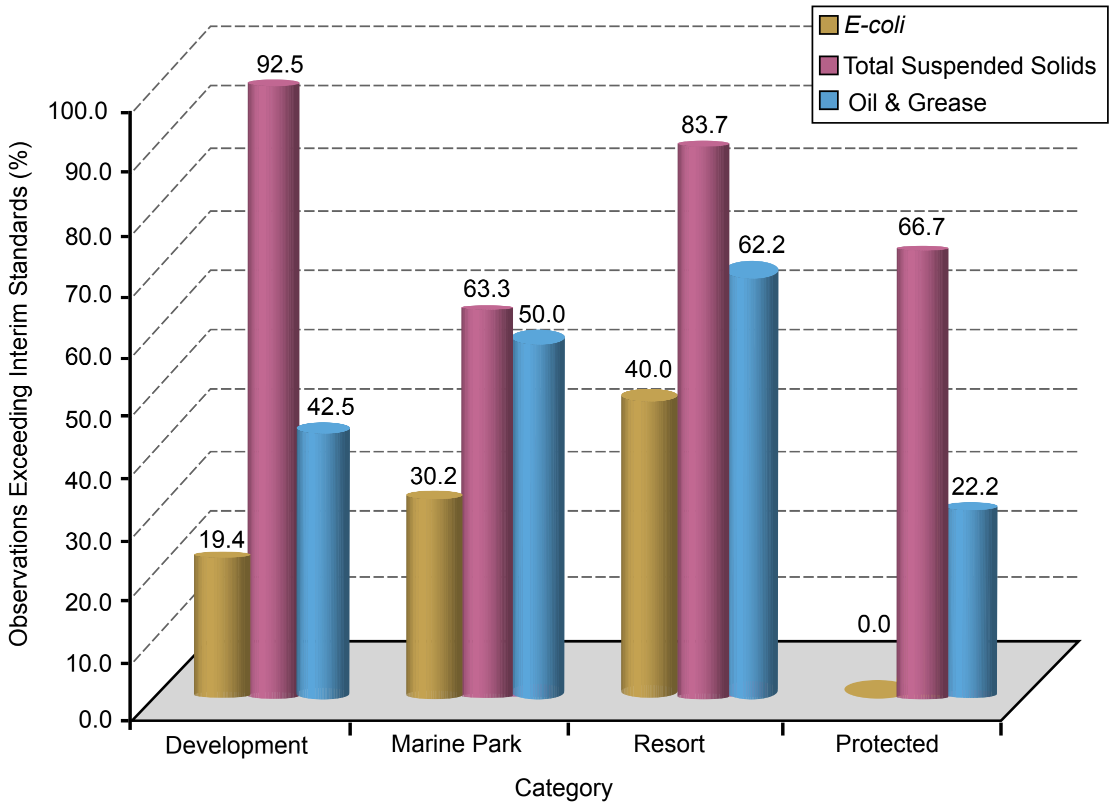


Figure 5.2 Malaysia : Island Marine Water Quality Status, 2005

ISLAND MARINE WATER QUALITY STATUS

The islands monitored are categorised as development islands (12 islands), resort islands (21 islands), marine park islands (25 islands) and protected islands (3 islands). A total of 208 samples were collected and analysed. The major pollutants identified in island marine waters were total suspended solids, *E. coli* and oil and grease. Total suspended solids was the predominant pollutant recorded in development islands, of which 92.5 percent of samples monitored exceeded the interim standards **(Figure 5.2)**. Resort islands recorded *E. coli* and oil and grease exceeding the standards by 40 percent and 62.2 percent respectively. For protected islands, total suspended solids and oil and grease exceeded the standards by 66.7 percent and 22.2 percent respectively and none of *E. coli* samples exceeded the standard.

Potential Oil Pollution Source (DOE Photo Library)

All samples for *E. coli* contamination in Perak waters exceeded the standard of 100MPN/100ml, followed by Terengganu (43.5%) and Labuan (26.1%) **(Figure 5.3).** *E. coli* contamination was not detected for islands in Kedah, Pulau Pinang, Selangor, Melaka, Johor and Sarawak. As for total suspended solids, all samples analysed in Kedah, Perak, Johor and Sabah exceeded the standard. All samples in Kedah and Pahang exceeded the standard for oil and grease.

TARBALL MONITORING

In 2005, there were 133 monitoring stations for tarball. Almost all beaches were found to be free from tarball pollution with the exception of Kuala Sungai Kerteh Tioxide Selatan and Kerteh Tengah Industrial Area in Terengganu (observed on 3 May 2005) and Club Med and Legend Hotel, Pantai Cherating in Pahang (observed on 11 May 2005). The amount of tarballs quantified were 337.7g, 31.6g and 50g per 100m beach strip respectively. Tarball residues on beaches were caused by oily discharges from fishing boats as well as passing vessels.

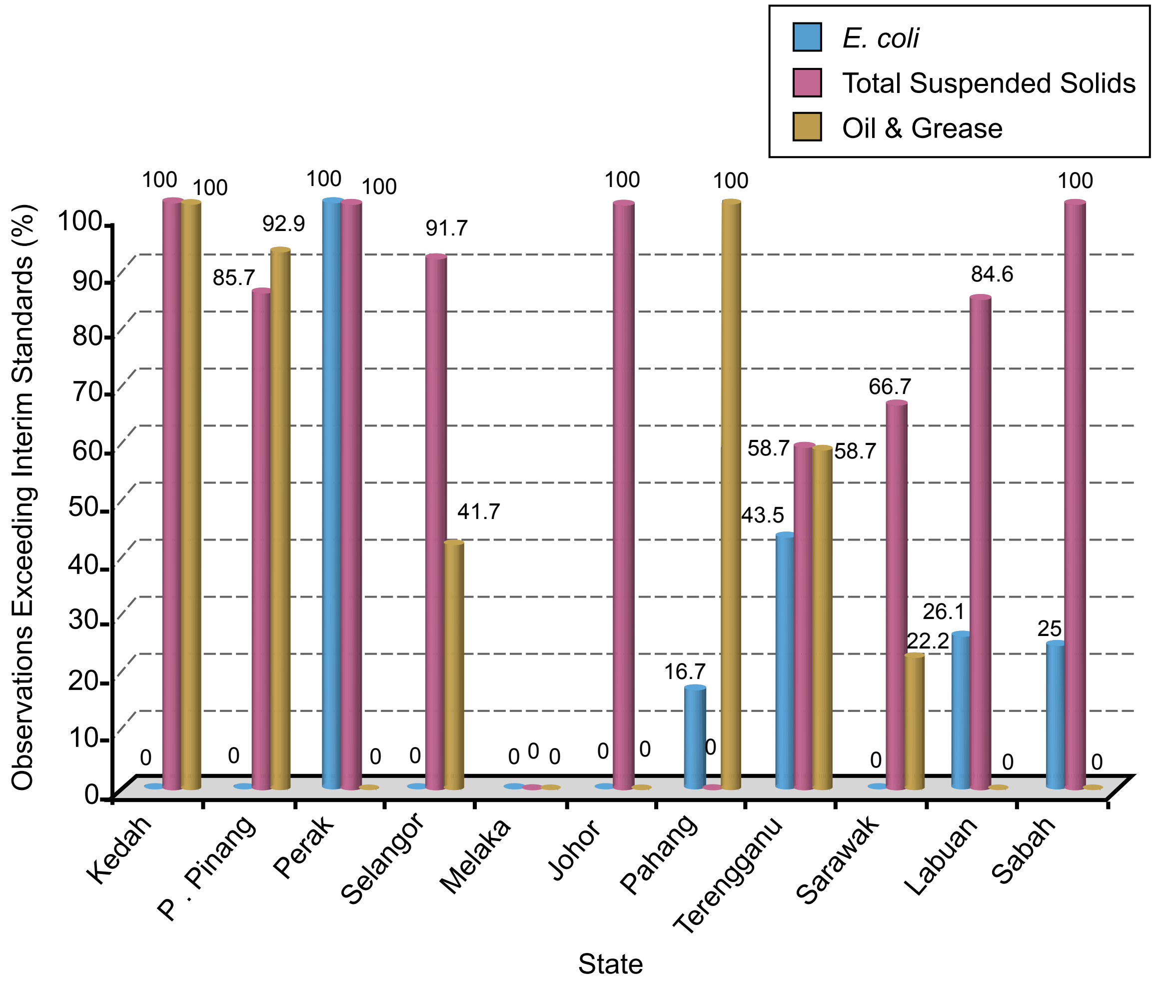
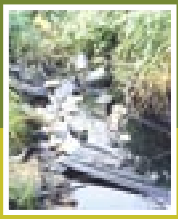


Figure 5.3 Malaysia : Status of Island Marine Water Quality by State, 2005



CHAPTER 6

POLLUTION SOURCES INVENTORY

SOURCES OF WATER POLLUTION

Water pollution is caused by point and non-point sources. Point sources include sewage treatment plants, manufacturing and agro-based industries and animal farms. Non-point sources are mainly diffused sources such as agricultural activities and surface runoffs.

In 2005, the Department of Environment (DOE) registered 18,724 water pollution point sources comprising mainly sewage treatment plants (8,782 : 46.9% inclusive of 562 Network Pump Stations), manufacturing industries (8,562 : 45.7%), animal farms (898 : 4.8%) and agro-based industries (482 : 2.6%) **(Figure 6.1)**.

Figure 6.2 represents the distribution of industrial water pollution sources from agro-based and manufacturing industries compiled by the DOE in 2005 through field surveys and questionnaires. A total of 9,044 sources were identified with Selangor having the highest number of water pollution sources (1,853 : 20.5%), followed by Johor (1,774 : 19.6%). According to statistics compiled by the Veterinary Department of Malaysia shows that the total standing pig population for 2005 was about 1.7 million, an increase of 13.3 percent compared to 1.5 million in 2004. However, the number of animal farms decreased from 904 in 2004 to 898 in 2005.

Water Pollution: Uncontrolled Earthworks (DOE Photo Library)

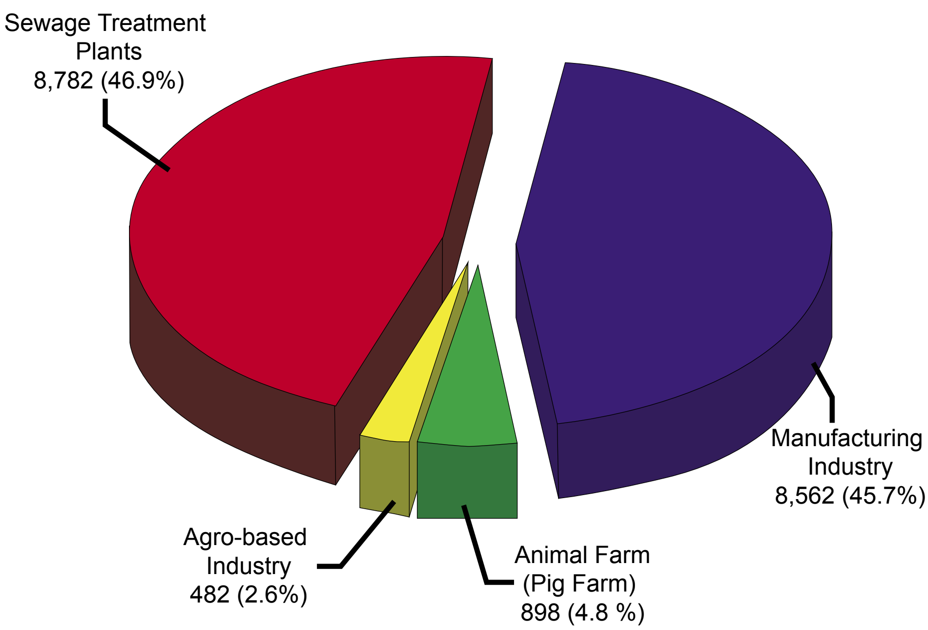


Figure 6.1 Malaysia : Composition of Water Pollution Sources by Sector, 2005

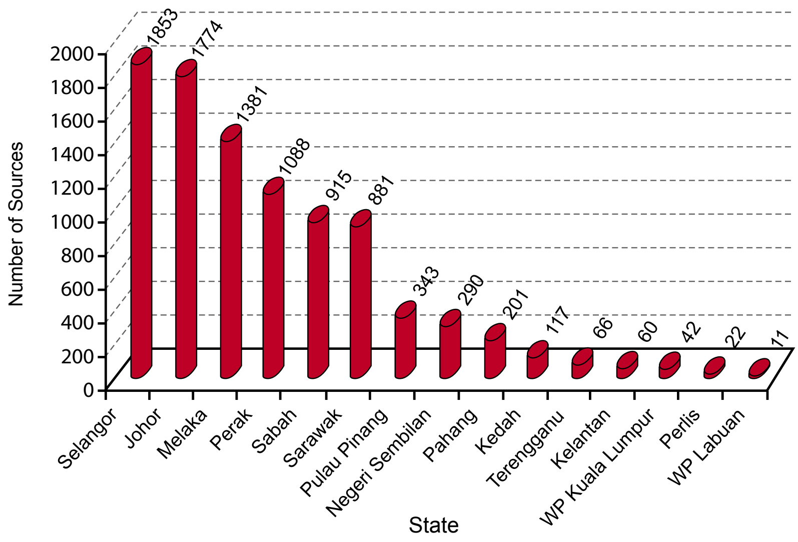


Figure 6.2 Malaysia :
Distribution of Industrial Water Pollution Sources
(Agro-based and Manufacturing Industries) by States, 2005

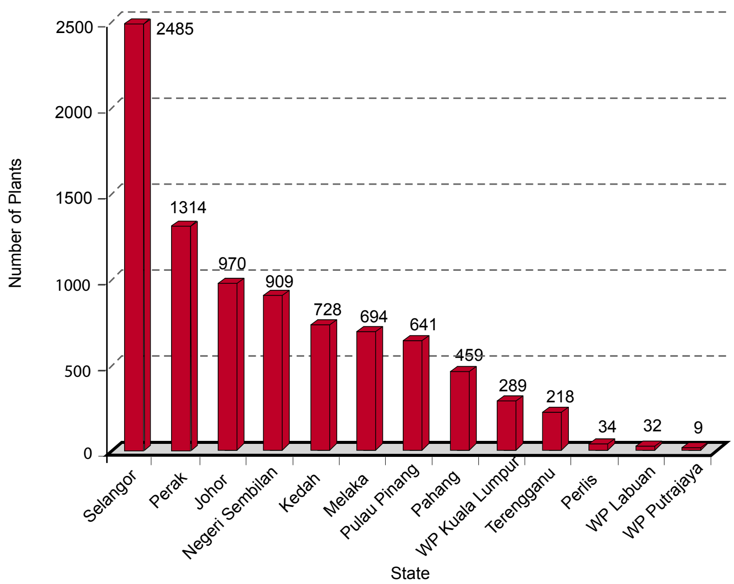


Figure 6.3 Malaysia :
Distribution of Sewage Treatment Plants by State, 2005
(Source : IWK Sdn. Bhd.)

The number of sewage treatment plants under the management of Indah Water Konsortium Sdn. Bhd. (IWK) had increased to 8,782 in 2005 compared to 8,414 plants in 2004. Selangor had the largest number of sewage treatment plants (2,485 : 28.3%), Perak (1,314 : 15.0%), Johor (970 : 11.0%) and Negeri Sembilan (909 : 10.3%) **(Figure 6.3)**.

BOD POLLUTION LOAD

Domestic sewage discharge, in the form of treated sewage and partially treated sewage, remained the largest contributor of organic pollution load with an estimated biochemical oxygen demand (BOD) load of 821,669.5 kg/day. The estimated BOD loading contributed by other major sectors were agro-based and manufacturing industries (52,282.2 kg/day) and pig farming (217,680.8 kg/day) **Table 6.1** indicates the total BOD load in kg/day discharged from sewage treatment plants throughout Malaysia in 2005.

Water Pollution : Untreated Industrial Effluent
(DOE Photo Library)

Major Water Pollution Source : Untreated Sewage
(DOE Photo Library)

Table 6.1 Malaysia : Total BOD Load (kg/day) from Sewage Treatment Plants

State	No. of STP	Total PE	Flow (m^3/day)	BOD Load (kg/day)
Selangor	2,485	5,708,652	1,284,447	321,111.7
Perak	1,314	1,240,978	279,220	69,805.0
Johor	970	1,072,749	241,369	60,342.1
Negeri Sembilan	909	878,929	197,759	49,439.8
Kedah	728	496,654	111,747	27,936.8
Melaka	694	524,134	117,930	29,482.5
Pulau Pinang	641	1,927,896	433,777	108,444.2
Pahang	459	291,759	65,646	16,411.4
WP Kuala Lumpur	289	2,270,639	510,894	127,723.4
Terengganu	218	70,315	15,821	3,955.2
Perlis	34	15,296	3,442	860.4
WP Labuan	32	39,270	8,836	2,208.9
WP Putrajaya	9	70,188	15,792	3,948.1
Total	**8,782**	**14,607,459**	**3,286,680**	**821,669.5**

Notes:
STP = Sewage Treatment Plant
PE = Population Equivalent
* Source: IWK Sdn. Bhd.

AIR POLLUTION SOURCES AND EMISSION LOAD

The main air pollution sources in Malaysia in 2005 were :

- Mobile sources
- Stationary sources
- Open burning
- Transboundary pollution

Emissions from mobile sources, stationary sources and open burning activities within the country were the most significant sources of air pollution in 2005. However, transboundary pollution of fine particles from external large-scale biomass open burning activities was also a significant contributor of poor air quality in the country.

Inefficient Air Pollution (Filter Bag) Control System
(DOE Photo Library)

Air Pollution from Stationary Sources

The main stationary sources of air pollution were industrial premises and power generation stations. The total number of stationary air pollution sources identified in 2005 which were subjected to Environmental Quality (Clean Air) Regulations 1978 was 13,185 **(Figure 6.4)**, Selangor reported the highest number of stationary pollution sources (2,943 : 22.2%), followed by Johor (2,509 : 18.9%) and Sarawak (1,822 : 13.7%).

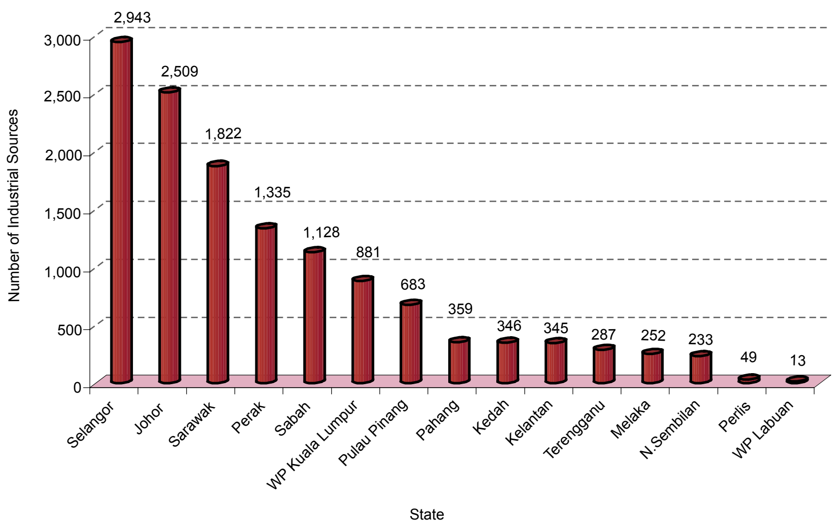


Figure 6.4 Malaysia : Industrial Air Pollution Sources by State, 2005

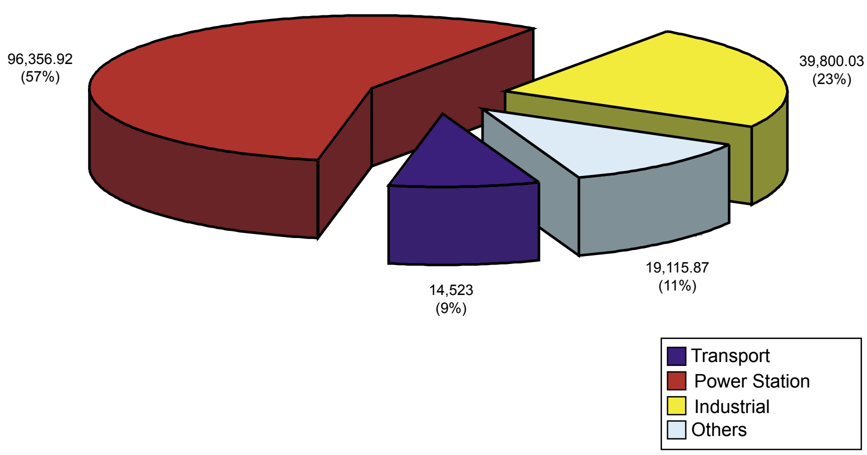


Figure 6.5 Malaysia : Combined SO_2 Emission by Sources (Metric Tonnes), 2005

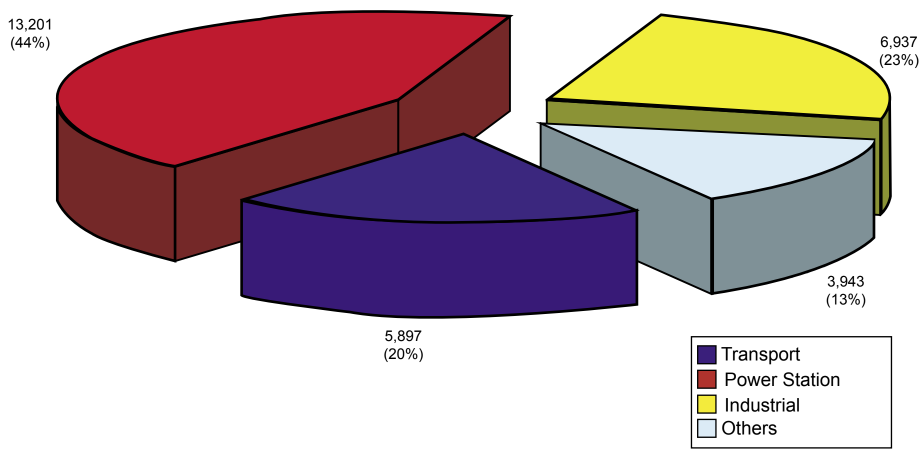


Figure 6.6 Malaysia : Combined Particulate Matter (PM) Emission by Sources (Metric Tonnes), 2005

Emission Load from Stationary Sources

The estimated combined air emission load for 2005 was about 1,321,379 metric tonnes of carbon monoxide (CO); 346,037 metric tonnes of nitrogen oxides (NO_X), 169,796 metric tonnes of sulphur dioxide (SO_2) and 29,978 metric tonnes of particulate matter (PM). Stationary sources which included industrial premises and power stations were the main contributors to total SO_2 emission load (80%) and PM emission load (67%) **(Figures 6.5, 6.6)**. On the other hand, mobile sources were the main contributors to NO_X (67%) and CO (98%) emission load **(Figures 6.7, 6.8)**. Apart from stationary and mobile sources, open burning activities were significant contributors to PM emission load. **Figure 6.9** shows the air pollutant emission load from stationary sources in 2005 and 2004.

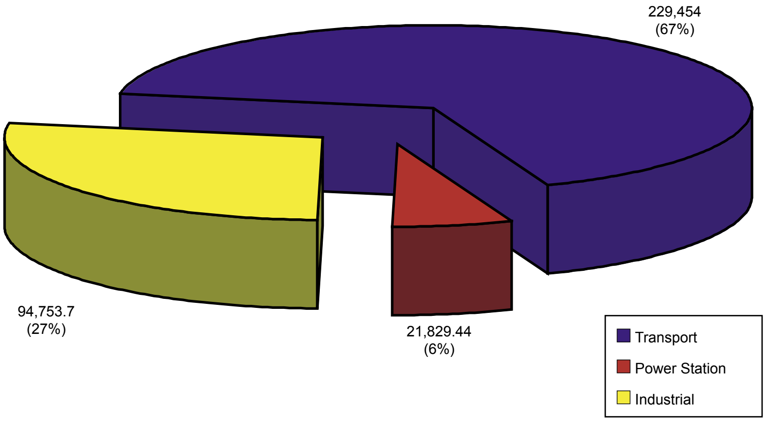


Figure 6.7 Malaysia :
Combined Nitrogen Oxides (NO_x) Emission by Sources (Metric Tonnes), 2005

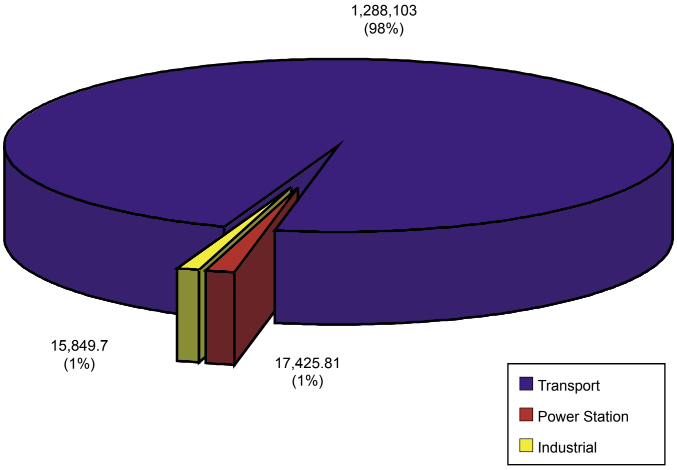


Figure 6.8 Malaysia :
Combined Carbon Monoxide (CO) Emission by Sources (Metric Tonnes), 2005

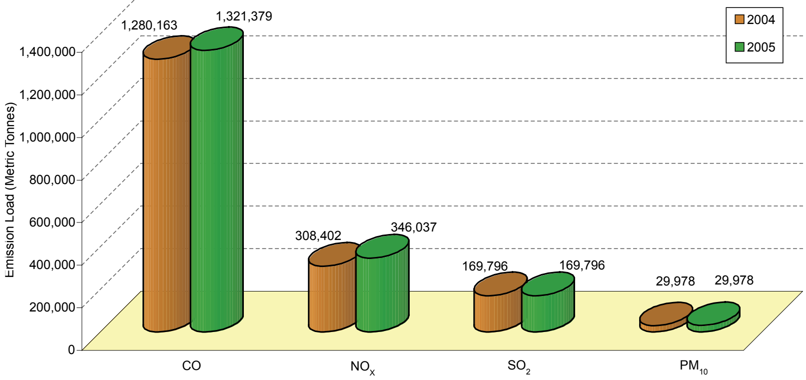


Figure 6.9 Malaysia :
Air Pollutant Emission Load from Stationary Sources, 2004 - 2005

Air Pollution from Mobile Sources

Mobile sources which include passenger cars, taxis, buses, motorcycles, vans and lorries are the major contributors to air pollution in cities. The number of registered vehicles in Malaysia for the year 2004 and 2005 is shown in **Figure 6.10.** In 2005 the number of registered passenger cars increased by 9.5 percent and motorcycles by 6.6 percent. There was a slight increase in the numbers of buses, goods vehicles and taxis in 2005 compared to 2004. The number of in-use vehicles or active vehicles dropped slightly in 2005 compared to 2004 except for passenger cars **(Figure 6.11)**.

Vehicular Black Smoke Enforcement Campaign (DOE Photo Library)

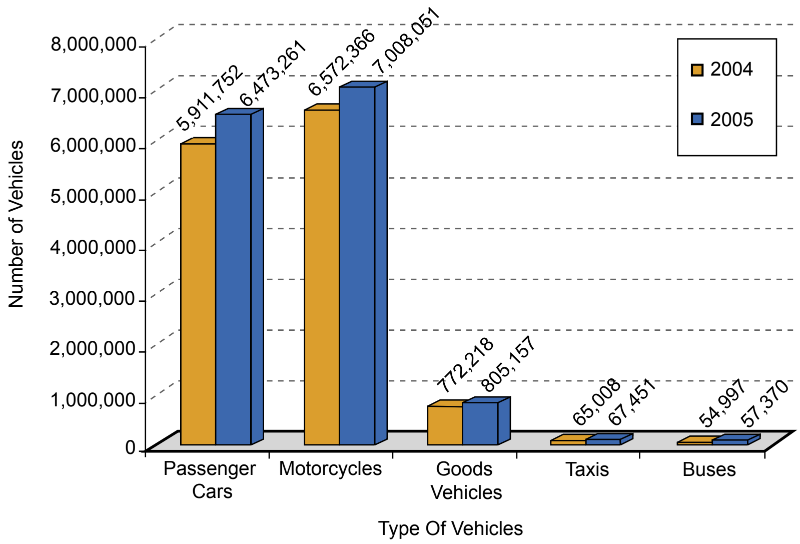


Figure 6.10 Malaysia : Number of Registered Vehicles, 2004 - 2005
(Source : Road Transport Department, 2005)

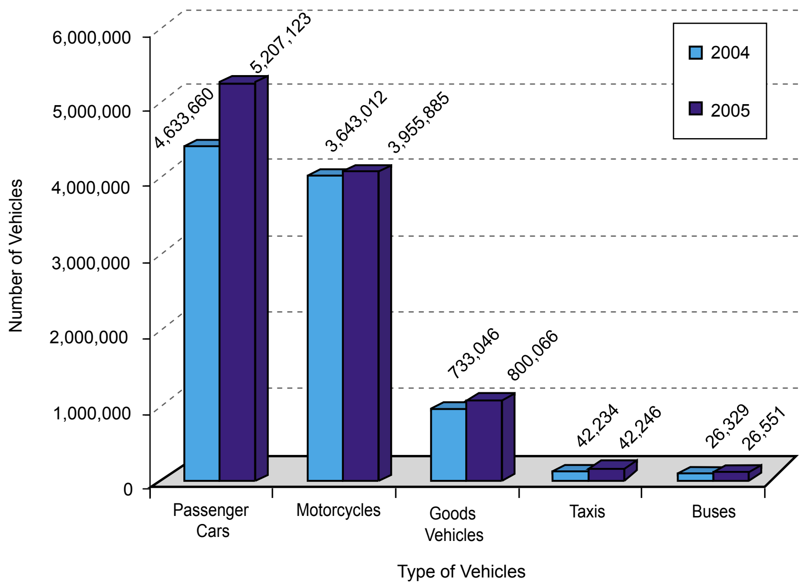


Figure 6.11 Malaysia : Number of In-use Vehicles, 2004 - 2005
(Source : Road Transport Department, 2005)

Emission Load from Mobile Sources

The estimated annual air pollutant emission loads of hydrocarbon (HC), carbon monoxide (CO), particulate matter (PM_{10}), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) from the road transport sector for 2004 and 2005 are shown in **Figure 6.12**. In 2005, the emission loads of HC and CO were estimated to be 274,997 metric tonnes per year and 1,288,103 metric tonnes per year respectively, an increase of 7.0 percent for HC and 3.8 percent for CO emission load in 2005 compared to 2004. Correspondingly an increasing trend was observed in the emission load of PM_{10}, SO_2 and NO_2 in 2005 compared to 2004. Emission load of PM_{10} was 5,897 metric tonnes in 2005 as compared to 4,174 metric tonnes in 2004 (41.3% increase); SO_2 was 14,523 metric tonnes in 2005 as compared to 11,624 metric tonnes in 2004 (24.9% increase); and NO_2 was 229,454 metric tonnes as compared to 182,282 metric tonnes in 2004 (25.9% increase).

Figure 6.13 to **Figure 6.17** show the contribution of various categories of vehicle to the respective air pollution emission load in 2005. It was estimated that 73.1 percent of PM_{10} emission load was contributed by vans and

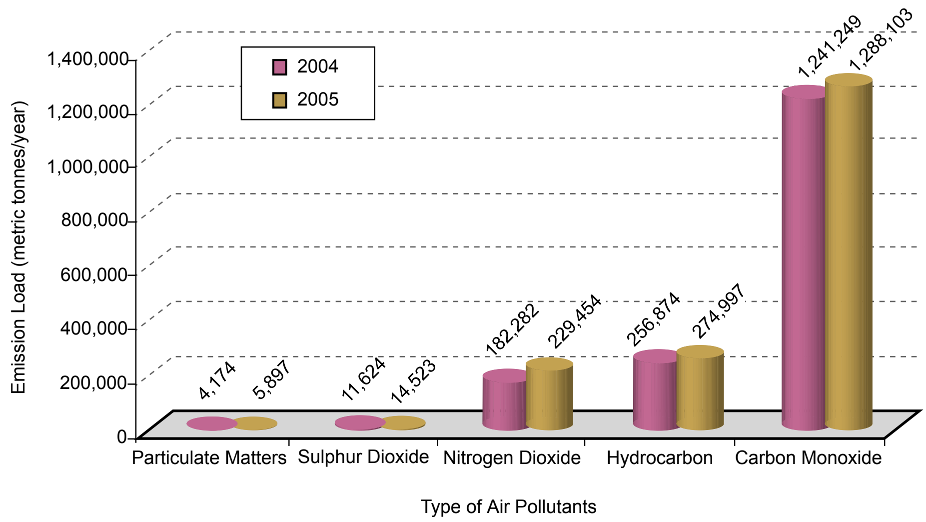


Figure 6.12 Malaysia : Air Pollutant Emission Load from Mobile Sources, 2004 - 2005

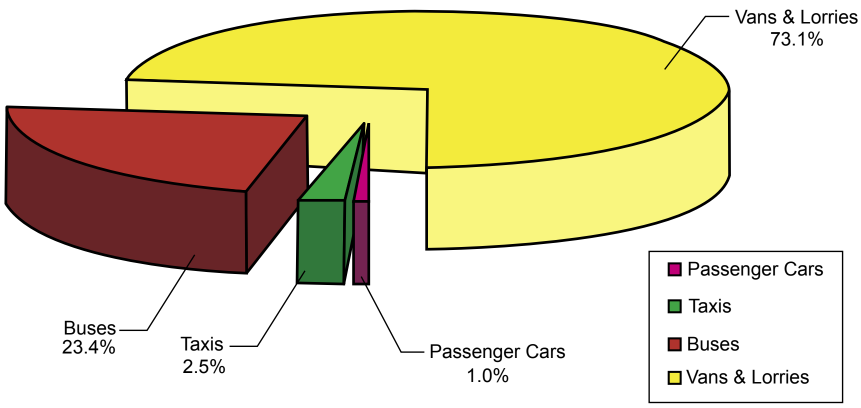


Figure 6.13 DOE : Distribution of PM_{10} Emission Load from Mobile Sources, 2005

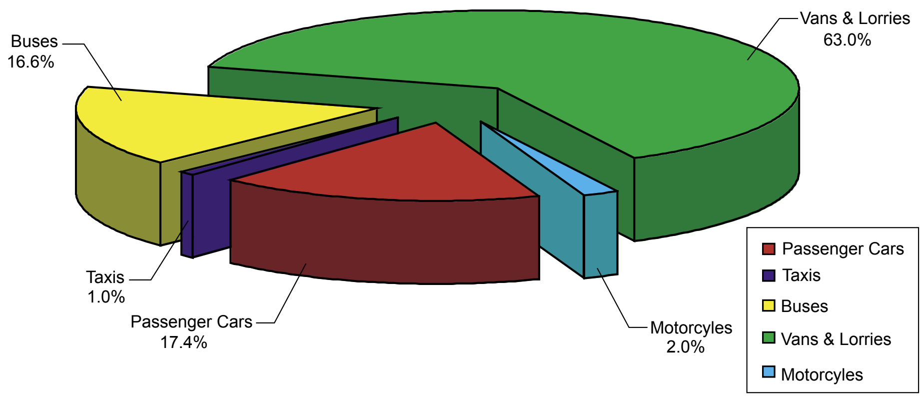


Figure 6.14 DOE : Distribution of NO_2 Emission Load from Mobile Sources, 2005

lorries, 23.4 percent from buses, 2.5 percent from taxis and 1.0 percent from passenger cars **(Figure 6.13)**.

Figure 6.14 shows that an estimated 63.0 percent of NO_2 emission load was contributed by vans and lorries, 16.6 percent from buses, 17.4 percent from passenger cars, 2.0 percent from motorcycles and 1.0 percent from taxis.

From the total emission of SO_2, it was estimated that 60.6 percent was emitted by vans and lorries, 17.9 percent from passenger cars, 15.9 percent from buses, 3.6 percent from motorcycles and 2.0 percent from taxis **(Figure 6.15)**.

Figure 6.16 shows that motorcycles contributed 60.7 percent of the total HC emissions from mobile sources, 17.2 percent by vans and lorries, 19.7 percent by passenger cars while buses and taxis contributed 1.5 percent and 0.9 percent respectively.

Passenger cars contributed 45.4 percent of the total CO emission load from mobile sources, vans and lorries contributed 35.4 percent, motorcycles 15.3 percent, buses 2.0 percent and taxis 1.9 percent **(Figure 6.17)**.

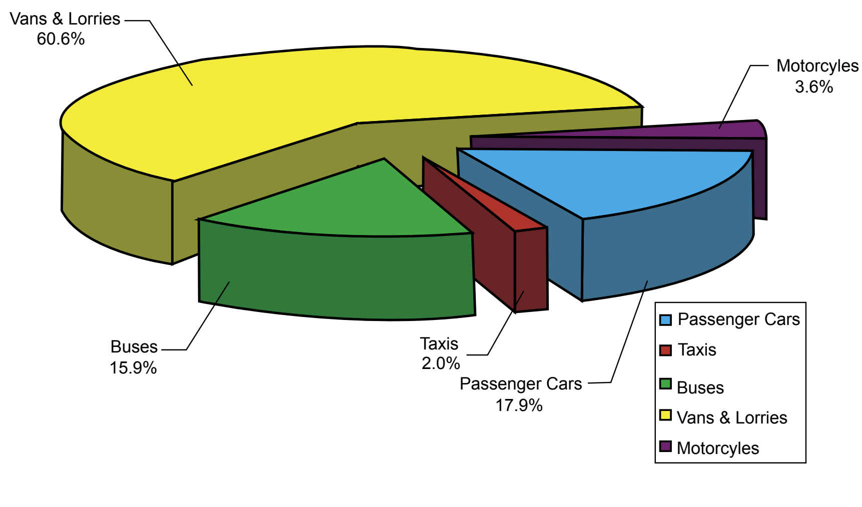


Figure 6.15 DOE : Distribution of SO_2 Emission Load from Mobile Sources, 2005

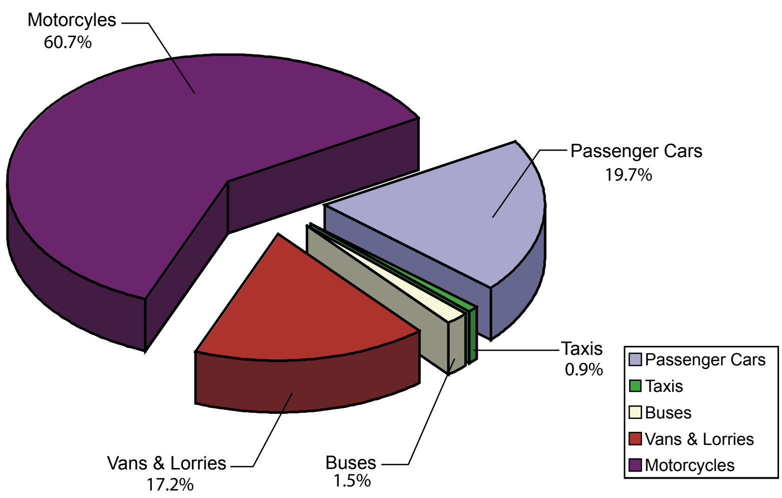


Figure 6.16 DOE : Distribution of HC Emission Load from Mobile Sources, 2005

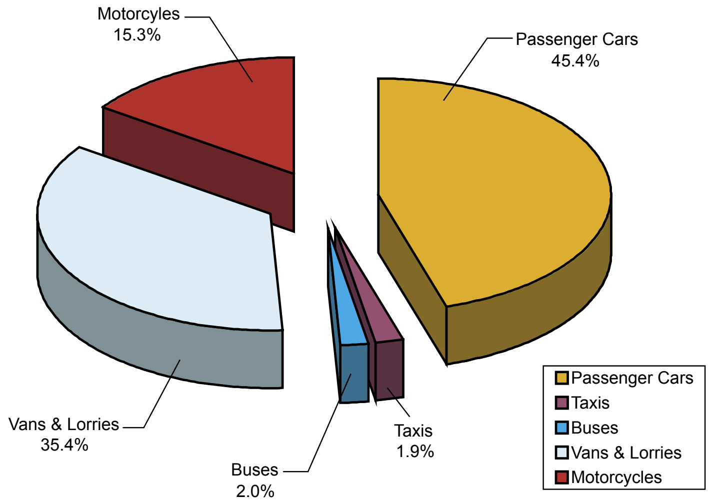


Figure 6.17 DOE : Distribution of CO Emission Load from Mobile Sources, 2005

SCHEDULED WASTES INVENTORY

Based on notification received by the Department of Environment (DOE), a total of 548,916.11 metric tonnes of scheduled wastes were generated in 2005 as compared to 469,584.07 metric tonnes in 2004. Oil and hydrocarbon, mineral sludge and dross were the main categories of waste produced in the country. The breakdown according to waste categories and industry types are given in **Table 6.2, 6.3 and Figure 6.18, 6.19** respectively. Of the total wastes produced; 85,734.92 metric tonnes (15.6%) were treated and disposed at Kualiti Alam Sdn. Bhd., 8,423.26 metric tonnes (1.5%) were treated and disposed at Trinekens (Sarawak) Sdn. Bhd., 17,650.01 metric tonnes (3.2%) of clinical wastes were incinerated at licensed off-site facilities, 5,224.00 metric tonnes (1.0%) were exported for recovery purposes, 149,569.99 metric tonnes (27.2%) of scheduled wastes were recovered at off-site facilities, an estimated 120,345.25 metric tonnes (21.9%) were treated on-site and 161,968.68 metric tonnes (29.5%) were stored on-site at waste generators' premises **(Table 6.4)**. Six landfarms and 16 on-site waste incinerators had been licensed by DOE to allow for on-site treatment and incineration respectively.

Scheduled Waste : Industrial Sludge (DOE Photo Library)

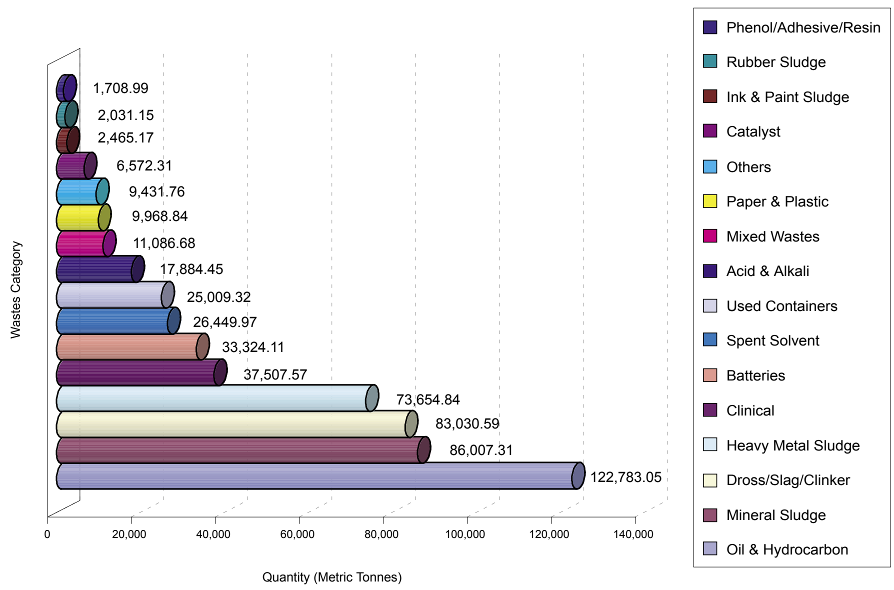


Figure 6.18 DOE : Quantity of Scheduled Wastes Generated by Category, 2005

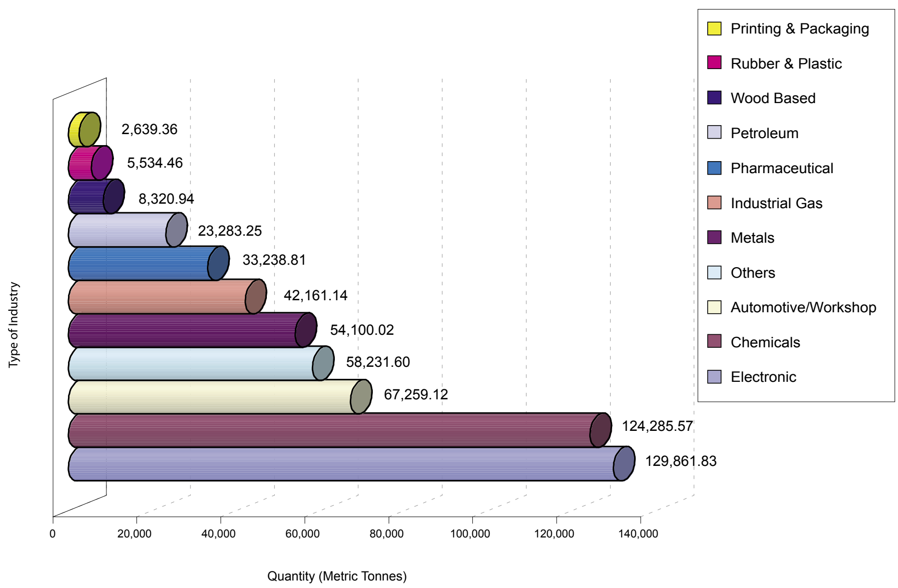


Figure 6.19 DOE : Quantity of Scheduled Wastes Generated by Industry, 2005

Table 6.2 DOE : Quantity of Scheduled Wastes Generated by Category, 2005

Waste Category	Quantity of Wastes (Metric Tonnes/Year)	Percentage (%)
Oil & Hydrocarbon	122,783.05	22.4
Mineral Sludge	86,007.31	15.7
Dross/Slag/Clinker	83,030.59	15.1
Heavy Metal Sludge	73,654.84	13.4
Clinical	37,507.57	6.8
Batteries	33,324.11	6.1
Spent Solvent	26,449.97	4.8
Used Containers	25,009.32	4.6
Acid & Alkali	17,884.45	3.3
Mixed Wastes	11,086.68	2.0
Paper & Plastic	9,968.84	1.8
Others	9,431.76	1.7
Catalyst	6,572.31	1.2
Ink & Paint Sludge	2,465.17	0.4
Rubber Sludge	2,031.15	0.4
Phenol/Adhesive/Resin	1,708.99	0.3
Total	**548,916.11**	**100.0**

Table 6.3 DOE : Quantity of Scheduled Wastes Generated by Industry, 2005

Type of Industry	Quantity of Wastes (Metric Tonnes/Year)	Percentage (%)
Electronic	129,861.83	23.7
Chemicals	124,285.57	22.6
Automotive/Workshop	67,259.12	12.2
Others	58,231.60	10.6
Metals	54,100.02	9.9
Industrial Gas	42,161.14	7.7
Pharmaceutical	33,238.81	6.1
Petroleum	23,283.25	4.2
Wood Based	8,320.94	1.5
Rubber & Plastic	5,534.46	1.0
Printing & Packaging	2,639.36	0.5
Total	**548,916.11**	**100.0**

Table 6.4 DOE : Facilities Handling Scheduled Wastes, 2005

Facility	Quantity of Wastes (Metric Tonnes/Year)	Percentage (%)
On-site Storage	161,968.68	29.5
Local Off-site Recovery Facilities	149,569.99	27.2
On-site Treatment	120,345.25	21.9
Kualiti Alam Sdn. Bhd.	85,734.92	15.6
Off-site Clinical Wastes Incinerators	17,650.01	3.2
Trinekens (Sarawak) Sdn. Bhd.	8,423.26	1.5
Foreign Facilities	5,224.00	1.0
Total	**548,916.11**	**100.0**

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

In 2005, five Written Approvals were issued for the import of 306,646 metric tonnes of wastes for use as raw materials (**Figure 6.20**). The wastes comprised of :

- granulated blast furnace slag (241,872 MT, 78.9%)
- copper slag (58,774 MT, 19.1%); and
- spent fluid cracking catalyst (6,000 MT, 2.0%)

The spent catalyst and blast furnace slag were used as raw materials in cement manufacturing plants and the copper slag for sand blasting operations. A total of 5,224 metric tonnes of scheduled wastes were exported in 2005. The exported wastes from 25 waste generators comprised of :

- zinc dross (2,347 MT, 44.9%)
- metal hydroxide sludges containing heavy metals such as silver, nickel and copper (2,288 MT, 43.8%)
- waste of nickel cadmium battery (272 MT, 5.2%)
- spent catalyst (215 MT, 4.1%)
- used xerox office equipment (90 MT, 1.7%); and
- used drums containing toxic and hazardous chemicals (12 MT, 0.2%).

The wastes were exported for recovery at various countries as shown in **Table 6.5.** The quantity and type of wastes exported between 2001 and 2005 are shown in **Figure 6.21.**

Scheduled Wastes : Illegal Dumping Site (DOE Photo Library)

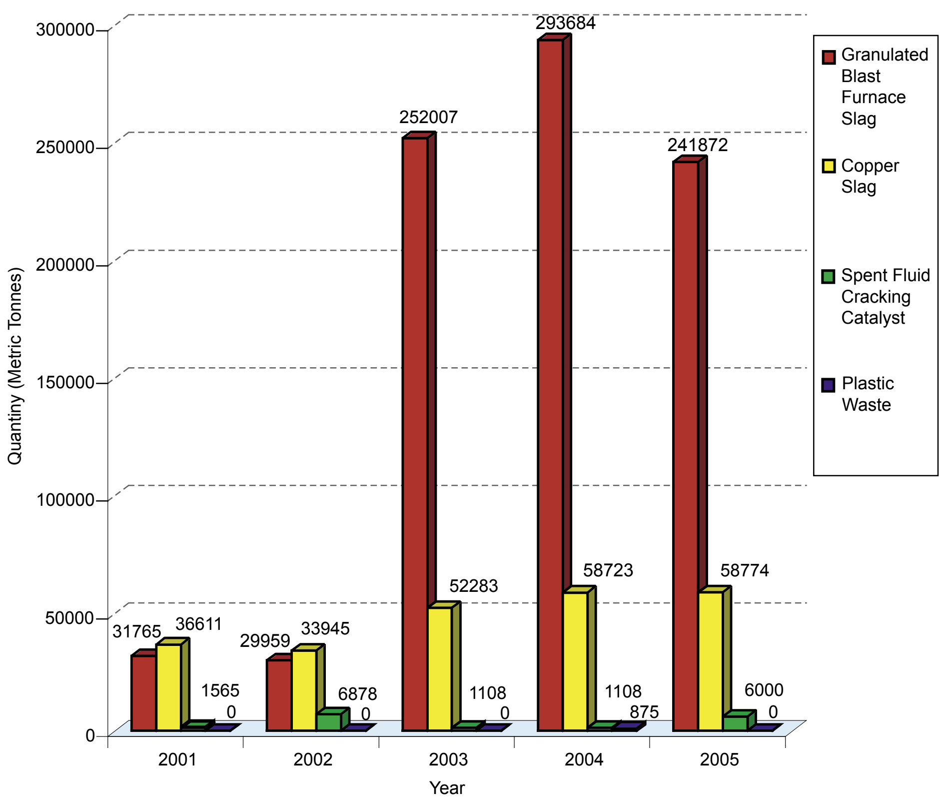
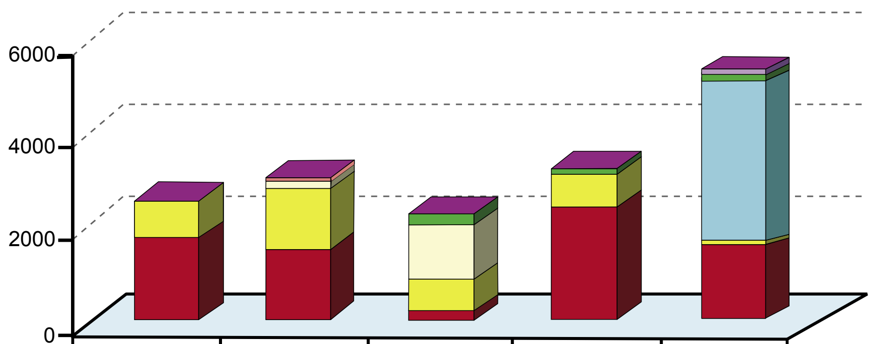


Figure 6.20 Malaysia : Quantity and Type of Scheduled Wastes Imported (Metric Tonnes), 2001 - 2005

Table 6.5 Malaysia : Quantity and Destination of Scheduled Wastes Exported (Metric Tonnes), 2001 to 2005

Country	2001	2002	2003	2004	2005
Australia	-	315	209	-	-
Germany	159	128	349	476	492
Holland	487	570	323	296	-
Italy	107	44	28	-	-
Japan	68	1,035	1,007	1,019	1,793
Finland	-	100	23	190	-
France	-	67	99	189	272
Philippines	532	-	-	1,000	1,000
Singapore	-	170	-	22	14
Thailand	-	-	-	-	90
South Korea	-	-	118	-	-
Sweden	27	149	7	6	8
South Africa	-	-	-	-	1,555
Belgium	-	-	140	51	-
United States of America	1,295	533	60	80	-
Canada	-	-	-	25	-
Total (Metric Tonnes)	**2,675**	**3,111**	**2,363**	**3,354**	**5,224**



	2001	2002	2003	2004	2005
Glass Cutlet	45	0	0	0	0
Used Xerox Office Equipment	0	0	0	0	90
Used Drums Containing Chemicals	0	0	0	10	12
Waste Of Nickel Cadmium Battery	0	0	217	103	272
Zinc Dross	0	0	0	0	2347
Cadmium Nickel Oxide	0	67	30	0	0
Used Blasting Material	19	0	0	25	0
Copper Oxide	0	142	1209	0	0
Spent Catalyst	816	1365	693	722	215
Metal Hydroxide Sludge	1795	1537	212	2494	2288

Figure 6.21 Malaysia :
Quantity and Type of Scheduled Wastes Exported (Metric Tonnes), 2001 - 2005

ANNEX

National Water Quality Standards For Malaysia

PARAMETER	UNIT	CLASS				
		I	IIA/IIB	III#	IV	V
Al	mg/l	NATURAL LEVELS OR ABSENT	-	(0.06)	0.5	LEVELS ABOVE IV
As	mg/l		0.05	0.4 (0.05)	0.1	
Ba	mg/l		1	-	-	
Cd	mg/l		0.01	0.01* (0.001)	0.01	
Cr (IV)	mg/l		0.05	1.4 (0.05)	0.1	
Cr (III)	mg/l		-	2.5	-	
Cu	mg/l		0.02	-	0.2	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l		-	-	3 SAR	
K	mg/l		-	-	-	
Fe	mg/l		1	1	1 (Leaf) 5 (Others)	
Pb	mg/l		0.05	0.02* (0.01)	5	
Mn	mg/l		0.1	0.1	0.2	
Hg	mg/l		0.001	0.004 (0.0001)	0.002	
Ni	mg/l		0.05	0.9*	0.2	
Se	mg/l		0.01	0.25 (0.04)	0.02	
Ag	mg/l		0.05	0.0002	-	
Sn	mg/l		-	0.004	-	
U	mg/l		-	-	-	
Zn	mg/l		5	0.4*	2	
B	mg/l		1	(3.4)	0.8	
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-α	Bq/l		0.1	-	-	
Gross-ß	Bq/l		1	-	-	
Ra-226	Bq/l		< 0.1	-	-	
Sr-90	Bq/l		< 1	-	-	
CCE	μg/l		500	-	-	-
MBAS/BAS	μg/l		500	5000 (200)	-	-
O & G (Mineral)	μg/l		40; N	N	-	-
O & G (Emulsified Edible)	μg/l		7000; N	N	-	-
PCB	μg/l		0.1	6 (0.05)	-	-
Phenol	μg/l		10	-	-	-
Aldrin/Dieldrin	μg/l		0.02	0.2 (0.01)	-	-
BHC	μg/l		2	9 (0.1)	-	-
Chlordane	μg/l		0.08	2 (0.02)	-	-
t-DDT	μg/l		0.1	(1)	-	-
Endosulfan	μg/l		10	-	-	-
Heptachlor/Epoxide	μg/l		0.05	0.9 (0.06)	-	-
Lindane	μg/l		2	3 (0.4)	-	-
2,4-D	μg/l		70	450	-	-
2,4,5-T	μg/l		10	160	-	-
2,4,5-TP	μg/l		4	850	-	-
Paraquat	μg/l		10	1800	-	-

Notes :
* = At hardness 50 mg/l $CaCO_3$
\# = Maximum (unbracketed) and 24-hour average (bracketed) concentrations
N = Free from visible film sheen, discolouration and deposits

National Water Quality Standards For Malaysia

PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	> 12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	> 100
Dissolved Oxygen	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*	μmhos/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	-	Normal + 2 °C	-	Normal + 2 °C	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	count/100 ml	10	100	400	5000 (20000)[a]	5000 (20000)[a]	-
Total Coliform	count/100 ml	100	5000	5000	50000	50000	> 50000

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

DOE Water Quality Index Classification

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 – 0.3	0.3 – 0.9	0.9 – 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 – 3	3 – 6	6 – 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 – 25	25 – 50	50 – 100	> 100
Dissolved Oxygen	mg/l	> 7	5 – 7	3 – 5	1 – 3	< 1
pH	-	> 7	6 – 7	5 – 6	< 5	> 5
Total Suspended Solid	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

Water Classes And Uses

CLASS	USES
Class I	Conservation of natural environment. Water Supply I – Practically no treatment necessary. Fishery I – Very sensitive aquatic species.
Class IIA Class IIB	Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species. 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 Classification Based On Water Quality Index

SUB INDEX & WATER QUALITY INDEX	INDEX RANGE		
	CLEAN	SLIGHTLY POLLUTED	POLLUTED
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
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59