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CONFLICT BETWEEN INDUSTRIAL GROWTH AND WATER SUPPLY PRESERVATION : CASE STUDIES IN MALAYSIA

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ABSTRACT

The industrial growth in Malaysia in the past decades has not only brought about economic success to the country but also the unwanted side-effect - environmental pollution. Many Malaysian rivers being used for the public water supply are polluted because of the location of polluting industries upstream. In the long run, the public is at risk as the pollutants not only degrade the physical water quality but the presence of microorganisms and chemicals are liable to cause health problems such as diarrhoeal diseases and cancer. There are many cases of watershed mismanagement in areas of high industrial growth in the country such as the watersheds of Sungai Langat, Sungai Skudai, Sungai Linggi, Sungai Damansara and Sungai Buluh. The State Governments and other relevant authorities must be made aware of these problems and therefore can avoid future mistakes by planning the location of future industrial estates with care.

ABSTRAK

Pertumbuhan industri di Malaysia pada beberapa dekad yang lalu membawa kejayaan ekonomi kepada negara tetapi dalam masa yang sama ia juga membawa satu kesan sampingan iaitu pencemaran alam sekitar. Banyak sungai-sungai di Malaysia yang menjadi punca air minuman telah tercemar oleh kerana kedudukan kilang-kilang di hulu tempat pengambilan air. Dalam masa jangka panjang, orang awam akan menanggung risiko kerana bahan-bahan pencemaran itu bukan sahaja boleh menimbulkan masalah estetik kepada air minuman tetapi pelbagai mikroorganisma dan bahan kimia dalam air boleh mendatangkan masalah kesihatan seperti ceret-beret dan barah. Beberapa kes pengurusan kawasan tadahan air yang tidak sempurna berlaku di beberapa kawasan perindustrian yang pesat seperti di kawasan tadahan air Sungai Langat, Sungai Skudai, Sungai Linggi, Sungai Damansara dan Sungai Buluh. Pihak kerajaan negeri dan pihak berkuasa lain perlu disedarkan tentang masalah tersebut dan dengan ini dapat menghindarkan kesilapan yang sama dengan merancangkan penempatan kawasan industri di masa depan dengan baik.

INTRODUCTION

As a tropical country, Malaysia is blessed with plenty of water year round. But as the country strives for developed country status, mistakes have been made especially in locating of water polluting industries above water intakes point. Most of the avoidable mistakes have occurred in areas of high industrial growth namely in the states of Selangor, Negeri Sembilan, Melaka and Johore and therefore at the same time areas which are densely populated and with high demand for finished water.

This paper is a compilation of short researches and studies carried out by the author when working with the Department of Environment and the continuation of such works after joining Universiti Teknologi Malaysia.

MATERIALS AND METHODS

The major rivers with industries located above water intakes which were studied are Sungai Damansara, Sungai Skudai, Sungai Langat and Sungai Buluh. However, only the first three will be discussed extensively in this paper. Other than water quality samplings and analysis the studies

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also entailed the inventory of polluting sources, samplings of effluent and pinpointing the extent of illegal industries within the watershed.

In situ reading such as for dissolved oxygen, temperature, salinity, conductivity, turbidity and pH were carried out on site using portable electronic equipment. The dissolved oxygen meter used was a Yellow Springs Equipment Model YSI 58, the Salinity-Conductivity and Temperature Meter (SCT meter) was another Yellow Springs Equipment (Model YSI 33). The turbiditimeter used was a HACH Model 16800, while the pH meter was HORIBA Model 21. There was a minor difference for an equipment used in Universiti Teknologi Malaysia as the pH meter used was Orion Research Model SA 210.

Grab samplings of river water at the various stations were carried out for chemical analysis at the laboratory. The types of bottle used and the preservatives added were in accordance with Standard Mesthods and/or the recommendations given by the Chemistry Department, Malaysia. The chemical analysis carried out by the Chemistry Department, Petalling Jaya and by the Environmental Engineering Laboratory at Universiti Teknologi Malaysia used Standard Methods as the main reference.

RESULTS AND DISCUSSION

Case 1: Sungai Damansara

Sungai Damansara is an atypical watershed for a water supply source as instead of a protected forested area with clear unpolluted water. The watershed includes a few of the most development parts of Petaling Jaya and an exclusive housing area of Kuala Lumpur.

The watershed includes traditional Malay villages (Kampung Sungai Penchala, Kampung Bukit Lanjan and Kampung Melayu Subang), squatter communities (Kampung Sungai Kayu Ara, Kampung Cempaka and Kampung Sungai Rumput) and modern townships (Taman Tun Dr. Ismail, Damansara Utama, Damansara Jaya, SS2, Taman Megah and Taman Mayang). The Kuala Lumpur International Airport and Rubber Research Institute of Malaysia (RRIM) with its rubber factory is also within the watershed. Major polluting sources include AIROD which services aircraft and is a possible source of oil and grease pollution, petrol service stations and the pig-rearing industry at Kampung Baru Subang. A new polluting source of importance is the controversial Petaling Jaya Municipal Council solid waste disposal site at Kelana Jaya. It does not fully practise the sanitary landfill method and became the source of local residents'ire because of the foul smell and housefly problems. A tributary of Sungai Damansara, Sungai Kayu Ara flows at the edge of the dump and receives foul smelling leachate especially after rainfalls. Analysis of leachate indicated a high amount of arsenic (0.58 mg/l) which is more than 10 times the amount of the heavy metal allowed to be discharged upstream of a water supply intake point.

Sewage is still the major contributor of pollution of the river as most of the townships mentioned mostly rely on septic and Imhoff tanks for treatment. There is ia sprinkling of oxidation ponds but even these do not comply with environmental standards.

The water intake is close to the Montfort Boys' Home, Batu Tiga and the water is treated at the Bukit Jelutong Water Treatment Plant before being distributed in parts of Shah Alam. There is a possibility that this water intake will be close due to the increasing pollution levels but at the time of the preparation of this paper, the treatment plant at Bukit Jelutong is still using raw water from Sungai Damansara.

The data analysed which are presented in Figures 1 to 12 were from 5 samplings of three study stations. Station 1 is on Sungai Kayu Ara at the bridge (Jalan SS 25/29) near Taman Mayang; Station 2 is on Sungai Damansara at the bridge of the road towards the Selangor Shooting Club range and Station 3 is about 100 meters above the water intake.

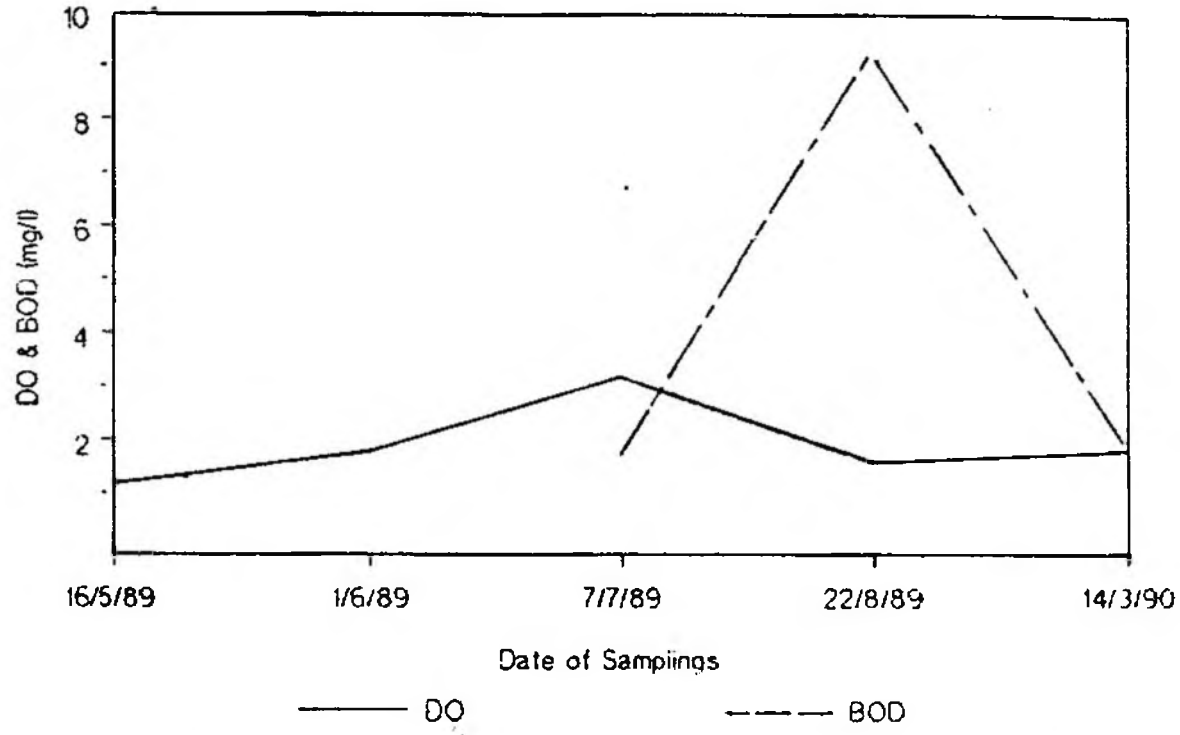

Figure 1: Sungai Damansara; Value of DO (Dissolved oxygen) and BOD (Biochemical oxygen demand) at Station 1.

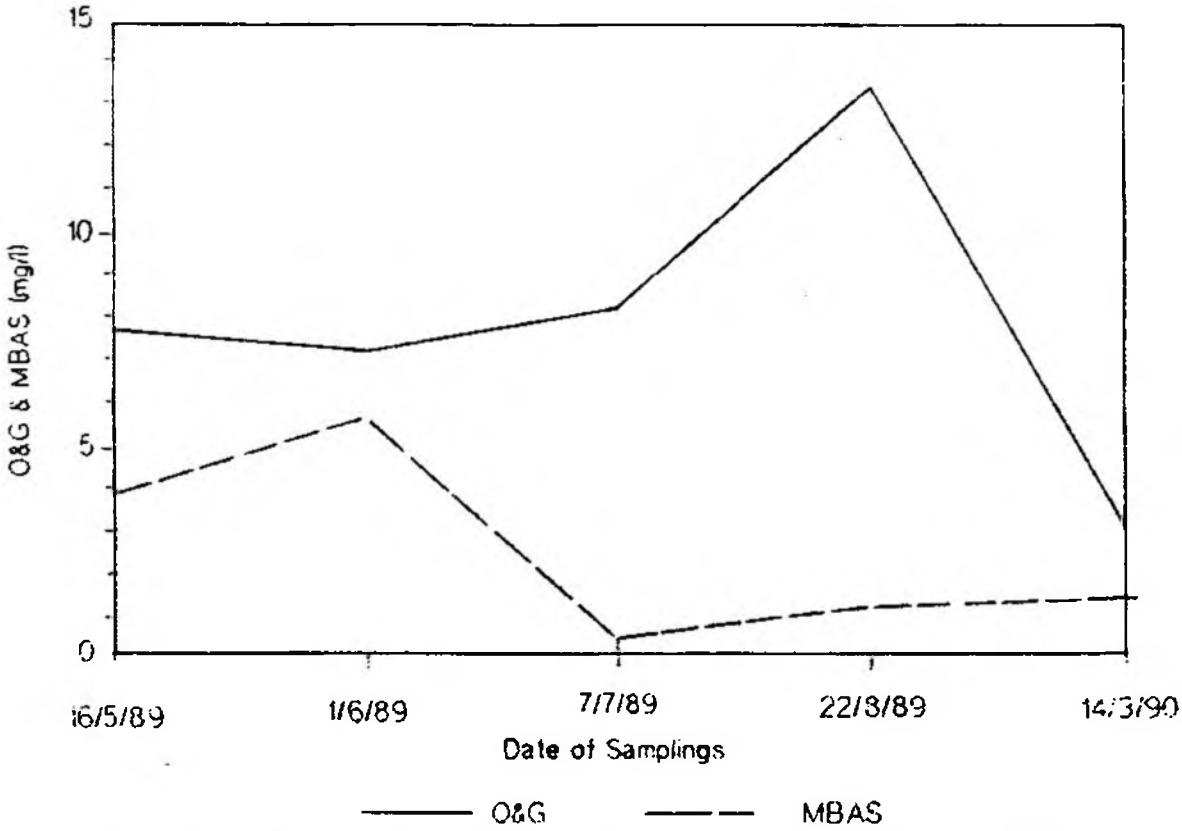

Figure 2: Sungai Damansara; Value of O and G (oil and grease) and MBAS at Station 1.

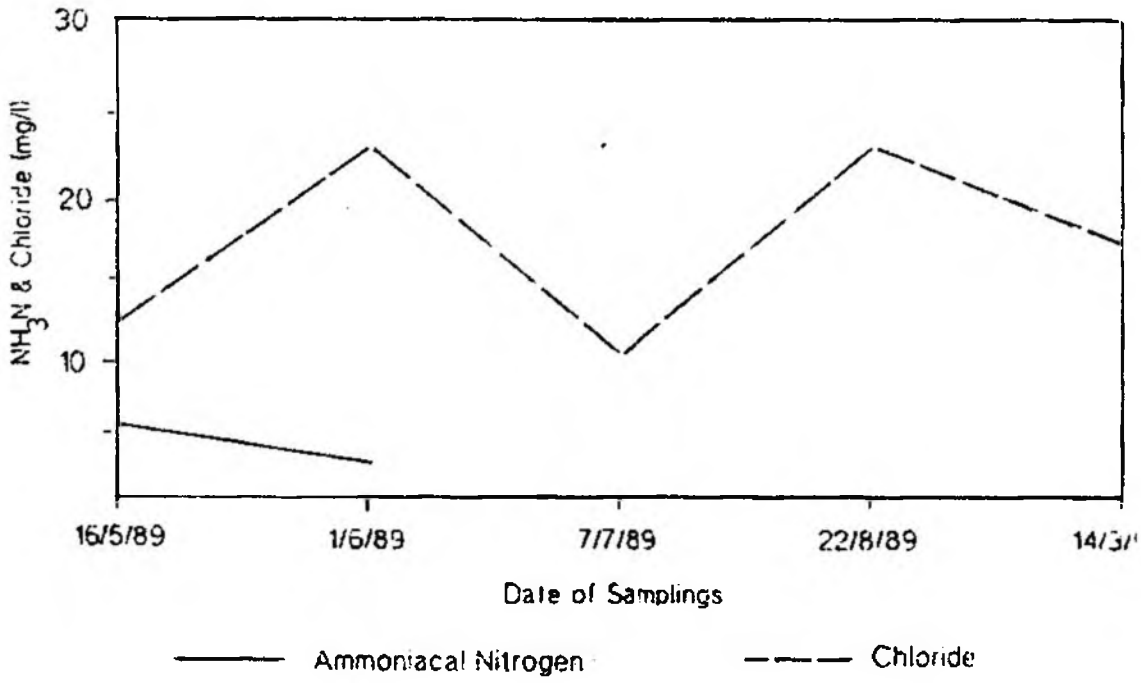

Figure 3: Sungai Damansara; Value of ammoniacal nitrogen and chloride at Station 1.

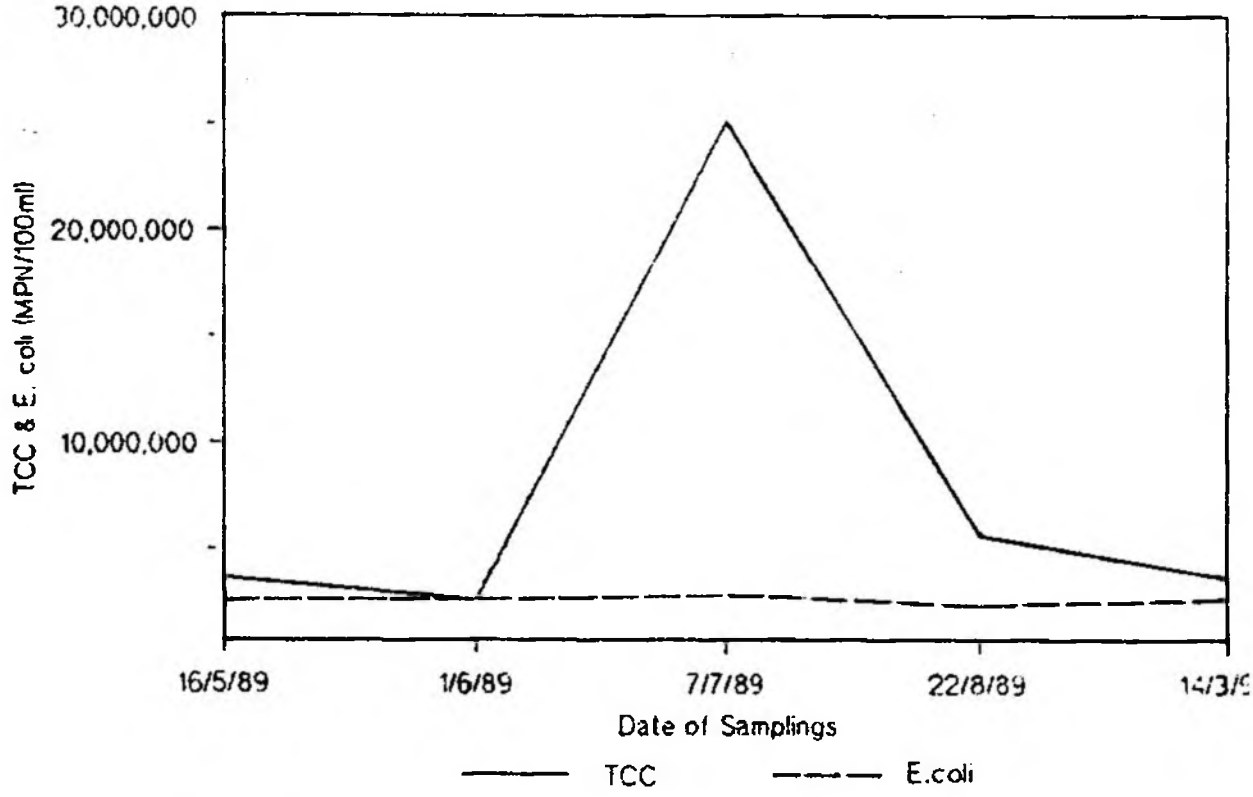

Figure 4: Sungai. Damansara; Value of TCC (total choliform count) and *E. coli* for Station 1.

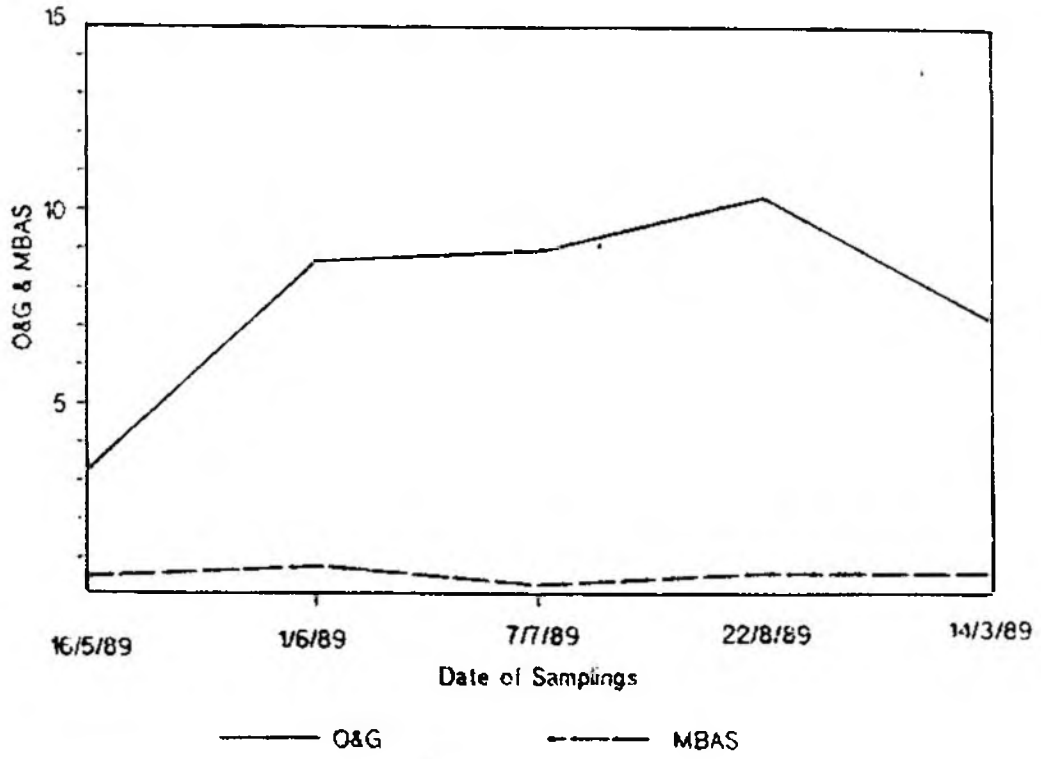

Figure 5: Sungai Damansara; Value of O and G (oil and grease) and MBAS at Station 2.

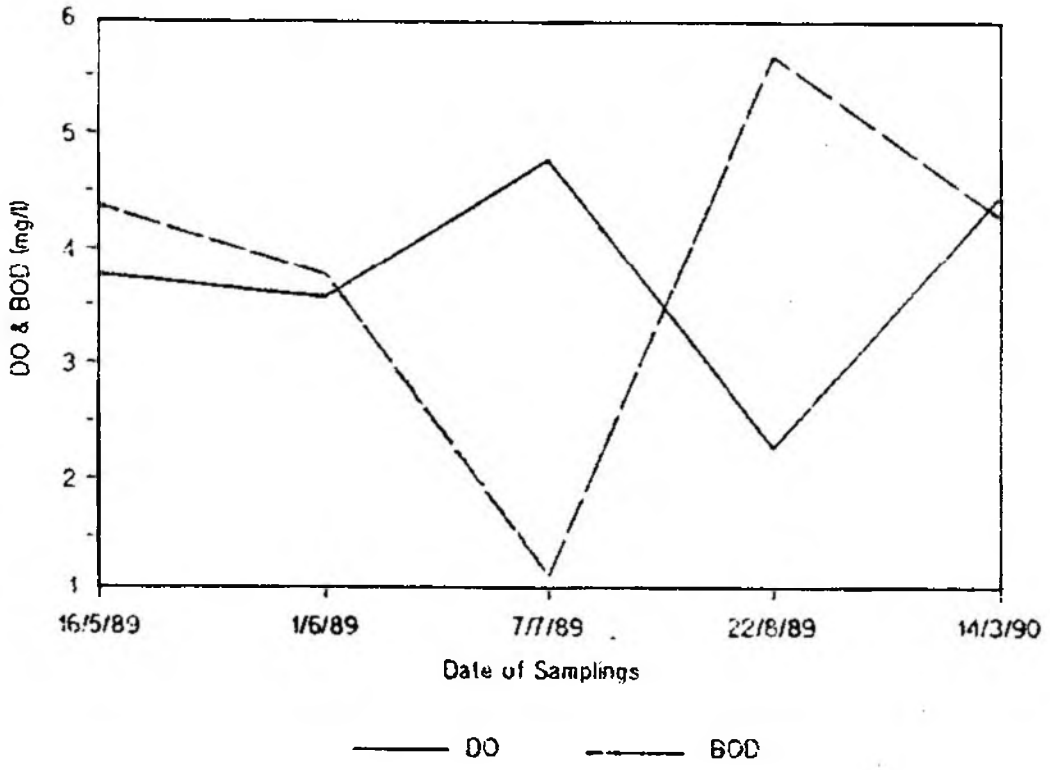

Figure 6: Sungai. Damansara; Value of DO (Dissolved oxygen) and BOD (Biochemical oxygen demand) at Station 2.

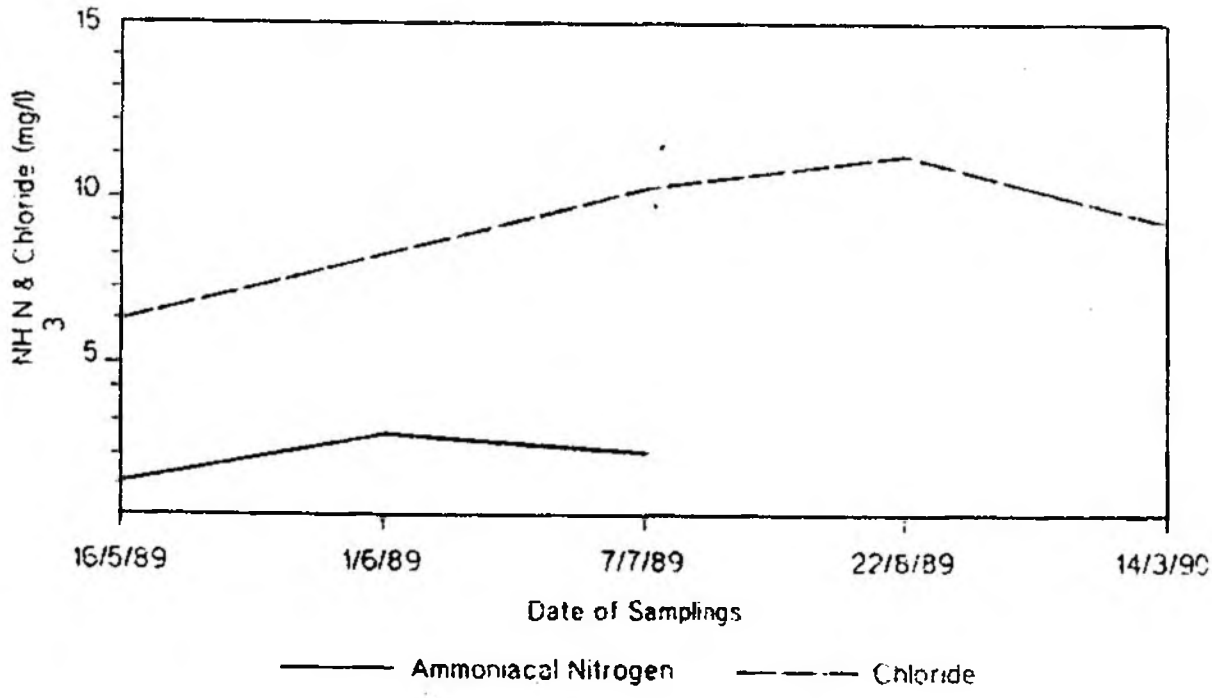

Figure 7: Sungai Damansara; Value of ammoniacal nitrogen and chloride at Station 2.

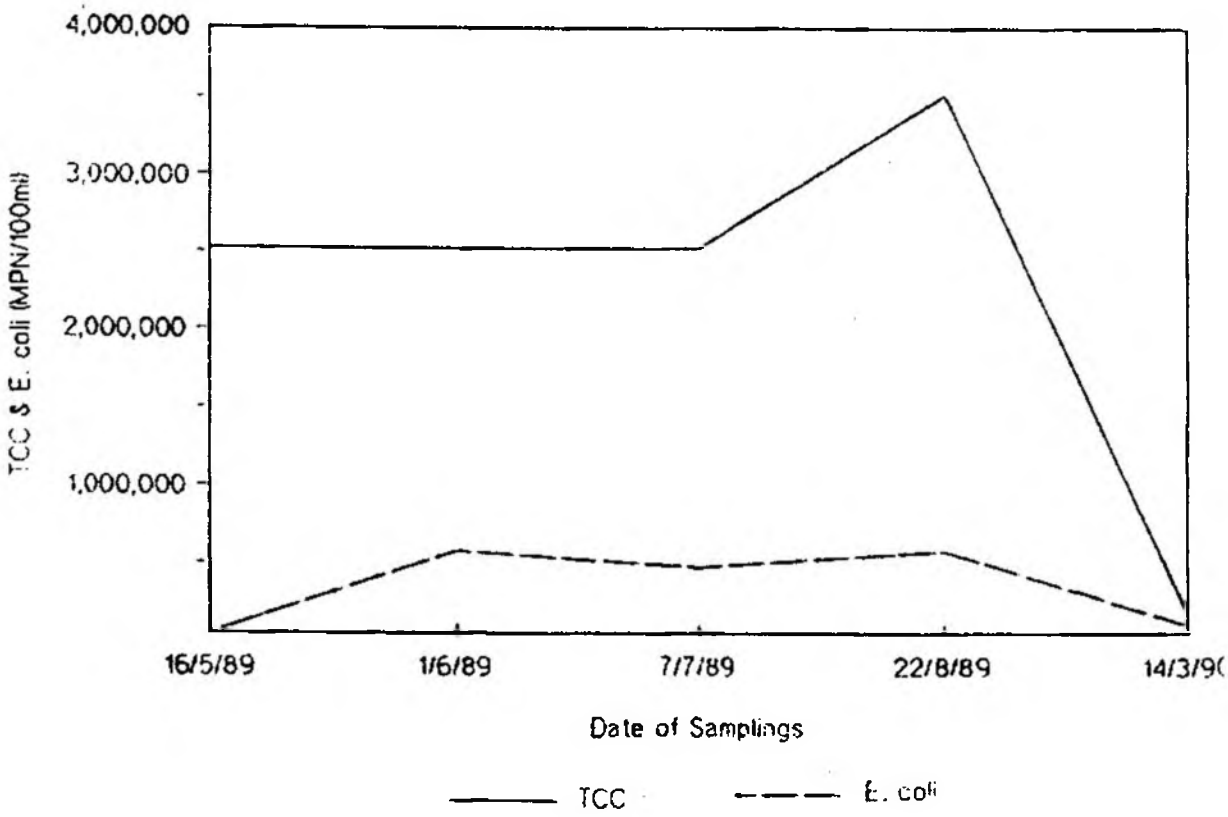

Figure 8: Sungai Damansara; Value of TCC (total choliform count) and *E. coli* for Station 2.

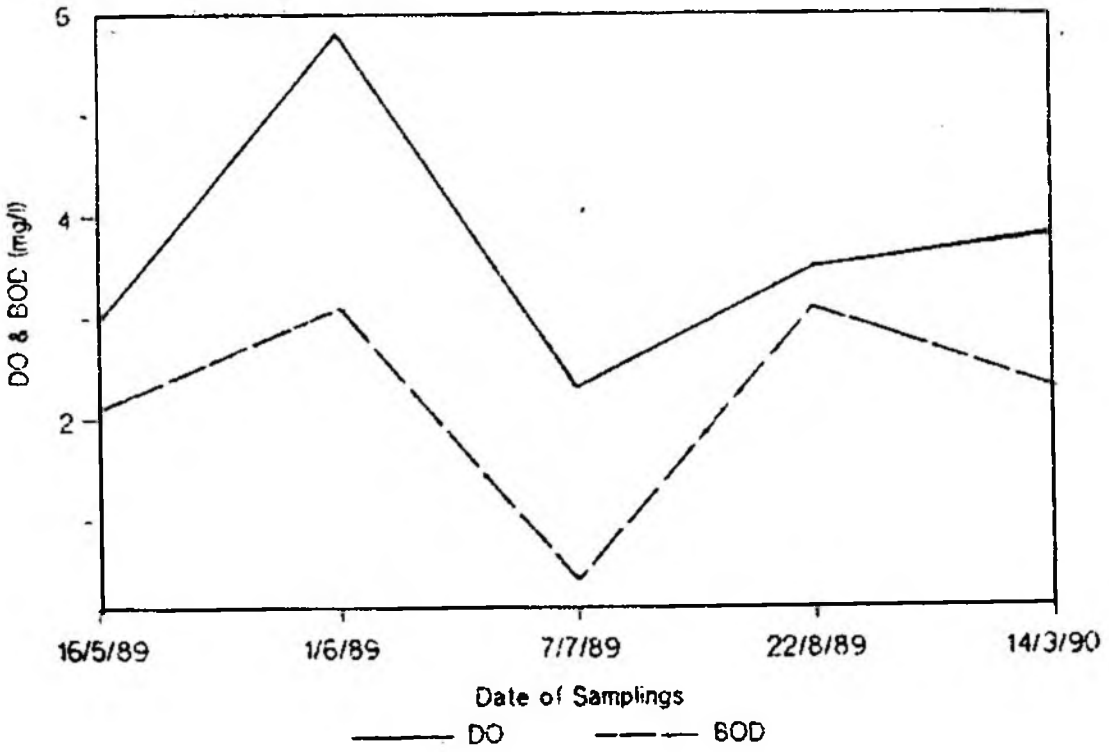

Figure 9: Sungai Damansara; Value of DO (Dissolved oxygen) and BOD (Biochemical oxygen demand) at Station 3.

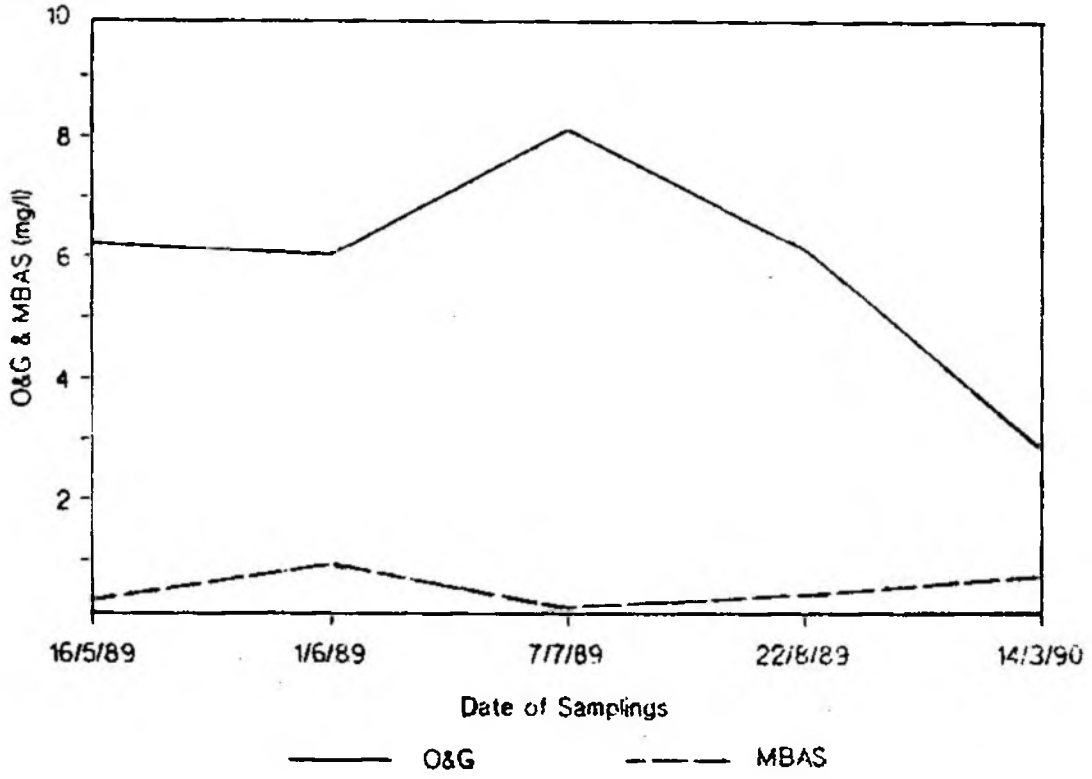

Figure 10 : Sungai Damansara; Value of O and G (oil and grease) and MBAS at Station 3.

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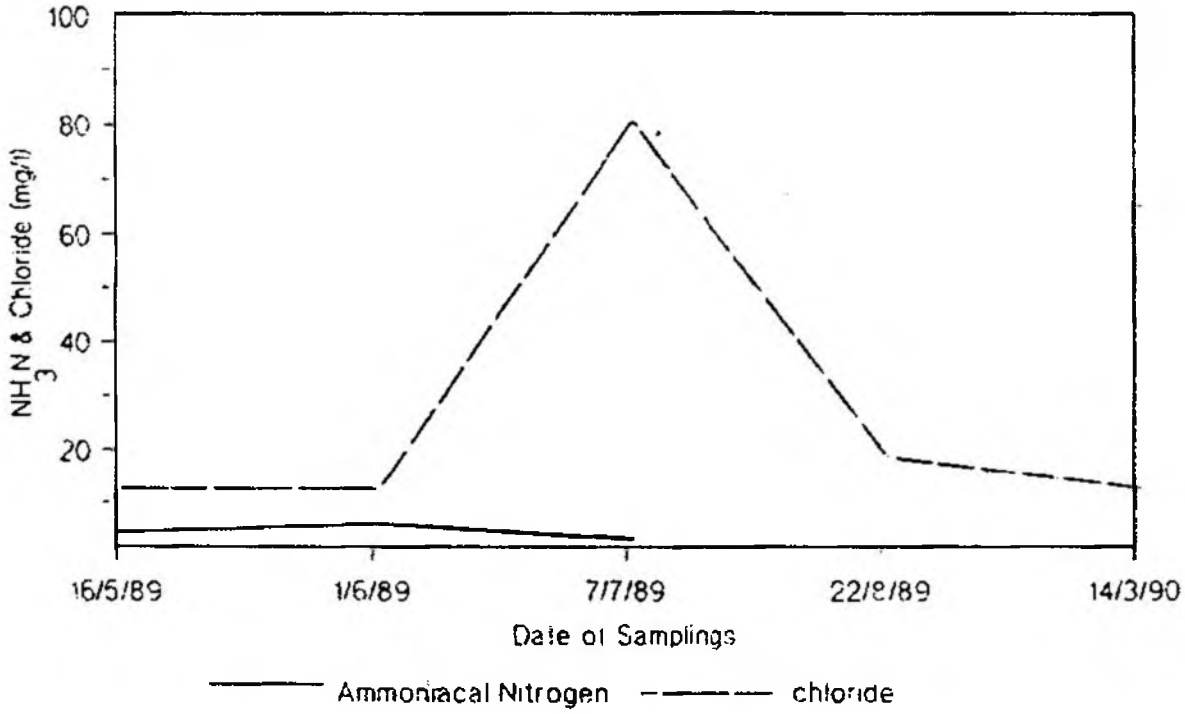

Figure 11: Sungai Damansara; Value of ammoniacal nitrogen and chloride at Station 3.

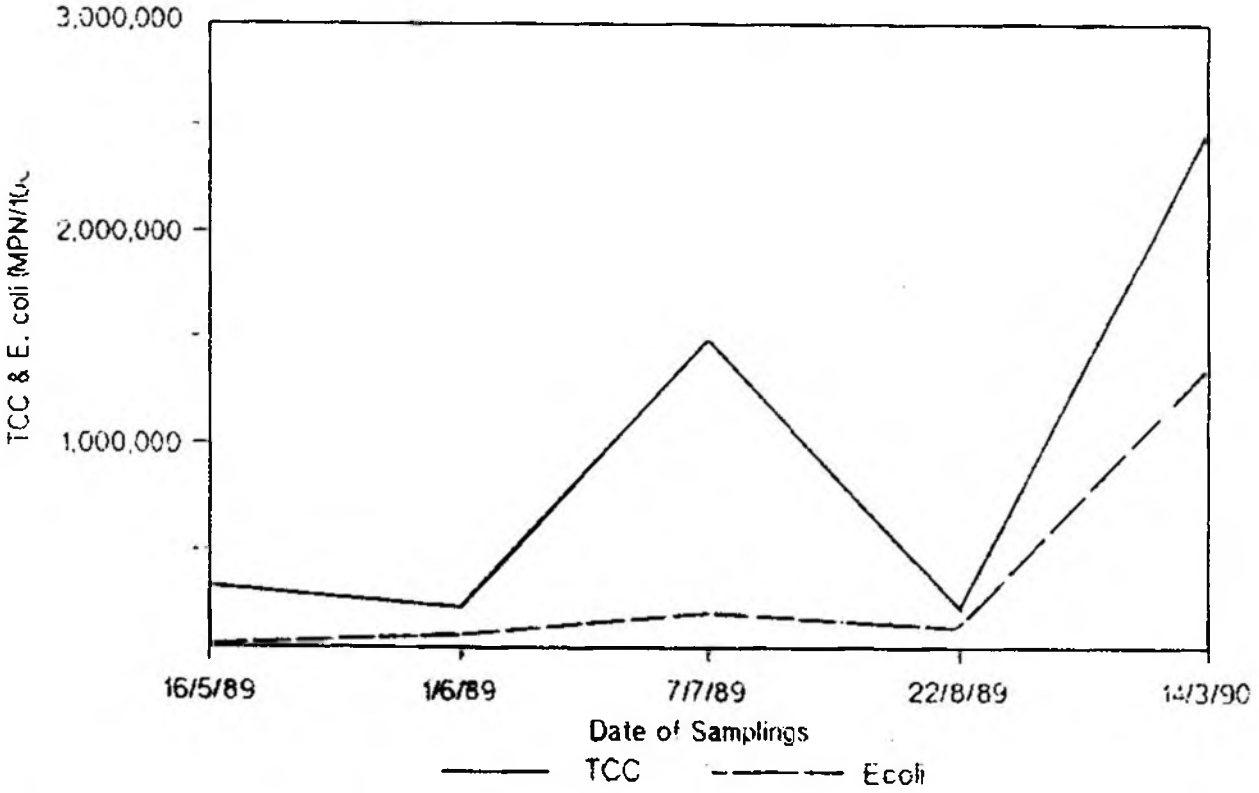

Figure 12: Sungai Damansara; Value of TCC (total choliform count) and *E. coli* for Station 3.

The results which show high amounts of ammoniacal nitrogen, chloride and oil and grease, indicate that the river is polluted mostly in the form of organic pollutants. High counts of fecal coliforms indicate that the source of the organic pollutants is mostly of human or animal origins but animal husbandry is limited to poultry and pig farming activities at Kampung Baru Subang.

It can be summerised that the major source of pollution is from the Sungai Kayu Ara sub-watershed (Station 1) relative to the Sungai Damansara sub-watershed as shown is their respective results. New projects within the Sungai Kayu Ara sub-watershed that will increase the pollutants load of Sungai Damansara include the new township of Bandar Utama and the Tropicana Golf Resort. The development of the degazetted Sungai Buloh Forest Reserve into a large self-containing township in the next five years also will increase the total pollutants load of Sungai Damansara. The former forest reserve is drained by three tributaries of the river namely Sungai Rumput, Sungai Takil and Sungai Tambul.

The quality of the river water at the intake point cannot fully comply with the Class III category of the Interim Water Quality Standards for Malaysia especially for ammoniacal nitrogen and fecal coliforms. Class III is the least stringent for water supply which needs extensive treatment.

Case 2: Sungai Skudai

Sungai Skudai is a small river with a comparatively small watershed situated in southern Johor Darul Ta'zim. The length of the river is about 47 km form its source in the Yule Catto oil palm estate at Sedenak to its estuary in the Straits of Johore (Selat Tebrau). The river is an important water supply source for the Public Utilities Board, Singapore (PUB), with the water intake and treatment plant beside the Senai Highway before the Skudai township. The maximum capacity of the treatment plant is about 40 mgd (million gallons per day) but it is usually processes only between 10 to 20 mgd. About 60 per cent of the finished water is for the Johor Bharu residents.

PUB has been regularly complaining about the increasing deterioration of the raw water quality in the form of ammoniacal nitrogen (AN) and phenolic compounds. Therefore, a special study on the quality of the river water and the inventory of major pollution sources was carried out in November 1989. Analysis of the raw data of the eight monitoring stations was also done so as to escertain the most polluted segments of the river. An automatic water sampler was used to sample water at the raw water intake at PUB for 24 hours. The samples were analysed for BOD_5 (Biochemical Oxygen Demand for 5 days at 20°C) and ammoniacal nitrogen.

The pollution problem of Sungai Skudai is tremendous because the watershed is an important developing area for Johore with a population of about 60,000 in five major townships and residential area (Kulai, Kulai Besar, Kulai Baru, Saleng dan Senai), an industrial area (Senai Industrial Estate), an open solid waste dump, pig-farms and mixed single industries (Figure 13). With the recent economic upswing, the area is set for rapid development as it will be receiving the growth spill over from the other surburbia surrounding Johor Bahru. The growth, if not in the industrial sector, tends to be in the form of support services such as residential areas.

As in the case of most small townships in the country, the preferred method of sewage treatment in the Sungai Skudai watershed is by using septic and Imhoff tanks with a sprinkling of other methods such as oxidation ponds and activated sludge. The infamous "hanging" latrines built over drains or streams are also used by some residents. The three pig farms in the area do not have proper treatment facilities except for settling ponds.

Figures 14 to 21 indicate that the water quality near the source at Sedenak is quite good as the dissolved oxygen level (DO) is high while other pollution indicator parameter such as BOD_5, oil and grease, ammoniacal nitrogen and turbidity are low. The water quality changes for the worse when the river passes through drains carrying effluents from factories and drains

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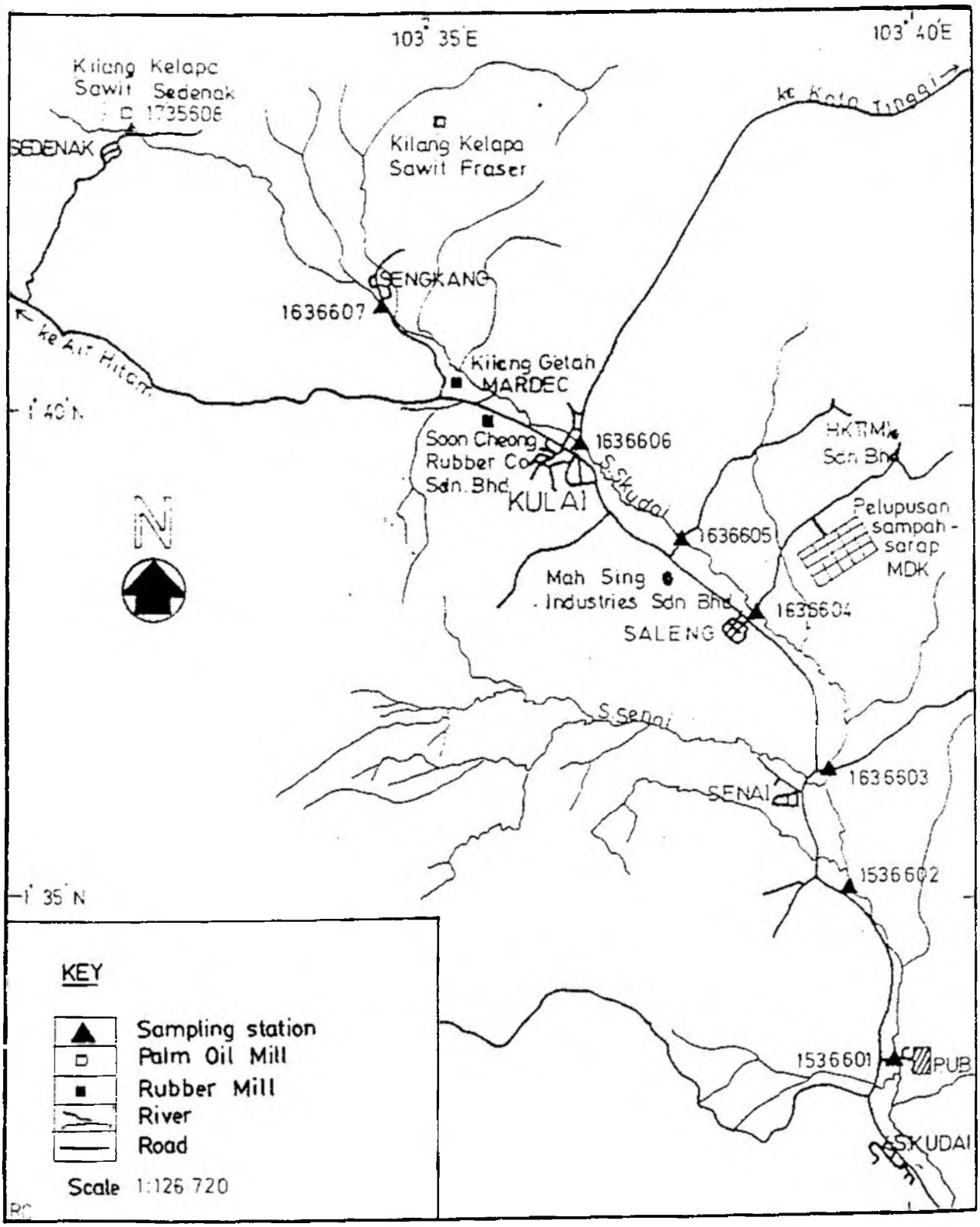

Figure 13: Sampling stations in Sungai Skudai watershed

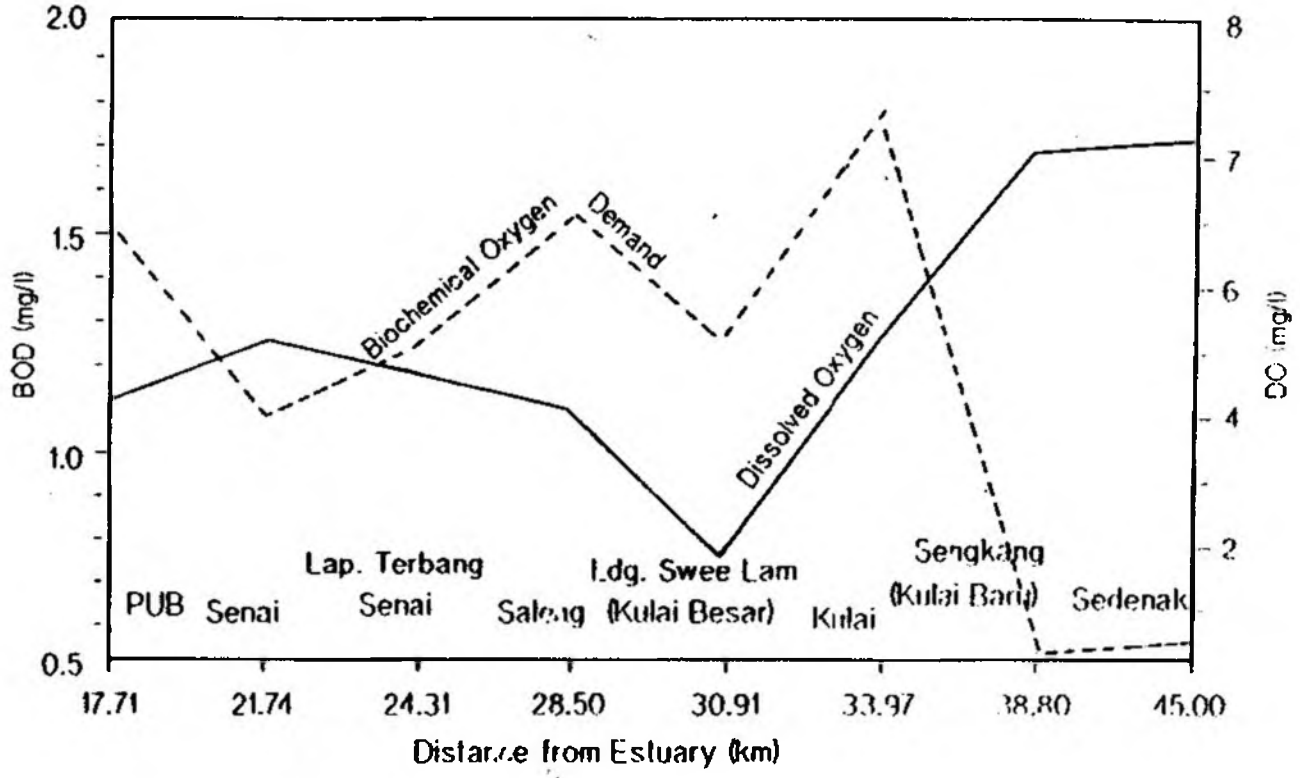

Figure 14: Sungai Skudai, Johor; Average concentration of biochemical oxygen demand (BOD) and dissolved oxygen (DO), 1988.

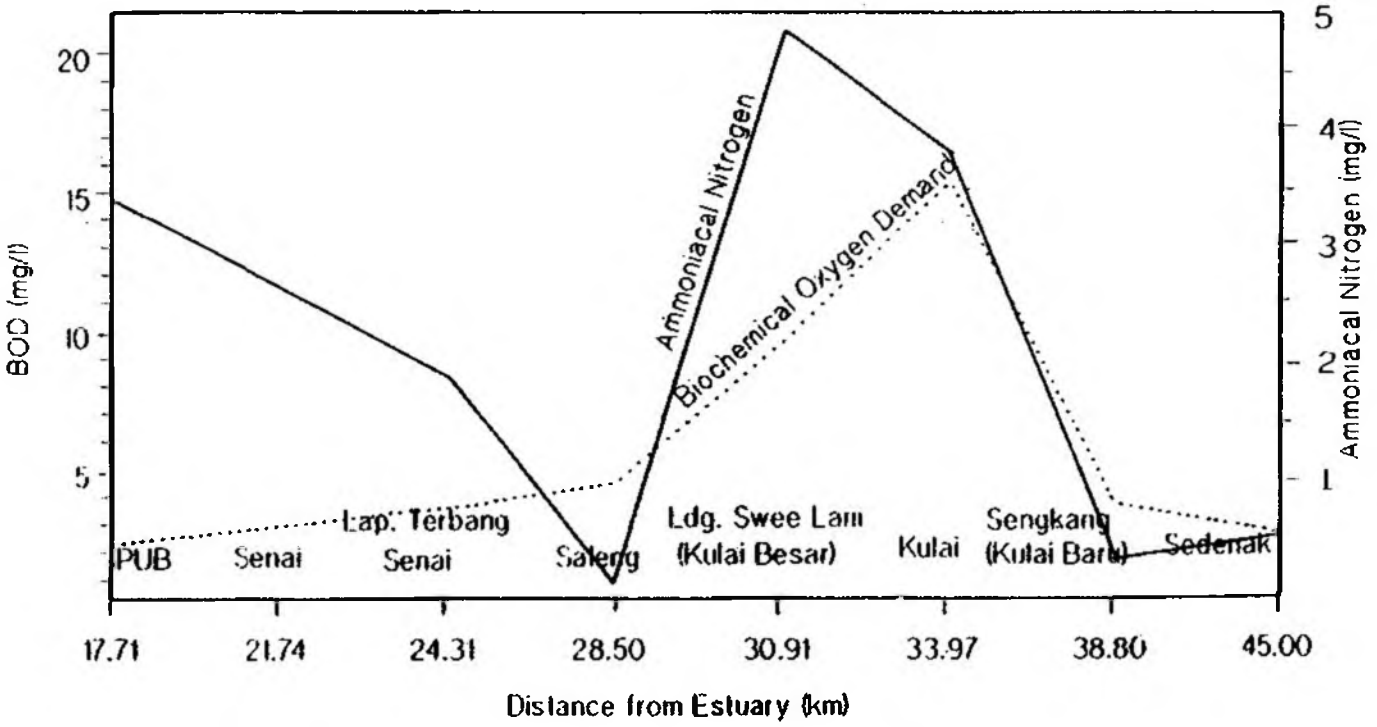

Figure 15: Sungai Skudai, Johor; Average concentration of biochemical oxygen demand (BOD) and ammoniacal nitrogen on 20/9/86

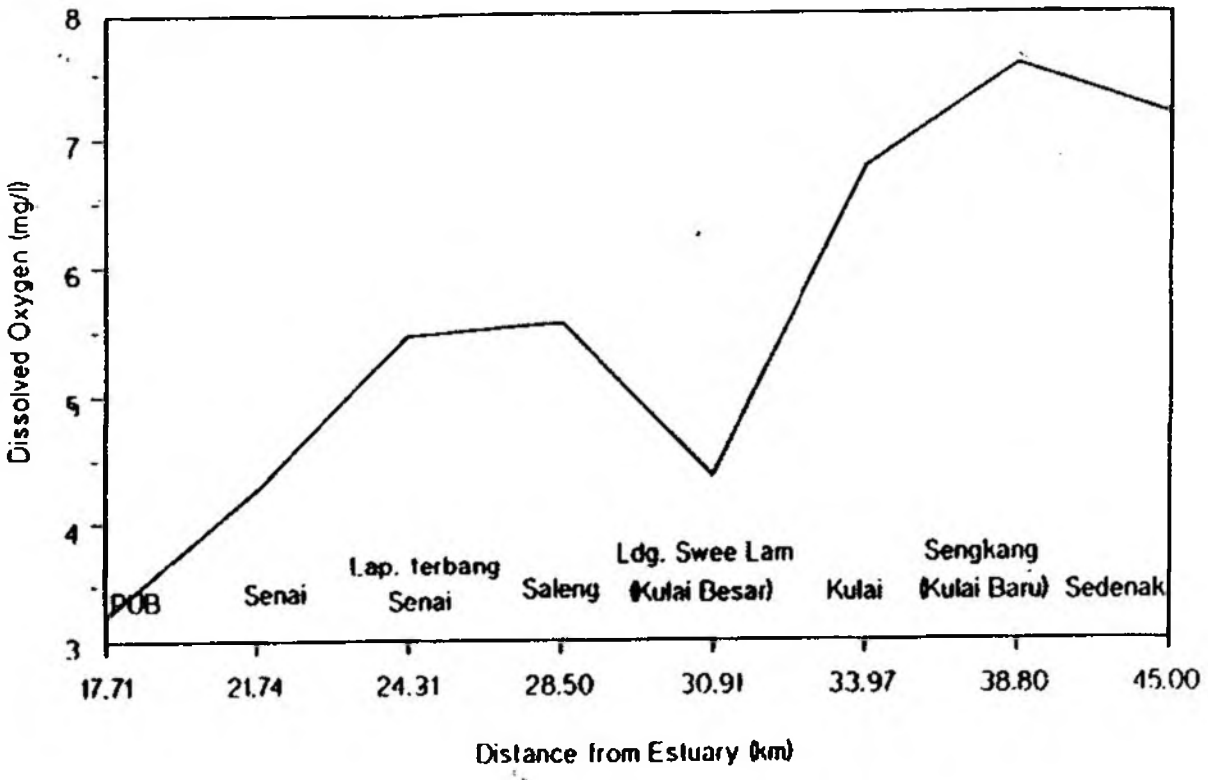

Figure 16: Sungai Skudai, Johor; Concentration of dissolved oxygen (DO) from 8/11/89 to 9/11/89

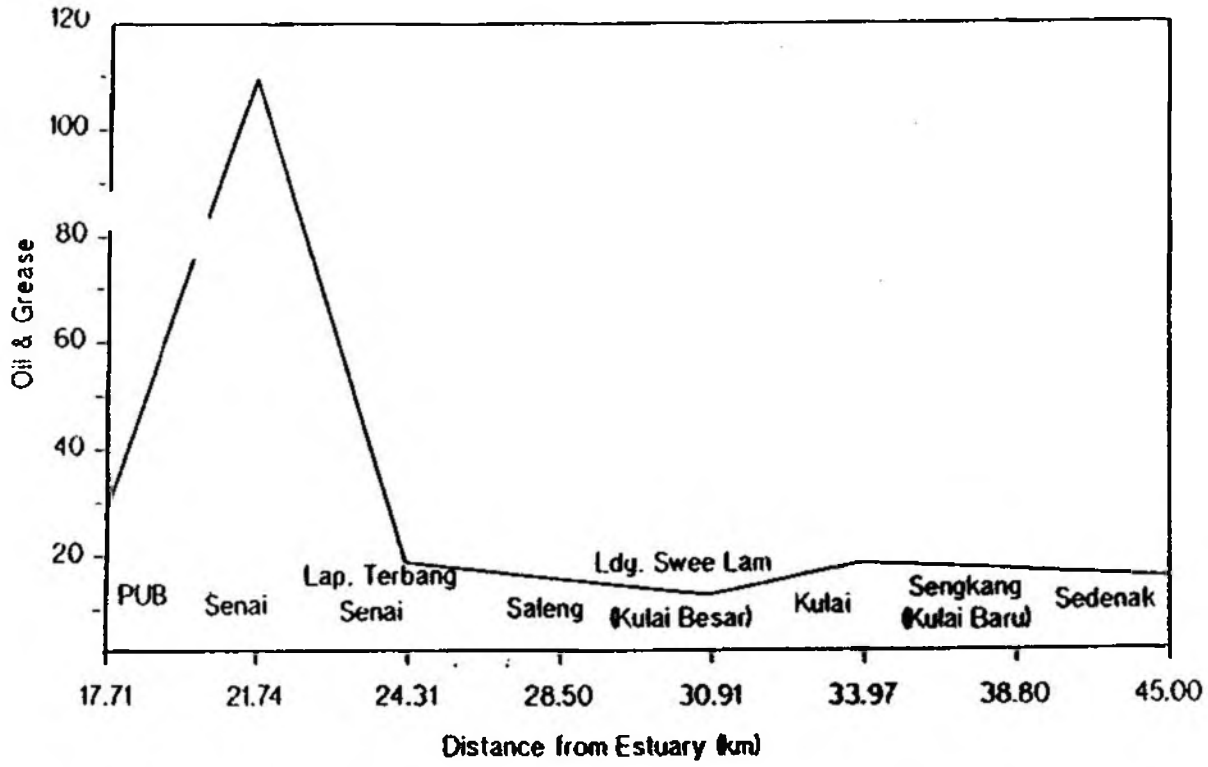

Figure 17: Sungai Skudai, Johor; Average concentration of oil and grease, 1979

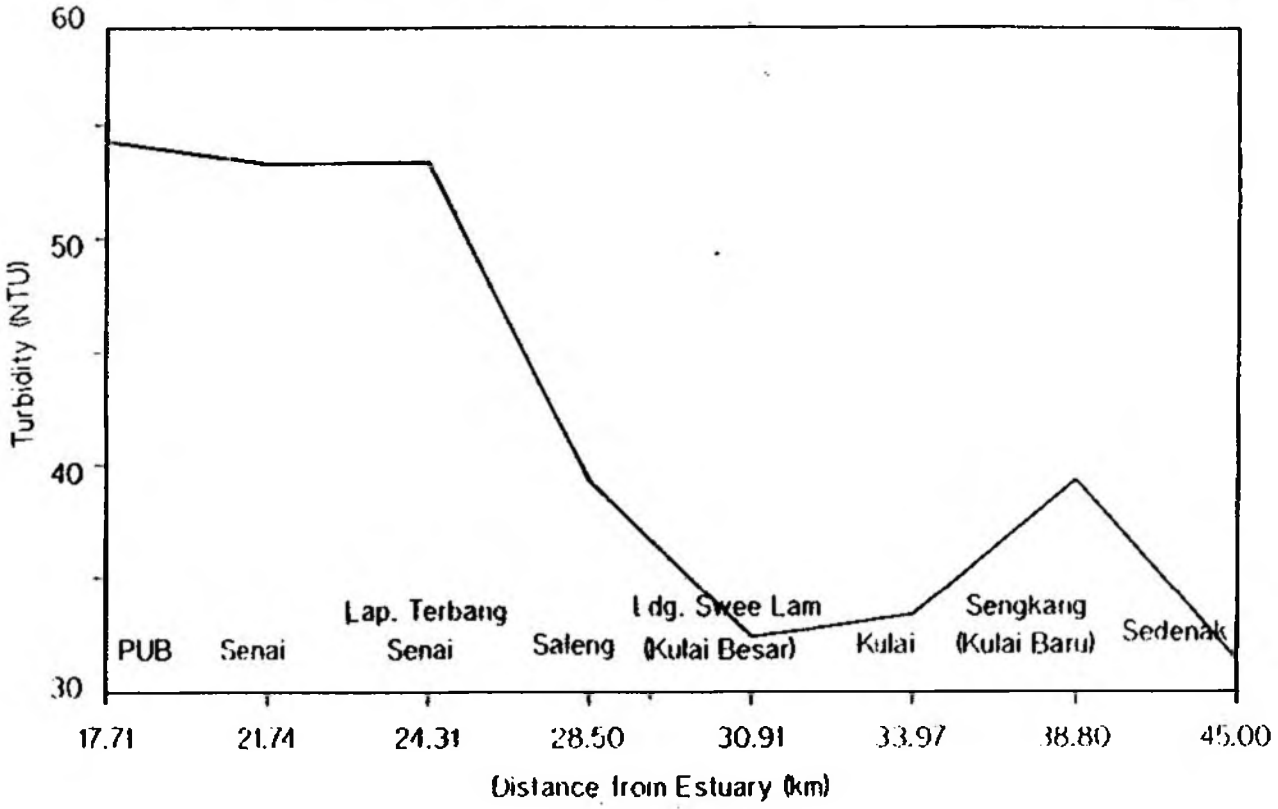

Figure 18: Sungai Skudai, Johor; Status of turbidity from 8/11/89 to 9/11/89

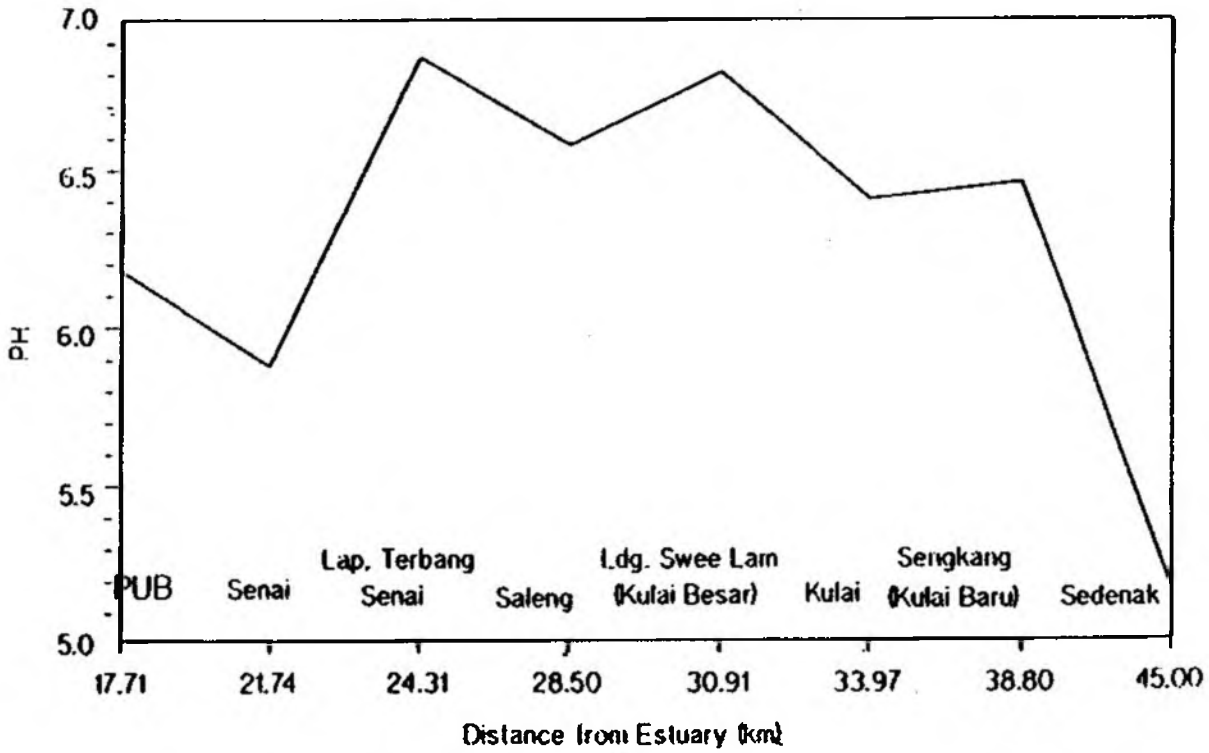

Figure 19: Sungai Skudai, Johor; Status of pH from 8/11/89 to 9/11/89

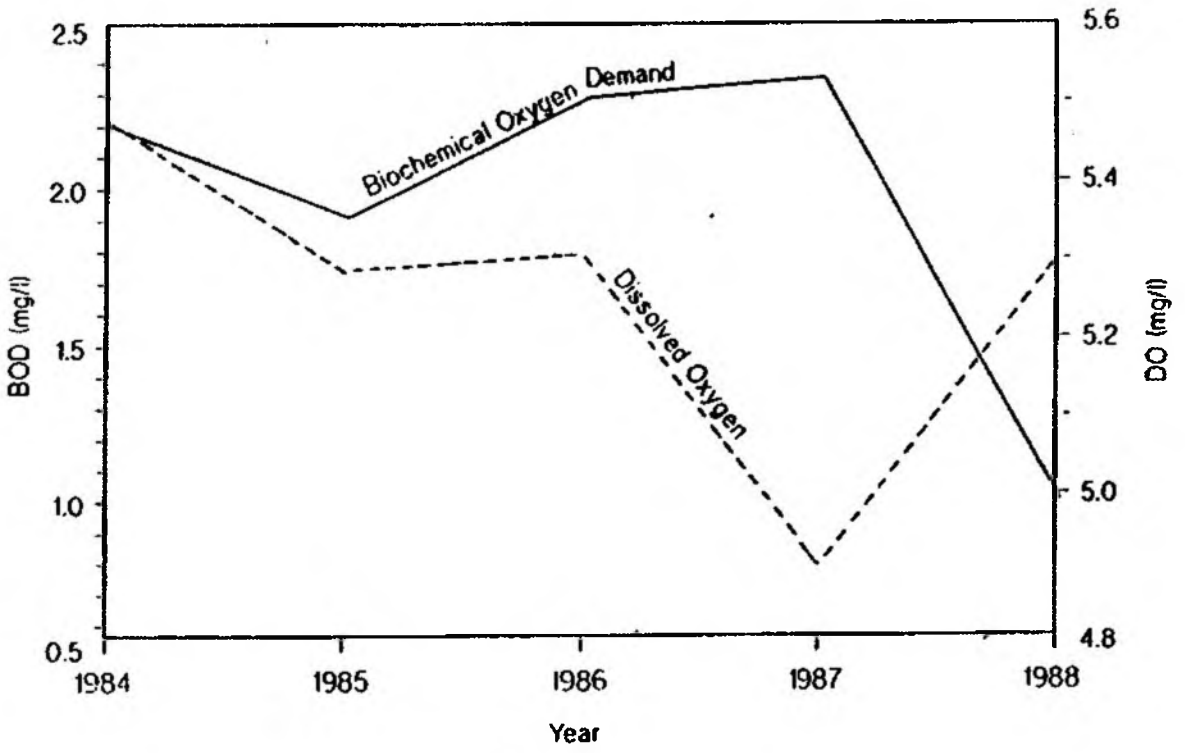

Figure 20: Sungai Skudai, Johor; Trend of biochemical oxygen demand (BOD) and dissolved oxygen (DO) from 1984 to 1988

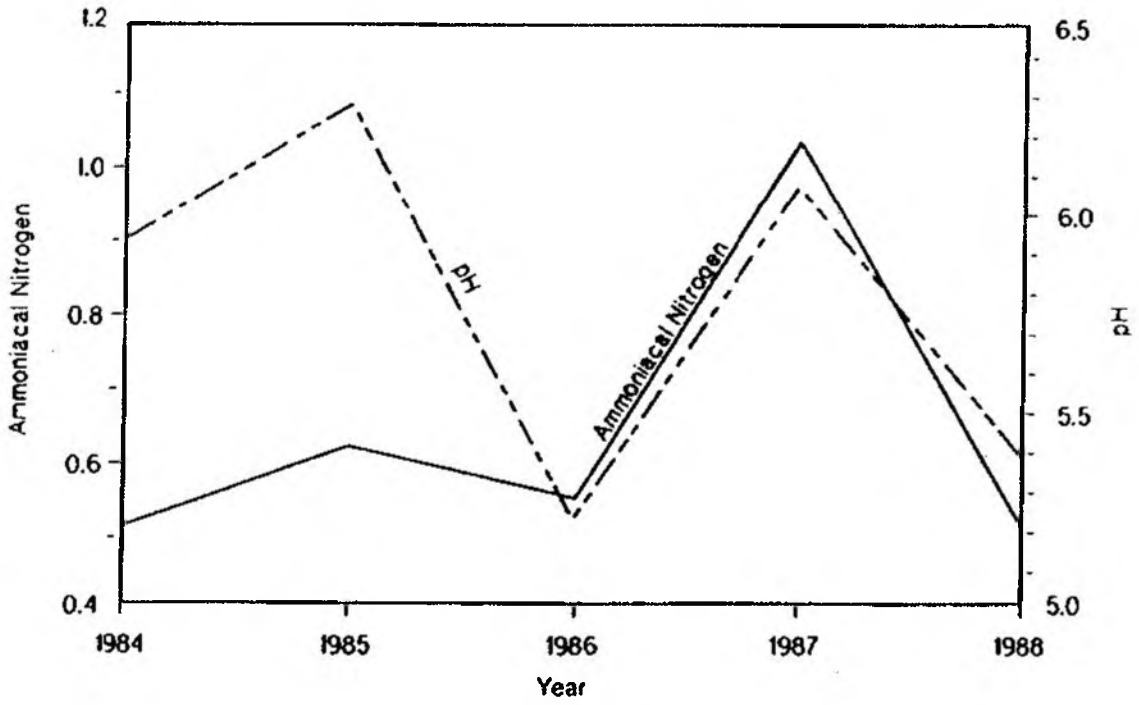

Figure 21: Sungai. Skudai, Johor; Trend of ammoniacal nitrogen and pH from 1984 to 1988.

from highly populated areas such as Kulai which discharge poorly treated sewage and untreated sullage into the river.

High ammoniacal nitrogen in the river especially during dry spells is unavoidable since major sources are from the semi-treated sewage, pig-wastes and a number of rubber and palm oil factories. The results of the 24-hour monitoring at the PUB water intake show a relatively high amount of ammoniacal nitrogen especially at 12:40 a.m. on November 10, 1989 even though it was the rainy season. Phenolic compounds can be emanated from organic pollutant similar to the sources of pollution for ammoniacal nitrogen especially from palm oil mills but direct pollution from a few textile industries and an optical lens grinding factory are also possible.

Both ammoniacal nitrogen and phenolic compounds can cause water treatment problems. Ammoniacal nitrogen forms monochloramines and dichloramines with chlorine, depriving the finished water of the necessary residual chlorine while phenolics form chlorophenols also with chlorine, causing noxious smelling drinking water.

The water quality of Sungai Skudai will never take a turn for the butter unless drastic actions are taken such as providing better sewage treatment for all the townships, closing down the pig farms and enforcing more stringent standard for the factories.

Case 3: Sungai Langat/Sungai Semenyih

Sungai Langat is a very important watershed which supplies water to most of the Klang Valley. There are two major dams for controlling the water flow of the river. These are the Langat and the Semenyih dams. On the Sungai Langat, there are three major water intakes and one on Sungai Semenyih before its confluence with Sungai Langat. The last one is the biggest. Smaller intakes and plants are also operational on the smaller tributaries of Sungai Langat including the one on Sungai Batang Nilai near Salak.

While the upper reaches of Sungai Semenyih and Sungai Langat above the dams are forested, unpopulated and unpolluted area, the watershed below the dams onwards to the water intake points are with population. There are traditional villages with rubber and fruit plantations, small towns plus several industrial estates. Within the sungai Langat watershed, there are industrial areas at the ninth mile Cheras, Inch Kenneth/ Balakong Industrial Estate, Kajang Industrial Area and Bangi Industrial Area (Figure 22).

Meanwhile the Sungai Semenyih water catchment has Semenyih and Beranang Industrial Estates as well as the fast-growing Nilai Industrial Estate in the neighboring state of Negeri Sembilan. There are also numerous individual factories manufacturing a variety of products from both watersheds. Appendix III lists out the various industries in the Sungai Langat/Sungai Semenyih watershed.

As shown in Figures 23 to 32 the levels of organic pollutant as measured using the Biochemical Oxygen Demand (BOD) indicated that Sungai Langat was quite polluted especially as drinking water. Tables 1 to 5 indicate the results of the chemical analysis of several industries' effluent discharged into Sungai Langat and Sungai Semenyih. The names of the industries are not revealed as to avoid possible legal complications. The most denominator was that the industries are not complying with Standard A of the Third Schedule of the Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979 (Appendix 1). Most industries were not complying with the organic parameter of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Lead, which is important in public considerations was 7 to 100 times higher than the stipulated standard. The culprit is a well known battery manufacturer. Discharge form a glove making factory was high for both the organics and zinc, while two textile plants effluent was high in organic wastes, oils and grease and phenol.

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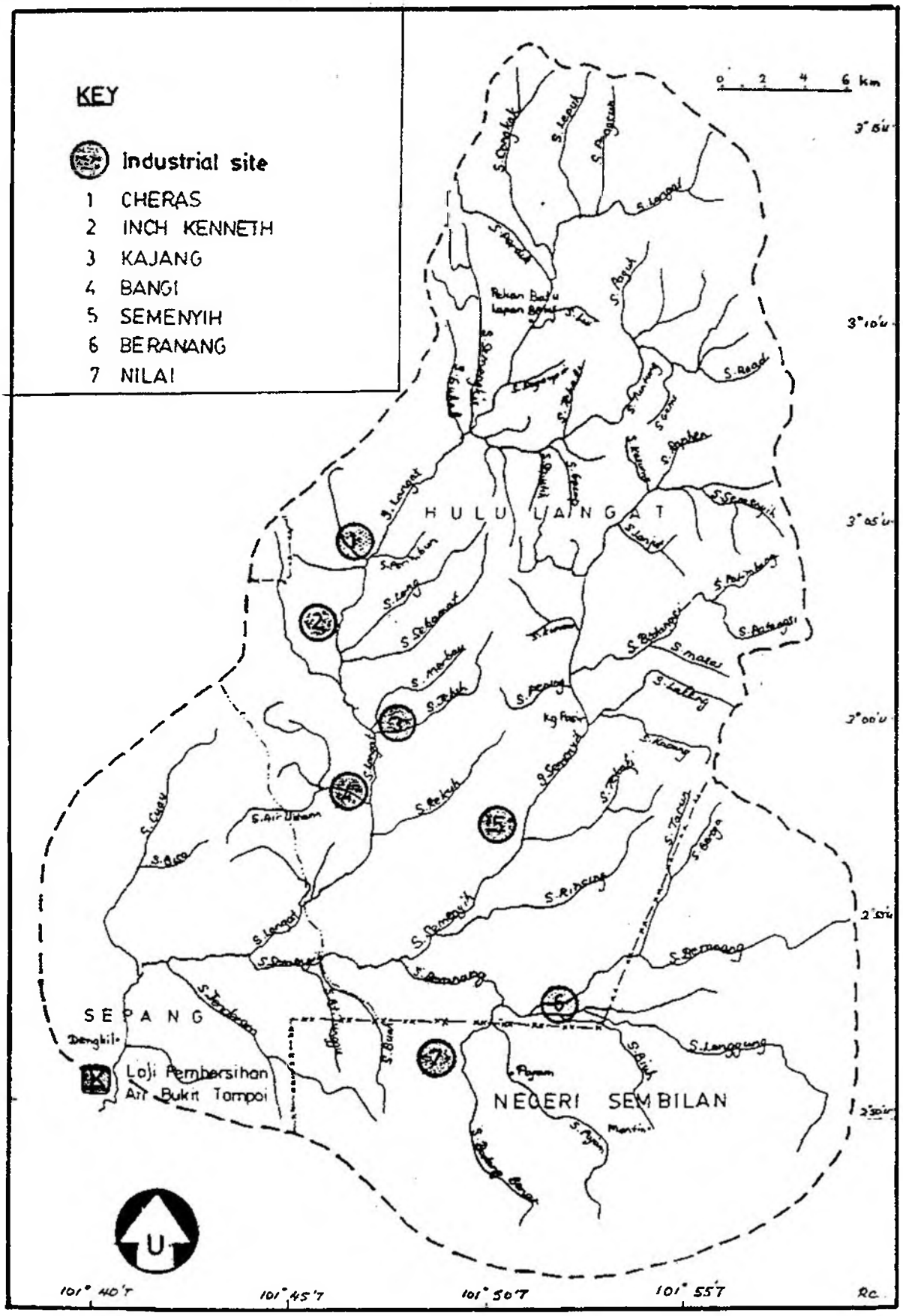

Figure 22: Bukit Tampoi waterworks catchment area

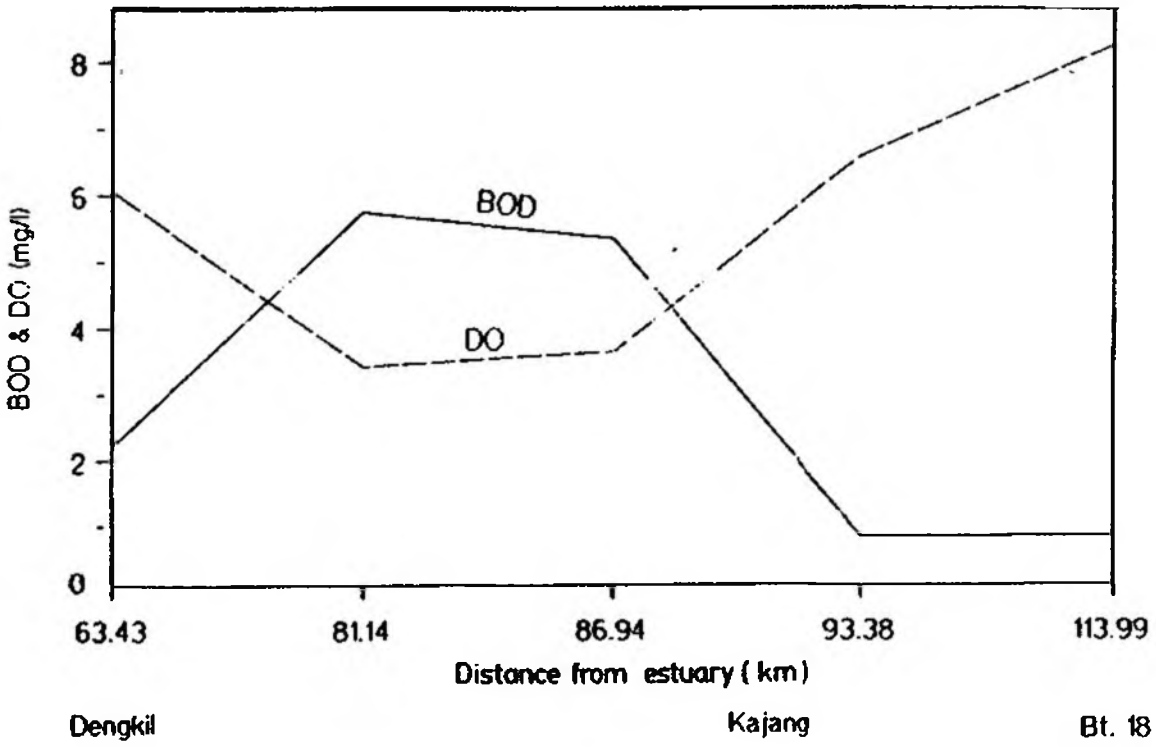

Figure 23: Sungai Langat water quality, 1985 (Biochemical oxygen demand [BOD] and Dissolved oxygen [DO])

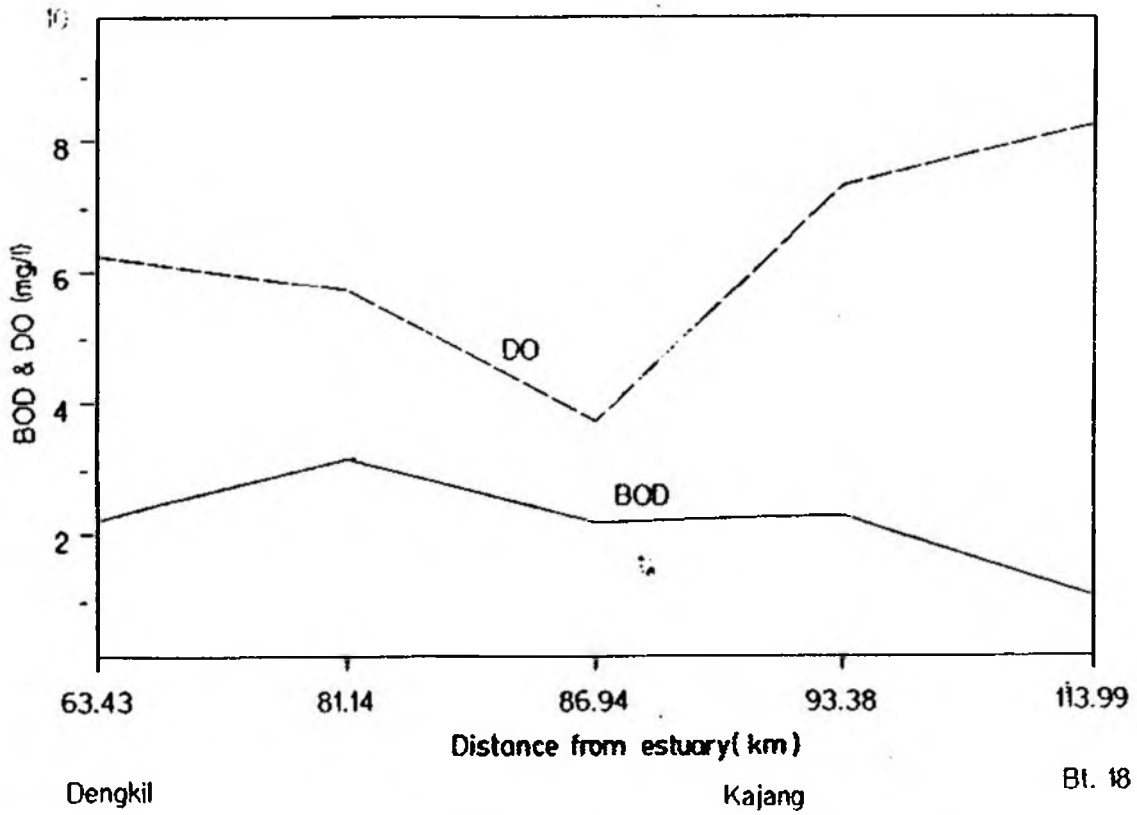

Figure 24: Sungai Langat water quality, 1986 (Biochemical oxygen demand [BOD] and Dissolved oxygen [DO])

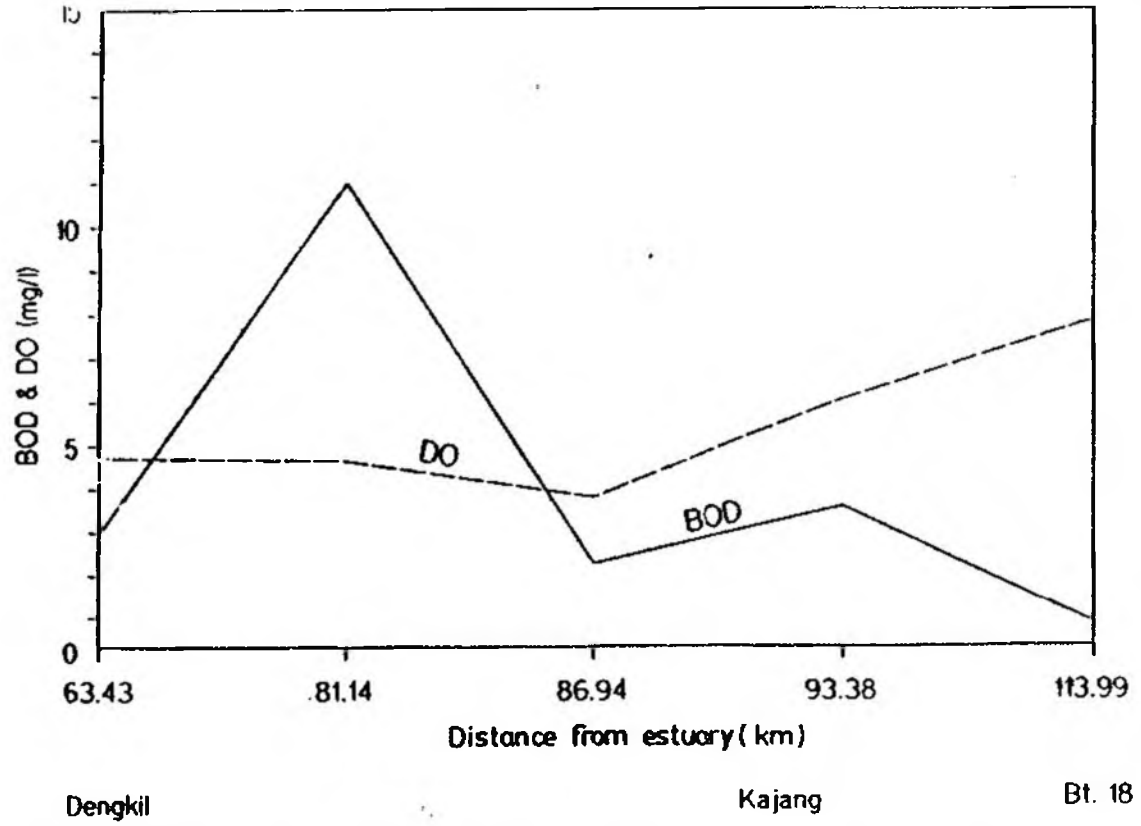

Figure 25: Sungai Langat water quality, 1987 (biochemical oxygen demand [BOD] and dissolved oxygen [DO])

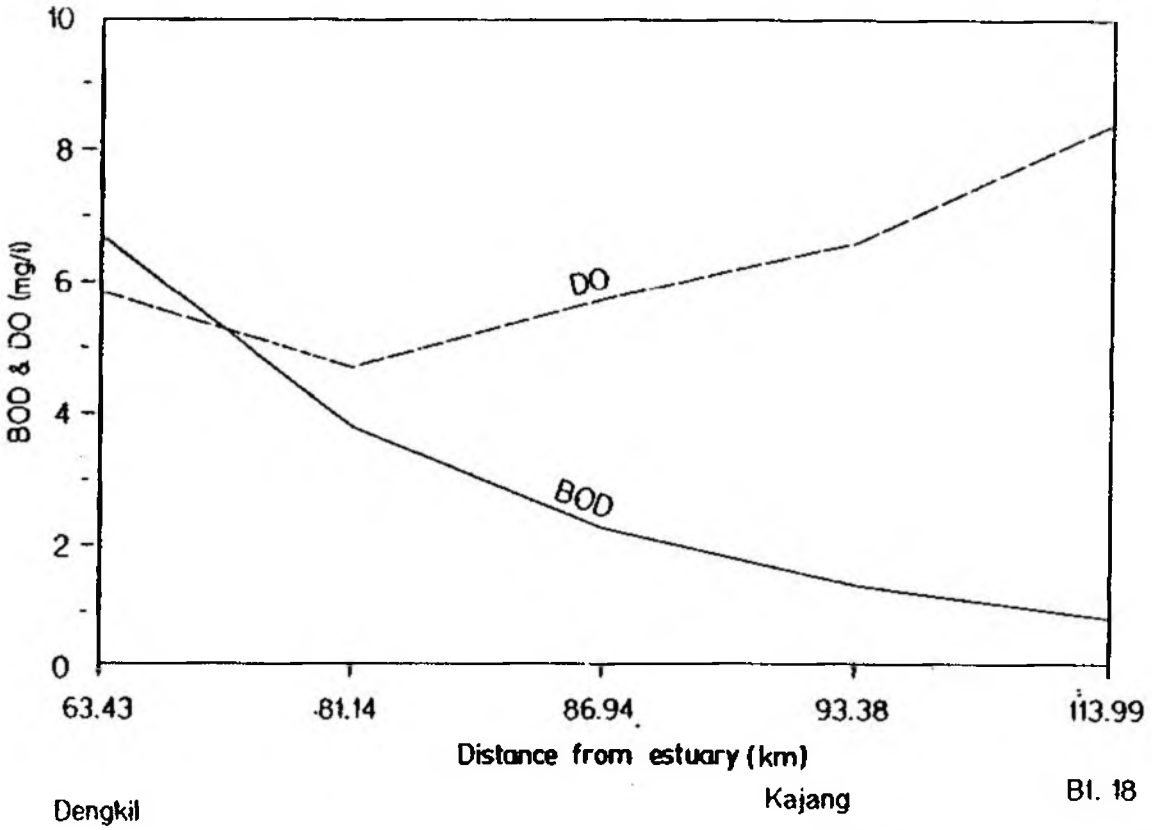

Figure 26: Sungai Langat water quality, 1988 (biochemical oxygen demand [BOD] and dissolved oxygen [DO]

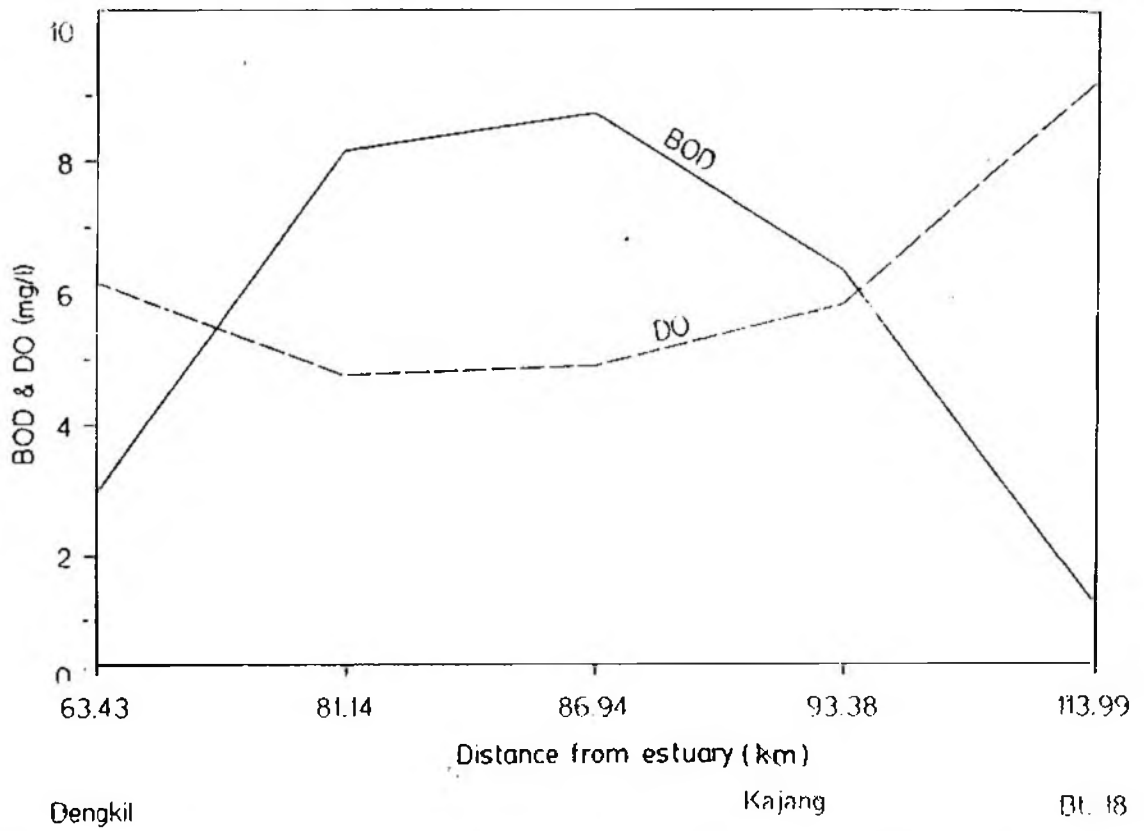

Figure 27: Sungai Langat water quality, 1989 (Biochemical oxygen demand [BOD] and Dissolved oxygen [DO])

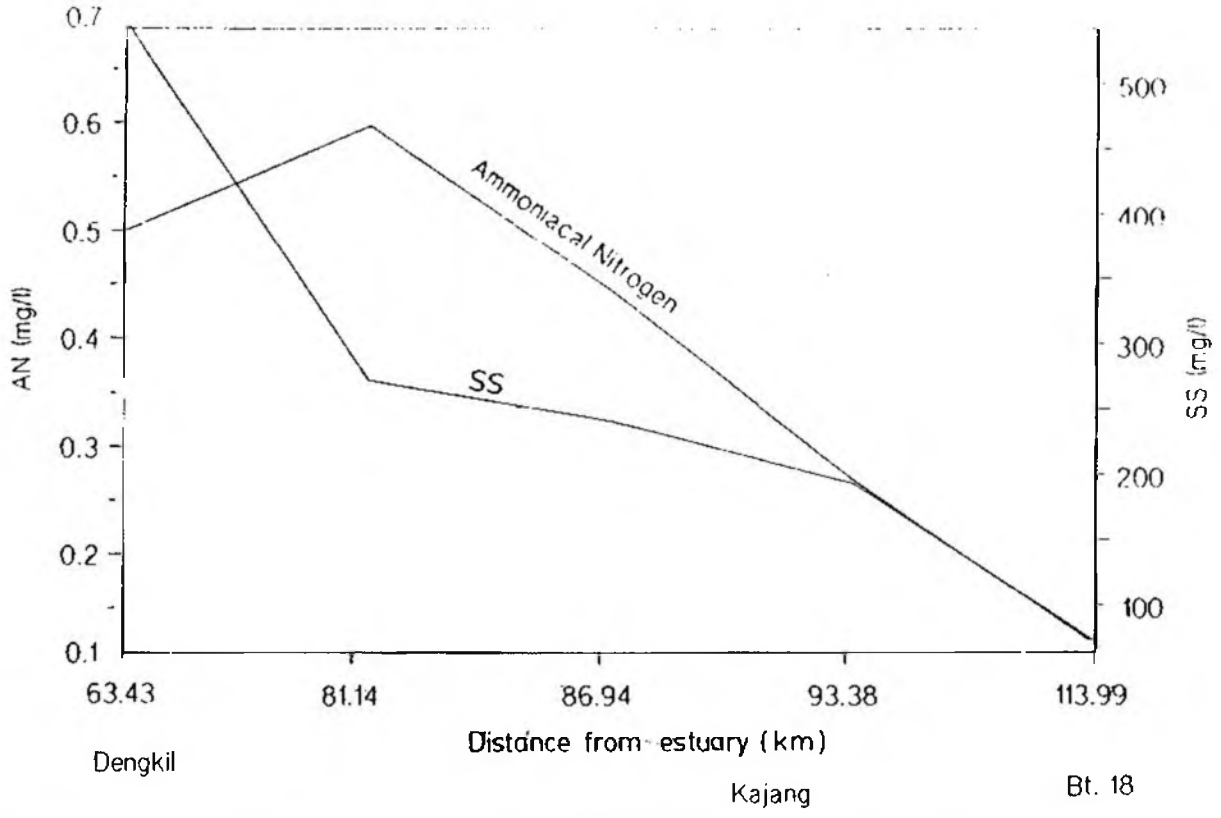

Figure 28: Sungai Langat water quality, 1985 (ammoniacal nitrogen [AN] and suspended solids [SS])

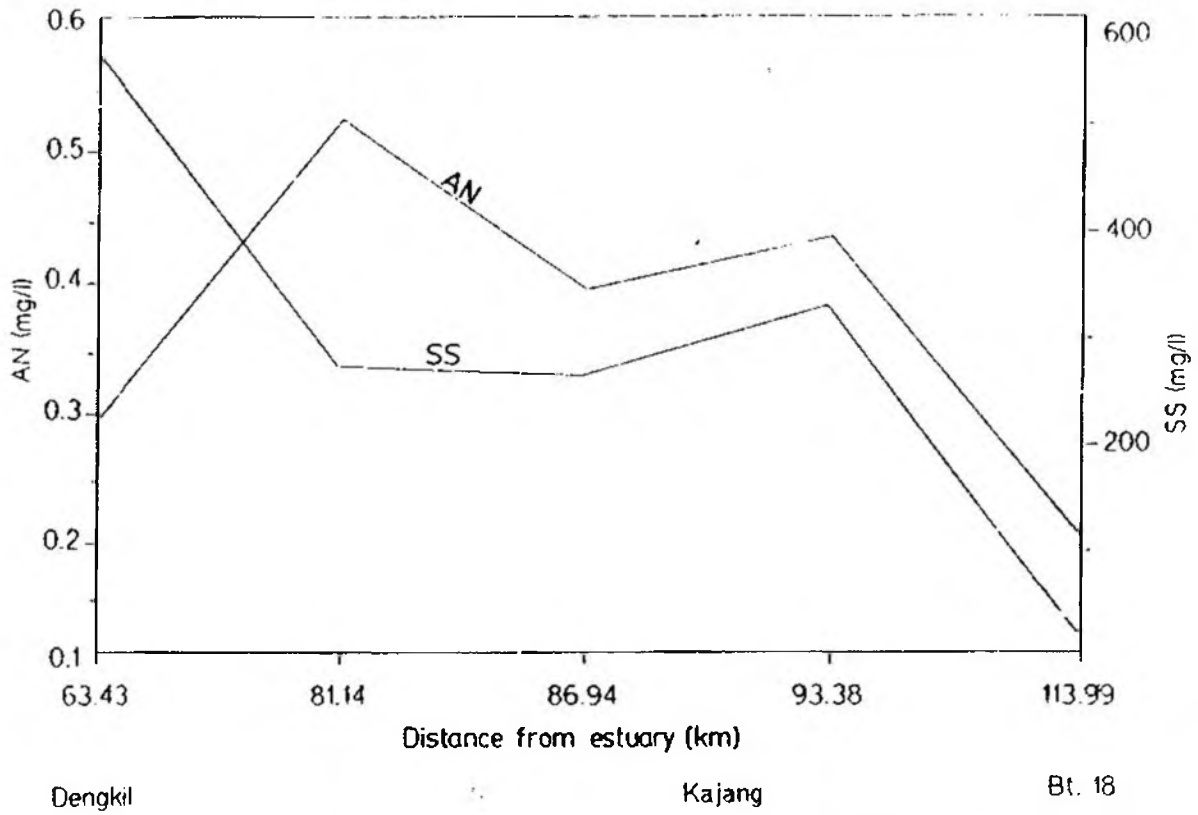

Figure 29: Sungai Langat water quality, 1986 (ammoniacal nitrogen [AN] and suspended solids [SS])

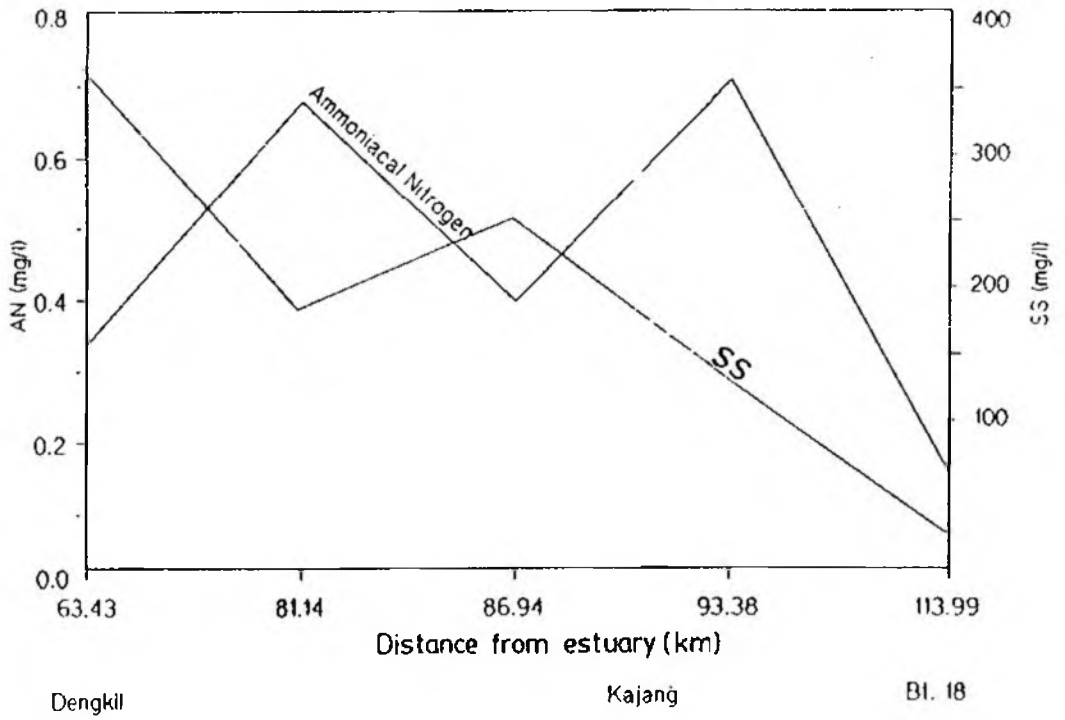

Figure 30: Sungai Langat water quality, 1987 (ammoniacal nitrogen [AN] and suspended solids [SS])

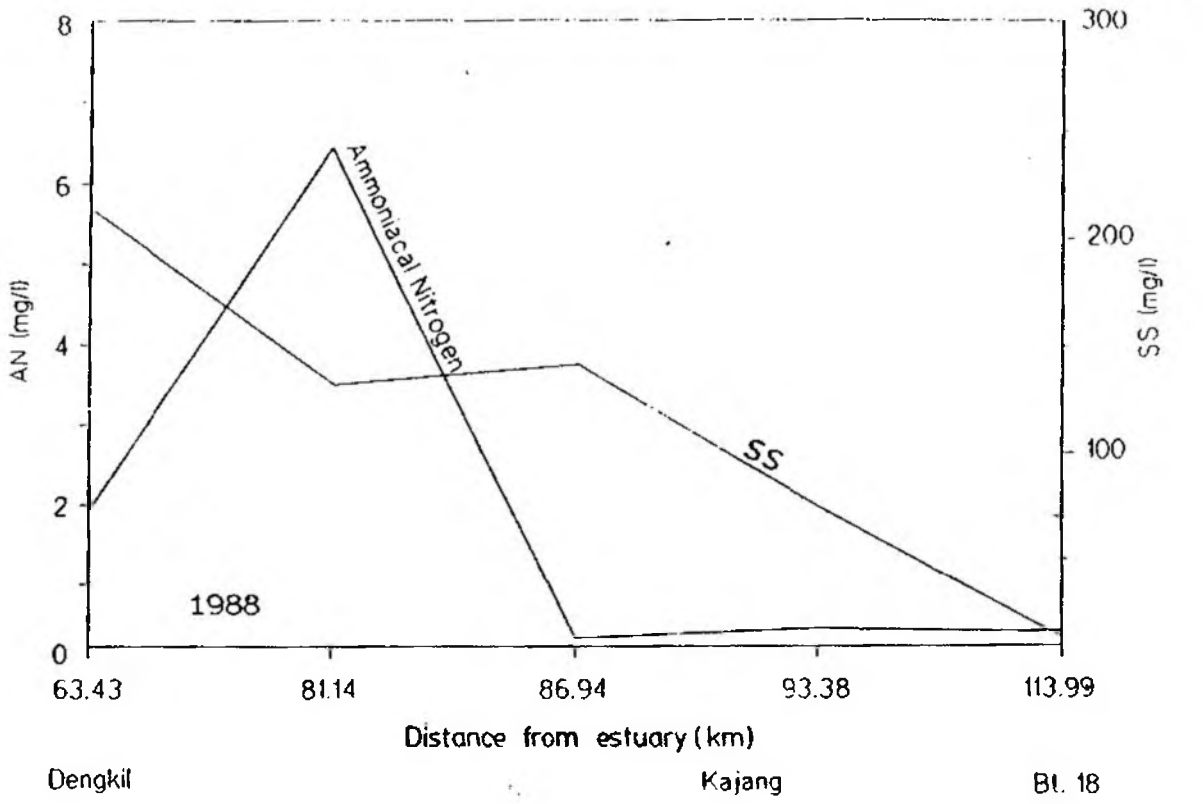

Figure 31: Sungai Langat water quality, 1988 (ammoniacal nitrogen [AN] and suspended solids [SS])

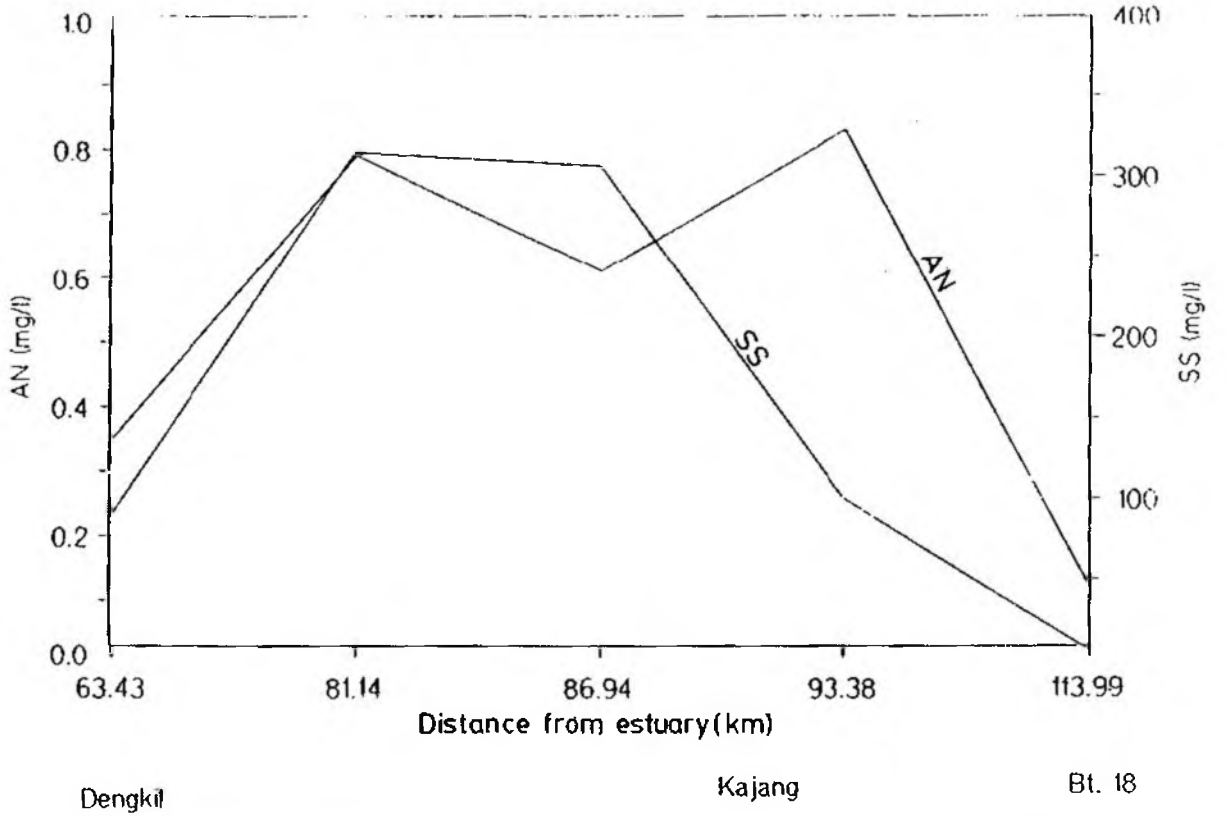

Figure 32: Sungai Langat water quality, 1989 (ammoniacal nitrogen [AN] and suspended solids [SS])

Other Present and Future Polluted Water Catchment Areas

The rivers discussed are some of the problematic watersheds at the present time but there are many rivers that can be categorized as such and there are many potential watersheds that might be added to the list unless some action is taken.

One of the well known problematic rivers is Sungai Linggi in Negeri Sembilan which includes the state capital, Seremban, its suburbs and most of the state's industries in its watershed. The raw water supply at its intake is usually high in the organic content and the finished water noxious but things are improving with the future centralised sewerage system for the city and more advanced water treatment with the incorporation of the ozonation technology.

Sungai Buluh in the state of Selangor is another polluted raw water supply. Housing estates and various developments such as industries and the construction of the Klang-Rawang highway rendered the water quality poor, with tremendously high suspended solids and organic constituents. At the time of the writing of this paper the water intake at Paya Jaras is closed and is to be used only for training purposes.

Future problems related to water supply will be concentrated in the various states with high development potential. Sungai Selangor is a river that may be polluted in the future as the Selangor state government is keen on locating various industries in its watershed. The decision may jeopardize the Sungai Selangor Water Scheme which is not yet in operation.

In Johore state, the unchecked growth of water polluting industries within sensitive water catchment areas will cause problems to this highly industrialized state. The best strategy for any sensitive water catchment it to ensure that only compatible industries are allowed to operate in it.

Table 1 : Results of chemical analysis for effluent receiving waters: Sg. Langat (Battery factory, Kawasan Perindustrian Balakong (Ladang Inch Kenneth) Ulu Langat)

Date		11/11/87	26/11/87	10/2/88	5/4/88	12/5/88
Parameter		(MS)	(JKM)	(JKM)	(MS)	(MS)
pH	5.5*	9.0*	6.0	3.0	7.9	4.3*
Conductivity	3500	-	2600	2450	-	-
BOD_5	3	<5	4	-	9.0	20
COD	19	5	67*	10	14.0	40
Suspended Solids	23	-	5	6	-	-
Total Solids	3060	940	1780	1840	2410	2010
Oil and Grease	-	-	-	12*	-	-
Lead	2.40*	0.21*	0.7*	2.1*	0.16*	2.9*
Zinc	0.34	-	0.1	0.5	-	-
Iron	2.83*	0.11	0.3	6.1*	0.16	0.34
Copper	-	-	0.5	0.1	-	-
Sulphate	-	-	1000	890	-	-
Chloride	-	-	9	15	-	-
Nickel	-	-	-	-	-	-
Tin	-	-	-	-	-	-
Chromium (hexa)	-	-	-	-	-	-

ation of Table 1

: Results of chemical analysis for effluent receiving waters: Sungai Langat (Battery factory, Kawasan Perindustrian Balakong (Ladang Inch Ken
Ulu Langat, Selangor D. E.)

er	12/5/88	14/6/88	27/3/89 (MS)		14/4/89 (MS)			11/5/89			3/11/89		
	4.4*	10.3*	3.0	6.4	7.6	7.1	6.9	2.1*	8.2	8.2	6.4	6.5	7.2
ivity	-	3250	3200	4500	-	-	-	-	-	-	-	-	-
	105*	-	20*	6	15	10	5	-	-	-	<5	5	5
	280*	30	110*	90*	40	20	15	-	-	-	10	20	20
ed Solids	-	6	10	30	65	35	5	-	-	-	-	-	-
lids	1700	1700	1980	2980	-	-	-	-	-	-	1700	2100	2200
Grease	-	-	15.4*	9.6*	-	-	-	-	-	-	-	-	-
	0.01	0.7*	10*	2.1*	5.85*	4.00*	0.75*	1.58*	<0.01	<0.01	0.01	1.92*	1.30*
	-	-	0.3	0.1	-	-	-	-	-	-	-	-	-
	1.0	0.4	1.7*	0.9	2.39*	1.38*	0.39*	-	-	-	0.05	0.08	0.18
	-	-	0.2	-	-	-	-	-	-	-	-	-	-
	-	774	-	-	-	-	-	-	-	-	-	-	-
	-	-	11.0	13.0	-	-	-	-	-	-	-	-	-

5000 gln/day (8 hours) atau 22.727 liter/day
e is about 100 meter from Sg. Langat.
S - Private Laboratory
- Not complying with Standard A

Table 2: Result of chemical analysis for effluent receiving waters: Sungai Langat (Paper Mill, 72 miles off Jalan Sungai Chua, Kajang, Selangor

te rameter	22/9/82	4/5/83	13/3/84	3/5/86	19/8/86	15/9/86	3/2/86	16/5/87	12/12/87	
	6.2	8.5	4.1*	4.0*	4.8	4.1	5.2	6.6	6.4	
nductivity	265	450	-	-	-	-	1680	270	320	
OD	150*	300*	47*	22*	100*	36*	158*	450*	230*	
OD_5	1170*	1180*	117*	64*	288*	288*	1115*	-	345*	
spended Solids	750*	940*	30*	105*	105*	230*	-	200*	210*	
tal Solids	1080	1380	-	-	-	-	-	640	770	
l and Grease	20*	-	-	-	-	-	-	-	3*	
nc	-	-	-	-	-	-	-	-	-	
n	-	-	-	-	-	-	-	-	-	

al : 4,500 cubic meter/day (24/6/87)

es: * - Not complying with Standard A

Table 3: Results of chemical analysis for effluent receiving waters: Sungai Langat (Textile Mill, Sungai. Chua, 43007 Kajang, Selangor D. E.)

Date / Parameter	19/8/86 (MS)	18/8/86 (MS)	16/8/86 (MS)	28/10/86 (MS)	30/10/86 (MS)	22/2/89 (JKM)
pH	12.3*	12.7*	12.1*	12.7*	12.6*	9.2*
Conductivity	-	-	-	-	-	18500
BOD_5	588*	397*	284*	440*	517*	540*
COD	3320*	2135*	1540*	1920*	1680*	2080*
Suspended Solids	148*	120*	-	52*	30	80*
Total Solids	-	-	-	-	-	5860
Total Nitrogen	-	-	-	28*	-	-
Oil and Grease	52*	24*	56*	33*	20*	50*
Phenol	6.2*	2.5*	2.9*	4.0*	5.3*	-

Notes JKM - Chemistry Department, Malaysia
MS - Private Laboratory
* - Not complying with Standard A

Table 4: Results of chemical analysis for effluent receiving waters: Sungai Langat (Rubber Glove Factory, Jln. 34A, Kawasan Perindustrian Balakong, Bt. 9, Cheras, Selangor Darul Ehsan)

Date / Parameter	2/12/86	10/3/87	25/6/87	14/4/87	3/12/87	28/1/88	21/6/88
pH	6.7	6.9	8.1	6.9	6.6	6.9	7.1
Conductivity	550	265	1900	960	430	190	245
BOD_5	13	20	650*	85*	245*	90*	50*
COD	256*	1000*	1500*	350*	600*	165*	120*
Suspended Solids	350*	1450*	550*	175*	1100*	760*	30
Total Solids	5000	1660	2510	750	1620	-	200
Nitrate Nitrogen	0.3	8.1	6.0	4.0	1.8	-	4.9
Ammoniacal Nitrogen	3.9	3.6	43	4.8	3.6	3.4	3.1
Oil and Grease	-	-	-	-	-	-	16*
Nickel	0.05	-	-	-	-	-	-
Manganese	0.12	0.1	-	-	-	-	-
Zinc	-	5.0*	7.8*	4.3*	4.3*	1.5*	1.4*
Iron	-	-	-	-	1.6*	1.1*	0.5
Chromium	-	-	-	-	1.3*	0.2	0.1
Sulphate	-	-	-	-	-	-	4.6

Notes: JKM - Chemistry Department, Malaysia
MS - Private Laboratory
* - Not complying with Standard A

Table 5: Results of chemical analysis of water samples taken during a sanitary survey of Sungai Langat

		Factory			
		Bt. Tampoi Treatment Works	Textile Factory	Papermill	Woolen Textile
Date		10/10/89	11/10/89	11/10/89	11/10/89
Time of sampling (hours)		1045	1030	1150	1440
Parameter	Unit				
Dissolved Oxygen *(in situ)*	mgl^{-1}	5.4	4.2	-	3.0
Temperature *(in situ)*	°C	25.0	40.0	-	35.0
Turbidity *(in situ)*	NTU	150	85	37	62
Conductivity *(in situ)*	µS	26	16500	-	700
Salinity *(in situ)*	ppt	'0	8	-	'0
pH *(in situ)*		6.09	12.66	3.67	7.91
BOD_5 (20 °C)	mgl^{-1}	2.6	-	-	-
COD	mgl^{-1}	21.9	-	79.4	-
Ammoniacal Nitrogen	mgl^{-1}	0.2	-	0.15	-
Nitrate Nitrogen	mgl^{-1}	0.46	-	0.04	-
Phosphate	mgl^{-1}	0.10	-	-	-
Suspended Solids	mgl^{-1}	208	-	33	-
Dissolved Solids	mgl^{-1}	70	-	372	-
Total Solids	mgl^{-1}	278	-	405	-
Oil and Grease	mgl^{-1}	8.5	4.4	6.8	8.9
Phenol	mgl^{-1}	<0.005	0.034	-	<0.005
Detergents (MBAS)	mgl^{-1}	-	-	0.9	-
Cd	mgl^{-1}	0.02	0.01	-	-
Cr	mgl^{-1}	0.01	-	-	-
Fe	mgl^{-1}	2.0	0.7	-	-
Pb	mgl^{-1}	0.01	0.04	-	-
Ni	mgl^{-1}	0.01	-	-	-
Zn	mgl^{-1}	0.35	0.21	-	-

Notes: JKM - Chemistry Department, Malaysia
MS - Private Laboratory
* - Not complying with Standard A

CONCLUSION

The march of our country towards achieving developed nation status in line with the 2020 Vision is inevitable. But to prevent a fiasco similar to that Sungai Melaka, we must prevent unplanned growth within water catchment areas especially with water polluting industries. Otherwise, the whole concept of sustainable development will be a mockery and at the same time the health of the most important resource of our future - our people, will be endangered.

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APPENDIX I

THIRD SCHEDULE
ENVIRONMENTAL QUALITY ACT. 1974,
ENVIRONMENTAL QUALITY (SEWAGE AND INDUSTRIAL EFFLUENT) REGULATIONS, 1979
[(Regulation 8 (1), 8(2), 8(3)]

Parameter limits of effluents of Standard A and D.

Parameter	Unit	Standard A	Standard D
(1)	(2)	(3)	(4)
(i) Temperature	°C	40	40
(ii) pH Value	-	6.0-9.0	5.5-9.0
(iii) BOD_5 at 20°C	mg/l	20	50
(iv) COD	mg/l	50	100
(v) Suspended Solids	mg/l	50	100
(vi) Mercury	mg/l	0.005	0.05
(vii) Cadmium	mg/l	0.01	0.02
(viii) Chromium, Hexavalent	mg/l	0.05	0.05
(ix) Arsenic	mg/l	0.05	0.10
(x) Cyanide	mg/l	0.05	0.10
(xi) Lead	mg/l	0.10	0.5
(xii) Chromium, Trivalent	mg/l	0.20	1.0
(xiii) Copper	mg/l	0.20	1.0
(xiv) Manganese	mg/l	0.20	1.0
(xv) Nickel	mg/l	0.20	1.0
(xvi) Tin	mg/l	0.20	1.0
(xvii) Zinc	mg/l	1.0	1.0
(xviii) Boron	mg/l	1.0	4.0
(xix) Iron (Fe)	mg/l	1.0	5.0
(xx) Phenol	mg/l	0.001	1.0
(xxi) Free Chlorine	mg/l	1.0	2.0
(xxii) Sulphide	mg/l	0.50	0.50
(xxiii) Oil and Grease	mg/l	Not Detectable	10.0

APPENDIX II

WATER QUALITY CLASSIFICATION

CLASS	USES
I	Conservation of natural environment Water supply I - practically no treatment necessary (except by disinfection or boiling only) Fishery I - very sensitive aquatic species
IIA	Water supply II - conventional treatment required Fishery II - sensitive aquatic species
IIB	Recreational use with body contact
III	Water supply III - extensive treatment required Fishery III - common, of economic value, and tolerant species Livestock drinking
IV	Irrigation
V	None of the above

Class I represents water bodies of excellent quality. Standard are set for the conservation of natural environment in its undisturbed states. Water bodies such as those in the national park areas, fountain-heads, and in high-land and uninhabited areas come under this category where strictly no discharge of any kind is permitted. Water bodies in this category meet the most stringent requirements ion human health and aquatic life protection.

Class IIA represents water bodies of good quality, most existing raw water supply sources come under this category. In pratice, no body-contact activity is allowed in these waters for the prevention of transmission of probable human pathogens. There is need to introduce another class for water bodies not used for water supply but of similar quality which may be referred to as for class IIB. The determination of Class IIB standards is based on criteria for recreational use and protection of sensitive aquatic species.

Class III is defined with the primary objective of protecting common and moderately tolerant aquatic species of economic value. Water under this classifiction may be used for water supply with extensive/advanced treatment. This class of water is also defined to suit livestock drinking needs.

Class IV defines water quality required for major agricultural activities which may not cover minor applications to sensitive crops.

Class V represents other waters which do not meet any of the above uses.

APPENDIX III

LIST OF FACTORIES WITHIN SUNGAI LANGAT AND SUNGAI SEMENYIH WATERSHED

FACTORY NAME	ADDRESS
ADVANCED PACKAGING TECHNOLOGY SDN. BHD.	Factory B. Lot 2, Jalan P/24, Kawasan Miel Kawasan Perusahaan Bangi.
BINA MANUFACTURING & CO. BITUMIX SDN. BHD.	Lot 898, MK-Cheras, Jajahan Ulu Langat, c/o Kuari Ind. Sdn. Bhd., Batu 19, Jalan Semenyih, Kajang.
BONCEY HIN DEV. SDN BHD.	Lot 1046, Mukim Cheras, Ulu Langat
BUKHARY (KL) SDN. BHD.	Kawasan Perusahaan II, Bandar Baru, Bangi.
C.H. (MALAYSIA) SDN. BHD CARRIER INTERNATIONAL SDN. BHD.	Batu 16 1/4, Jalan Reko, Kajang. Bandar Baru bangi.
CHEN HIN YAP PLYWOOD SDN. BHD.	Batu 8, Jln. Cheras, Kajang.
CHEN SEONG CHIN CONCRETE WORKS.	143, Jalan Reko, Kajang.
CHEONG THONG (M) SDN. BHD. TETUAN.	Lot 6, Jalan P/5B, Bandar Baru Bangi.
CHERAS IND. SDN. BHD.	Batu 10 1/2, Jln. Cheras, Kajang.
CHIN HUAT FURNITURE MFGS SDN. BHD. TETUAN	Lot 2633, MK-Cheras, Daerah Ulu Langat
CORRUGATED PRODUCTS SDN. BHD.	P.T. 4843, Bt. 11, Jalan Balakong, Cheras.
DECOR WOOD IND. SDN. BHD.	Batu 16 1/4, Jalan Reko, Kajang.
DUA SAMA SDN. BHD. TETUAN SYARIKAT	Lot 25, Jalan 3A, Kawasan Perusahaan Balakong, Ulu Langat.
DUPLEX TYPE LIGHT INDS.	Lot 1-8, Balakong, Cheras, Ulu Langat
ELECTRICAL AND ALLIED INDUSTRIES BHD.	Bandar Baru Bangi, Kajang.
GENERAL CONCRETE SDN. BHD.	Kawasan Perusahaan Bandar Baru Bangi.
FARIMAN ENT. SDN. BHD.	Kawasan Perusahaan Bandar Baru Bangi.
HAVY'S, KILANG KELAPA SAWIT.	Sydney Estate, Semenyih.
HIGH PLAINS ENTERPRISE SDN. BHD.	Lot 2259, Batu 11 1/2, Jalan Cheras, Kajang
HITACHI CONSUMER SDN. BHD.	Lot 4, Perindustrian Estate Bangi
HONG LEE IRON WORKS	No. 8, Jln. Bunga Tanjung 9, Taman Muda, Cheras, Kuala Lumpur.
HUME BALKEN (M) SDN. BHD.	Plot 709, Kawasan Perindustrian Beranang Estate, Kajang.
HUME FORSEDA (M) SDN.	Lot 4-9, Kawasan Perusahaan Beranang
HUME INDS. (M'SIA) BHD.	Kawasan Perindustrian Beranang Estate, Kajang.
HUME ROOFING TILES SDN. BHD.	Kawasan Perindustrian SDN. Beranang.
JATIMUR SDN. BHD.	Lot P.T. 207, MK-Cheras, Ulu Langat.
KAJANG KUARI SDN. BHD.	Kajang.
KAJANG PAPER MILL.	Sungai Chua, Kajang.
KAR POH KNITTING FAC. BHD.	Lot 23, Jalan 34, Kawasan SDN. Perindustrian Balakong, 43100 Ulu Langat.
KILANG KELULI	Kawasan Perumahan 176, batu 12, Jalan Cheras, Kajang.
KILANG MATA DAWAI	Lot 1007 & 128, Bandar Baru Bangi.
KIM GUAN HUAT SAWMILLS SDN. BHD.	Sungai Lalang, Semenyih.
KIMIA INDUSTRIES SDN. BHD.	Sungai Chua, Kajang.
KINN'S CREAMERIES SDN. BHD.	Lot 11, Kawasan Perusahaan Balakong, Kajang
KONBINA IND. SDN. BHD.	Lot 1007 & 128, Bandar Baru Bangi, Bangi.
KONG PENG RUBBER IND. SDN. BHD.	Lot Tapak No. 30, Jalan 1, Kawasan Perindustrian Balakong, Kajang.
KUARI, SYKT. MEMECAH.	Batu 18, Jalan Semenyih, Kajang

KWANG FOI ONN SAWMILL SDN. BHD.	No. 2, Jalan Sungai Chua, Kajang
LADANG SUNGAI RINCHING	Semenyih
LEASCO MALAYSIA SDN. BHD./NARISAN ALAM SB.	Lot 2297, Geran 6079, Kajang
LEE CHIN CHENG, KILANG SAWIT.	Batu 2, Jalan Dengkil/Kajang
LEE YEN KEE SMR FACTORY	874, Jln. Won Siow, Sg. Chua, Kajang
LIAN ANN TRADING, SYKT.	340, Batu 16, Jalan Reko, Kajang
LIAN NGOI INDUSTRIES SDN. BHD.	Lot 4, Jalan Satu, Kawasan Perindustrian Balakong, Ulu Langat.
LON TAI CHEMICAL IND. CO. (M) SDN. BHD.	Lot 3, Lorong P/1B, Kawasan Perindustrian Bangi.
MALAYSIA TOPMAKING MILLS SDN. BHD.	Batu 23, Jalan Kachan, 43500 Semenyih.
M.T. AGRO INDS. ENG. SDN. BHD.	Kawasan Perusahaan, Bandar Baru Bangi.
MALAYA PINE SDN. BHD.	Bangi
MALAYSIAN INDS. EST. SDN. BHD. TETUAN	Kawasan Miel, Bangi Fasa II Bangi
MARDEC ULU LANGAT	Batu 12, Ulu Langat.
MATSUSHITA ELECTRIC CO. SDN. BHD.	Jalan P1, P2 & P2A, Bangi (M) Industrial Estate.
MEAT MANUFACTURES SDN. BHD.	Kawasan Perindustrian Estate, Miel, Bangi.
NEW ENGINEERING SDN. BHD.	Lot 37, Jalan 3A, Kawasan Perusahaan, Balakong, 43100 Ulu Langat.
OTHMAN & AMAT B. HASSAN PLASTICTERIC (M) SDN. BHD. PRANG BESAR ESTATE	6776, Lot 4337, MK-Dengkil Kawasan Perindustrian Bangi Batu 10 1/2, Jalan Dengkil-Kajang, Kajang.
QUARRY IND. SDN. BHD.	Batu 19, Jalan Semenyih, Kajang.
READY MIXED CONCRETE MALAYSIA SDN. BHD.	Universiti Kebangsaan Malaysia, Bangi, Kajang.
RENOWA INDUSTRIES (M) SDN. BHD.	Lot 23, Jalan 3A, Kawasan Perusahaan Balakong, Ulu Langat.
RISDA, BAHAGIAN TANAM SEMULA.	Makmal Kecerakinan Tanah & Dedaun, Bangi
RUMPUN HIJAU SDN. BHD. SYARIKAT	Kawasan Perindustrian Pertama, Jalan P/1A, Bandar Baru Bangi.
SELANGOR COTTON TOWELS MFGS SDN. BHD.	Batu 11, Cheras, Jalan Balakong, 43200 Kajang.
SELANGOR GRANITE KUARI BHD.	Batu 10 1/2, Jalan Cheras, SDN. Kajang.
SIN CHUAN AIK SDN. BHD.	Batu 8, Jalan Cheras.
SIONG HOE KILANG PAPAN.	Batu 10 1/2, Jalan Cheras, Kajang.
SOUTH EAST ASIA IND. SDN. BHD.	Lot 33, Jalan 3A, Balakong, Ulu Langat.
SRI JOHANI SDN. BHD.	Lot P.T. 7178 (Balakong New Village), 57000 MK-Cheras.
SRI KAJANG ROCK PDTS (M) SDN. BHD	Batu 20, Bangi Industrial Estate, Bangi, Kajang.
STEEL SERVICE CENTRE (M) SDN. BHD.	Lot 20, Bangi Industrial Estate, Bangi, Kajang.
SUM WOH SAWMILL.	No. 6, Jalan Reko, Kajang.
TAI KWONG BATTERY INDS. SDN. BHD.	Lot 7, Jalan 1, Kawasan Perusahaan Balakong, Cheras.
TAITAT KNITTING FACTORY SDN. BHD	Lot 11A, Jalan 3A, Balakong 43200 Ulu Langat.
TOSHIBA (M) BHD.	Bandar Baru Bangi
TUNA JAYA SDN. BHD.	Jalan P/U, Kawasan Perusahaan Peringkat , Bandar Bangi.
UNITED CONCRETE WORKS CONSTRUCTION CO.	Batu 12, Jalan Cheras, Kajang.
WATTA BATTERY INDUSTRIES SDN. BHD.	Lot 6, Jalan 1, Kawasan Perusahaan Balakong, 43000 Kajang.
WATTA BATTERY INDUSTRIES SDN. BHD.	Lot 4, Jalan Quarry, Kampong Cheras Baru, Off Jalan Cheras.
WEST COUNTRY ESTATE SDN. BHD.	Kajang
YAM TENGKU BADLI SHAH	MK-Jugra, Ulu Langat
YAP OH & SONS SDN. BHD.	63 Batu 14, Jalan Cheras, Kajang.
YU EE TEXTILE INDUSTRIES SDN. BHD.	Batu 11, Jalan Cheras, 43000 Kajang.