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Analysis of recent marine pollution problems and effects arising from sea transport activities in Jakarta Bay

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ANALYSIS OF RECENT MARINE POLLUTION PROBLEMS AND EFFECTS ARISING FROM SEA TRANSPORT ACTIVITIES IN JAKARTA BAY

By

NAHDUDDIN
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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation: **Analysis of Recent Marine Pollution Problems and Effects Arising from Sea Transport Activities in Jakarta Bay**

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This dissertation, a study of the *"Analysis of Recent Marine Pollution Problems and Effects Arising from Sea Transport Activities in Jakarta Bay"*, was prepared for the Research and Development Agency under the Indonesian Ministry of Communications. The results of the study are applicable to other areas of Indonesian territorial waters, as the problems related to sea transportation seem to be of a similar nature in most areas.

Marine pollution problems and effects are only one of the environmental problems that the world faces today. However, it has a far and wide-reaching impact on the globe and its population, thus making it one of the most important subjects in global environmental issues around the world. Although marine pollution problems come from various sources, those which come from sea transportation are given more public attention because of their potential threat to the marine environment.

Many of the international regulations relating to marine pollution prevention are the outcome of marine accident problems which have caused extensive oil spills. Legislation has been concerned with new designs, structure and equipment. But, it cannot be fully effective until the human element is committed to safety and possesses a high respect for the environment.

This study endeavers to provide an understanding of the current condition of Jakarta Bay, polluted by human activities, especially sea transport activities. In this connection, the study also endeavers to provide a framework for incorporating an environmental protection policy in the Indonesian sea transportation system to raise the awareness of Indonesian sea transport operators.

The approach discussed in this study is the integration of pollution prevention and environment protection through the identification of the present problems and scope of marine pollution from sea transport activities, and analysis of the impact created by sea transport on the marine environment of Jakarta Bay. Other important effective tools to protect our environment are also examined. These include setting up environmental impact and risk assessment of sea transport activities, analysis of sources and effects of marine environment pollution from sea transport activities, scientific guidance on pollution issues attributable to sea transport activities, and the application of international, regional and national legal instruments or regulations.

The concluding chapters offer measures to improve existing environment conditions of Jakarta Bay, and discuss the potential use of legal instruments and regulations, international, regional and national, to integrate marine pollution prevention and environmental protection in Indonesian territorial waters. The interplay between international or regional environmental policy and national action is emphasised to achieve an effective sustainable development program in the maritime sector.

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LIST OF ABBREVIATION

ANDAL	Analysis Dampak Lingkungan *(Environmental Impacts Analysis)*
ATBA	Areas to be Avoided
BCH	Bulk Chemical Hazardous
BOD	Biological Oxygen Demand
Ca	Calcium
CO	Carbon monoxide
CO_2	Carbon dioxide
CFCs	Chlorofluoro carbons
CLC	Civil Liability Convention *(The International Convention on Civil Liability for Oil Pollution Damage)*
COD	Chemical Oxygen Demand
COLREGS	The Convention on the International Regulation for Preventing Collision at Sea
Cu	Copper
DGSC	Directorate General of Sea Communications
DKI	Daerah Khusus Ibukota *(The Regional Government of Jakarta)*
DWT	Dead Weigh Tonnage
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
GEF	Global Environment Facilities
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
GRT	Gross Tonnage

HCFC's	Hidro-chlorofluoro Carbons
HNO_3	Nitrite acid
IBC	International Bulk Chemical Code
IMDG Code	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
ITOPF	International Tanker Owners Pollution Federation
KL	Kilo Litre
KPPL - DKI	Kantor Pengkajian Perkotaan dan Lingkungan Daerah Khusus Ibukota Jakarta *(The Research and Development Urban Environment Agency of Jakarta)*
LIPI	Lembaga Ilmu Pengetahuan Indonesia *(The Indonesian Scientific Institution)*
MARPOL	The International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
MEPC	Marine Environment Protection Committee
MFO	Marine Fuel Oil
MOC	Ministry of Communications
MOE	Ministry of Environment
MPP-EAS	Marine Pollution Programme East Asian Seas
Na	Natrium
NAS	The National Academy of Sciences
NH_4	Ammonia
Ni	Nickel
NMPAs	National Marine Protected Areas

NO	Nitrogen Monoxide
NO_2	Nitrogen Dioxide
NO_4	Nitrate
NOx	Nitrogen Oxides *(the label of both NO and NO_2 compounds)*
O_2	Oxygen
O_3	Ozone
OPRC	The International Convention on Oil Pollution Preparedness Response and Co-operation
PAME	Protection of the Arctic Marine Environment
Pb	Lead
PDMO	Programme Development and Management Office
PERTAMINA	Perusahaan Pertambangan Minyak dan Gas Bumi Negara *(The Indonesian Oil Company)*
PO_4	Phosphate
ppm	part per million
PPSML-UI	Pusat Penelitian Sumber Daya Manusia dan Lingkungan - Universitas Indonesia *(Centre Research of Human Resources and Environment of Indonesia Univesrsity)*
PSSA	Particularly Sensitive Sea Area
REPELITA	Rencana Pembangunan Lima Tahun *(Five Years Development Plans)*
SA	Special Area
SO_2	Sulphur dioxide
SO_3	Sulphur trioxide
SO_4	Sulphate

SOLAS	The International Convention for the Safety of Life at Sea
SOx	Sulphur Oxides *(the label for both SO_2 and SO_3 compounds)*
STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TBT	Trybutil tin
TEU's	Twenty Meters Cubic Equivalent Units
UN	United Nations
UNCLOS	The United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VLCC	Very Large Crude Carrier
VOC's	Volatile Organic Compounds
VTSS	Vessel Traffic Service System
WHO	World Health Organization
WMU	World Maritime University
Zn	Zinc

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CHAPTER 1

INTRODUCTION

1.1. Background of Study

The growing attention of the public with regard to existing global environmental problems has led to the development of the global agenda which is called Agenda 21. It was developed by the United Nations (UN) Conference on Environment and Development. The purposes of it are to achieve sustainable development in the year 2000 and beyond. Sustainable development means *"a development that ensures that the needs of the present population are met without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).*

Marine pollution is just one of those environmental problems that the world faces today. However, it has far and wide-reaching impact on the earth and its population, thus making it one of the most important of global environment issues.

Indonesia, which has a unique geography, is situated in Southeast Asia, the world's largest archipelago state, with more than 17,000 islands and 81,000 km of coastline, and a rapidly growing economy. The country's annual real economic growth was 7,4% in the 1990s (Ocean and Coastal Management p. 63) and 7,6% until the middle of 1997 before the Indonesian economic crisis. This growth places substantial pressure upon its sources to support local subsistence activities and to provide sustained economic growth. The Indonesian government has acknowledged the need for a balance between growth and sustained use of natural resources based on a 25-year, long-term plan which commenced in 1969, and ended in 1994. This has formed the basis for medium-term, Five Year Development Plans (REPELITA). In the final REPELITA (V), which ended in 1994, Indonesia has recognised the role which National Marine Protected Areas (NMPAs) can play in the management of marine resources, and has set a target of 10 million hectare of twenty-four (24) NMPAs, as shown in the Map 1 attached. One of them is the NMPA of Kepulauan Seribu (Thousand Archipelago), DKI, Jakarta which is located in the Jakarta Bay area where this study is concentrated.

The public concern is that Jakarta Bay is really under pressure with the burden of the mega-city of Jakarta which had a population more than 12 million in 1998. Several human activities contribute to the pollution in the Jakarta Bay area. There are nine river mouth and several channels entering the Jakarta Bay area which carry water with many kinds of wastes and substances, such as industrial, domestic, and agriculture waste from the approximately 9,000 square km of mainland of West Java Province surrounding the mega-city of Jakarta.

It is known that for the East Asia region, as in other regions of the world, most contaminants of the marine environment originate from land-based activities. With nearly 60% of the region's population living within 60 km of a coastline, there is little doubt that human activities will continue to have a major impact on coastal waters of Jakarta Bay and the resources therein. However, it is also recognised that, with the ever-increasing volume of shipping traffic into and within the region, sea-based pollution is also a source of concern, especially along heavily congested shipping routes. Oil and chemical spills from ships are easily visible and attract wide media coverage and public attention. Furthermore, shipping accidents are perceived by the general public to pose an immediate and serious threat to the livelihoods and welfare of coastal populations like Jakarta, in as much as the effects of resulting spills cannot be precisely predicted or controlled.

We know that the pollution of the sea comes from various sources. Oil enters the marine environment by a number of different routes as a result of both human activities and natural processes, but sea transportation activities is given more attention because of its potential threat to the marine environment from the safety aspect. Sea transport operates in a dynamic environment as an increase in the volume of trade, advancement in technologies and the world-wide economic competition and pressures have created enormous complexities in the shipping business. Approximately 13,000 vessels visit the port of Tanjung Priok in Jakarta Bay annually. Cargo throughput totals approximately 20,000,000 tons/year and containers amount to approximately 1,200,000 TEU's.

The heavy traffic of ships coming to and going from Tanjung Priok Port can make Jakarta Bay's marine environment vulnerable to the threat of pollution from sea transport activities. As a consequence, the pollution problem can rise more than ever before. It is evident there is a need to prevent damage to the environment from sea transport activities which is felt much greater today than it was ever in the past. Prevention is clearly the most logical method of reducing marine pollution problems in the Jakarta Bay area. Therefore, marine environmental protection from sea transport is regarded as one of the major objectives of the Ministry of Communications (MOC) of Indonesia through the Directorate General of Sea Communications (DGSC).

1.2. Objective of Study

In view of the above facts, and recognising the role of Indonesia as an archipelagic country where sea transportation plays an important role for its national economy, it is felt that marine environmental protection from sea transport would greatly contribute to the global call for marine pollution prevention resulting from ship-generated wastes and other shipping activities where they are directly involved. Thus, the present work is aimed to provide a framework for environmental analysis of the Jakarta Bay area as representative of Indonesian territorial waters. Hopefully the results of this study are also applicable for the whole of the Indonesian territorial waters. The three objectives of the study are:

1. to identify the present environmental profile, problems and scope of marine pollution from sea transport activities in the Jakarta Bay area with a view to achieving sustainable development;

2. to identify the present sea transport activities and analyse how they have impacted the marine environment of Jakarta Bay as an indication of the effectiveness of the total coastal environmental management program in Indonesia;

3. to analyse the available major international legal instruments as a means for reduction of marine pollution from sea transport activities in Indonesia, and an assessment of their effect on Indonesian environment policy.

1.3. Geographic Definition of Study

The project is geographically limited to the Jakarta Bay area. Furthermore, the study results from the Kantor Pengkajian Perkotaan dan Lingkungan (KPPL) DKI - Jakarta (Research and Development of Urban Environment Office of Jakarta), Lembaga Ilmu Pengetahuan Indonesia (LIPI) (the Indonesian Scientific Institution), the Indonesian Ministry of Environment (MOE) and the Indonesian Ministry of Communications (MOC) which are dealing with marine environmental matters and were included in the study. Results from coast monitoring programmes and the like from other areas are dealt with, to some extent, in the report.

1.4. Methodology of Study

The data used in the study are primarily based on secondary data from previous studies which include recently published periodicals and surveys conducted by maritime-related organisations combined with the lectures given at the World Maritime University (WMU) of Malmö, Sweden. During the study's process contact has been made by the author with several relevant organisations in Jakarta such as the Directorate General of Sea Communications (DGSC), Research and Development Agency of the MOC, Indonesian Oceanography Agency (LIPI), and the Indonesia Oil Company (PERTAMINA). Interviews with knowledgeable persons (experts) on the subject matter, both in Jakarta and the visiting professors of WMU, were also conducted to elicit the important points to be included in the study.

Unpublished reports of concerned government agencies in Indonesia were also utilised to describe the recent condition of marine environment protection issues of the country.

1.5. Scope and LImitation of the Study

The discussion of the study is mostly focused on the analysis of marine pollution, particularly of the Jakarta Bay area, which is generated by sea transport activities only. However, it is assumed that environmental protection should be mandatory for all Indonesian water territories.

The study is arranged in six chapters. The importance of preserving the marine environment of the Jakarta Bay area through identification of the current environment condition and Indonesia's needs of it are discussed in the ***first chapter*** which is supported by an overview of Agenda 21, in particular the concept of sustainable development.

Chapter two examines the present general environmental profile of the Jakarta Bay area through the identification of the uses of it and investigates the physical, chemical and biological parameters as an indicator of the state of the environment in Jakarta Bay.

Chapter three examines the current condition of sea transport activities, examines the environmental impacts, and provides a risk assessment of these activities;

Chapter four presents the analysis of sources and effects of marine environment pollution from sea transport activities. It includes a comprehensive review of statistical information of oil spills and major accidental oil pollution and the scientific guidance on pollution issues attributable to the sea transport activities.

To address the Indonesian marine environmental protection needs and to make the prevention of marine pollution from sea transport activities more effective in general and in particular in Jakarta Bay, approaches and strategies are provided in ***chapter***

five. The approaches and strategies identified in this study consist of international, regional, and national legal instruments and regulations.

The study ends with the conclusions and recommendations presented in ***chapter six***, directed to the policymakers and administrators, particularly those in the Ministry of Communications of the Republic of Indonesia (MOC) as an institution which is responsible and regulates sea transport activities in the country. The importance of marine environmental protection as a path to achieve sustainable development should become Indonesia's priority.

CHAPTER 2

CURRENT GENERAL DESCRIPTION OF THE JAKARTA BAY ENVIRONMENT

2.1. The Natural Profile of Jakarta Bay

Jakarta Bay is situated on the north coast of Java at 06°06′ S - 106°52′E. It is shallow water with a depth of not more than 50 metres. On average, the depth is about 15 metres. The bay's mouth is about 34 kilometres wide; in the east direction bordered by Tanjung Karawang (West of Java) and in the west bordered by Tanjung Pasir (West of Java). The total area of the Jakarta Bay is approximately 514 square km with a coast-line of about 80 km in length (map 2, attached).

There are nine main rivers and several channels entering into or discharging their water into Jakarta Bay. The rivers are Angke, Bekasi, Cisadane, Citarum, Cikarang, Cakung, Ciliwung, Krukut and Sunter.

The use of Jakarta Bay can be categorised into two groups which are the use of the bay and islands and the use by the interior of Jakarta.

2.1.1. The Use of the Bay and Islands

In the middle of the Jakarta Bay area, there is an archipelago (group of islands) called "Kepulauan Seribu (Thousands Archipelago)" which consists of tens small islands. It is about 80 km north of Jakarta city centre. This area has been appointed by the Regional Government of Jakarta (Pemerintah DKI-Jakarta) as a Marine National Park called a National Marine Protected Area (NMPA).

There are several human activities in this area using the bay and islands, such as: marine national park (in Belanda island); marine nature preserve (in Rambut island); culture preserve and mariculture (in Kapal or Onrust island); settlement or housing (in Untung Java island); hotels (in Bidadari island); coral exploitation (in Ubi Besar island); tourism area (in Air Besar island); sports (in Sampur island); sea navigation (in Damar Besar island); air navigation (in Nyamuk Kecil island); fishpond area (in Lancang Besar island); and fishery.

2.1.2. The Use by the Interior of Jakarta

The use of the coastline of Jakarta Bay is also varied, with fishponds, mangroves conservation area, agriculture area, settlements or housing (particularly luxury housing such as the Pluit estate, Ancol and Pantai Indah Kapuk), industrial estate, recreational area, generation of electricity (water power plant), ports, airport (the international airport called Soekarno-Hatta), roads and other activities. In this project the author concentrates on the land use of Jakarta Bay related to the sea transport activities, which is of course, land use for ports.

There are several ports along the coastline of Jakarta Bay namely Tanjung Priok (the main port of Indonesia as an international port), Port of Sunda Kelapa, Port of PERTAMINA (special port of Indonesian oil company), Port of MARINA Ancol (special port for tourism), shipyard (PT. Koja Bahari), Port of Muara Angke (special port for fishery) and several other small fishing ports.

2.2. The Present Environmental Profile of Jakarta Bay

One of the objectives of the study is to identify the present problem and scope of marine pollution from sea transport activities in order to achieve sustainable development. The investigation of previous research has resulted in an environmental profile of the bay, which identifies:

- the various sources of pollution, both land-based and sea-based;
- the living and non-living resources of the bay;
- the state of the marine environment, including some of the measurable indicators of marine pollution and the effects on living and non-living resources.

The environmental profile identifies the bay as a unique tropical environment, as well as one of the busy sea routes for international navigation in Indonesia. In this connection, the investigation of its environmental profile deals with physical, chemical and biological factors.

2.2.1. Water Quality Investigation

1. Location of Monitoring

The monitoring of Jakarta Bay's water quality is done within the water body of the Jakarta Bay area and in the mouth of nine rivers which discharge their water into bay. The monitoring point of Jakarta Bay is: west point Tanjung Kait; east point Ujung Karawang. By position:

05°59'40" S and 05°56'15"S
106°42'30"E 106°58'30"E.

The south point is the coastline of Ancol and the north point is Pulau Damar Besar (Damar Besar Island). By position:

06°06'00" S and 05°30'10"S
106°50'00"E 106°48'30"E.

These monitoring points are divided into four zones, as follows:

Zone 1, water area 5 km from the coastline: D1 - D4
Zone 2, water area 5 - 10 km from the coastline: C1 - C5
Zone 3, water area 10 - 15 km from the coastline: B1 - B7
Zone 4, water area 15 - 20 km from the coastline: A1 - A7
(Shown in the map 3 attached)

To get a clear picture and understand the influences of the 8 (eight) rivers which discharge their water into Jakarta Bay, monitoring water quality is also done in each river mouth (muara) as follows:

M1 = Muara Kamal
M2 = Muara Kali Angke
M3 = Muara Karang
M4 = Muara Kali Ancol
M5 = Muara Sunter

M6 = Muara Kali Cakung

M7 = Muara Kali Blencong

M8 = Muara Kali Bekasi.

(Map 3 of the monitoring location is attached)

2. Time of Monitoring:

Indonesia has four seasons, so the monitoring of water quality is done 4 (four) times a year in the following periods.

Monitoring 1: in January, representative of the rainy season/west monsoon.

Monitoring 2: in March, representative of the transition season from west monsoon to east-monsoon.

Monitoring 3: in September, representative of the transition season from east-monsoon to west-monsoon.

Monitoring 4: in December, representative of the rainy season or west-monsoon again.

2.2.2. Investigation of Physical Factors

The vertical gradients establish distinctive environmental parameters, e.g., temperature, light (turbidity), and pressure at a range of depths.

1. Temperature

Temperature plays an important role in the marine environment related to the life of marine organisms. Globally open sea surface temperatures vary with latitude and fluctuate seasonally with a salinity of 35U (Berman, 1997).

The temperature of the surface waters of Jakarta Bay in the east monsoon (December - February) is around 28,50 - 30,0°C; in the transition from west to east monsoon (September - November) around 29,50 - 30,70°C; and in the west monsoon (May - September) the temperature decreases to around 29,20 - 30,00°C.

The temperature at the bottom of Jakarta Bay is a little bit lower than on the surface which, during the west monsoon is around 28,00 - 28,70°C; and around 28,50 -

30,00°C during the east monsoon. This is caused by rain and wind effects. According to the Ilahude (1995) the highest temperature is located nearest the coast-line; that means that Jakarta Bay's temperature is influenced by the mainland.

2. Salinity

Salinity means the amount of sea salt per unit mass of sea water. The major constituents of salinity are cations ($^+$ charge): Na^+, K^+, Ca^{2+}, Mg^{2+} and Sr^{2+} and Anions (- charge): Cl^-, $SO_4{}^{2-}$, Br^-, and F^- (Preston, 1997).

The salinity of the Java Sea is around 31,50 - 34,00U with the highest salinity occurring in October (in the transition from dry to rainy season). The lowest salinity occurs in February (at the end of the rainy season). The annual average of salinity of Jakarta Bay is lower than that in the Java Sea. This is because of influences of discharge from rivers and channel water. The extreme salinity condition in Jakarta Bay occurs in January, when it can decrease up to 16,00U.

3. Turbidity

Turbidity measures the amount of sunlight arriving at the sea surface and penetrating into the water depth, which depends partly on the amount of suspended particles and chlorophyll in the water's body (Berman, 1997).

On average, the turbidity of Jakarta Bay allows light penetration between 3,41 - 3,87 meters. It should be taken into account that the turbidity in the rainy season is higher than in the dry season, because the turbidity in this area depends on the discharge of water from rivers and channels which contribute substances from the mainland. Ilahude (1995) said that this scale of turbidity still remains within the requirement for the Indonesian Mariculture Standard.

4. Depth

The depth of the Jakarta Bay area is around 4,60 - 50 metres, with depths fluctuating depending on the monsoon. In the rainy season the bay can be deeper than in the dry season. This is caused by the contribution of rain water from nine rivers and several channels discharging their water into Jakarta Bay.

2. 2.3. Investigation of Chemical Factors

To get accurate information of the Jakarta Bay, the area was divided into four zones for observation (A, B, C, and D, called zones 1, 2, 3, and 4 having a distance of 5 km from the coast-line and 5 km from each zone), as shown in the map 3, attached.

In order to have a good figure of water chemical quality of the Jakarta Bay area, the results of monitoring are always compared with the Indonesian Standard of Sea Water Quality for Indonesian Mariculture which is issued by the Indonesian Ministry of Environment, No. KEP-02/MENLH/1988. There are several main chemical indicators which are essential environmental parameters as follows:

1. COD (Chemical Oxygen Demand)

It is one of the important indicators to reflect the quality of the marine ecosystem, measuring the amount of dissolved oxygen (O_2) required to oxidise compounds that are not biologically degradable (Frankle, 1995). Observations from the bay's water sample by chemicals laboratory analysis gave COD ranging as in the following table.

Table 1: The COD Concentration (mg/l) of Jakarta Bay, 1996/1997.

	STATIONS OF OBSERVATION						
ZONE	1	2	3	4	5	6	7
A	27,36	32,49	37,50	34,32	32,62	35,49	34,63
B	33,35	35,30	32,08	37,36	34,95	37,36	41,38
C	-	45,71	41,85	46,85	41,10	49,12	-
D	-	-	54,98	59,30	55,91	54,83	-

Source: Pemantauan Kualitas Perairan Teluk Jakarta, 1996/1997
Kantor Pengkajian Perkotaan Dan Lingkungan DKI Jakarta.

The Indonesian Standard for mariculture noted that the COD desired is < 40,00 mg/l; and COD allowed is < 80.00 mg/l. The data shows that zones C and D are above the Indonesian standard level which means Jakarta Bay's COD is not good for mariculture. This is because zones C and D are close to the coast-line (land-based activities) and Tanjung Priok Port which might contribute some pollutant substances.

2. BOD (Biological Oxygen Demand)

Another criteria to measure the pollution level of the marine environment is BOD. It measures the amount of dissolved oxygen (O_2) required to oxidise biodegradable organic compounds (Frankle, 1995). The result of chemicals laboratory analysis of BOD of Jakarta Bay is as follows.

Table 2: The BOD Concentration (mg/l) of Jakarta Bay, 1996/1997.

ZONE	STATIONS OBSERVATION						
	1	2	3	4	5	6	7
A	10,08	12,65	12,50	10,99	12,28	13,28	34,42
B	13,45	13,03	10,44	13,95	12,59	13,15	14,95
C	-	13,28	12,90	16,43	15,78	16,43	-
D							

Source: Pemantauan Kualitas Perairan Teluk Jakarta, 1996/1997
Kantor Pengkajian Perkotaan Dan Lingkungan DKI Jakarta.

The Indonesian standard for mariculture noted that the desired BOD is < 25,00 mg/l; and the BOD allowed is < 45.00 mg/l (Illahude, 1995). The data shows that zones A, B, C, and D are below the level of Indonesian's mariculture standard which is the average of BOD between 10,08-23,68 mg/l. This is indicates that Jakarta Bay's BOD is good for mariculture.

3. Ammonia (NH_4)

Ammonia is a poisonous substance for all aquatic organisms when the amount of it is about 1,00-25,00 ppm (Ilahude,1995). Ammonia is one of the important parameters for monitoring water quality. Hereunder are the results of ammonia observation in the Jakarta Bay area during 1996/1997.

Table 3: The Ammonia (NH_4) Concentration (mg/l) of Jakarta Bay, 1996/1997.

ZONE	STATIONS OF OBSERVATION 1	2	3	4	5	6	7
A	0,37	0,32	0,72	0,23	0,30	0,29	0,36
B	0,36	0,80	0, 30	0,23	0,18	0,27	0,21
C	-	0,37	0,30	0,17	0,24	0,69	-
D	-	-	0,69	0,34	0,36	0,50	-

Note : (-) = undetectable
Source: Pemantauan Kualitas Perairan Teluk Jakarta, 1996/1997
Kantor Pengkajian Perkotaan Dan Lingkungan DKI Jakarta.

The Indonesian standard for mariculture quality of ammonia desired is < 0,30 mg/l; and ammonia allowed is < 1,00 mg/l (Illahude, 1995).

The data shows that zones A, B, C, and D are below the Indonesian standard. This means that the Jakarta Bay's ammonia concentration is in good condition or fulfils the mariculture standard.

4. Nutrient

The concentration of nutrients in the water ecosystem depends on input from the rivers and channels. A high concentration is found near the coast-line and data shows that the nutrient concentration is higher during the rainy season than during the dry season.

The nutrients in the marine environment are normally represented by Phosphate (PO_4) and Nitrate (NO_4) as two of the main food-chain items for marine life, namely for plankton (both phytoplankton and zooplankton) and other marine micro-organisms. Muchtar (1996) shows the average concentration of phosphate and nitrate from observations in the Jakarta Bay area, carried out in September, October and November each year since 1994 as below.

Table 4: The Nutrient Concentration (μg/l) of Jakarta Bay, 1996/1997.

	PERIOD OF OBSERVATION			
SUBSTANCE	September	October	November	Average
Phosphate	0,21-1,37	0,21-1,40	0,16-1,42	0,79
(PO_4)				
Nitrate (NO_4)	0,35-1,44	0,31-1,35	0,43-2,70	1,09

Source: Pemantauan Kualitas Perairan Teluk Jakarta, 1996/1997
Kantor Pengkajian Perkotaan Dan Lingkungan DKI Jakarta.

The Indonesian desired standard for phosphate (PO_4) for mariculture quality is < 0,50 μg/l; and phosphate is allowed to be < 1,00μg/l. For nitrate (NO_4), the desired level is < 0,50 μg/l; and the nitrate allowed is < 1,00 μg/l (Illahude, 1995). The data shows that the average of phosphate is below the maximum level allowed by the Indonesian mariculture standard. The average of nitrate is little bit exceed of the maximum level allowed. This means the Jakarta Bay's nutrient are in acceptable condition for mariculture.

The results of monitoring were compared with previous studies (1975, 1976, and 1978). The amounts of nutrients recently (during 1994 - 1996) were higher, than in the previous study around 0,02 - 0,90μg/l (phosphate) and 0,02-2,68μg/l (Muchtar, 1996). This is likely because of environmental changes surrounding the Jakarta Bay area, with the density of human activities such as industries, housing, and mariculture creating wastes which have been discharged into the Jakarta Bay area.

5. Metal elements

Some metals are essential for the healthy growth of marine organisms (e.g. iron, copper, vanadium, cobalt and zinc). If, however, there is too much (high concentration) of these metals present, or there are excessive amounts of other, non-essential metals, then toxic effects may occur (Preston, 1997).

Naturally, various metal elements exist in the marine environment which might come from sediments carried by rivers or channel water because of erosion or dust absorption from the atmosphere. Also it should be taken into account that the metal concentration could come from several human activities onshore or offshore such as industries, agriculture, mining, and sea transportation activities. To get accurate data, there are two types of metal analysis: water and sediment samples. The results of metal concentration observation in the Jakarta Bay area are shown below, in tables 5 and 6.

Table 5: The Metal Element Concentration (mg/l) from Water Sample of Jakarta Bay, 1996/1997.

	LOCATION OF OBSERVATION			
SUBSTANCE	Jakarta Bay	Mouth River	Allowed Standard	Desired Standard
Cu	(*) -0,07	0,02-0,06	< 0,06	< 0,001
Pb	(*) -0,05	(*) -0,07	< 0,01	< 0,002
Zn	(*) -0,16	0,02-0,35	< 0,10	< 0,002
Ni	-	(*) - 0,07	< 0,007	< 0,002

Note : (*) = undetectable

Source: Pemantauan Kualitas Perairan Teluk Jakarta, 1996/1997
Kantor Pengkajian Perkotaan Dan Lingkungan DKI Jakarta.

Metal concentrations from water samples from the mouths of rivers which empty into the Jakarta Bay area are higher than in the water samples from the middle of Jakarta Bay. This means that the higher metal concentration might come from land-based sources. The data shown above on average are exceed of the allowed level of the Indonesian mariculture standard. It means not acceptable for mariculture.

Table 6: The Metal Element Concentration from Sediment Sample (mg/l) of Jakarta Bay, 1996/1997.

SUBSTANCE	ZONE OF OBSERVATION			
	A	B	C	D
Cu	9,17-17,13	10,83-25,27	18,42-29,66	28,05-65,66
Pb	12,34-14,12	12,23-19,77	16,89-29,70	24,36-43,08
Zn	52,70-71,58	60,02-82,14	78,54-107,71	111,11-219,80
Ni	8,50-20,70	7,62-11,81	6,79-9,47	4,97-26,84
Cr	8,75-14,54	10,68-14,72	10,80-13,78	10,18-18,96
Cd	(*)	(*)	(*)	(*)-0,15

Note : (*) = undetectable
Source: Pemantauan Kualitas Perairan Teluk Jakarta, 1996/1997
Kantor Pengkajian Perkotaan Dan Lingkungan DKI Jakarta.

The metal concentration from samples of sediment from the Jakarta Bay area show that the highest concentration is in zone D (the nearest zone to the coast-line).

2.2.4. Investigation of Biological Factors

1. Plankton

Ocean waters support complex communities of plankton, microscopic plants (phytoplankton) and animals (zooplankton) which from the basis for the food webs that support the larger, multi-celled animals. The smallest phytoplankton, picoplankton, are less than 2 microns (a hair's width) thick; the largest, or macroplankton, exceed 2 millimetres in length (Pernetta, 1994).

a. Phytoplankton

Phytoplankton are single-celled, floating plants from which the vast majority of ocean primary production is based. Most phytoplankton are unicellular, some grow in chains, or form spherical colonies of larger size. Large colonial phytoplankton are characteristic of areas of upwelling, where nutrients are more abundant than in the open sea (Pernetta, 1994).

Based on the observation results in January 1996, the phytoplankton composition in Jakarta Bay has been found to be dominated by 30 genus which consist of 25 genus of *Diatomae*; and 5 genus of *Dinoflagellata.* Others genus are often found during investigation, such as *Bacteriastrum, Chaetoceros*, and *Rizosolenia* (which found 100% during investigation); as well as *Thallassiothrix, Biddulphia, Lauderia, Skeletonema, Cosinodiscus, Dynophisis*, and *Nocticula* (KPPL-DKI Jakarta, 1996).

b. Zooplankton

Zooplankton includes many different species of animals, ranging in size from microscopic protozoan to animals of several metres dimension (Berman, 1997). The existence of zooplankton depends on phytoplankton. In the food chain hierarchy, the planktonic herbivores are preyed on by carnivorous zooplankton which are, in turn, fed on by small fishes (Pernetta, 1994).

According to the results of the investigation of 1996, the composition of zooplankton in Jakarta Bay recorded 22 genus which consist of the group *Tintinids, Chaetognatha, Echinodermata, Polychaeta, Cladocera, Copepoda*, and *Decapoda.* The percentage of the zooplankton composition is as follows: *Copepoda* (75,17%), *Chaetognatha* (13,09%), *Echinodermata* (2,99%), *Polychaeta* (1,42%), and *Ciliata* (1,08%) (KPPL-DKI Jakarta, 1996).

2. Macro-zoobenthos

According to the Berman (1997), macro-zoobenthos are the benthic animals and can be separated into infaunal and epifaunal species, depending upon whether they live within the sediments or on the surface of the seafloor and consist of the larger macrofauna (> 1,0 millimetres).

The result of the investigation in 1996 shows that the composition of macro-zoobenthos in Jakarta Bay includes 55 genus, consisting of the group of *Molusca, Annelida, Arthropoda*, and *Echinodermata*. According to Dahuri (1997), the group of macro-zoobenthos is the one which suffers from organic, chemical and metal compound pollutants, because they have a mobile limit and accumulate the pollutant material. The consequence of this is that most macro-zoobenthos from Jakarta Bay, such as cockle shells, green mussel and shellfish are not safe to consume.

3. Coral Reefs

Coral is the massive calcareous skeleton formed by certain species of *Anthozoa* and some *Hydrozoa* or the colonies of polyps that form this skeleton (Walker, 1990). Coral reefs hold the highest number of species in the ocean. The diversity benefits us directly through harvestable food, medicines, and raw materials while the reef itself provides coastline protection, and indirectly sustains the ecological processes that provide these resources. Coral reefs are also highly productive ecosystems and support large populations of organisms, whether measured in numbers or biomes. For these reasons, coral reefs are of great importance for conservation and economic interests. A developing tropical country like Indonesia, especially small island states such as Thousand Archipelago (Kepulauan Seribu), depend heavily on their coral reef resources for food from reef fisheries and from the economic benefits deserved from the tourism sector, namely visiting scuba divers and snorkelers.

There are ten coral islands that form part of the Thousand Archipelago in Jakarta Bay. Before, the coral reefs of the Jakarta Bay were one of the greatest natural treasures of Indonesia. Both their quality and their quantity are impressive. Currently, only 29% of Indonesian reefs are in good condition (i.e. with more than 50% live coral cover) (AMBIO, 1997 p. 345-350).

Near the Thousand Archipelago (Jakarta Bay) there are 68 genera and sub genera of coral which are divided into 132 species. The dominant species found is the giant clam *Tridacna gigas*. It is one of the species which has value, apparently extinct throughout the islands, and still used to make floor tiles.

Several decades ago, the Jakarta Bay area had no serious environmental problems from human activities. Umbgrove (1928 in Rahardjo et all, 1993) recorded the ecological condition with high biodiversity. There were about 140 species of coral reef, and more than 130 species of fish. But today the ecological condition has been totally changed. Public opinion considers that Jakarta Bay has been polluted by several human activities. But, as mentioned earlier in the introduction, the Indonesian media and general public are concerned with the shipping activities as one of Jakarta Bay's major polluting agents.

CHAPTER 3

CURRENT CONDITION OF SEA TRANSPORT ACTIVITIES AND THE RISK ASSESSMENT OF JAKARTA BAY

3.1. Current Sea Transport Activities

Indonesia is an archipelago country of which 70% of the territory is sea; sea transport is growing vastly and becoming a concern of the general public. Sea transport is one of the vital modes of transport with strategies to provide cargo and passenger services all around Indonesian territory, and to support the export-import trade all around the world.

Generally, the basic sea transport activities of Jakarta Bay are handled by Tanjung Priok Port and Sunda Kelapa Port. Hence, it is necessary to illustrate the situation of this port briefly. The port of Tanjung Priok is located on the coastline of Jakarta Bay about 12 km from the centre of Jakarta, and is characterised by a sand channel of 8,000 metres with a depth of about 11 - 13 metres. The business undertaking of the port has so far provided and managed: port basins; pilotage and towage service; port infrastructure facilities, including quays, dolphins, and mooring buoys; warehouses, open storage, cargo handling equipment; container handling operations; bulk cargo handling operations; passengers terminal; electricity, drinking water and telecommunication facilities; office space for public and industrial activities; and a port study and training centre.

The sea transport or shipping activities in Jakarta Bay can be divided into the following categories:

- Shipping of cargoes and passengers including tourism;
- Shipping related to product transport of onshore and offshore oil and gas activities which are handled by the Indonesia Oil Company (PERTAMINA);
- Shipping related to fishing or catching of living resources;

- Shipping related to research activities; and
- Other miscellaneous activities.

3.1.1. Shipping of Cargoes and Passengers Including Tourism

To handle the services of cargoes, passengers, and tourism there are several ports located in the Jakarta Bay area namely: Tanjung Priok Port (the biggest Indonesian port for cargo and passengers both domestic and international) and Sunda Kelapa Port; PERTAMINA Port (the special port for the Indonesian Oil Company); MARINA Ancol Port (the special port for tourism), and several fishing ports such as Muara Angke Port, and Sunter Port.

Jakarta Bay is one of the busiest areas for sea transport activities in Indonesia, because the Indonesian capital city is situated along the coastline of this bay. Human activities (business, trade, etc.) are concentrated there. The following data shows the calling ships at the port of Tanjung Priok annually:

Table 7: The Calling Ships of Tanjung Priok Port (Jakarta Bay), 1993-1997.

YEAR	Units	GRT
1993	12,525	53,645,539
1994	14,582	118,427,937
1995	13,109	63,884,188
1996	13,246	67,966,595
1997	11,253	55,360,518
AVERAGE	12,943	71,856,955

Source: Directorate General Sea Communication (DGSC) Indonesia, 1997.

The movement of cargoes can be divided into two groups, namely inter-island (domestic) and ocean-going (export-import merchandise).

1. Inter-island cargoes

In general the structure of cargoes carried by inter-island ships from the whole of the Indonesian territory to Tanjung Priok Port can be divided into three categories which are agricultural commodities, industrial products, and raw materials.

2. Ocean-going cargoes

Ocean-going cargoes can be classified as consolidated cargoes which come from several ports in Indonesia and are to be transported to destinations abroad, or cargoes which come from outside the country and are to be distributed to several Indonesian ports as final destinations. The kinds of cargo are quite veried. The export cargoes normally consist of agricultural commodities, raw materials, and a few finished products. The import cargoes, are comprised of capital goods such as machinery, base metals, vehicles, and also finished products (chemicals, foods, and beverages).

The movement of passenger embarkation and disembarkation at Tanjung Priok Port to almost all over the Indonesian territory are carried out by domestic fleets. The data of passenger movements from 1992-1996 are shown in the following table.

Table 8: The Passenger Movement in Tanjung Priok Port (Jakarta Bay), 1992-1996.

YEAR	Embarkation	Disembarkation	Total
1992	240,092	266,642	508,734
1993	399,459	339,090	738,549
1994	250,582	251,152	501,734
1995	345,719	361,355	707,074
1996	397,730	333,939	731,669

Source: Directorate General Sea Communication (DGSC) Indonesia, 1996

Alder, et all (1995) says that the tourism sector in the Jakarta Bay area has grown rapidly, from one operator on one island of Thousand Archipelago in 1982 to 11 operators using 18 islands in 1992. Official figures are about 15,000 international and 5,000 domestic visitors in 1991. Kompas (8 August, 1997 p.9) shows that in 1995 there were 1,388,980 visitors registered and in 1996 (until June) 841,121 visitors both foreign and domestic.

The tourist transportation from Jakarta to the Thousand Archipelago is handled at a special port called MARINA Ancol Port and Muara Angke Port. It is carried out by small tourist ships and speed-boats which are owned by private companies. In total, to serve tourism transport there are about 50 small tourist ships operating.

3.1.2. Shipping Related to Product Transport of Onshore and Offshore Oil and Gas

In recent years, oil and gas resources have been found in many parts of Indonesian territory in deep waters offshore and onshore. The drilling process and refining require transportation. Jakarta is one of the biggest oil and gas consumption areas in Indonesia. To handle oil product distribution for the Jakarta area a special port called PERTAMINA Port is used, which is located inside Tanjung Priok Port. The data shows the tankers calling in PERTAMINA Port as follows:

Table 9: Tankers Calls of PERTAMINA Port (Jakarta Bay), 1993-1997.

YEAR	Unit	Oil Discharged (Ton)	Increase/Decrease (%)
1993	634	6,549,268	+10,83
1994	743	7,088,506	+ 8,23
1995	614	7,702,667	+ 8,66
1996	513	6,985,439	- 9,31
1997	602	7,063,314	+ 1,11

Note : (+) = increase ; (-) = decrease.
Source: The Indonesian Oil Company (PT. PERTAMINA), 1997.

3.1.3. Shipping Related to Fishing/Catching of Living Resources

Fishing and the catching of living resources is the traditional use of the bay. The villagers of Thousand Archipelago depend heavily on reef and island resources.

Local villagers receive little economic benefit from the tourist/recreation sector. The tourist industry employs less than 5% of the local population and of course the other villagers are still fishing and catching the natural resources.

These kinds of activities create an increasing of traffic density. Annually, there are about 279 ships and 85 medium fishing boats operating in Jakarta Bay, surrounding the Thousand Islands.

3.2. The Environmental Impacts and Risk Assessment of Sea Transport Activities

3.2.1. Environmental Impacts

The impact of "normal" operational discharges of oil, sewage, and other waste from MARPOL 73/78 compliant vessels is likely to be negligible at the current and any probable medium-term future level of shipping operations. Two aspects in this area which should be considered, are:

tank/hold cleaning discharges could have a somewhat greater impact if these became regular and locally concentrated;

the long-term effects of any chronic, low-level contaminants on Jakarta Bay species have not been exhaustively researched.

Significant environmental impacts are only likely to result from large, concentrated, accidental releases. There are a number of very sensitive sites in the Jakarta Bay associated with critical habitats such as wildlife breeding areas. Accidental spills in these areas could have serious long-term effects, particularly given the low breeding rates of many of Jakarta Bay's species.

3.2.2. Risk Assessment

The initial risk assessment of the Jakarta Bay involves the appraisal of:

risks and uncertainties of major polluting sources and activities (land-based and sea-based) and the effects of pollution on living and non-living resources;

identification of endpoints that are the most significant indicators of ecological, human health and societal risk; and

- interactions between sea-based and land-based activities and living and non-living resources in and along the bay.

Again, this study is limited and focuses on an assessment of the risk created by sea transport activities. There is insufficient information available on present and future shipping activities in Jakarta Bay and their effects on the marine environment. Nevertheless increases in the ship traffic in Jakarta Bay, as well as land-based economic developments, will increase the risk of marine pollution, with its impacts on human and ecosystem health, which are likely to be significant.

At present, there is a shortage of shore reception facilities for ship waste in the Jakarta Bay area. This adds to the problem of chronic pollution associated with shipping activities. This poses a greater risk for accidents than other activities in the Indonesian area because of the extreme high traffic density, thus increasing the risk of environmental damage as a consequence.

Indonesian sea transport operates in a dynamic environment with the steady increase in the volume of trade, advancement in technologies and world-wide economic competition. Such pressures have created enormous complexities in the Indonesian shipping business. There are approximately 13,000 vessel calls at the Tanjung Priok Port in Jakarta Bay annually. Cargo throughput totals approximately 20,000,000 tons/year and container throughput totals approximately 1,200,000 TEU's.

As shown earlier the calling of tankers at the Port of PERTAMINA is growing rapidly. On average during 1993 - 1997 there were 621 calling tankers at this port. It is clear that as the numbers of tankers increase more risk for pollution occurs in

Jakarta Bay due to tanker operational or accidental discharge, this will be discussed in more depth in chapter 4.

Regarding the risk assessments, the prevention of accidental pollution in the sea is very closely linked to safety, as pollution is likely to occur if there is a breach in the integrity of the vessel that also endangers the vessel. Relevant safety factors are, e.g. the construction of the hull, condition of machinery, equipment onboard, crew qualifications, navigational hazards, and routing of ships. The lack of harmonised standards for Indonesian ship construction and crew qualifications can increase the risk of accidents.

CHAPTER 4

ANALYSIS OF SOURCES AND EFFECTS OF MARINE ENVIRONMENTAL POLLUTION FROM SEA TRANSPORT ACTIVITIES

4.1. The Sources of Marine Environmental Pollution

Since pollution arises from human activities, most of the contaminants entering the sea come from the continental land masses and can be traced back particularly to centres of population and to industrial and agricultural operations. The proportions of pollutants from different sources have been estimated by the UNEP Regional Seas Reports and Studies No. 155, 1990, and show that marine transport contributes 12% (into the sea).

Although the contribution from shipping (maritime transportation) is a relatively small proportion of the total, it can cause significant environmental effects when it occurs in coastal waters or enclosed sea areas as illustrated below.

The most common contaminant or pollutant from maritime transportation is oil, which also has the highest public profile. The word "oil" refers to a wide range of materials including petroleum (crude oil), bunker fuels, petrol and lubricants. Crude oil is a natural substance, produced over geological time from the remains of plants and animals, so it can serve as food for bacteria, which break it down eventually to its basic components, mainly carbon.

As mentioned earlier, oil pollution in the marine environment might come from several sources, e.g. accidental and operational discharges of waste oil from production processes, transportation and refineries, and waste from industry.

The National Academy of Sciences (1985) shows the figure of hydrocarbon oil entering into the world's oceans annually at 3,2 million metrics ton, as shown in the following table.

Table 10. The Average of Hydrocarbon (Oil) Input Into the World Ocean (in million metrics ton/year)

SOURCES	RANGE	BEST ESTIMATION
1. Natural:		
- Marine seeps	0,02-2,00	0,2
- Sediment Erosion	0,005-0,50	0,05
Sub Total 1	***0,025-2,5***	***0,25***
2. Offshore production	0,04-0,06	0,05
3. Transportation:		
- Tanker operational	0,04-1,5	0,7
- Dry docking	0,02-0,05	0,03
- Terminal	0,01-0,03	0,02
- Tanker accidental	0,3-0,4	0,4
- Non tanker accidental	0,02-0,04	0,02
- Other form of pollution from ship & fuel oil	0,2-0,6	0,3
Sub Total 3	***0,95-2,62***	***1,47***
4. Atmosphere	0,05-0,5	0,3
5. Waste from the city and Industry		
- Municipal wastes	0,4-1,5	0,7
- Preparation, manufacture	0,06-0,6	0,1
- Industry non manufacture	0,1-0,3	0,2
- Run-off from the city	0,01-0,2	0,12
- Run-off from the rivers	0,01-0,5	0,04
- Dumping at sea	0,005-0,2	0,02
Sub Total 5	***0,585-3,12***	***1,18***
TOTAL	**1,7-8,8**	**2,9**

Source : The National Academy of Sciences (1985).

4.1.1. Statistical Information of Oil Spills and Accidents That Have Occurred

1. The Statistics of Major Accidental Oil Spills Around the World

Growth in world trade has brought increases in the volume of seaborne trade and changes in its direction; ships have developed in size and design to meet new requirements. The changes have made significant impacts on pollution risk factors around the world in the history of major accidental oil pollution:

- The biggest accidental oil spill in the world up to now is the *Amoco Cadiz* accident in 1978. She was wrecked on north coast of France after steering gear failure in bad weather, despite attempts to tow the ship offshore - after grounding 232,000 tonnes of oil was spilt, causing grave environmental damage. An American investigation team still found traces of oil on beaches in 1989;

- Before that, in 1967 it was the *Torrey Canyon* that ran aground near the south coast of England- salvage attempts were thwarted by an explosion in the engine room and precipitous government action - 120,000 tonnes of oil was split and also grave environment damage resulted with clean-up costs exceeding $16m. This was the first major pollution incident to come to public attention;

- In 1989, the *Exxon Valdez* ran ground off the coast of Alaska spilling 37,000 tonnes of oil and causing grave environmental damage;

- The last major occurrence of accidental oil pollution was in 1996. The *Sea Empress* stranded off the entrance to Milford Haven, UK, when entering port. Bad weather made refloating difficult and 65,000 tonnes of oil leaked into the sea and caused grave damage to highly sensitive coastal areas and to fishing; and

- There have been several major accidental oil pollution cases which are not covered in this paper. All of these can provide examples from where lessons can be learnt for environment protection policy in the future.

According to the Seaways data (November 1996), the number of major spills involving over 700 tonnes of oil fell by one-third by the end of the 1980s compared with the previous decade. The falling trend has continued in the 1990s with only two major spills reported in 1995 as compared with 13 spills in 1989 and 35 spills 10 years earlier, as in the following table.

Table 11. The Total Oil Spilt into the Sea

YEAR	VOLUME OF OIL SPILT (TONNES)
1979	615,000
1989	178,000
1990	61,000
1991	437,000
1992	162,000
1993	150,000
1994	71,000
1995	8,000
1996 up to March	69,000

Source: ITOPF - International Tanker Owners Pollution Federation Ltd, in Seaways - November 1996.

The lessons learned from accidental oil pollution are also available from Asia, as in the following:

- in the Middle-East area near Jeddah Port the VLCC "*Kanchenjunga*" (270,000 DWT) on 21 April 1989 hit coral reefs, and as a result 25,000 tonnes of oil were spilled into the Red Sea;
- The super tanker "*Diamond Grace*" (259,999 DWT) on 2 July 1997 at 18.00 hour hit a coral reef and grounded in the Gulf of Tokyo, Japan. It was carrying 257,000 tonnes of oil from the United Arab Emirates. As a result, about 13,400 tonnes of oil were spilled into the sea. In the bad weather condition the oil spill spread-out to a radius of 20 km from the point of the accident within two days (The Daily Newspaper "Media Indonesia", 3 July 1997 p.12).

Based on the statistics of major tanker accident of oil spills in the world, average calculations by the experts indicate that since 1967, a tanker accident happens almost every 6 years (KPPL-DKI, 1997).

The history of accidental oil pollution also exists in Indonesia as the following shows:

- Still fresh in the minds of Indonesians is the grounding of the super tanker "*SHOWA MARU* " on 6 January 1975, which was the first such experience for all Indonesian expert and decision makers. It happened just three days after the first National Maritime Seminar in Jakarta which discussed marine environmental protection programs in Indonesia. The super tanker, of 237,698 DWT, en route for Japan with a cargo of Arabian light, Berry and Murban crude oils, grounded near Buffalo Rock ("Karang Banteng") close to the Singapore Strait. It is estimated that approximately 54,000 barrels of oil were spilled into the sea.
- On 8 August 1983, the *KM. TIPISON* (a wood carrier of 9,000 DWT) sank in the Gresik area (East of Java) and washed away into the Java Sea 330 tonnes of MDO (Marine Diesel Oil) and 246 tonnes MFO (Marine Fuel Oil).

2. Statistical Information of Oil Spills from Operational Discharges in Jakarta Bay

Investigation of the operational discharge of oil in the special oil port of Tanjung Priok (Port of PERTAMINA) has not indicated oil pollution problems for the port environment. There are relatively small oil spills (leakage) during operational discharges activities. The data during 1993 - 1997 is shown in the following table.

Table 12. The Volume of Oil Spills During the Oil Discharging Process at PERTAMINA Port-Jakarta (1993-1997)

Year	Volume of Oil Spill (Litre)	Total Volume of Oil Discharges (KL)	%
1993	2,540	8,337,713	0,00003
1994	825	8,241,585	0,00001
1995	10,000	5,887,488	0,0002
1996	1,755	6,420,144	0,00003
1997	80	7,427,477	0

Source: PT. PERTAMINA , January 1998.

To emphasise that the oil spills (leakage) at PERTAMINA Port during the discharging process is relatively small, a memorandum of Tanjung Priok Port

Authority, No. 147/F/G0210/97 on 29 December 1997, which says that leakages from PERTAMINA's ships in Jakarta Bay is zero.

In this connection it could be said that if there is oil pollution in Jakarta Bay, it is not caused from either major accidental oil spills or oil operational discharges, but from other sources which need to be investigated more deeply.

This means that the indication of the low water quality for some chemical parameters (as shown in chapter-2) of Jakarta Bay might be created by other pollution sources such as industry, agriculture, other shipping activities, and other land-based activities.

4.1.2. Scientific Guidance on Pollution Issues Attributable to Sea Transport Activities in Jakarta Bay Area.

In all arround the world, there is a very rough estimate of the relative contribution of all potential pollution from various human activities entering into the sea. It also happens in the Jakarta Bay area, but the general public attention is more concerned with the shipping activities (maritime transportation). As mentioned earlier, according to the UNEP Regional Seas Reports and Studies No. 155, 1990 and GESAMP (Group of Experts on the Scientific Aspects of Marine Pollution,1990) there are at least five main categories of marine pollutants as shown by the following table.

Table 13. The Relative Contribution of all Potential Pollution into the Sea from Various activities

SOURCE	All Potential Pollutants (Percent Contribution)
Off-shore production	1
Maritime transportation	12
Dumping	10
Run-off and land based discharges	44
Atmosphere	33

Source: GESAMP, 1990.

These figures clearly demonstrate that marine pollution is derived mainly from land based sources and the atmosphere. The impact from these two sources are very different. Atmospheric input to the sea is normally diluted and diffuse, while land based inputs are often from point sources and can have long residence time in waters which are relatively enclosed by either geographic or hydrographic structure. The relative contribution from each source is different in the different sea areas as these contributions depend on the degree of industrialisation, the density of populations, the extent of offshore activities, and on other factors.

The objective of this chapter (chapter 4) is to assist the littoral state namely Jakarta Bay region to identify existing and potential pollution risks from maritime transportation to the coastal and marine environment; to strengthen surveillance and regulatory mechanisms and instruments for managing pollution in the Jakarta Bay, and to indicate an approach process and methods for use in other subregions where similar issues are apparent.

The environment profile identifies that Jakarta Bay is a unique tropical environment, as well as one of the busiest sea routes in Indonesian territorial waters. The actual human activities contributing to adverse environmental changes in the Jakarta Bay are as follows:

- Land-based activities, deforestation, disposal of industrial wastes, disposal of agricultural wastes, sewage disposal, solid waste disposal, mangrove swamp conversion, and land reclamation;
- Sea-based activities; shipping, dumping of dredging spoil, oil exploration, mariculture, and fishing.

Although maritime transportation contributes only a part of marine pollution in Jakarta Bay, this paper focuses attention on the exploration of the marine pollution issue attributable to sea transport activity matters only. It is important because maritime transportation in the Indonesian area plays a very important role regarding the economic support of the nation. However, maritime transportation poses certain environmental threats, mainly in the form of oil and chemical pollution, ship generated waste and sewage and ballast water organisms.

In general, marine pollution from maritime transportation can be divided into two categories, namely discharges derived from the operation of the ship and accidental pollution.

1. Pollution from Ship Operational Discharge

Operational pollution from ships has different origins, pollution generated on board the ship (oil, garbage, and sewage), and pollution generated during cargo operations in port (oil, chemicals, and dust). In addition there are other forms of pollution from ships, such as emissions into the air, micro-organisms carried in ballast water, losses from the use of antifouling paints and physical disturbances (noise and waves).

a. Pollution Generated Onboard the Ships

1) Oil pollution

No doubt, oil at sea is one of the most significant of all types of marine pollution. A long time ago, oil spilt at sea attracted world-wide, media attention and created large scale protests by the general public. On the other hand, there are other types of oil pollution which have not attracted the general public's attention, which is oil pollution generated by ships' routine-activities.

The important source of such oil pollution is oil waste from the operation of ships. Oil waste from ships can be classified into two main categories, which are oily waste from machinery spaces and the tanker cargo related category, as follows:

a) Oil residues (sludge)

Fuel and oil residues are collected from fuel separators and at the bottom of fuel tanks. This material is thick, almost solid with a specific gravity of over 1. After unlawful discharge at sea, it may find their way to the shore, producing the familiar "tar balls" on the beaches. This condition is often seen at the beach of Kepulauan Seribu (Thousand Archipelago -Jakarta Bay).

b) Oily bilge water

This oily waste is a cocktail of water, various oils, and detergents accumulated from leakage from the equipment in the engine room and other machinery on board. Quantities generated vary to a great extent, depending on the age of the ship, size, maintenance programme and operating practices. Generally, oil is separated from bilge water using oil/water separators on board, followed by discharge of the separated and cleaned water back to sea. The oil phase is retained on board and pumped into a slop tank together with the oily waste from fuel oil separators. Some ships have installed segregated tanks for separator sludge and bilge water oil.

c) Oil contaminated ballast water

Oil-containing ballast water comes predominantly from oil tankers without segregated ballast and cargo tanks, where the cargo tanks are used as ballast tanks after the oil is unloaded.

When a ship sails empty, or partly with cargo, ballast water is taken on board in order to stabilise the vessel during voyage. Ballast water is taken either in the cargo tanks or in separate ballast tanks. In the latter case there is no problem of oil pollution; the water is clean and is allowed to be discharged back into the sea. In the first case the ballast water is contaminated with small quantities of oil. The ship will normally discharge ballast water at sea just before arriving at the loading port, in the case when the ship is equipped with oil/water separators. The oil content is retained on board and may later be mixed with new cargo. When no discharge of ballast water is allowed, or the ship is not equipped with adequate oil/water separators, the loading terminal must be able to accept ballast water for treatment and disposal. This case often occurs in Tanjung Priok Port which has limited reception facilities.

According to the IMO's Comprehensive Manual on Reception Facilities (IMO,1995) the volume of ballast water which must be expected to be delivered in port from ships without segregated ballast, constitutes 30 per cent of the deadweight tonnage.

d) Tank washing

Petroleum product carriers need to clean their tanks when changing from one type of cargo to another. The residues of wash water are held in slop tanks. The loading terminal must be able to receive and treat these wash water quantities. Where these kinds of pollutants (oil substances) enter into the sea, it is not only the biggest eyesore in the marine environment, it also damages marine life and coastal ecosystems.

2) Sewage pollution from ships

According to MARPOL 73/78, sewage means, drainage and other wastes from any form of toilets, urinals, and WC scuppers. Sewage is also defined as all kinds of discharge from sanitary appliances in living quarters, working places, medical premises and spaces containing living animals.

Sewage contains a wide variety of inorganic (i.e., nutrients and trace metals) and organic compounds. There are also suspended solids originating from human excrement, inorganic grit, and a variety of garbage. Sewage water readily contains large quantities of pathogenic organisms. Pathogens are living organisms that can cause sickness or biological imbalance in either plants or animals within the oceans or in human beings.

Considering that the quantity of sewage generated on board and in ports is only a fraction of the quantities produced in nearby urban area, provision of separate sewage reception and treatment facilities in ports is not common. In most developing countries sewage is not separated from industrial discharges, which can create additional problems. Moreover, proper sewage treatment facilities are uncommon in many developing countries. In the future, plans for such municipal facilities should be developed. Such systems should also include sewage generated in port areas.

3) Solid waste (garbage) pollution from ships

Solid waste generated in the port environment are either directly related to ships and the cargo, or to port based sources. MARPOL 73/78 Annex V (Regulation 1) is restricted to *"garbage"*, which is defined as all kinds of victual, domestic, and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the ship and liable to be disposed of continuously or periodically.

Generally, garbage can be defined as the product which is no more useful for any human activity and therefore is separated for disposal. Garbage is a growing global problem.

Not surprisingly, solid waste (garbage) in colossal proportions is a growing urban problem in a mega-city like Jakarta. Oceans have been long favoured as an inexpensive and easy dumping site to get rid of almost every kind of garbage.

Garbage if not contaminated by toxic substances is relatively less harmful than other pollutants. However, garbage is a serious hazard for many marine animals including mammals and birds. Plastics are essentially the worst form of garbage that can float or be suspended in the water column and be mistaken by marine mammals as a source of food. It can make the animals sick and in most cases the result is the animals' death.

b. Pollution Generated During Cargo Operations in the Port

Besides the waste generated on-board, there is an amount of waste generated inside the port area itself which cannot be neglected. This encompasses waste produced during the loading and unloading of cargo, and other types of waste generated during activities inside the port area.

Cargo handling have environmental implications both inside and outside the port area, in addition to important safety implications for port employees. The overriding objective of a port environmental policy so far as cargo handling is concerned should be to minimise the nuisance and environmental impacts caused by the operation of the port, with particular reference to ship's solid waste, dust, and atmospheric pollution due to leakage and spillage, as well as noise.

1) Solid waste pollution

The total volume of solid waste can be subdivided into five categories, namely MARPOL waste and port waste groups, as in the following.

MARPOL waste groups:

a) Ship waste

Ship waste is generated during the voyage and during a stay in port. This waste comprises nearly all waste components. First, domestic waste generated by crew members and passengers includes food residuals, paper, plastic, tins, bottles, etc. Secondly, refuse from ship operation and maintenance activities, such as ropes, dunnage, batteries, paint residuals, oily rags and similar material. Part of the ship waste is classified as hazardous waste, while other fractions may contain bacteria which are not common in Indonesia but could pose a threat to public health and the environment.

b) Cargo waste

Cargo waste is generated during the loading and unloading of ships at berth. It originates from cleaning of chemical tankers and both spillage or residuals of the cargo itself. It also includes dunnage, shoring, pallets, lining, and packing materials. Materials concerned include, among others, wood, plastic, paper, cartons, metals, and a small proportion of organic matter.

Port waste group:

c) Floating port waste

Waste floating in the port basin mainly originates from land based sources, comprised of households and commercial and industrial establishments, located upstream along rivers or from drains discharging into rivers. In the Jakarta Bay area, large volumes of waste enter the river system through the careless attitude of citizens with regard to waste disposal. Subsequently, rivers discharge the debris via the port basin into the Jakarta Bay and into the Java Sea. The discharge of wastes from vessels or from shipping activities on the quay also contribute to the amount of floating waste in Jakarta Bay of which typical components are wood, plastic, ropes, and textiles.

d) Waste from premises

Premises located inside the port area are comprised of offices of the Port Company (PT. Pelabuhan Indonesia II), port administration offices, shipping agents, and stores, warehouses, shops, and restaurants. Waste is generated as a result of working activities by employees and operating equipment. This category contains a wide variety of components, such as paper, glass, plastic, food-waste, bottles, carton and hazardous waste components like batteries, ink, glue, paint residuals and lubricants.

e) Waste from area cleaning activities

People working inside the port area (such as Tanjung Priok) are potential polluters of streets, parking lots, storage sites, wharf and recreational areas. This includes both port employees and visitors. Waste components include paper, wood, plastic, tins, tobacco residuals, bottle lids, and glass. In addition there is organic litter from trees, bushes and plants, and animal excrement.

2) Dust

No doubt, a mega-city like Jakarta-Indonesia, in a tropical country, has a big problem with wind and dust. Wind-blown dust can be a major problem in Jakarta Bay namely in Tanjung Priok Port area where dry bulk cargoes are being handled. Fertilisers, coal dust, grains, bauxite and cement are common materials which can result in major increases to dust levels. These can be detrimental to the health of port employees and cause damage at neighbouring residential property.

Exhaust from traffic can also cause major problems within a port, especially when there is a high level of cargo being imported and exported by road or when passenger ferries with their large number of associated cars operate within the port.

3) Atmospheric pollution due to leakage and emission

Emission to air, water, and land: An inventory of the main pollution received or generated from all sources includes dry-dock activities (sand, paints/antifouling, solvents, can/drums, scrap), maintenance (oils and solvents), cargo storage and handling areas (particularly hazardous materials), general house keeping, pest controls (silo flushing with cyanide), vehicle and port traffic, dredging, and external sources (e.g. upriver discharges).

Spills can occur during transfer operations and the ultimate disposal of the wastes presents environmental problems that are air and land related.

Waterfront drainage is a problem for every port and is a major source of pollutants, such as oil, into port waters. Likewise, run-off from cargo storage areas can be a major source of pollutants (oil and pesticides, for example).

Cargo spills can cause a build-up of organic and inorganic material on the seabed as well as an increased dust levels in the air. Fertilisers, grains, sulphur, coal dust and bauxite are a few examples of cargoes which can lead to decreased water and air quality. When ports are located in close proximity to residential areas such as Tanjung Priok, increased dust levels can result in numerous public complaints.

c. Pollution Generated from Dumping of Dredging Spoil

Tanjung Priok Port and approach channel require regular dredging in order to maintain a sufficient depth of water for safe navigation.

About 80 to 90 % of all dredging material dumped at sea is dredging spoil, and if uncontaminated and properly handled it can cause few problems. However, around 10% of dredged material is contaminated from a variety of sources, including shipping operations, land run-off, industrial and municipal discharges. Typical contaminant include oil, heavy metals, nutrients and organochlorine compounds.

Principally, the dumping of dredging spoil can affects marine benthic organisms in the disposal area through smothering and physical disruption of their habitat; but direct toxicity and bioaccumulation of toxic compounds may also take place.

2. Accidental Pollution

At present, crude oil and chemical substances have been imported by tankers from overseas. Tanker movements have consisted considerable portion of the traffic in the Jakarta Bay area. No accurate statistics are presently available on the accidental oil pollution from the passing oil traffic (tanker); but, that the consumption of oil products and chemical substances is as always on the increase. Consequently, the size and total tonnage of tankers has increased enormously to meet the increased demand for oil and chemical substances.

The increasing demand for oil in Jakarta is indicated by the increasing number of calling tankers and the volume of oil discharges at the special oil port (PERTAMINA Port) Jakarta is as shown earlier in the table 9.

Jakarta Bay is the second busiest vessel traffic area in Indonesia after the Strait of Malacca. This is no doubt that Jakarta Bay has a high risk of accidental pollution. As known, oil tankers can fall victim to the whole range of normal marine perils such as collisions, grounding, explosions, fires and structural failures which are brought about by such factors as design, breakdown, human error or inadequate training.

The biggest concern from vessel-source pollution comes from oil tanker accidents. However, most of the current oil pollution comes from the operational discharges of ships. In other words, oil spills also take place during loading and discharge operations.

Marine pollution incidents such as oil spills, chemical leaks or the discharge of sewage effluent without full treatment can have a disastrous effect on marine or estuarine ecosystems like Jakarta Bay. No one can be unaware of the ecological damage caused in Alaska when a major oil spillage occurred from the *Exxon Valdez* disaster. We should learn from this experience. Here, in Jakarta Bay it is predicted that the important sources of oil pollution (accidental pollution) are arising from maritime transportation or shipping activities and port operations.

Of less interest to the national press perhaps, but nevertheless of particular environmental significance, is the long-term cumulative effect on fish and shellfish of the frequent "minor", or unreported pollution incidents associated with the shipping or maritime industries. On the other hand, the fishing industry is becoming increasingly concerned with the effects of any possible contaminant which might be discharged into the water, deliberately or accidentally, as the result of proposed development.

3. Other Forms of Pollution from Sea Transport Activities

a. Emission to the air

The complete composition of the exhausts from diesel engines used on board ships is complex and the gases contain a number of substances.

Air pollutant emissions associated with maritime transportation or vessel activities in ports for various operational scenarios is a global issue. It arises from fuel combustion related emissions from marine engines that result from vessel cruising, transit, manoeuvring, hotelling, tug assistance, and recreational vessel usage. It also arises from hydrocarbon vapour emissions during liquid bulk loading/unloading, ballasting, lightering, and bunkering operations.

In Jakarta Bay, in particular the Port Tanjung Priok, exhaust from traffic can also cause major problems within port areas, especially when there is a high level of cargo being imported and exported by road or when passenger ferries with their large number of associated cars operate within the port area.

The handling and storage of solid materials in bulk is also of major concern to the port authorities. The resulting air pollution depends mainly on the dust-making properties of the material and the method of handling that is employed. It is important to choose methods of handling and storage suitable for the material. With certain materials, considerations of dust and odour emissions may require special measures, both when handling and storing the material.

Wind-blown dust can also be a major problem of fugitive including dust from dry cargoes such as coal-dust, bauxite, cereals and phosphates which are typical materials being handled in bulk.

Another source of emission into the air is leakage of gases and vapours. It is of particular concern to port authorities as, aside from toxicity and fire or explosion risk, resulting odours may give rise to complaints. Globally and in Jakarta Bay (Tanjung Priok Port), emissions into the air are very complex and need the awareness of the port authority.

There are several emission types and effects from sea transport activities, as shown in the following items:

1) Nitrogen compounds

In most combustion processes nitrogen oxides are normally formed and the most common of these are nitrogen monoxide (NO), and nitrogen dioxide (NO_2). Both these two compounds are usually labelled NOx of which the NO_2 rate is approximately 5 per cent. In the atmosphere the NO share is oxidised to NO_2 and nitric acid (HNO_3). As regards the application on ships, NOx is mainly formed from the nitrogen and oxygen of the air (thermal NOx) and to a smaller extent the nitrogen compounds combined in the fuel are converted to NOx (fuel NOx).

According to the Alexandersson et al. (1993), the emission of NOx causes problems by:

- nitrogen saturation of forest soil resulting in acidification which means an increase of the acidity of the soil, causing a dramatic change of its health condition;
- increased photochemical oxidant contents, e.g. ozone (O_3) in the troposphere, and;
- direct gaseous damage to plants and organisms. Apart from damage from acidification and oxidants, the environment is affected by several types of direct gaseous damage directly to the trees and corps through leaves and pine needles, and may affect the health of sensitive groups of the population, causing respiratory and other problems.

2) Sulphur compounds

The sulphur compounds occurring in the exhausts from ships are sulphur oxides; predominantly SO_2 and to a lesser extent SO_3 about 2 - 3 per cent. Sulphate (SO_4), may also be emitted in small amounts combined with metals (Na, Ca) in particulate matter. The emission of sulphur oxides is a strongly contributory cause of the acidification of soil and water. Furthermore, the emission of sulphur oxides lead to directly adverse effects on human health (i.e. an increase in respiratory problems) and to corrosion of buildings and other materials (Alexandersson et al. 1993).

3) Hydrocarbon compounds

Hydrocarbons are released, partly as a consequence of incomplete fuel combustion, and partly from radical reactions in the combustion process. According to Alexandersson et al. (1993), hydrocarbons may exist in several different forms and more than 300 different compounds have been identified with regards to emissions from diesel-powered vehicles. Polycyclic aromatic hydrocarbon (PAH), occurs both in a gaseous phase as well as in a particle bound form in exhausts. This group of hydrocarbons include several which have proved to cause cancer and are mutagenic substances (cancerogenic effect). Another hydrocarbon compound called aldehydes e.g. alkenes and alkyl benzenes which occur in the diesel exhausts, may damage crops and forests, and also directly affect human health (cancerogenic, mutagenicity, irritation of eyes and mucous membranes).

4) Particulate matter

Particulate matter in the flue gases mainly consists of unburned carbon and ashes, but also may contain trace metals and bound PAH. In general the particles are small (90 per cent < 1 micron) and are therefore able to penetrate the finest cavities of the lungs (alveoli) and cause health problems. Certain PAH compounds have a direct mutagenic effect and may cause cancer. The most important trace metals emitted from ships are arsenic, cadmium, cobalt, chrome, copper, mercury, manganese, molybdenum, nickel, lead, vanadium and zinc. Of these, cadmium, lead and mercury have attracted most attention due to their toxic effect. Many large diesel engines operate on heavy fuel oil with a comparatively high sulphur content, and therefore a lubricating oil with alkali-metal additives (Na, Ca) which counteract the corrosive effect of the sulphur compounds is used. As a consequence there are alkali-metal sulphates combined in the particles (Alexandersson et al. 1993).

5) Carbon monoxide (CO) and carbon dioxide (CO_2)

Carbon monoxide (CO), forms as a consequence of incomplete combustion. The gas is photochemically active and directly toxic in high proportions, and person suffering from heart and vascular diseases are particularly sensitive to it. Carbon dioxide (CO_2), is formed in comparatively large amounts in all types of combustion processes. In spite of the fact that CO_2 has no direct harmful effect on nature, it is the most important of the so called greenhouse gases. Raised concentrations of these gases disturb the thermic balance of the Earth by re-reflecting the thermic radiation of earth. At present, CO_2 from the burning of fossil fuel amounts to almost three times the quantity that the plants of the planet are able to consume (Alexandersson et al. 1993).

There is a new international response to air pollution from ships, which is the new Annex VI (Regulations for the Prevention of Air Pollution from Ships) of MARPOL 73/78 which will reduce air pollution from ships. The rules set limits of sulphur oxide (SOx) and nitrogen oxide (NOx) emission from ship exhausts and prohibit deliberate emissions of ozone-depleting substances, which include halons and chlorofluorocarbons (CFCs) or another volatile organic compounds. It also covers requirements for shipboard incineration, provision of reception facilities at ports to receive substances removed from ships, fuel oil quality, and requirements for drilling rigs and other flatforms.

In this connection, the IMO as a international body has been deeply concerned with the phenomena of depletion of the ozone layer, atmospheric pollution and global warming. This new rules represent a contribution from the maritime community to international determination to solve regional and global environmental problems related to air pollution. It also referred to the United Nations Framework Convention on Climate Change adopted in Rio de Jeneiro in 1992 (Rio Earth Summit) and Framework Convention on Climate Change in December 1997 in Kyoto, Japan.

b. Micro-organisms Carried in Ballast-water

Ballast is any solid or liquid placed in a ship to increase the draft, to change the trim, to regulate stability, or to maintain stress loads within acceptable limits. Ships have always required ballast to operate successfully and safely. For millennia, ships carried solid ballast in the form of rocks, and sand, roof tiles, and many other heavy materials. According to the Marine Board Commission on Engineering and Technical Systems National Research Council (1996), from the 1880s onward, ships increasingly used water for ballast, thereby avoiding time-consuming loading of solid materials and dangerous vessel instabilities resulting from the shifting of solid ballast during a voyage. Today, vessels carry ballast that may be fresh, brackish, or salt water.

Water has been used as ballast since the introduction of steel hulled vessels to stabilise vessels at sea. The amount of ballast carried on board vessels is various from several hundred litres to more than 100,000 tons; this depends on the size and purpose of the vessel. According to the MEPC 40/10/2 (18 June 1997), it is estimated that about 10 billion tonnes of ballast water are transferred each year.

The modern ship transports living organisms on the hull, in sea chests, and elsewhere on and in the vessel, such as in seawater piping systems, on the rudder, entangled in the anchor or in the anchor chain, in chain lockers or caught up in fish nets. Ballast water has a clearly identified role in directly and consistently releasing large numbers of organisms in every major port of the world every day.

Studies carried out in several countries such as Argentina, Australia, Brazil, Japan, and the Netherlands. have shown that many species of bacteria, plants, and animals can survive in a viable form in the ballast water and suspended matters, e.g. sediment particles and organic debris carried in a ship, even after journeys of several months duration.

Together with the ballast water and associated sediments, all life stages of aquatic organism may be taken, including dormant stages (cysts) of microscopic toxic aquatic plants; e.g. dinoflagellates, which are often resting in sediments and may cause harmful algae blooms after their release. In addition, pathogens such as the bacterium *Vibrio cholerae*, have been transported with ballast water.

The transfer of harmful organisms and pathogens causes injury to public health and damage to property and the environment. This has been recognised not only by the IMO but also by the World Health Organisation (WHO) which is concerned about the role of ballast water as a medium for the spreading of epidemic disease bacteria.

A main issue of harmful aquatic organism in ballast is the many introductions of non-indigenous organisms in new locations. Several cases where new organisms have been introduced have caused tremendous damage and also endangered human health (IMO's web site, April 1998) :

> the introduction of the European zebra mussel (*Dreissena polymorpha*) in the North American Great Lakes, resulting in a cost of billions of dollars for pollution control and cleaning of fouled underwater structures and waterpipes;
>
> the introduction of the American comb jelly (*Mnemiopsis leidyi*) to the Black and Azov Seas, causing the near extinction of the anchovy and sprat fisheries;
>
> the introduction of the South-east Asian dinoflagellates of the genera *Gymnodinium* and *Alexandrium* to Australian waters, which cause Paralytic Shellfish Poisoning;
>
> the introduction of the Japanese brown kelp (*Undaria pinnatifida*) to Tasmania waters, having detrimental impacts on the abalone and sea urchins fisheries;
>
> the introduction of the *Vibrio cholerae* in Latin American coastal waters, probably through discharges of ballast water from Asia, seriously threatened the health of thousands of people after consumption of seafood from affected areas.

Table 14 provides examples of shipborne introductions of organisms transferred from one country to another.

Table 14. Example of Shipborne Introductions World-wide since the 1980s

SPECIES	ORIGIN	LOCATION
Dinoflagellates *Gymnodium catenatum*	Japan	Australia
Comb Jellyfish (Ctenophora) *Mnemiopsis leidyi* (American Comb Jellyfish)	North America	Black and Azov Seas
Polychaete Worm (Annelida) *Marenzelleria viridis* (Spionid Tubeworm)	North America	Western & Northern Europe
Mussels and Clams (Bivalvia) *Ensis Americanus* (America Razor Clams) *Musculista senhousia* (Japanese Mussel)	North America Japan	Western & Northern Europe New Zealand
Crabs (Decapoda) *Charybdis helleri* (Indo-Pacific Swimming Crab)	Mediterranean	Colombia, Venezuela, Cuba, & United State
Seastars (Asteroidea) *Asterias amurensis* (North Pacific Seaster)	Japan	Australia

Sources: Carlton and Geller, 1993; Carlton et al., 1995; LeMaitre, 1995 in NRC, 1996

In addition, as ships travel faster, and global shipping moves 80% of the world's commodities, the survival rates of species carried in ballast tanks have increased and introduction of non-indigenous species has recently received increasing attention. In this connection, it is the right time for the port of Tanjung Priok, as an international port, to be aware of this problem In order to protect the Jakarta Bay environment.

c. Harmful Effects of the Use of Anti-fouling Paints from Ships

Anti-fouling paints are used to coat the bottoms of ships to prevent sealife such as algae and molluscs from attaching themselves to the hull - thereby slowing down the ship and increasing fuel oil consumption. Today bottom paints commonly contain organotin compounds which have been widely used.

Anti-fouling paints and the other toxic wastes in the marine environment generated from shipping's maintenance activities can have severe impacts on marine ecosystems. Mostly the harbours with heavy international traffic, like Jakarta port (Tanjung Priok) are at a high risk of pollution from these substances. Organotin compounds are detected not only in the organisms in the coastal waters but also in mammals in the ocean and organisms of the deep sea. All of this suggests that marine pollution by organotin compounds is already a global phenomenon and an international issue (MEPC 41/INF 3, 1997).

Most anti-fouling paints contain metallic compounds which slowly "leach" into the sea water, killing barnacles and other marine life that have attached themselves to the ship - but studies have shown that these compounds persist in the water, killing sealife, harming the environment and possibly entering the food chain. One of the most effective of organotin compounds developed in the 1960s is trybutil tin (TBT), which has been proven to cause deformations in oysters and imposex (sex changes) in sea snails (IMO's web site, 1997). Imposex has already been observed in more than 100 species of sea snails. It is suggested that imposex is occurring in many species around the world.

In this connection, the Indonesian government through the port authority under the national law should implement the necessary measures to prohibit the production, import and use of organotin compounds. However, no country can avoid the pollution by international traffic, even if the domestic use of the organotin-based anti-fouling paints is strictly controlled.

The MEPC adopted a Resolution in 1990 which recommended that the Governments adopt measures to eliminate the use of antifouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of antifouling paints with a leaching rate of more than 4 micrograms of TBT per day. Some countries, such as Japan, have already banned the use of TBT in antifouling paint for most ships (MEPC 41/INF3, 1997).

d. Physical Disturbance (Noise)

One of the physical disturbances from sea transport activities is noise. Noise from sea transport activities in ports and coastal areas such as Jakarta Bay can occur all the time. The twenty-four hour working day is common in ports like Tanjung Priok port and the related industrial area. Such unacceptable noise levels near residential areas such as Jakarta can result in numerous public complaints. In this case, the government, through the port authority, should take into consideration residential complaints regarding noise matters.

4.2. The Environmental Impact of Pollution From Ships

The most conspicuous consequences of pollution from ships is usually the large quantities of solid waste on the coasts and oil-smeared birds.

4.2.1. The Environmental impact of oil discharge into the sea

Discharge of waste oil into the sea is not permitted according to the MARPOL Convention. Still, discharge of waste oil from ships occurs in several ocean areas. It may be oil from the engine room, oil from the cleaning of oil tanks or, for instance, discharge of oil-containing ballast water.

In such cases, where the oil remains floating on the surface of the sea - which can be quite common, since only a few oils have a specific weight higher than that of sea water - sea-birds may be soiled by the oil. An oil smudge of a few centimetres in diameter may kill the birds.

When oil is discharged into the sea, the oil will usually spread and some of it will evaporate before it reaches land. Where only moderate quantities are involved, the damage on the marine fauna and flora, with the exception of the sea-birds, will be limited. However, many marine organisms are sensitive to even minute concentrations of oil. This applies particularly to the earliest life stage of such organisms, i.e. eggs and larvae.

4.2.2. Environmental damage due to solid waste

Apart from being an eyesore in nature, solid waste may also inflict damage on life in the sea and on the shores. There are several examples of birds being entangled in plastic waste such as plastic rings from beer tins. Also fish may be entangled in plastic objects, and seals may accidentally get plastic rings around their neck or mouth, thus being strangled or starved to death. Plastic bags are thrown into the sea in vast numbers. Fish may get caught in them, and sea mammals may swallow them. In one instance, a volume of about 100 litres of plastic bags was found in the stomach of a whale (IMO, 1989 in Lutzen and Petersen, 1996).

In general, pollution of the sea from sea transport activities can affect public health, kill marine plants and animals, damage fisheries and reduce amenities. Again, the precise effects of substances spilled or released into the sea from ships (maritime transportation) depend on the types, the toxicity and the quantity of the substances, and also depend on the environmental conditions.

1. Concentration and extent of pollution

An important factor in determining the effect of a contaminant is its concentration. This will be highest at the site of an incident, but will progressively decrease with distance and time by dispersion and dilution. Dispersion will be least in still, enclosed waters, where the effects of the oil can persist for more than 10 years, and it will be greatest in areas exposed to the open sea, and when currents, tide and wind are strong. Bad weather can be favourable to rapid dispersal especially with off-shore winds, but adverse when sea conditions impede treatment operations.

According to the report of Lord Donaldson (1994), a very large spill over an extended area will have maximum impact. In the *IXTOC* incident (a wellhead blow-out in 1979) oil travelled across almost the whole width of the Gulf of Mexico and reached the shores of south Texas, but for most off-shore spills there is a good chance of the oil being dispersed and reduced to tar balls before it reaches the coast. Oil from the *ARGO MERCHANT* which ran a ground on Nantucket Shoals off the east coast of the USA in 1976, for example, was carried away and lost in the

Atlantic. On the other hand, a spill close to the coast can have maximum impact, especially with on-shore winds. The *AMOCO CADIZ,* grounding off Brittany in 1978, released 230,000 tonnes of oil which contaminated a wide range of coastal systems, including rocky shores, sandy pocket beaches, saltmarshes and estuarine tidal rivers.

2. The nature of the coastiine

Indeed, once pollutants have come ashore, the degree of damage will depend on the nature of the coastline. Rocky shores, which are usually populated by seaweeds and attached animals such as limpets and mussels, tend to be exposed to waves, and the movement of the seas has a cleansing action. Sandy beaches like along the coastline of Jakarta Bay, are also usually subjected to at least moderate wave action, but in this case waves may be able to bury the pollutants deep into the sand. Oil and other pollutants can become trapped in coastal wetlands or buried in beach sediments and may leach out for up to a decade.

Considerable efforts are made to treat a spill at sea and prevent it from reaching the coast, but local geography can cause problems. The configuration of the coast may make it difficult to set up protective booms, and clean-up after pollution may be impeded by the remoteness or inaccessibility of the site.

4.3. The Consequences of Pollution

4.3.1. Seabirds

Seabirds are the species most generally vulnerable, particularly to floating oil and other viscous substances. Birds which land on, or dive through, slicks become coated with oil, which clogs the fine structure of the feathers responsible for maintaining water repellence and heat insulation. This causes birds to lose their natural buoyancy and their thermal protection. In the struggle to stay afloat and keep warm they quickly become exhausted. In addition, they attempt to clean their plumage by preening and so ingest toxic oil.

4.3.2. Fish and Fisheries

Wild fish, living beneath the sea surface, are able to detect and avoid oil which contaminates the water column and are thus seldom directly affected by pollution. Fishing operations such as the shooting and hauling of nets and creels could be impeded, since gear operated through a slick would be contaminated. Most commercial species of invertebrates are not very mobile, especially those living on the seabed, and shellfish beds are at risk from oil sinking onto the bottom. Contamination of farmed fish is a major concern in Jakarta Bay, particularly in Kepulauan Seribu (Thousand Archipelago), as the fish are confined in cages and cannot avoid the oil.

4.3.3. Other wildlife

Other marine life plant and animal plankton in the water column are likely to be affected only immediately beneath heavy slicks. The major damage occurs when oil comes ashore and coats the beaches, smothering living organisms and causing toxic effects when fresh.

4.3.4. Local communities and economic damage

Damage to fish and fisheries and tourism can have a substantial effect on local communities dependent on them such as the villagers in Kepulauan Seribu - Jakarta Bay.

Oil spills and other pollution can also result in considerable harm to local communities when beaches and beauty spots are contaminated. Amenities are reduced and tourism is discouraged, perhaps with considerable financial loss to the area. Beaches which are oiled or covered with plastic debris and oiled seabirds lose their attraction and holidays are cancelled. Further, the loss of an area's reputation, however undeserved, can cause more damage than the pollution itself.

CHAPTER 5

LEGISLATION AND REGULATIONS ADDRESSING MARINE POLLUTION PREVENTION FROM SEA TRANSPORT ACTIVITIES

5.1. General Analysis of Existing Legal and Other Instruments Relating to Sea Transport Activities.

As seen before in Chapter-3, the different aspects of the prevention of marine pollution from sea transport activities in the Jakarta Bay (as well as in others area of Indonesia), involve not only regulations primarily aimed at the prevention of pollution, but also regulations related to safety. The aim of this chapter is to present an introductory overview of the relevant international legal instruments, with a focus on the extent to which they have, or can provide, special requirements for the Indonesian area.

Disposal of waste from ships is regulated by international, regional agreements as well as by national legislation. The states bordering on South-east Asia have adopted a number of international conventions with the purpose of preventing marine pollution. These conventions are incorporated in the national legislation.

5.2. International Legal Instruments

This chapter examines those international conventions which are of importance for the prevention of marine pollution and the reduction and regulation of discharges of waste substances into the oceans. In particular, MARPOL 73/78 and other important international conventions which are concerned with marine environmental protection are addressed.

Generally, the analysis of a convention's description in this chapter is based on "Status of Multilateral Conventions and Instruments in Respect of which the

International Maritime Organization or its Secretary General Performs Depository or other Functions" (IMO, 1994).

5.2.1. The United Nations Convention on the Law of the Sea, 1982 (UNCLOS)

a. Description

Adopted: 10 December 1982, Montego Bay, Jamaica
Entry into force: 16 November 1994

UNCLOS codifies what is generally accepted as customary international law, and sets forth provisions relating to vessel source pollution. The provisions relating to vessel source pollution are found in many parts of the Convention, most notably Parts II, III and XII.

The pertinent section of Part II addresses measures in the territorial sea. A Coastal State may adopt laws and regulations relating to passage of vessels through the territorial sea in respect to the safety of navigation and regulation of maritime traffic, the conservation of living resources of the sea and the preservation of the environment and prevention, reduction, and control of pollution.

Part III sets forth the regime applicable to vessels navigating in international straits. If a vessel is exercising transit passage, States bordering the straits may adopt laws and regulations to prevent, reduce and control pollution, by giving effect to applicable international rules regarding the discharge of oil, oily wastes and other noxious substances in the straits.

Part XII of UNCLOS expressly states the obligation of all States to protect and preserve the marine environment. If further sets forth obligations relating to each source of marine pollution. This part also contains both prescriptive and enforcement provisions relating to vessel source pollution. Article 211 *"Pollution from vessels"* sets forth the prescriptive measures. It requires States, acting through the competent International Maritime Organisation (IMO) or diplomatic conference, to establish international rules and standards to prevent, reduce and control vessel source marine pollution and promote the adoption of routing systems designed to minimise the threat of accidents which might cause marine pollution. It requires States to adopt laws and regulations to prevent, reduce and control pollution from vessels flying their flag. Such rules shall have at least the same effect as generally accepted international rules and standards. Article 211 calls on States within a region to co-operate in the establishment of port entry requirements. It reaffirms the rights and duties of coastal States regarding vessel source pollution set forth in Part II. In the Exclusive Economic Zone (EEZ), laws and regulations adopted to prevent, reduce and control vessel source pollution must conform and give effect to generally accepted international rules and standards.

There are provisions in Part XII that address situations where international rules and standards are inadequate. Article 211 (6) entitles coastal States to impose special mandatory measures, if the IMO so determines, for the prevention of vessel source pollution in a clearly defined areas of their EEZ where they are required because of recognised technical reasons in relation to the oceanographic and ecological conditions as well as utilisation or the protection of its resources and the particular character of its traffic.

b. Assessment

One advantage is that Indonesia has signed and become a party of the UNCLOS since 10 December 1982. Indonesia has ratified it on 3 February 1986. Actually, UNCLOS provides a general legal framework for dealing with shipping activities, but does not contain any specific regulations with regard to limiting and reducing pollution from shipping activities. UNCLOS can be regarded as a catalyst for the adoption of national laws and regulations to prevent, reduce and control marine pollution arising from shipping activities. Although the convention provides a general legal framework, issues like liability for marine pollution, reporting and inspection are not addressed and military vessels are to a large extent exempted from the provisions.

Because of its character as a framework Convention, and the fact that some aspects regarding shipping activities are not addressed in UNCLOS, this Convention is not in itself sufficient in order to regulate shipping activities.

5.2.2. The International Convention for the Prevention of Pollution from Ships, 73 (MARPOL 73/78)

a. Descriptlon

Adopted: 2 November 1973 / 17 February 1978, London

Entry into force: 2 October 1983

MARPOL is the most important international treaty to address vessel source pollution. Right now, MARPOL contains six separate Annexes. Annexes I and II are compulsory for all Contacting Parties. Annexes III, IV, V and VI are optional.

The Annexes encompass the following items:

- ***Annex I:*** This annex relates to measures against marine pollution by oil. The annex took force on 2 October 1983, since then it has been expanded with several amendments.

  The annex contains, i.a., regulations for the control of discharges of oil containing water, reception facilities for oil waste from ships, segregation of oil and ballast water, installations for oil retention on ships, inspection and monitoring systems for oil discharges, and various appliances for the prevention of pollution by oil.

- ***Annex II***: This provides regulations for control of harmful, liquid substances which are transported in bulk. Liquid substances carried in bulk (chemical tankers) into four categories, according to their hazard profile, and are identified as marine pollutants in the Bulk Chemical Hazardous (BCH) and in the International Bulk Chemical Code (IBC);

  Annex II entered into force on 6 April 1987, since supplements to the annex have undergone revision. The annex contains regulation for, i.a., discharge, inspection, tank washing, and log keeping for chemical tankers. Further, the annex contains regulations for the classification of liquid substances which are transported in bulk.

- ***Annex III***: This provides regulations for the prevention of pollution by harmful substances carried by sea in packaged form. There are substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) and therefore produce a hazard to aquatic life or human health.

  This annex entered into force on 1 July 1992. The annex relates to transportation by sea of packed chemicals and chemicals which are shipped in containers, railway wagons or lorry tanks. The annex lays down regulations for packing, labelling, stowing, and possible ocean disposal of such chemicals, which may take place only in cases of emergency.

- ***Annex IV*** (not yet in force): This provides regulations for the prevention of pollution by sewage from ships. The annex has not yet entered into force, as it has not yet been adopted by the required number of countries with sufficient ship tonnage. The annex contains regulations for the discharge of sewage from ships. Specific regulations are laid down for the processing of the sewage prior to discharge, and a minimum distance from the nearest land during discharge. The annex prescribes those countries that have adopted the annex to establish reception facilities for the sewage.

- ***Annex V***: This provides regulations for prevention of pollution by garbage from ships. This annex entered into force on 31 December 1988; since, it has been expanded with amendments.

  For the purposes of Annex V, "garbage" means all kinds of victual, domestic and operational waste due to normal operation of the ship, except fresh fish and substances included in the other Annexes to the MARPOL Convention.

- ***Annex VI***: Air pollution. This annex is intended to regulate the emission of halons, CFCs, NOx, SOx, VOCs and other emissions to air from ships. It has been discussed in detail earlier in chapter-3. This annex will enter into force when accepted by the required number of countries.

Furthermore, it should be mentioned that the Marine Environment Protection Committee (MEPC) on 16 November 1990 adopted a resolution on the use of tributyl tin (TBT) compounds in anti-fouling paints for shipping (resolution MEPC. 46/30) recommending Governments to "adopt and promote effective measures within their jurisdiction to control the potential for adverse impacts to the marine environment associated with the use of TBT compounds in anti-fouling paints".

One action of Indonesian Government should be considered is "to eliminate the use of anti-fouling paints containing TBT compounds on non-aluminium hulled vessels of less than 25 m in length".

In accordance with MARPOL Annexes I, II, V and the latest Annex VI (the Baltic Sea as *"a sulphur emission control area"* - not yet in force), certain sea areas can be designated "Special Areas (SAs)" in relation to the type of pollution covered by the relevant annex. The MARPOL 73/78 Convention defines a SA as *"a sea area where for recognised technical reasons in relation to its oceanographic and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by oil, noxious liquid substances or garbage are required"*. The protective measures that are applied in SAs are more stringent vessel discharge standards than in other areas.

Presently, Special Areas in relation to:

- Annex I are: the Mediterranean Sea area, the Baltic Sea area, the Black Sea area, the Red Sea area, North Sea area, the "Gulfs area", the Gulf of Aden area and the Antarctic area;
- Annex II are: the Baltic Sea and the Black Sea area;

- Annex V are: the Mediterranean Sea area, the Baltic Sea area, the Black Sea area, the Red Sea area, the Gulf area, the North Sea area, the Antarctic area and the Wider Caribbean Region;
- Annex VI is: the Baltic Sea which is the only one area at present pointed out as a *"SOx Emission Control Area".*

b. Assessment

One advantage is that Indonesia has adopted MARPOL, namely Annexes I and II, as compulsory. Through an accession, Indonesia also signed the optional Annexes III, IV and V of the Convention on 21 October 1986 and which entered into force for implementation in Indonesia on 21 January 1987.

Generally, the MARPOL 73/78 Convention sets global standards with regards to operational pollution from ships. In this connection, the Special Area's concept can be established according to Annexes I, II and V. MARPOL is still open for amendments and new solutions for the prevention of pollution from ships.

MARPOL is on the other hand a global Convention with a considerable number of Contacting Parties (95) representing a very large majority of the world's shipping fleet in tonnage (92,74%). Because of the migratory nature of shipping, there are considerable advantages connected with the application of global rules

Based on the determination and definition of Special Area of MARPOL 73/78, there are some (at least 24 Indonesian locations) which are designated as a National Marine Protected Areas (NMPAs). One example is Thousand Archipelago area (Kepulauan Seribu) in Jakarta Bay.

Beside the Special Area concept as a tool of marine environmental protection, there is also the possibility that an area can be designated through IMO as Particularly Sensitive Sea Areas (PSSAs). A proposal must be accompanied by identification of the measures needed in the area. Since the concept of PSSA has no legal status of its own, the possible measures must be found in conventions or other instruments issued by IMO, such as special routing measures in accordance with

SOLAS, COLREGS and the General Provisions on Ships' Routing, designation of the Areas to be Avoided (ATBA) under SOLAS or adoption of other measures aimed at protecting sea areas against damage from ships, such as mandatory Vessel Traffic Service Systems (VTSS) and compulsory pilotage.

5.2.3. The Convention on the International Regulation for Preventing of Collisions at Sea, 1972 (COLREGS)

a. Description

Adopted: 20 October 1972, London

Entry into force: 15 July 1977

COLREGS lay down requirements for the navigation of all ships to prevent collisions, including steering and sailing rules (e.g. proper look-out and traffic separation schemes), lights and shapes, and sound and light signals. The Convention applies to the prevention of collisions between vessels, but not to groundings.

b. Assessment

One advantage is that Indonesia has signed and become a party of this convention since 13 November 1979 and at the same time this convention directly entered into force for implementation in Indonesia.

For the Indonesian area, as an archipelagic country, it has a high risk of collisions, (in particular the Malacca Strait, the busiest vessel traffic area in the world). Here in other areas, such as Jakarta Bay, application of COLREGS is essential.

5.2.4. The International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC)

a. Description

Adopted: 30 November 1990, London

Entry into force: 13 May 1995

The convention requires ships to carry a shipboard oil pollution emergency plan (also required by MARPOL), the contents of which have been developed by IMO. Ships are further required to report incidents of pollution to coastal authorities (also required by MARPOL).

The resolution 7 of the OPRC is the most important provisions (development and implementation of training programme for oil pollution preparedness and response) for country like Indonesia. The convention noting that a key element in the IMO's strategy for protection of the marine environment is the enhancement of the capacity for national and regional action to prevent, control, combat and mitigate marine pollution and to promote technical co-operation.

b. Assessment

Eventhoug the Indonesian representative was joint the conference of OPRC at the Headquarters of IMO (19 to 30 November 1990), up to now, Indonesia has not ratified this Convention.

5.2.5. The International Convention for the Safety of Life at Sea 1974 (SOLAS)

a. Description

Adopted: 1 November 1974, done at London

Entry into force: 25 May 1980

Of all the international Conventions dealing with maritime safety, the most important is the International Convention for the Safety of Life at Sea (SOLAS). This Convention covers a wide range of measures designed to improve the safety of shipping. SOLAS, as amended, sets out detailed regulations on the construction of ships, stability, machinery, electrical installations, fire protection, life-saving appliances, radio-communications, safety of navigation, the carriage of goods by sea and regulations pertaining to nuclear ships.

Generally speaking, safety factors in terms of sea transportation activities play an important role, contributing to improving of marine pollution prevention.

b. Assessment

One advantage is that Indonesia has adopted the SOLAS Convention. Indonesia signed this Convention on 17 February 1981 and three months later it entred into force for implementation on 17 May 1981.

Chapter V of SOLAS has direct relevance to the protection of the marine environment from vessel source pollution. Regulations V/8 and V/8-1 address the adoption of routing systems, including any mandatory systems, for vessels. The regulations recognise that such systems contribute to, and may be based on, concern for the safety of life at sea, the safety and efficiency of navigation and/or the protection of the marine environment. The reporting amendment came into force on 1 January 1996 and the routing amendment came into force on 1 January 1997.

5.2.6. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW'95)

a. Description

Adopted: 7 July 1978, London

Entry into force: 28 April 1984

This Convention provides regulations for the basic principles to be observed for keeping navigational watch, radio and engineering activities, and lays down minimum requirements for certification. The Convention was revised in 1995 and the new and more specific regulations entered into force in 1997.

b. Assessment

One advantage is that Indonesia is a Party to STCW and it has been adopted by the Indonesian Government into its national regulations. Indonesia signed STCW on 27 January 1987, and three months later it entred into force for implementation on 27 April 1987.

STCW lays down the minimum requirements for certification and requires e.g. knowledge of navigation and the protection of the marine environment. STCW also could be amended to set stricter standards so Indonesian crew qualifications can compete with foreign crews internationally.

5.2.7. The International Convention on Civil Liability for Oil Pollution Damage, 1969 (Civil Liability Convention or CLC, 1969)

a. Description

Adopted: 29 November 1969, Brussels

Entry into force: 19 June 1975

The CLC Convention deals with the liability of the shipowners for oil pollution damage. The Convention lays down the principles of **Strict liability** for shipowners and requires them to take out *liability insurance* which is normally made through P&I Clubs.

The aim of the CLC is to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. CLC places the liability for such damage on the owner of the ship.

Subject to a number of specific exceptions, this liability is strict; it is the duty of the owner to prove in each case if any of the exceptions should in fact operate. Except where the owner has been guilty of actual fault, he may limit his liability wich respect to any one incident.

b. Assessment

One advantage is that Indonesia is a Party to the 1969 CLC and the 1971 Fund Convention but not the 1992 Protocols thereto, it ratified the CLC 1969 on 1 September 1978 and three months later it entred into force for implementation in Indonesia on 30 November 1978.

CLC 1969 has high relevancy considering the international oil sea-borne trade that passes through Indonesian territorial waters. This means that Indonesia has a high risk of damage from oil pollution when accidents occur.

5.2.8. The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (Fund-Convention)

a. Description

Adopted: 18 December 1971, Brussels

Entry into force: 16 October 1978

The Fund-convention (Fund) is supplementary to the CLC and creates a system whereby additional compensation is to be provided to a Member State which is a victim of an oil spill and cannot obtain full compensation for the damage either from the shipowner or from the insurance company under the CLC Convention.

The main purposes of the Fund convention are to provide compensation for pollution damage to the extent that the protection offered by CLC is inadequate; and to give relief to shipowners in respect to the additional financial burden imposed on them by CLC. Such relief is subject to conditions designed to ensure compliance with safety at sea and other conventions. The Contributions to the Fund are made by the oil industry in the Member States of the convention and are based on the yearly quantities of oil transported by sea to those States.

b. Assessment

One advantage is that Indonesia signed the 1971 Fund Convention on 1 September 1978, and three months later it entred into force on 30 November 1978 for implementation in Indonesia, but not the 1992 Fund Protocols.

5.3. Regional Agreements or Legal Instruments

In addition to these important agreements concerning marine pollution, there are a number of agreements between two or more of the South-east Asian countries. These are not discussed in the following, but only the latest one and the more comprehensive agreement, which can be a representative of those regional agreements are discussed briefly below.

5.3.1. Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas

Established in 1995, under the Global Environment Facility (GEF), the United Nations Development Programme (UNDP), the International Maritime Organisation (IMO) and its Programme Development and Management Office (PDMO) for the Marine Pollution Programme in the East Asian Seas.

The primary objective of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas is to support the efforts of the 11 participating governments in the East Asian region to prevent and manage marine pollution at the national and subregional levels on a long-term and self-reliant basis. The 11 participating countries (in alphabetic order) are: Brunei Darussalam, Cambodia, Democratic People's Republic of Korea, Indonesia, Malaysia, People's Republic of China, the Philippines, Republic of Korea, Singapore, Thailand and Vietnam. It is the Programme's vision that, through the concerted efforts of stakeholders to collectively address marine pollution arising from both land- and sea-based sources, and to see that adverse impacts of marine pollution can be prevented or minimised without compromising desired economic development.

The programme framework is built upon innovative and effective schemes for marine pollution management, technical assistance in strategic maritime sectors of the region, and the identification and promotion of capability-building and investment opportunities for public agencies and the private sector. According to Calow and Forbes (1997), the Specific Programme Strategies are:

- develop and demonstrate workable models on marine pollution reduction/prevention and risk management;
- assist countries in developing the necessary legislation and technical capability to implement international conventions related to marine pollution;
- strengthen institutional capacity to manage marine and coastal areas;
- develop a regional network of stations for marine pollution monitoring;

- promote public awareness on, and participation in, the prevention and abatement of marine pollution;
- facilitate standardisation and intercalibration of sampling and analytical techniques and environmental impact assessment procedures; and
- promote sustainable financing mechanisms for activities requiring long-term commitments.

The implementation of these strategies and activities will result in appropriate and effective policy, management and technological interventions at the local, national, and regional levels, contributing to the ultimate goal of reducing marine pollution in both coastal and international waters, over the longer term.

5.4. National Regulation or Legal Instruments

The obligations assumed by Indonesia in relation to marine environment pollution from ships, are formulated in relation to international conventions. The international conventions are implemented through their integration into national legislation. To an extent the matters agreed to internationally seek to regulate the actions of persons or organisations of legal standing. Enforcement is generally not provided for the international setting but must be arranged in national laws, regulations, and decree.

5.4.1. Shipping Acts and Supporting Regulations

MARPOL 73/78 was ratified in Presidential Decree 46 of 1986, and its provisions have been implemented in the Shipping Act of 1992. However, the shipping Act leaves a number of issues to be further stipulated by Government Regulation. There are several such Government Regulations which have been drafted and are in various stages as the following:

- Draft of Government Regulations on port affairs, navigation, and maritime transport have already been submitted to the State Secretariat, and their promulgation is reported to be imminent;

- Draft of Government Regulations on shipping and seafarers are still in inter-departmental discussion, and will subsequently be forwarded to the State Secretariat as well;

- Draft of Government Regulations covering enforcement, control, implementation and an arrangement of regulations of a Maritime Court, are under preparation in the Indonesian Ministry of Communications (MOC).

Those drafts of Government Regulations, although more specific in nature than the Shipping Act, leave a number of technical details to be further stipulated in Ministerial Decrees which are prepared by the Directorate General of Sea Communications (DGSC).

The ratification of MARPOL 73/78 implied acceptance of Annexes I and II. A Presidential Decree is in preparation by the MOC. Under existing shipping legislation, the Indonesian Government has already issued a number of regulations and decrees. To meet its responsibilities under Annex I of MARPOL 73/78 for Flag State Control, the MOC has issued Ministerial Decree 167 of 1986 on the International Oil Pollution Prevention Certificate, which, *inter alia,* deals with arrangements for discharge and storage of oil residues and oily waste.

Indonesia has also ratified the Annex V of MARPOL 73/78, which deals with garbage from ships. In this case the reception facilities for garbage from ships has been mandated. As regards the Port State responsibilities, the MOC has issued Ministerial Decree 215 of 1987 instructing the gateway ports (Belawan-Medan, Tanjung Priok-Jakarta, Tanjung Perak-Surabaya, and Makassar-South of Sulawesi) as well as special ports of oil (Port of PERTAMINA) and shipyards (PT. Koja Bahari - Jakarta) to install ship waste reception facilities by 1 April 1988.

5.4.2. Environmental Legislation

The basis of environmental regulations in Indonesia, related to port environmental management, is contained in Law 4 of 1982 (*Basic Provisions for the Management* *of the Living Environment Act*). It is also supported by Government Regulation No. 51 of 1993. Law 4/1982 established the right of the Ministry of Environment (MOE) to issue further regulations and to co-ordinate environmental management across the different sectors of government activities. It also introduced an environmental impacts analysis (ANDAL). In this connection, the MOC has issued Ministerial Decree No.1 of 1992, stating that development planning and other operational activities in ports must take the ANDAL procedures into account. It is also supported by Ministerial Decree No. 75 of 1994 of the MOE which issues technical guidelines for ANDAL in ports and for port activities.

Other other environment legislation is provided by Law No.5 1990, which is refered to the *"Conservation of Living Natural Resources and their Ecosystem Act"*. It is seeks to have sustainable resources utilisation in balance with ecosystem maintenance. This law provides for management and marine conservation, including marine parks and reserves and is the key legislation used for the management of all protected areas in Indonesian territorial waters.

Another important piece of legislation is Law No.24,1992, the "*Spatial Planning Act*", in which the management of land, sea and air resources are to be spatially accommodated in a co-ordinated, integrated and sustainable manner at national, regional and local levels.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1. Marine Environment of Jakarta Bay

The current Jakarta Bay marine environment was discussed in chapter II of this study. From the data shown, the main conclusion can be that presently, on average, the amount of marine pollution from the physical, chemical and biological point of view is still within allowed limits of the Indonesian mariculture standard. Except for the metal elements such as Pb, Zn, and Ni are in exceed of allowed limits.

Based on the above, the important recommendations to the public authority of the Regional Government of Jakarta should be to give priority to a marine monitoring program that serves management purposes. This is an important aspect in the process of protecting and managing the marine environment against pollution by the measurement and assessment of environmental quality. Ideally, monitoring efforts go beyond identifying the state of the marine environment. Changes and possible ecological and socio-economic impacts on the marine environment should be predicted and then translated into terms understood by management. Eventhoug the existing marine pollution monitoring efforts in the Jakarta Bay area, of which there are many, but they have not been effective in assessing and predicting changes and impacts nor in providing guidance to marine environmental management.

In the development of control strategies for reducing marine pollution, a number of factors must be taken into account, in addition to the level of scientific and technological capabilities. There are four phases of reducing marine pollution which should be taken as follows.

1. Collection of basic information

This will require an analysis of the substances that may be introduced into the marine environment, their sources, pathways, potential targets, the general characteristics of the marine environment concerned and the available technology for pollution control.

2. Environment Impact Assessments (EIA)

The assessment of how a pollutant impacts on the marine environment is critical. This will include the identification of targets and possible targets at risk, identification of pathways by which the pollutant may reach the targets at risk, selection or derivation of standards, by utilising existing standards achieved by data from similar cases.

3. Control Action and Implementation

There are two main categories that should be addressed to reduce marine pollution, as follows.

a. Improving management of the marine environment

This aims at a reduction of substances introduced in variety, quantity and toxicity. This will focus on producers and users of pollutants from land-based sources. For new installations an environmental impacts assessment (EIA) should be undertaken. In other words, for each existing plant, prior to the drawing-up of statutory disposal standards it is necessary :

- to estimate the discharge in quantity and quality by measuring any relevant parameters;
- to assess the various existing techniques to eliminate or to reduce pollution;
- to estimate the economic consequences on the industrial activities themselves; and
- to define the quality objectives for the receiving environment.

b. Regulatory measures and monitoring

An important aspect in the process of protecting and managing the marine environment against pollution is the measurement and assessment of environmental quality. Ideally, monitoring efforts go beyond identifying the state of the marine environment.

Laws and regulations which aim at achieving the minimum proposed standards of prevention, reduction and control of marine environmental degradation should be put in place. This will include environmental quality standards, emission standards and specification standards.

In addition, the orders authorising any disposal should lay down the means of analyses and the measures necessary for the control of the facility and supervision of its effects on the environment, together with arrangements for the results of these analysis and measures to be reported to the authorities.

4. Evaluation

The effectiveness of the control measures should be evaluated by monitoring changes in the state of the marine environment.

In this context, some of the steps that could be taken by the Regional Government of Jakarta as a process to establish a monitoring programme as part of the marine environment management system as follows:

- Adopt a common water quality standard;
- Standardise sampling and analytical methods;
- Initiate a training programme for greater environmental competence;
- Use agreed standard procedures and references, incorporating quality assurance/quality control protocols;
- Integrate the different monitoring programs of the local areas into a single unified monitoring programme;
- Collate and evaluate the monitoring results; and

- Regularly report to a local coastal management committee any recommended management interventions.

6.2. Shipping Activities In Jakarta Bay Area Related to Marine Pollution

These were discussed in Chapter III of this study. It showed that there is not sufficient information with regard to present and future shipping activities in the Jakarta Bay area, and those activities have potential effects on the marine environment. This is partly a result of lack of compatibility of the current data on shipping. It is also a result of limited knowledge about the future expansion of shipping activities associated with Indonesian sea routes, oil and gas development and mining activities.

In this context some steps should be taken by the Regional Government of Jakarta to promote the sustainable development of shipping industry and the marine environment in Jakarta Bay. They are as follows:

- Develop a co-ordinated system for collection and sharing of data on shipping activities and the environmental effects thereof;
- Undertake an assessment of the potential of current activities and future increases in shipping activities due to expansion of the Indonesian sea route, oil, gas, mining and other significant activities;
- Initiate development projects within the shipping industry for reduced environmental impact;
- Promote the ongoing work with regard to the development of an IMO Code, with standards for ship construction and crew qualifications and facilitate implementation of the code;
- Initiate a review of the adequacy of national and international measures to address prevention of any chronic pollution problem of marine environment from sea transport activities; and
- Investigate additional regulatory measures for the prevention of marine pollution from sea transport activities such as pollution from the uses of Tri Butyl Tin (TBT) in anti-fouling paints, NOx and SOx from fuel oil, and new species carried in ballast tanks.

The other recommendations that should be taken by the Port Authority of Jakarta against chronic marine pollution from ships while in port area are as follows:

1. Garbage

Pollution by garbage can be avoided by the introduction of collecting services. This could be done by a barge service, collecting garbage from the ships or by placing garbage containers on the quays. It is also suggested that the use of reception facilities should be made compulsory and should be enforced. It also should be realised that charges to the ships should be realistic in order to keep the port competitive and to avoid illegal discharges or dumping of garbage into the sea.

2. Cargo hold wastes from dry cargo vessels

Particular attention should be paid to the waste material, depending on the type. In this case it should be treated according to its harmful properties. In other words, adequate reception and treatment facilities should be available in the port area.

3. Sewage

The MARPOL 73/78 Convention also applies to the disposal of sewage from ships at sea. This may lead to the necessity of sewage reception and treatment facilities in port areas such as Tanjung Priok Port.

4. Oily and chemical waste

Reception facilities in port are required to enable ships to dispose of oily and chemical wastes. The necessity for a port to create reception facilities depends on the type of vessels calling at the port. It may be a dedicated terminal but a barge service collecting wastes in the port may be equally effective. Charges to ships should be realistic, in order to avoid illegal discharges or dumping of harmful oily and chemical wastes into the sea. This could equally be achieved by incorporating the discharge costs in the harbour dues. Thus, the disposal appears to be free of charges and illegal discharges or dumping is discouraged.

5. Ships maintenance and repairs process

Water and grit used for ship maintenance and repairs that become contaminated should not be dumped into the port water area. It is recommended that a system be implemented by which the port authority may attach conditions to a permit to carry out certain repairs. The system should also contain rules for the disposal of the contaminated waste materials.

6.3. Pollution and the Environmental Threat to the Jakarta Bay Area

This was discussed in chapter 4 of this study. The main conclusion on chapter 4 is that pollutants are extremely harmful to the marine environment. During the last few decades the pollution of the Indonesian oceans has become a matter of increasing public concern, especially for the Jakarta Bay area. Most of it comes from land-based sources and includes the 5 products of industrial waste, run-off from agriculture, such as pesticides, fungicides and herbicides, and discharges from urban areas and result of shipping activities.

In this context some of the steps that should be taken to minimise marine pollution of Jakarta Bay are:

- The industrial, agricultural (including mariculture), and domestic/urban discharges into marine environment of Jakarta Bay should be effectively regulated;
- Pollution generated from ships, whether while in port or in the open sea, should be controlled by flag and port state implementation;
- Appropriate and adequate reception and treatment facilities for ship waste should be provided in all port (Tanjung Priok, Sunda Kelapa, PERTAMINA, and Marina) areas around Jakarta Bay;
- Public media should be used to propagate the cause of pollution reduction among people (advising customers of social and ethical responsibility); and
- The sensitive environment of wetlands and mangroves should be given additional attention to safeguard them from pollution.

The logical threat to the marine environment of the Jakarta Bay area from the sea transportation point of view is as the follows:

- More ships at bay raise the probability of the occurrence of operational and accidental pollution incidents.
- Increased traffic concentration in Jakarta Bay (Tanjung Priok Port) approaches pose higher collision risks.

6.4. Legal Instruments for Marine Environmental Protection Relating to Sea Transport Activities

The legal instruments relating to marine environmental protection in Indonesia (Study of Jakarta Bay) was discussed in chapter 5. The main conclusion is that the current legal instruments for marine environmental protection in Indonesia still need to be further addressed.

In view of the above, some important recommendations for the Indonesian Government via the Ministry of Communications to achieve better marine environmental protection are made, as follows:

- The implementation and enforcement of environment laws should be the foremost requirement of the Indonesian environmental protection programme.
- Supplementary legal instruments to address marine environment issues should be prepared.
- The necessary framework to provide integrated marine environmental protection should be prepared;
- Co-operation and co-ordination among the scattered agencies with environmental responsibilities should be encouraged.

It can also be concluded that sea transport activities in Jakarta Bay are one of the sources of marine pollution which has attracted global attention more than any other source. It was also noted that Indonesia has not yet ratified some of the important IMO conventions which are very important for marine environmental protection and Indonesia is not a very active member of the UNDP Regional Programme for the

Prevention and Management of Marine Pollution in the East Asian Seas. In this context some of the recommendations to be pursued by Indonesia are the following:

- Indonesia should ratify some important IMO Conventions which are essential for the marine environmental protection programme, namely:
  - MARPOL 73/78 Annex VI (Air Pollution from Ships);
  - OPRC 1990;
  - CLC (the 1992 Protocols thereto); and
  - Fund Convention (the 1992 Protocols thereto).
- The ratified IMO Convention should be timely integrated into Indonesian national laws and applied in daily activities of sea transport operations.
- Indonesia as a maritime country should participate more actively in the IMO proceedings.
- Indonesia should also more actively participate in the UNDP Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas.

6.5. Concluding Remarks

The Jakarta Bay area is still underdeveloped. In regard to Indonesian marine environment protection this is an added value. However, the future prospect of development along the coast of Jakarta Bay and others Indonesian coastline is expected.

To achieve sustainable development, better understanding of Indonesian marine environment protection should be taken before the development takes place. Today the Indonesian government is faced with the complex problem of encouraging development for economic growth while at the same time attempting to contain the damage of environment.

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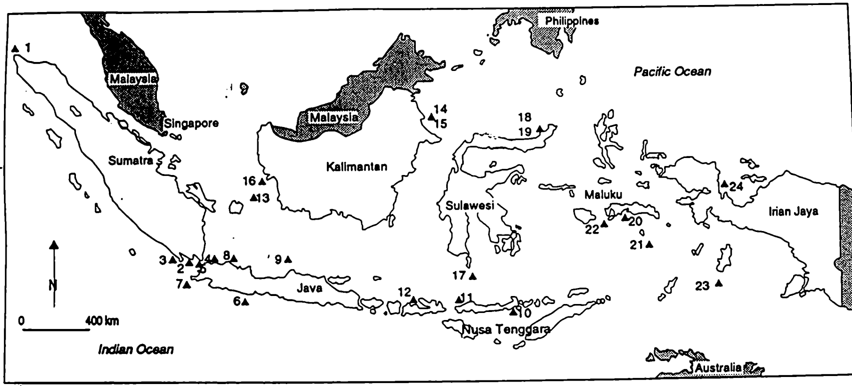
APPENDIXES

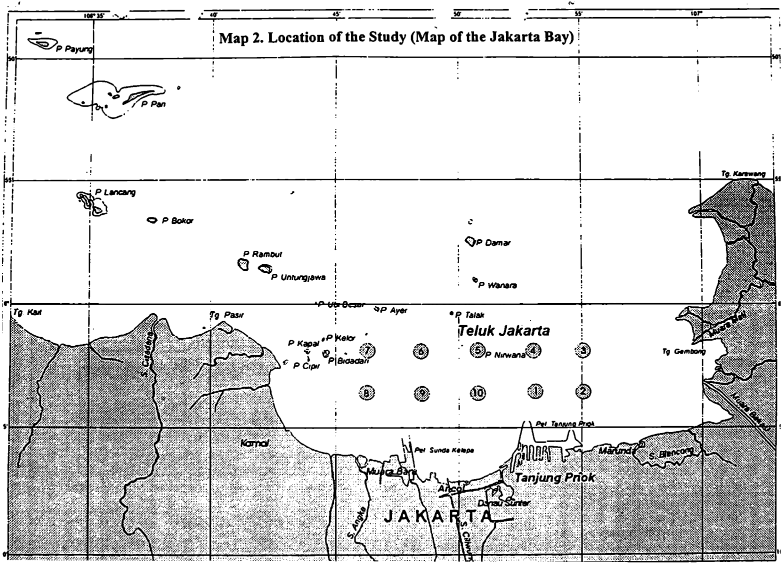
Map 1. The Indonesian and Archipelago Waters

(Distribution of Indonesian Marine Protected Areas, year of declaration in parentheses).

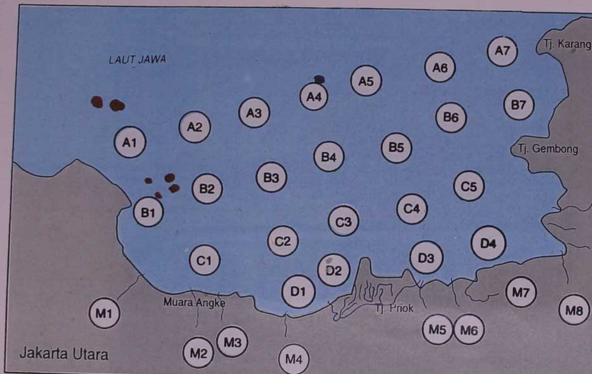


1 Pulau We, Sumatra (1982)
2 Kepulauan Krakatau, Sumatra (1990)
3 Bukit Barisan Selatan, Sumatra (1990)
4 Pulau Dua, Java (1974)
5 Pulau Sangiang, Java (1985)
6 Leuweung Sancang, Java (1990)
7 Ujong Kulon, Java (1992)
8 Kepulauan Seribu, DKI, Jakarta (1982)
9 Karimnjawa, Java (1886)
10 Teluk Maumere, Nusa Tenggara (1987)
11 Tujuh Belas Pulau, Nusa Tenggara (1987)
12 Pulau Moyo, Nusa Tenggara (1986)
13 Kepulauan Karimata, Kalimantan (1985)
14 Pulau Semana, Kalimantan (1982)
15 Pulau Sangalaki, Kalimantan (1982)
16 Tanjung Keluan, Kalimantan (1984)
17 Kepulauan Taka Bone Rate, Sulawesi (1989)
18 Bunaken Manado Tua, Sulawesi (1986)
19 Arakan Wowontulap, Sulawesi (1986)
20 Pulau Pombo, Maluku (1973)
21 Pulau Banda, Maluku (1977)
22 Pulau Kasa, Maluku (1978)
23 Kepulauan Aru, Maluku (1991)
24 Teluk Cendrawasih, Irian Jaya (1990)

Source: Research Centre of Oceanology of Indonesian Scientific Institution (LON-LIPI) Jakarta, 1997



Map 2. Location of the Study (Map of the Jakarta Bay)



Map. 3

LOCATION OF WATER QUALITY MONITORING IN JAKARTA BAY (1996/1997)

NOTES:

- River
- Sample location
- Rambut Archipelago
- Damar island
- Sea
- Jakarta Area

Source: *KPPL DKI Jakarta*