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Environmental considerations for Sihanoukville port development in the Kingdom of Cambodia

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ENVIRONMENTAL CONSIDERATIONS FOR SIHANOUKVILLE PORT DEVELOPMENT IN THE KINGDOM OF CAMBODIA

By

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Kingdom of Cambodia

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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: Environmental Impacts of Sihanoukville Port Development in the Kingdom of Cambodia.

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The dissertation is a study of the environment constraints, which may be created from Sihanoukville Port development in Cambodia. This dissertation can be used as a fundamental guide for evaluation of the degree and level of pollution, in order to prevent, reduce and control of pollution resulting from port location, port construction and port operation. It consists of seven chapters connecting to the development of Sihanoukville Port and the environmental considerations from this development.

Firstly, the author will addresses the historical background including the socio-economic situation and natural resources condition in the Kingdom of Cambodia, and the port and transportation network and its development. Secondly, there will also be discussed of the impacts of port location, port construction and port operation on the natural resources, water, air and soil quality by the construction material, shipping activities and cargo handling in the port.

In this dissertation, the author will also review of the international and national instruments which are related to the prevention and mitigation of environmental pollution from port construction and port activities and will also focus on how to implement them.

In addition, the author will also address the policy of the government and the roles and responsibilities of the Ministry of Environment regarding to the development of the Sihanoukville Port Development Project.

Finally, the concluding chapter will evaluate the degree of environment constraints from the development of Sihanoukville Port and how the constraints can be mitigated if the project comply with national and international instruments. A number of recommendations are made to prevent and reduce pollution from Sihanoukville Port development.

Keywords: Environmental constraints, evaluation, prevention, reduction, control, and pollution.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
CKC	State Fuel Company
dwt	Death weight tonnages
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GFRS	The Global Foundation for Research and Scholarship of Japan
IMO	International Maritime Organization
JICA	Japan International Co-operation Agency
km	Kilometre
km^2	Square kilometre
LC	London Convention
LDC	The Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Dumping Convention)
LEPNRM	The Law on Environmental Protection and Natural Resource Management
LLMUC	The Law on Lands Management, Urbanization and Construction
m	Metre
m^3	Cubic meter
MARPOL	The International Convention for the Prevention of Pollution from Ships
MOE	Ministry of Environment
MPWT	Ministry of Public Works and Transportation
MSEP	Maritime Safety and Environmental Protection
NGOs	Non Governmental Organizations
RGOC	Royal Government of Cambodia
UNDP	United Nations Development Program
UNEP	United Nation Environmental Programme
UNTAC	United Nations Transitional Authority in Cambodia

US$	United States Dollar
WMU	World Maritime University
WPC	Water Pollution Control

CHAPTER 1
INTRODUCTION

1.1 Description of topic

The Kingdom of Cambodia is a country covering an area of 181,035 square kilometres. It situated in the Southeast Asia. The coastline of Cambodia comprises 435 km in three provinces: Kamport, Koh Kong and Sihanoukville.

Sihanoukville is the most important coastal province, with land used for agriculture and forestry, tourism, fisheries, industrial and harbour development, navigation, natural conservation and oil exploration. Population density is greater than the other two provinces, composed of mostly businessmen, farmers and fishermen. Most of population migrated from the other provinces in the country.

Since the Royal Government of Cambodia was established in 1993, the Government has been pursuing two basic principles, which are to establish the strategy and administration for the rehabilitation and the development of the country, and to promote private sector participation in the economic development of Cambodia, which includes Sihnoukville International Port development.

According to the plan of the Royal Government of Cambodia for developing an industrial zone in the North-eastern of Sihanoukville, and the cargo traffic in Sihanoukvillle Port has subsequently increased at every high rate over the past five years; therefore, the Government of Cambodia has a plan to build a new

Sihanoukville Port up to the year of 2015. New port development may create local environmental problems during both construction and port operations.

1.2 Aim of the dissertation

In this dissertation the writer will address the issues of the environmental constraints from the new Sihanoukville Port location, Sihanoukville Port construction and operations, and then find methods to prevent and mitigate the pollution. The writer will evaluate and analyze the impacts of the location of Sihanoukville Port on the marine environment and the socio-economics of the people, who are living in the project area. This including the resettlement of the people, losing their jobs and their business opportunities.

The author will also address and analyze on the accident from ship activities, such as cargo handling and collision. As accidents happen, they create many problems to the environment, especially to the marine environment and local socio-economy.

The Environmental Impacts of Sihanoukville Port Development will provide a fundamental analysis of the environmental considerations for Sihanoukville Port location, port construction and port operation, and how to implement national and international instruments for this development. From this point of view, this dissertation will help to prevent, reduce and control the pollution from the development of Sihanoukville Port on the marine environment to ensure sustainable development.

1.3 Difficulties

There are some difficulties faced during writing this dissertation due to the fact that information related to the topic is not available or out of date. The other difficulty faced is that during semester break, the author was not able to conduct interviews

with the people living in the proposed area because at that time Sihanoukville was faced with a strike as the result of toxic wastes imported to Cambodia.

1.4 Research methodology

During writing this dissertation, the author has been contacting colleagues, searching documents in the university library, and on the internet, asking people for information, interviewing professors and experts, frequency consulting with his supervisor, and making contacts and searching for information during field training and semester break.

CHAPTER 2
HISTORICAL BACKGROUND

2.1 Geography

Cambodia has a land area of 181,035 km^2, which is located in the south-western part of the Indochina peninsula, and about 20% of which is only used for agriculture. It lies completely in the tropics with its southern, most point slightly more than 10 degrees above the Equator. International boarders are shared with Thailand and the Lao People's Democratic Republic in the western and on the north and the Socialist Republic of Vietnam on the east and the south-east. In the south-west, Cambodia is bounded by the Gulf of Thailand (see Figure 1). Cambodia has a 435 km coastline which lies along the three provinces Kampot, Sihanoukville, and Koh Kong.

2.2 General aspects of the country

Cambodia is well known in agriculture productions and forestry resources such as rice, rubber and logs. In the 1960s, the country was enjoying a growing economy in the production and trade of these products. However, through a period of the disturbance of civil war, the infrastructure of the country was almost completely ruined. The economic activities were stagnant over the years from 1979 to 1990.

The restoration of the nation was then started by the newly established Royal Government of Cambodia (RGOC) within a framework of parliamentary democracy, after an election was conducted under the United Nations Transitional Authority in Cambodia (UNTAC) in 1993.

The new government is making a great effort to rehabilitate the nation and to restructure its previous plan to free a market economy. The new government published the five-year economic development plan in 1996, which announced its policy and strategy to the public.

Moreover, after the economic boom during the UNTAC period, the government continuously exerted its great effort in the rehabilitation and restoration of urban and rural infrastructure basically; the basic government intention was to invite investment by the private sector both foreign and local based.

According to the policy of the Royal Government of Cambodia (RGOC) in term of the rehabilitation and the development of the country, various investment projects have been brought into the country. Among other rehabilitation and development projects of the infrastructure, the Government of Cambodia has a plan to build a new international port, which is located close to the old International Sihanoukville Port.

The new International Sihanoukville Port will construct on 12 ha of land area. It is situated at the south-west entrance at Kompong Some Bay where there are small islands lining up to the coast, in the gulf of Thailand. The port is ideally located between Koh Poah island and mainland, with a natural navigation channel and natural break water, which connects offshore with a water depth of 8 m.

The old Sihanoukville Port was constructed in the 1960s. This port is one of the two main international ports in Cambodia. The other international port, which also handles foreign cargoes, is Phnom Penh Port. These two ports shared the same functions as the gateways of the country.

Being the main international seaport, Sihanoukville Port handled most of the bulk cargoes, heavy machinery, wood product and almost all containers. It can accommodate vessels of up to 10,000 dwt. Despite this, Sihanoukville Port managed

only 15,7% of oil in 1995, and the rest of 84,3% was handed by Phnom Penh Port. It is expected to increase its share of oil handling volume with other companies for oil terminal at Sihoukville.

2.3 Socio-economic aspects

2.3.1 Population

An estimated that 85 to 90 percent of the population of Cambodia lives in rural areas. Ethnically, the population consists of about 90 percent Khmer, 5 percent each of Chinese and Vietnamese, and small numbers of hill tribes (Chams and Burmese). Khmer is the country's official language. It is spoken by more than 95 percent of the population. Older people also speak French as a second language. English is more commonly spoken by the younger generation.

The social indicators of human development such as the high fertility rate of 5.1 births per woman, infant mortality at 110 per 1,000 live births, and a life expectancy of 53, reflect the impact of poverty and inadequate health and education systems. 30 percent of the population is below the poverty line.

According to a source from the Ministry of Planning of Cambodia, the population of Cambodia at midnight of March 3, 1998 was 11.43 million, which consists in 5.51 million males and 5.92 million females (see Table 1).

The population of Cambodia was about seven million in 1970 with an annual growth rate of 2.4%. By 1980, the total population had fallen to 6.4 million with an annual growth rate of 0.8 percentage. The population shortfall in 1980 is attributed to a net migration of people through the 1970s to mid 1980s, the decline in birth rate, and excess death during the years of 1970-79 caused by civil war, bombing and growing food shortages. An estimate showed that more than one million people died during the Khmere Rouge regime. Furthermore, during civil war from 1970-75, there was a

mass immigration from the countryside to capital city of Phnom Penh. However, during the Khmere rouge regime, the inhabitants were forced to move into the rural areas, from Phnom Penh as well as the other cities in the country.

Table 1 Population of Cambodia from 1962 to 1998

Sources	Population			Remarks
	Both Sexes	Males	Females	
1962 Census	5,728,771	2,862,939	2,865,832	Reference time of census night of April 18, 1962
1980 General demographic survey	6,589,954	3,049,450	3,540,504	With reference to the end of 1980
1993-94 Socio-economic survey of Cambodia	9,870,000	4,714,000	5,156,000	Extrapolated population with reference to April 1994, based on a sample of 5,578 households
1996 Demographic survey of Cambodia	10,702,329	5,119,587	5,582,742	Extrapolated population with reference to April 20 1996, based on a sample of 20,000 households
1998 Census	11,426,223	5,509,204	5,917,019	With reference to March 3, 1998. Does not include a few areas where conflict took place at the time of census. The population in these areas is estimated as 45,000

Source: Ministry of Planning, Cambodia

It was forecasted that the population may considerably increase in the year of 2015 (see Table 2).

Table 2 Forecast of Population growth

(Unit: 1000)

	1994	1995	2000	2005	2010	2015
Population	9,870	10,107	11,403	12,964	14,763	16,504
Annual growth rate(%)		2,4	2,4	2,6	2,6	2,3

Source: JICA, 1996

2.3.2 Gross domestic product

The Cambodian economy stagnated in 1998 and saw no gross domestic product (GDP) growth due to poor rains, the continuing regional economic crisis and local political uncertainty in the run up to the elections in July 1998. GDP growth in 1998 is estimated at zero percent (World Bank). In the five years up to 1997, the Cambodian GDP grew at an average rate of six percent. In 1996, JICA forecasted that Cambodian GDP growth rate will be of 6 percent in the year 2015 (Appendix 1).

In addition, the inflation rate in Cambodia in 1998 was 12 percent and 9.1 percent in 1997compared with a target of 5 percent. Cambodia's account deficit in 1998 was an estimated $329 million, or 1.6 percent of the GDP, compared with $561 million, or 15.2 percent of the GDP in the previous year.

In 1998, foreign direct investment was seen at $120 million in the previous year while official development assistance edged lower to around $203 million in 1998 compared with $208 million the previous year. Budget revenue as a percent of GDP was 8.1 percent in 1998 compared with a target of 11.1 percent and actual rate of 9.7 percent in 1997. This level of domestic revenue is about half of the average for lower income countries (World Bank).

The main reason for the poor revenue performance were inadequate implementation of taxes, generous tax exemptions under the investment law, weak collection of revenue from logging and limited capacity in tax and customs administration. This low revenue effort is extremely detrimental to achieving sustainable development over the medium term.

2.3.3 Production

2.3.3.1 Agricultural production

Rice is a major agricultural product of Cambodia, and its supplies about 75 percent of the calories consumed by Cambodians. Agriculture accounts for 43 percent of the GDP. In 1996, rice production increased very little, because 85 percent of production is dependent on rained agriculture. Increased production will depend on greater irrigation, improved seed varieties, and other form of intensive cultivation. Farm-to-market roads and crops diversification are also critical. Other food crops include corn, root vegetables, and garden vegetables.

On the other hand, the production of agriculture in Sihanoukville is approximately 39,960 ha of land used, which accounts 60% of this for rice production. Rice and corn crops in Sihanoukville are primarily grown for local consumption and are considered to be the predominant crops. Agriculture production is significantly influenced from year to year by the weather, particularly by the impact of drought and floods. In recent years, Cambodia has experienced prolonged dry seasons followed by months of heavy rains resulting in flash floods that have destroyed crops.

2.3.3.2 Rubber

Cambodia's rubber plantations are second only to timber as a source of export earnings and are the major employers of labour in Kompong Cham and Prey Veng.

Production of rubber peaked at about 52,000 tonnes in 1960, and fell off to 50,782 tonnes in 1966. Rubber production increased from 17,645 tonnes in 1985 to 40,000 tonnes in 1994 (data from 1995 to 1998 not available). However, in 1995, FAO (the United Nations Food and Agriculture Organisation) estimated that Cambodia could produce at least 600,000 tonnes of rubber annually. In comparison to the data in 1985, the increase in production is very high because in 1985 much more of rubber farmlands were controlled under the Khmer rouge, but since 1993, all the rubber farmlands has been under the government control.

2.3.3.3 Forestry

Forests, with large stocks of teak and rosewood, are one of Cambodia's most valuable assets. The main forestry products consisted of round wood (309,000 cubic meters), swan wood (16,000m^3) and firewood (62,000m^3) in 1991. The exportation of log woods and swan woods was about 259,800 m^3 in 1991. The exportation of logs in 1992 was 273,000 cubic meters. The Royal Government has banned timber exports since 1996 and has encouraged local wood processing.

2.3.3.4 Livestock and Fisheries

Livestock and fisheries account for 15 percent of GDP and provide the main source of protein in the diet. Cross-border shipments of livestock are an important source of unofficial export earnings. In 1994, the fresh water fish catch was about 65,000 tonnes, with 21,000 tonnes of marine catch, and 7,600 tonnes of aquaculture production. Furthermore, marine fishery production primarily comes from marine capture and aquaculture. From 1994, there has been no available information regarding marine fisheries because the past administration only considered inland fisheries as high priority for fishery production in Cambodia. In addition, aquaculture in Cambodia is principally in inland areas of the country. However, the

techniques and methods are expanding to the coastal areas. Less than 10% of the total fishery production is contributed by aquaculture (Vichet, 1996).

2.3.3.5 Industry and services

In 1996, the industry sector grew up by 13.5 percent while the service sector went up by 7.7 percent. Industry now accounts for 20 percent of GDP while services account for 37 percent. The growth of the industry and service sectors reflects strong construction activity, including for hotels and upscale accommodation. Cambodia's manufacturing base is still small. This sector is largely undeveloped, with factories operating at low capacity because of outdated machinery, shortage of raw materials, poor management, and shortages of electricity.

2.3.3.6 Oil and gas

Presently all commercial energy used in Cambodia is imported. It is believed that there could be a significant potential for natural gas and oil in Cambodia. Contracts have been issued for offshore exploration and further contracts are expected to be issued. The estimation has been put at 1 to 5 trillion cubic feet of gas and 30 to 180 million barrels of oil. In this regard, the Government of Cambodia is working very hard to develop national policy, guidelines and legislation both from sector and macro development perspectives, in order to draw attention to the investment to exploit oil and gas in Cambodia. However, due to the political and economical crisis in Cambodia last year, the activities for exploiting oil and gas have not been conducted.

2.3.3.7 Mining

Mineral exploitation in Cambodia is mainly mining of gold and gems. Cambodia's mineral resources are not well documented, but there is a potential for production of

phosphate, granite, limestone, sand, gravel, cement, clay, bauxite, zinc, and copper. In previous year, both internal and external investors have been concentrated in the cement production. Correspondingly, two or three cement factories will be built in the near future in the Kampot province.

2.3.3.8 Tourism

The country offers a rich cultural and historic heritage and several fine natural attractions. The world heritage Angkorwat, unspoiled beaches, coral islands, beautiful mountains, and forests make Cambodia a unique travel destination. However, there is no available information of income from tourism due to lack of management and political and economical crisis in Cambodia.

2.3.4 Private investment

After the Royal Government of Cambodia (RGOC) was established in 1993, the Government has adopted a long-term plan for the development of the country. Therefore, the Investment Law of the Kingdom of Cambodia was instituted to provide a legislative background for incentives to the investors, hence encouraging both local and foreign investment in Cambodia.

Based on the goals and objectives defined in the first five-year socio-economic development plan 1996-2000, the RGOC will be required to accelerate growth in both public and private investment in the country. The budget projection to public investment of US$ 1.3 billion, assumes private investment will amount to US$ 3.7 billion during 1996-2000 compared to the equivalent of only US$ 240 million and US$ 1.4 billion respectively during 1991-1995. Furthermore, if public investment will be extended more widely to include other elements of capital expenditure such as those mentioned above, the total public expenditure programme will amount to a large figure of around US$ 2.2 billion (Appendix 2).

2.4 Natural conditions

Cambodia is a country rich in valuable natural resources, which include the natural resources of the coastal areas as follows:

- Coastal watershed forests
- Mangrove forests
- Near coastal marine water

The combination of coastal ecosystems in Cambodia maintains coastal diversity, which is significant for the conservation of biological diversity and which has direct economic significance for Cambodia and all other countries situated in the Gulf of Thailand.

2.4.1 Climate

The climate of Sihanoukville is particularly marked by the changing of wind direction depending on the season, as in the entirety of Cambodia. In a year, there are two typical seasons, which are the northeast monsoon season and southwest monsoon season. The northeast season consistent is the dry season with light clouds, little rainfall and moderate air temperatures, while the southwest monsoon season is the rainy season with cloudy skies and rainfall mostly followed by storms. During the transitional periods, when the season is changing, the direction of wind, rains and storms is unpredictable.

2.4.2 Coastal forest

The coastal forests in Cambodia which are located mostly south of the Cardamom and Elephant ranges of mountains are among the most extensive and least disturbed in mainland Southeast Asia. The forests in the coastal area connected with these long ranges of mountains are the high value forests which can be used for timber, wood production, as well as for traditional medicine. In addition, the forests play an

important role in protection of the soil and regulation of the flow of water and nutrients near the coastal water.

2.4.3 Mangrove

The ecological characteristics of mangroves in Cambodia are well known. These forests exist on southern coastal sites, where sufficient muddy sediments can accumulate. Situated in the inter-tidal zone, mangroves are flooded twice daily by the tides. Furthermore, mangrove forests are well known for their high biological productivity and their consequent importance to the nutrient budget of adjacent coastal water. In addition, mangroves also play an important role in protecting the shoreline from erosion.

In the area bordering Kampongsome Bay, there are some generations of mangrove species, which differ from place to place according to the physical and chemical properties of the soil. In Kampongsome Bay there are about 13,621 ha of mangroves and 39,066 ha of rea-mangrove, which has not been commercially exploited, but are utilised by local habitants.

2.4.4 Marine zone

The diverse Cambodian coastline possesses sandy, muddy and rocky shores, and is likely to feature sea grass flats and coral reefs similar to those of the coast of the nearby Thai provinces of Chantaburi and Trat. These water areas are likely to contain dugongs and sea turtles as well as dolphins, which are becoming increasingly rare in other parts of the gulf.

2.4.5 Environment

Cambodians are relatively uninformed about environmental issues, most notably, deforestation. According to some estimates, Cambodia has lost more than three

million hectares of forest in the past three decades. The government announced on December 31, 1996 a ban on log exports. The ban will be lifted when measures are in place to ensure sustainable logging. Other serious environmental problems are sedimentation of the river Tonle Sap and the millions of land mines throughout wide areas of Cambodia. Furthermore, urban pollution is also worsening.

In brief, the income of Cambodia depends on the production of agriculture, forestry, rubber and fisheries. In recent years, agriculture production has slightly fallen because of the political and economical crisis in Cambodia. As a result, the GDP growth in Cambodia in the year 1998 was at zero percent. However, the reconciliation of the parties in the government is expected to significantly contribute to the recovery of the income of Cambodia in the near future.

Port and transport development in Cambodia is In line with the RGOC's concrete efforts in rehabilitation and infrastructure projects. The necessity of a well-developed port and organised transportation network in the country to support the gradual economic growth of Cambodia has been reconized. Chapter 3 provides these details.

Figure 1 Map of the Kingdom of Cambodia and its Main Transport Networks

Source. World Bank 1995

CHAPTER 3
TRANSPORT AND PORT NETWORK

3.1 Transport network

The infrastructure of transportation in Cambodia was destroyed by civil war during the 1970s. From 1980, transport services have been managed to operate with a minimal degree of efficiency despite severe shortages of material, human, and financial resources. Many roads and bridges have been repaired temporarily to allow the movement of goods and people. Major ferries crossing of the Mekong and Tonle Sap Rivers have been kept open. Ports have continued to function, and river ships and barges have managed to move the freight. Furthermore, the railways have also managed to operate.

Transportation development in Cambodia was faced with security and financial problems during 1990s. However, due to the reconciliation of the other parties to establish the new government in 1993, the transport network had to be re-constructed and repaired for the urgent rehabilitation. Therefore, some road works were funded by foreign aid, such as the reconstruction of National Road 6A and the repair work and expanding of National Road No 4, which were supported by Japan and the United States.

3.1.1 Civil aviation

3.1.1.1 Pochentong International Airport

There are six civil airfields operating in Cambodia, namely Pochentong International Airport, Siem Reap, Sihanoukville, Koh Kong, Battambang and Stung Treng airport. Pochentong Airport, which is located in Phnom Penh, the only international airport can accept large planes in Cambodia. Currently, there are 10 airlines operating with a total of 39 international weekly services into Pochentong Airport. Regular flights operate between Phnom Penh and Bangkok, Ho Chi Minh City, Hong Kong, Singapore, Vientiane, and Kuala Lumpur. Since air traffic is restricted by inappropriate infrastructure, it does not cause important environmental problems. The domestic service is operated solely by Royal Air Cambodge. There is also military traffic at Pochentong Airport.

In 1997 Pochentong Airport was remodelled through a privatisation scheme. Under the new development plan to be completed within the first 3 years is a new 3,600 x 60m wide runway which will be constructed to replace the existing 3,000 x 40m wide runway. Associated with this development is the construction of connecting taxiways, a new international passenger terminal building for the immediate phase of construction, a new fire and rescue building, navigational and airfield ground lighting aids (RGOC 1996).

Furthermore, Koh Kong and Sihanoukville airport are the two internal airports located in the coastal zone in Cambodia.

3.1.1.2 Sihanoukville and Koh Kong airports

The Sihanoukville airport, known as Kang Keng, is located approximately 15 kilometres from Sihanoukville. It has limited terminal facilities and no air traffic control. The National Road No 4 crosses the airport approximately 500 m north of the runway. The Royal Government is also in the process of upgrading and

constructing the new airport as part of the overall tourism development of the Naga Island, which is located in the western of the Sihanoukville.

Koh Kong airport is located approximately 6 km outside of the provincial capital. With a runway surface with laterite, the runway surface and drainage system need rehabilitation. Two small structures serve as a passenger waiting facility and check point.

3.1.2 Railways

Transportation by railways in Cambodia is under government control. There are two main railway lines which carry passenger and freight traffic in Cambodia; these are the Northern Line and the Southern Line.

The Northern Line was constructed in 1929 runs from Phnom Penh for 385 km to the Thai border at Poipet. This line connects Phnom Penh and Bangkok with a distance of 655 km. The last 48 km in Cambodia from Sisophon to the Thai border have been abandoned since the early 1970s. The Northern Line, intended to be part of a route linking Bangkok with Saigon. However, the Cambodian part of the Phnom Penh-Ho Chi Minh route still under the project has not been constructed yet. The line from Phnom Penh to Ho Chi Minh will be constructed very soon in the future if security in Cambodia become stable.

The Southern Line was built since 1960 and takes off 9.4 km from Phnom Penh station, continuing for 254 km to the port of Sihanoukville at km 263.

3.1.3 Inland waterways

The other traditional mode of transportation in Cambodia is inland waterways. This transportation mode is used especially during the rainy season when roads are

flooded. The country's waterways consist of the Mekong River and its tributaries, the Tonle Sap River, the Great Lake and its tributaries, and the Bassac River. The Mekong is navigable all year round from the estuary to Phnom Penh. The Tonle Sap River from Phnom Penh to Kampong Chnnang also remains navigable throughout the year.

Bassac river is the main other waterway which is important for commercial river transport, and its links Phnom Penh with Chau Doc, in Vietnam's An Giang Province.

In addition, the lines from Phnom Penh to Kompong Cham and to Siem Reap are routed by passenger liners with short distances and by smaller craft. However, most of the revenues from this route are derived from goods transport. The main goods transport are timber and agricultural product to Phnom Penh, and foodstuffs and household goods from Phnom Penh.

3.1.4 Routes through Vietnam

Navigation through Vietnam to Phnom Penh is via either the Mekong or the Bassac River. The important part for the Mekong route, which is preferred by Cambodia, is the river mouth with a depth of only 2.4 m during low tide and 4.5 m during the average high tide. Therefore, vessels up to 2,000 and 4,000 dwt can use it properly.

3.1.5 Road Networks

3.1.5.1 Roads, bridges and ferries

There are 3200 km of national roads, 3100 km of provincial roads and about 28,000 km of tertiary roads. The National Road No 4 to Sihanoukville was built with US assistance three decades ago to serve light vehicle traffic. Additionally, about 2,400

km of the national road network was paved with asphalt or bituminous material. Presently, about 600 km of paved road remains surfaced with gravel or laterite.

Moreover, ferries are the most important means to connect routes from one point to the other by providing three river crossing locations, two on the Mekong River and on other one on the Tonle Sap River. The one at Neak Luong serves the most important access road between Phnom Penh and Ho Chi Minh City in Vietnam.

With the perceived necessity of the transportation of goods, and a connecting route between the neighbouring countries in Asia, the government of Cambodia has a plan to build a new bridge at Neak Luong. The Japanese Government will fund this project. The government expects that this project will result in sufficient capacity and adequate service at all countries in the region.

3.1.5.2 Passenger transport

Passenger transport in Cambodia mainly utilises motorcycles, cars and buses as the transport means. Motorcycles with or without trailers used mainly for short distances. In addition, a shared taxi is the predominant mode for public transport on the primary roads with long distances from one province to an other province. Buses are commonly used neither for long distance nor short distance, but rather there are very few and the bus is not popular like the taxi.

3.1.5.3 Transport of goods

Transportation of goods utilise vehicles which were imported during 1980 to 1991 under a trade agreement with former Soviet Union, and others were imported second-hand after 1991. The main types of these vehicles are MAZ, KAMAZ and Daewoo. On National Road No 4, the maximum load of trucks is normally restricted to a 20-tonne limit for the gross vehicle weight, and further by the load restrictions

for individual bridges. In 1990, the legislation related to commercial transport services was liberalised. Operators have to register and declare their businesses, for tax purposes, and a license has to be secured from the transport department of MPWT.

3.2. Port network

There are three international and eight additional domestic ports in Cambodia (Table 3). Sihanoukville Port and Phnom Penh Port are the international ports. Sihanoukville Port is the main deep-sea port. Phnom Penh depends on access via the Mekong, through Vietnam.

Table 3 Classification of ports of Cambodia

Location	Name of port	classification
Mekong	Phnom Penh	International (Domestic)
	Phnom Penh (Municipal)	Domestic
	Kampong Cham	Domestic
	Kratie	Domestic
	Stung Treng	Domestic
Tonle Sap	Kampong Chnnang	Domestic
	Chnok Tru, Krakor, Siem Riep	Domestic
Gulf of Thailand	Sihanoukville	International
	Sihanoukville (Municipal)	Domestic
	Koh Kong	Domestic *
	Kampot	Domestic

Source: JICA 1996

** Use as international also*

3.2.1 Sihanoukville Port

Sihanoukville Port, which is the principal and only deep-water maritime port of the Kingdom of Cambodia, is under the supervision of the MPWT (Figure 3.1). It is situated in the Bay of Kompong Som, and about 540 nautical miles (1000 km) from Singapore. It was built in 1959. The capacity of Sihanoukville Port, in its present condition, is estimated at about 950,000 tonnes per year. The port can accommodate ships of 10,000 to 15,000 tons dead weight. In recent years, the number of ships as well as the cargo capacity has been increased, even though a slightly decline was observed in 1998 (Table 3.2). It was forecasted that cargo volume at Sihanoukville Port will be considerably increased in the year 2015 (Tables 5 and 6)

The main access to the port is via a 3 km-fairway channel, marked by buoys and leading lights and is suitable for daylight navigation only.

Sihanoukville Port is served by National Road No 4 by which it is 226 km to Phnom Penh. An immediate project to resurface the entire length of National Road No 4 as well as to rebuild several bridges between Phnom Penh and Sihanoukville was completed in 1997 under support from the United States. Railway also plays an important role in linking Phnom Penh and Sihanoukville and takes a more southerly route via Kampot.

The oil terminal at Sihanoukville is about ten kilometres north of the main port. This was originally an oil refinery, built in 1969, and destroyed a year later by civil war. This oil terminal is used by the State Fuel Company (CKC) and Shell to import refined oil from Singapore. The terminal is also connected by railway to Sihanoukville Port and to Phnom Penh City.

Table 4 Number of ships and amount of cargo imported and exported from 1991 to 1998 in Sihanoukville Port

Year	Ship	Cargo imported	Cargo exported	Container	
	(Units)	(Tons)	(Tons)	TEUs	Tons
1991	144	45,677	86,873	*	*
1992	226	206,642	77,350	4,194	30,671
1993	337	322,194	15,193	23,986	125,696
1994	411	439,738	10,575	21,186	138,997
1995	615	574,824	213,621	38,942	228,636
1996	686	636,581	104,421	55,734	309,991
1997	785	652,791	141,485	60,990	355,697
1998	648	726,048	138,143	69,237	398.244

Source: Sihanoukville Port, 1998

** No available information*

Table 5 Import volume of cargo by macro forecast in Sihanoukville Port

(Unit: ton)

Case	1995 (actual)	2000	2005	2010	2015
High case		1,249,346	2,080.968	3,296,714	5,085,287
Middle case	574,824	1,035,891	1,771,848	2,846,013	4,424,010
Low case		1,011,969	1,571,330	2,329,383	3,361,944

Source: JICA, 1996

Table 6 Export volume of cargo by macro forecast in Sihanoukville Port

(Unit: ton)

Case	1995 (actual)	2000	2005	2010	2015
High case		414,704	670,354	1,044,088	1,593,915
Middle case	213,621	349,086	575,327	905,538	1,390,632
Low case		341,732	513,686	746,720	1,064,141

Source: JICA, 1996

3.2.2 Phnom Penh Port

Phnom Penh Port is located in the city of Phnom Penh on the Sap River, about 3 km from the Mekong River. It is about 330 km from the mouth of the Mekong, of which about 100 km is in Cambodia and all the rest in Vietnam. The distance from Singapore is about 1450 km. Vessels of up to 2,000 dwt can use the route without difficulty, and 5,000 dwt ships can pass the entrance to the Mekong on favourable tides. The port serves up to 150 ships per year, especially from Singapore and Vietnam.

Oil is handled at separate terminals, at Km 4 and Km 13 north of the city on the Tonle Sap River. This terminal usually serves 600-1,000 dwt boats and connects to National Road 5; most of the vessels using this terminal come from Vietnam.

3.2.3 Dry port

In 1993, a suggestion was made by the Sihanoukville Port authority to build an inland clearance dry port in the Phnom Penh area. In 1994, the implementation of the project has been effected under a joint venture agreement with a private Singapore company. Today, containers arriving at Sihanoukville Port are transported by road or rail to the dry port in Phnom Penh.

3.2.4 Koh Kong Port

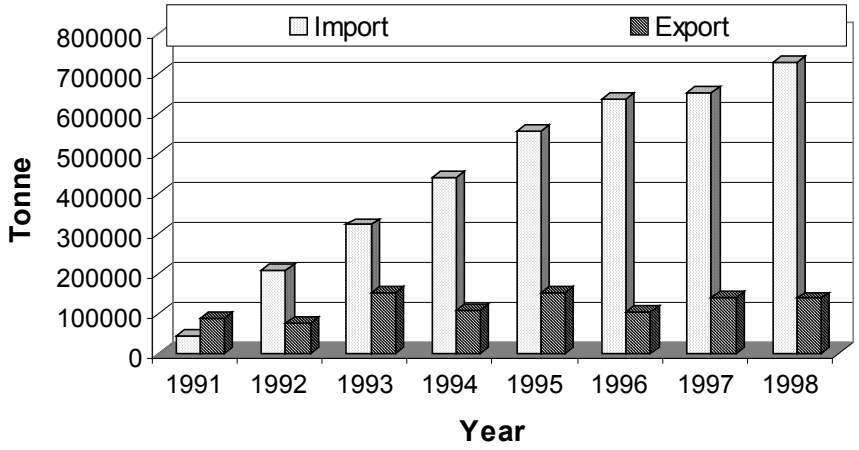
The Koh Kong provincial port mainly is a domestic port, but it also serves as an international port for transit cargo, mostly from Singapore, Malaysia and Thailand. This port is located in the coastal area about 15 km from the Thai border. Up to 300-tonne capacity boats can be accepted, or 500 tonnes at anchorage. The 300-tonne boats can then proceed across the bay to the town of Koh Kong for unloading or transhipment to smaller vessels if required.

The cargo that arrives at Koh Kong in larger boat has to be transhipped to vessels at Paklong or the town of Koh Kong because Koh Kong is a small provincial capital with no road access to the rest of Cambodia. There is some warehousing in the town of Koh Kong to support the transhipment activity. Koh Kong is also an important fishing port.

3.2.5 Existing port traffic

The traffic through Sihanoukville Port and Phnom Penh Port has considerably increased since 1991, up to now. Since 1991, the total port traffic has recovered from 130,000 tonnes to more than 800,000 tonnes in 1998 at Sihanoukville Port (see Figure 3) and about a half million tonnes at the Phnom Penh Port (see Figure 4).

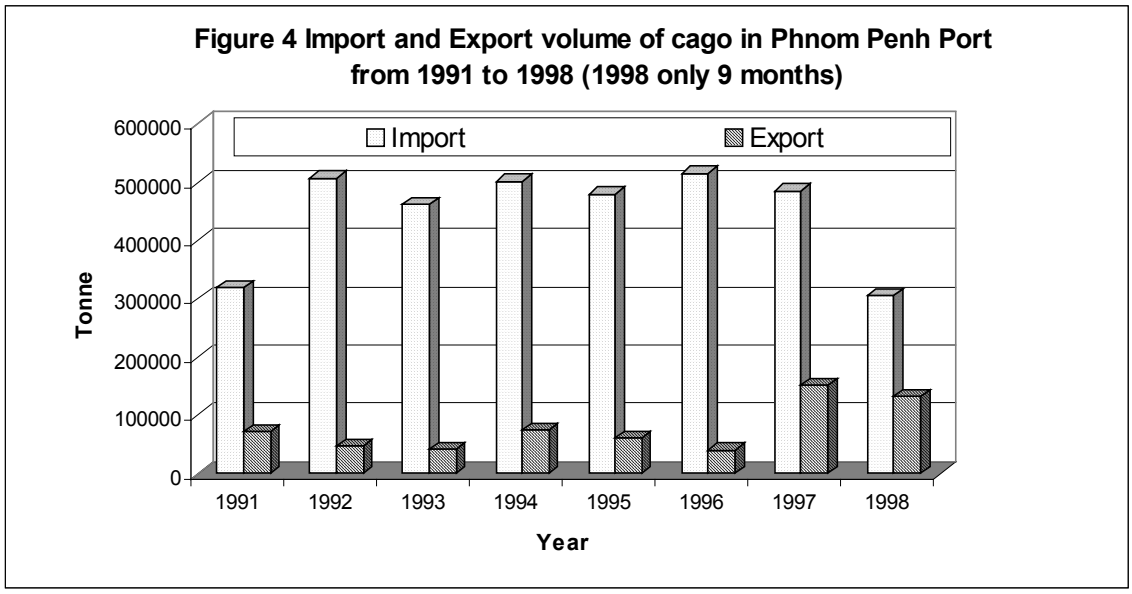
Figure 3 Import and Export volume of cargo in Sihanoukville Port from 1991 to 1998



Source: Sihanoukville Port 1998

Since the early 1960s, Phnom Penh Port handled most of the cargo volume, with close to one million tonnes in 1962-1963. During the mid-1960s most of the vessels came through via Sihanoukville because of the civil war between South Vietnam and

North Vietnam. Since 1991, Phnom Penh Port has increased its cargo volume up to about a half million tonnes per year and more than a half million tonnes in 1997.



Source: Phnom Penh Port 1998

Two-thirds of the traffic via Sihanoukville is imports, and one-third exports. Cement and construction materials made up nearly three-quarters of the non-fuel imports in 1993. Most of the exports were timber, logs and construction materials. Today Sihanoukville Port is becoming increasingly important as a container port. Three shipping lines make regular weekly calls at Sihanoukville with containers from Singapore. Some 4,000 containers passed through the port in 1992 and about 69,237 in 1997.

Singapore is the predominant overseas origin-destination for all three international ports including Koh Kong.

In brief, the port and transport network in Cambodia has been developed from time to time according to the demand of the country and economic development. These networks contribute to the development of the country as well as the development of

trade in the region. Furthermore, future expansion of the networks include a bridge at Neak Loung in the near future and the New Sihanoukville Port the year 2015. However, the development of Sihanoukville Port can create environmental constraints in the region. The next chapter contains an analysis and evaluation of the environmental constraints from the development.

CHAPTER 4
IMPACTS OF PORT CONSTRUCTION

4.1 Impact of port location

According to the policy of the Royal Government of Cambodia, the new Sihanoukville Port will be established by the year 2015. The new port area will be located close to the old port, with high potential to connect with the other ports in the region as well as the world. However, the development stage, such as the pre-construction and the construction period, will create many problems to the environment, as well as to the socio-economy in the proposed port area.

4.1.1 General impacts in area

As mentioned earlier, the development of Sihanoukville Port may create an environmental constraint to the local population, as well as to the coastal environment of the area. As the proposed location of Sihanoukville port is close to the Kampong Som Bay, the construction may change the water current pattern and cause the stagnation of water in the area.

Furthermore, the large amount of employment in the port area will dramatically increase the population in Sihanoukville during and after the construction. The increase in population will subsequently increase the amount of waste in the area. Correspondingly, sewage may be discharged directly into the sea without treatment. Currently, municipal sewage is discharged directly into the sea. The construction of

a wastewater treatment plant should therefore be considered and included in the development plan.

4.1.2 Impact on fishery village

There are about 2,635 people living and doing fishery business in the fishing village located near the new Shanoukville port area (JICA, 1996). Fishing is the main source of income; hence, the inhabitants are engaged in fishing activities. Most of those living in this area are settled from Prek Toek Sap Lake, which is located to the south of the New Sihanoukville Port.

However, there are no associations organised by people of the fishing village in the new port area. Only two companies have been established for the operation of the fishery business in the area. One is the Frozen Factory II, which was built in 1990 under the supervision of the Fishery Department, Ministry of Agriculture, Fisheries and Forestry during 1990 to 1993. Currently, this factory is under private company control. The other one concerns fish preservation for export.

According to government policy, there are no fishing rights in the area where the dredging and disposal of soil will be performed during the port development project. Therefore, no fishing operations will be conducted, and there will only be a minimal impact on the fishing activities.

In addition, the development of Sihanoukville in that area will have a small impact on the fishery and fishermen because the government will still allow utilisation of the existing basin and mooring facilities, which are used today. However, the problem is the conflict between fishing traffic and container shipping traffic calling at port.

4.1.3 Resettlement of people living in port area

There are some fishermen who have illegally occupied the state owned lots and have done their business in the area of Sihanoukville Port. This is not allowed by the Municipality of Sihanoukville, but these people have managed to do so. In 1984, the Municipality of Sihanoukwille, as well as the Government of Cambodia, had a plan to relocate them to Steng Have, which is a fishing village located about 23 km north of Sihanoukville, but failed to relocate them. At present, the municipallity of Sihanoukville has another plan to relocate them to three different locations, namely, Steng Have, Koh Rong and Koh Toy (JICA 1996).

Koh Rong is an island located close to the sea area for commercial fishing which was officially approved by the government, a place that has several advantages for people whose life depends mainly on fishing. At present, approximately 2,000 people have resettled from the mainland to Koh Rong Island. However, there is no information available about the resettlement to Steng Have and Koh Toy.

Based on the policy of the Municipality of Sihanoukville, in August 1996 the people living in the new port area had to be resettled from that place. In response to this policy, a resettlement committee was established, under approval by the Municipality of Sihanoukville. It consisted of the governor, and representatives of military police, the environmental office, the planning office, and the urbanisation and construction office, among others.

With the operation of the committee, approximately 30 houses were demolished. In this case, the committee was to pay a cost refund to the people whose houses were demolished. The scheme for payment depended on the policy of the government. However, a great number of people are still living in that area, and there has been no further action taking place. The Municipality of Sihanoukville as well as the Royal Government of Cambodia have never taken any actions to prevent the flow of people

into the project area. As a result, the influx of new families settling in the village close to the new port area has been rapidly increasing.

Also, there are various facilities operated by the local government, such as shipyards, a municipal port for passenger ships and fishery inspection services located in that area. The relocation of the public properties will be conducted according to the project development plan.

Similarly, the reclamation of Sihanoukville Port may cause a need to relocate the people living close to the project area, as well as the people living along the road leading to the oil terminal.

On the other hand, the exploitation of sand or gravel will lead to the relocation of the people living in the area where such activities are undertaken.

4.1.4 Socio-economic impact on the people in the port area

According to sources from the Municipality of Sihanoukville, there are about 110 fishing boats and 41 residential houses in the port area. The fishing boats from various places are sheltered outside Sihanoukville Port.

Most of the residents are employed in the fishing business, shipbuilding and repair, the transportation business, and shops. Some restaurants have been established since 1980, with some just started in 1990s. The residents seem to prefer living in the village for convenience and accessibility to their working place.

Unfortunately, they will have to be relocated to other places, hence losing their present jobs and sources of income.

4.2 Impact of port construction

The construction of Sihanoukville Port will probably create local environmental problems. The local problems that may occur include seawater pollution, loss of land use and air pollution. The construction activities can cause problems such as accelerated erosion, and can loss of animals, plants, marine species or natural habitats; contamination of fisheries by uncontrolled waste disposal; occupational and health hazards; salt wedge intrusion; and disposal of polluted dredging materials.

4.2.1 Impact on water quality

Port construction activities, especially the dredging of a channel for ship traffic, will create some problems to water quality in the area. Furthermore, the disposal of waste during port construction can also accelerate water pollution in the area as well as loss of aesthetics of the sea at the port.

4.2.1.1 Impact caused by dredging

According to a survey by JICA in 1996, this project is expected to generate a large volume of dredging materials (total: 1,777,000 m^3, basin: 1,312,00 m^3, North Channel: 465,00 m^3). On the other hand, a large volume of soil for reclamation will also be required. In addition, dredging material in Sihanoukville will create such marine environmental concerns as the following:

- Water pollution
- Impact on fauna and flora existing in the sea area adjacent to the project area
- Impact on fishery activities

4.2.1.1.1 Impact on water by dredging

It is anticipated that the dredged materials will have to be disposed of in the sea area. In general, it has been observed that at present the water at this sea area has a low transparency (transparency test resulted in 3.5 to 4.0 m). Therefore, floating material from the dredging to be disposed of can pollute the water in the sea near the new port project, because it was further observed that the seabed soil contains several chemical substances which may pollute the water (JICA 1996). In addition to the diffusion of suspended particles by the current, disposed material would be disturbed by waves. In this case, barges that can open the bottom of their hull are advisable in order to properly dispose of the dredged materials.

Moreover, dredging a channel may also cause re-suspension of sediments and turbid water. Re-suspension of sediments in water may increase the level of suspended solids and the concentration of organic matter, possibly to toxic or harmful levels. The suspended solids can reduce sunlight penetration.

Furthermore, vessels to be engaged in the construction work can cause oil spills, garbage discharge, and leakage of other substances into the water. The diffusion from concrete work in the water and overflows from landfills may be possible sources of water pollution.

Dredging can cause changes in current patterns and flows of tidal as well as salt wedge conditions. Furthermore, dredging for deepening the channel can result in intensified wave activity, especially on the shoreline with the consequent increased littoral drifts in the shore zone that can accelerate beach erosion or accretion.

Additionally, dredging activities can change the subsurface ground water flows near the Sihanoukville port area. Subsequently, they can effect the sources of the ground

water quality. In this case, people in the area using ground water for daily consumption will need to relocate or find an other water substitute.

With regard to a breakwater, an old breakwater is presently in place, which needs repair by adding soil and rock. With these activities, water turbility will increase; thus, the bottom sediments will be disturbed.

Likewise, the disposal of dredged material on land can cause leakage of harmful substances into the ground water, and may bring changes in waterfront drainage.

4.2.1.1.2 Impact of dredging on fauna and flora

Disposing of the dredging materials for the new North Channel and the basin in the new port will require dumping in two areas with 45 m and 25 m depth. The proposed sites are located on the east and the west of Dek Koul Island about 4.5 to 6 km from the new port area.

According to the observation of JICA in 1996, there are some coral reefs around Koah Poah Island and Dek Koul Island. With the floating material and sediments caused by dredging, the coral reef community in that area might be ruined.

In addition, due to the low transparency, sunlight cannot reach the sea bottom and the visibility is very low in both proposed dumping areas. Therefore, the divers will not see anything in the water below 20 m from the surface. It is observed that there are only few fishes living in these areas.

It is foreseen that an outstanding environmental impact of the implementation of the port development project will be caused by dredging and disposal of dredged materials into the sea area. The disposal may result in environmental pollution and may develop adverse effects on the marine biology.

4.2.1.1.3 Impact of dredging on fisheries

Actually, no fishing activities by either small boats or large boats are performed in the proposed dredging area and disposal area for the dredging materials. In addition, shrimp fishing is usually performed far away from the dredging area, especially during the high season of September to November. Therefore, the impact from the dredging and disposal of the dredged material on fishing activities would not be considerable. However, some marine habitats living in that area could be affected.

The piling constructed to support the construction into the water can disturb and destroy some of the habitats and temporarily displace the mobile bottom animals and local fisheries. In addition, when completed with decking, it will shade the area underneath and possibly diminish the survival of attached algae and other aquatic plants. Pilings will also delay existing tides, which can increase sediment at some locations beneath the structure.

4.2.1.2 Impact of blasting

Some bottom areas of the seabed consist of gravel rock, which need some equipment to be broken. Explosive charges used to break up rock may destroy bottom habitats. Compression effects of the blasting often injure or temporarily disable marine life some distance from the blasting site. In addition, the aquatic habitats in the area will be forced to move to other area far from this place until the work is completed.

4.2.1.3 Impact caused by construction materials

Cement, paints, sand, and gravel are some of primary construction materials required for the port development project. These materials contain toxic substances which might diminish the sea water quality. In addition, the construction materials spilled

on the ground and along the road will be washed off and flow into the sea, which can increase the sedimentation and toxic substances in the sea bottom area.

4.2.2 Impact on land use

Sihanoukville development will need land for the installation of berths, decks and road connections. The reclamation of land for construction material like sand and gravel can create concerns to the environment, including erosion and loss of land for recreation or agriculture.

4.2.2.1 Loss of land use

As mentioned earlier, the construction activities will need sand, gravel and rock used as construction material. All these materials will be exploited from the land area. Materials will be exploited from the topsoil and other surface land cover. These will make the land unavailable for agriculture, recreation, grazing, etc.

Furthermore, loss of the rainfall retention capabilities of the topsoil and its vegetation increases the speed and volume of water runoff during the heavy rain, thus producing greater potential for flooding at lower elevations in the watershed.

Furthermore, the exploitation of sand and gravel in the watershed may cause severe concern to the environment in that area by erosion and flooding in the rainy season. The erosion of soil leads to loss of fertilisation of the land downstream as well as bringing sedimentation to the waterways in the area nearby.

4.2.2.2 Soil erosion

The removal of sand and gravel from the shoreline, or dunes areas adjacent to the shore, can result in destabilisation of the entire shorefront. Eventually, it may lead to

erosion and reshaping of the shoreline region, and if the shore is subject to considerable wind forces, to possible acceleration of dune migrations toward the shore and ultimate destruction or inland to bury desirable agricultural lands. Persistence of onshore winds can result in increased sandstorm severity with resulting degradation of impacted upland areas.

In addition, the function of land can be lost including its use as crop or grazing land, loss of existing or potential residential areas, loss of timber if tree covered, or wind break capabilities, and loss of erosion prevention capabilities.

4.2.3 Impact on air quality

Air is very important to human beings' everyday life. It is the air that gives person oxygen for their existence. In this regard, it is vital that the air we inhale must be free from any dust, hazardous particles and other harmful substances.

Sihanoukville construction will introduce dust and air pollution, especially from emission and gases exhaustion brought about by the construction machinery and trucks. The air pollution will have a negative impact on the environment and the residents' health as well.

4.2.3.1 Dust emission

During the construction, there may be some dust emission to the air from the construction materials, especially cement and sand. First, the transportation of sand and cement will create dust by material spillage along the road. The spillage of the material along the road will create long term dust pollution to the extent that the transport has been used. Second, the major sources of dust and particles can be generated from the construction activities such as earthmoving and rock drilling in the construction area. The fine dust and particles suspended will be blown by wind

from the source to the area nearby. Fine dust effects the air quality as well as public health, especially for the people living in the area.

Finally, the emission of soot from construction machinery, trucks, vehicles, etc., also creates concerns about air quality, especially as it affects human health, because the soot contains harmful substances.

4.2.3.2 Exhaust gases emission from construction machinery

Before construction and during construction, there may be very busy traffic in the area as well as National Road No 4 from the capital city of Phnom Penh to Sihanoukville. The busy traffic can create air pollution in the area as well as along National Road No 4. The pollution can affect human health in the area as well as for people who live along National Road No 4.

On the other hand, smoke, fumes and gases can come from the electric generating station, smelters, construction machinery and many other industrial operations. The exhaust gases, fumes and smoke that may be generated present great potential harm to the environment and public health, especially to the people living in the project area.

The other forms of the air pollution may come from the imported fuel oil. In Cambodia, most of the fuel oil imported is not properly controlled, especially for the limitation of sulphur or the lead content. The same is true with most of machinery, trucks, vehicles, etc., which are second-hand imported. Therefore, the high concentration of sulphur or lead in fuel oil can create more concerns to the air quality in Cambodia, as well as during the port construction, and may seriously affect human health.

4.2.3.3 Noise from construction machinery and materials transportation

Material transportation may create noise problems in the project area and along the roads connecting to the port construction site. The major concerns come from the construction activities related to machinery for breaking rock and other construction machinery. The demands of the high construction period will create loud noise both at night and in the daytime. This will cause disturbances to the people living in the area and along the road connecting to the project area.

Most of the construction machinery, trucks and vehicles used in Cambodia today are second-hand imported. Mostly these are less sophisticated and produce louder noise during operation than new machinery or vehicles.

In addition, pile driving and water front construction activities can cause considerable disturbing noise and vibration within the proximity of the construction area.

In brief, the development of Sihanoukville Port requires the people who live in the area to be relocated, because it can affect their business as well as their income. Moreover, it will create problems to the environment, including water pollution, air pollution, land pollution and noise disturbance to the people who live close to the area and along the road connecting to the port during the construction activities, as well as during channel dredging. Furthermore, the construction and dredging activities of port can cause disturbance marine habitats in the area and its vicinity.

CHAPTER 5
THE IMPACT OF PORT OPERATION

During Sihanoukville Port operation, environmental pollution can be created by the dredging of contaminated sediment for maintenance of the port channel, ship traffic and its activities, cargo handling, and land transport. The pollution can affect water, soil and air quality. Water pollution can be generated by the dredging of contaminated sediment and its disposal, solid wastes, ballast water, oily wastes from ships, sewage discharge from ships and sewage from the municipality. In addition, air quality in the area can be diminished pollution by exhaust gases from both land transportation and ships, and by dust from cargo handling, with accompanying noise disturbance. Ship traffic and land transport can also create noise disturbance to the local community as well as to marine habitats.

5.1 Water pollution

Water quality in the port area can be diminished by pollution by wastes from ships, and cargo leakage into the sea during port operations. Furthermore, ship accidents can also create a severe problem to the water quality in the area and may reach to the vicinity if the amount of the leakage or spill of substances is substantial. Municipal sewage and industrial discharge can also generate problem to the water quality in the port and in the vicinity of the port area. In an indirect way, air pollution can also have a significant impact on water quality because some atmospheric deposition may result from ships and land transportation.

5.1.1 Waste from ships

Wastes in port can come from ships, cargo handling, storage and other business sectors in port. Both solid wastes and wastewater discharged from ships, the municipality, industry and other activities are the major pollution in port and its environment.

An important source of Sihanoukville Port pollution in the future may be the discharging of oily wastes and ballast water from ships using the port. Ballast water and oily waste from ships can be discharged into the sea directly if the port does not have the reception facilities. At present, Sihanoukville does not have any facilities to purify the wastes from ships, as well as wastes from the municipality. All the sewage is discharged directly into the sea at the other part of the port. Therefore, untreated sewage discharges can pose serious threats of the transmission of diseases to the local population and can also result in degradation of water quality in port. Oil and oily wastes discharged from ships may reach nearby beaches and spoil recreation areas, causing serious damage to tourism. In addition, garbage and other solid wastes discharged into the water from ships and land based activities in port or close to the port area can also be major sources of pollution in the port and its environment.

Careless application of anti-fouling paints for protection from ship corrosion can introduce significant concentrations into nearby water and severely damage aquatic life. Furthermore, removal of old anti-fouling paints and reapplication can also prove harmful to the water.

5.1.2 Dredging sediment

During a long period of Sihanoukville Port operation, there will be a thick level of sediment in the port area and its vicinity, which may contain both toxic and non-toxic

substances. The sediment can increase every year according to the spilling of materials and waste disposed of into the water.

According to the Royal Government of Cambodia, there have been no adequate restriction laws and regulations with respect to environmental management in the coastal and port areas. Moreover, the Cambodian people have little knowledge of environmental conservation, so they have used marine water for disposal of wastes, as well as for other purposes. As a consequence, the sediment can increase to a high level in a short time period. Therefore, dredging the channel and the area close to port will be needed as frequently as possible.

Dredging sediment from the channel in Sihanoukville Port may generate a number of adverse impacts on marine water quality and can affect marine habitats, and human health through the food chain. The contaminants released from the disturbed soils can be suspended and cause increased mortality among important marine species and fishery resources. Particles suspended may be re-deposited on bottom life and force them to move to the other places. Particles of suspended material can deplete available oxygen demand from the surrounding waters and temporarily create stressed conditions for many aquatic animals. The particles suspended can cover and concentrate on the surface water, which may reduce the penetration of sunlight into the water, causing damage to light-requiring photosynthetic algae, corals and other aquatic organisms.

Furthermore, the improvement of the economy in Cambodia after the year 2000 will be given priority by the government through the development a new industrial zone, especially in the Sihanoukville. This development can create complicated sea traffic in the port area, which will bring a large number of toxic substances to the sea bottom sediment. Toxic sediment may act as sink contaminants, which mobilise in aquatic ecosystems. Sediments and their associated contaminants mobilise on a wide scale resulting from dredging operations, with the potential to exert significant

toxicological effects in the vicinity of the dump site. These toxicological effects should be taken into consideration when determining the necessity of dredging the area.

With dredging operations it is not only compounds that have been recently deposited as sediment that are of concern, but it is also existing compounds reintroduced into the water. Persistent compounds which are no longer used may exist deep in the sediments and be reintroduced to the water upon dredging.

Direct transfer of the chemicals from the sediments is a major route of exposure for aquatic species. Many species spend a major portion of their life cycle living in or in contact with aquatic sediments.

5.1.3 Ship incidents

Due to development of the industrial zone in Sihanoukville as well as the development of the economy in the country, the traffic in Sihanoukville will dramatically increase. Because of this, accidents may sometimes occur in the proximity of the port or in the port area. Accidents may cause adverse effects on the marine environment in the area by releasing toxic or hazardous materials into the sea. In the accident-related damage of ship structure, there can be a spill of oil and ballast water into the sea. An accident, carelessness or deliberate wilful disregard for regulations may lead to plastics and other synthetic materials and marine debris, garbage and sewage being discharged directly into port water.

Furthermore, during cargo handling there can be an accidental release of materials into the sea, the spillage of material from the storage area etc, can explosion or fire in the port. These accidents can occur owing to marine casualties, failure of equipment, or improper operating procedures during cargo transfer or bunkering.

The spillage of oil from oil tank storage in port may result in seepage and contamination of soil and ground water and run off into the coastal water. The spill or discharge can be harmful to marine life and can also render fish and shellfish unfit for human consumption. The spillage of light oil is generally less harmful to the marine environment because it rapidly evaporates, but it can easily cause fire or explosion and may be very hazardous to human health by breathing.

Chemical spills can result in the introduction of toxic substances into the sea, which may severely affect the marine environment. Some chemicals even in low concentration can taint fish and reduce their marketability, and other chemicals may sink to the bottom of the sea, which can accelerate concentration of sediment contamination.

5.1.4 Waste disposal

The development of Sihanoukville will accelerate the population growth in the region, especially in locations close to the port area. The greater the population, the more waste disposal at landfill as well as into the sea will occur. Furthermore, development of Sihanoukville itself together with the industrial development in Steng Hav District may create more industrial waste in the region.

The disposing of waste into the water in port will result in an unsightly condition on the shoreline owing to the accumulation of non-biodegradable material such as plastic litter and other debris, and glass and metal containers. Plastic litter and other floating debris and rubbish getting into the marine environment have serious impact on wildlife, the environment, humans, and the local economy. Thousands of marine animals can be caught in and strangled by debris, while the coastal community loses considerable income when littered beaches must be closed or cleaned up. The shipping and fishing industry spend thousands of dollars annually for the repair of vessels that are damaged by debris, because plastic items foul propellers and clog

engine intake systems. Consequently, they lose fishing opportunities, time, and money, and eventually there are rising insurance claims. Communities may also end up paying ever-increasing costs for public maintenance and litter collection.

Moreover, industrial development may generate much more industrial waste, which enters into the sea. Industrial wastes dumped at sea can present much more various and intractable problems. They may be highly acidic or alkaline, liquid or largely particulate and may be extremely toxic.

On the other hand, the solid waste from ships as well as solid waste from the municipality will be discharged directly into a landfill about eleven kilometres from Sihanoukville. This landfill utilises an open dumping site on the top of a hill, which possibly creates many concerns for the ground water and soil in the area nearby.

5.1.5 Sedimentation from the waterfront

According to the location of Sihanoukville Port, sedimentation can be generated by the waterfront through three effluent routes. One route is the stream running from the existing pond to the port basin through culverts installed at three locations under the municipality road along the coast. During the rainy season, the effluents of the streams will flow into the port basin through these culverts containing substantial suspended soil, of which the major constituent is laterite, which is washed away by rain from land areas.

Another route is the rainwater discharged from the land area of the port, and the third route is the domestic sewage from the offices and the workshops of the port.

Of these three routes, the first route has the largest discharged water volume into the port basin, and thus would be the main cause of the sedimentation of the basin. On the other hand, the volume of water discharged through the other two routes is much

smaller. The domestic sewage, which is the third route of the effluents, would not contain much suspended soil. Therefore, from the viewpoint of the suspended soil and sedimentation, it is concluded that the effluents from the ponds in the waterfront area are the major cause. However, the sewage from services in port can contain micro-organisms.

5.2 Land pollution

Land pollution may happen, of course, during Sihanoukville Port operation. There may be soil and land pollution caused by the introduction of materials leakage during careless handling of cargo in port. The storage of cargo can also contribute to the soil pollution of the area nearby if the warehouses have inadequate control. In addition, the disposal of waste can pollute the soil.

5.2.1 Land pollution by materials leakage

According to the development of Sihanoukville Port as well as the development of the Cambodian economy in the future, the activities in port may dramatically increase from time to time. With the increase of cargo handling in port together with inadequate handling procedures and regulations, the spillage of cargoes, especially from bulk cargoes, of course, may happen.

The spillage of the material in port may create many concerns to the soil and water quality in the port and area close to the port. Hazardous cargoes, especially the materials that contain toxic substances, can present a risk during unloading/loading operations, storage or removal. Therefore, run-off to adjacent wetlands can occur when drainage from port storage areas is not properly controlled, which can lead to degradation of these highly productive ecosystems due to the build-up of heavy metals and oil. This may have a severe effect on soil in the area and contaminate the ground water.

5.2.2 Land pollution by disposal of solid waste

During port operation, actually cargo handling, wastes can be generated, such as the remains of bulk cargo storage, rubbish from unpacking, wood bark from log handling, garbage and other wastes from daily activities.

In addition, garbage, rubbish, plastic and other wastes can be generated in vast quantities within Sihanoukville port by the business activities in port. Improper disposal procedure conducted at the disposal site can result in soil degradation because some materials contain toxic substances, while others like plastic are not degradable and can stay for years in soil. Therefore, the municipality of Sihanoukville should consider measures that minimize the effects of the disposal of solid waste on the ground water.

5.3 Air pollution

Sihanoukville operation will increase road traffic to and from port areas. This will cause the particular problem of air pollution and noise disturbance along the road to and from Sihanoukville Port connected to the capital city of Phnom Penh, especially along National Road No 4.

In addition, ships alongside may release sulphurous smoke and other airborne emissions, especially oil gases from oil cargoes which can be emitted in the port causing health and environmental hazards. Liquid cargo handling may result in the release of vapour during the cleaning of storage tanks and by the breather system for ambient temperature change. Furthermore, accidental leakage of gases may cause problems such as toxic material emission, explosion, fumes and hazardous airborne emissions.

The other source of air pollution in the Sihanoukville terminal port may be the emission of the hydrocarbons when cargo is being loaded and transported. The biggest emissions will take place when the air contains hydrocarbons released from cargo tanks due to loading, or when it comes to ships without segregated ballast tanks. The vapours are let out via tank ventilation appliances.

5.3.1 Impact of exhaust gases

Exhaust gases, smoke and soot can present serious problems to the air primarily because of the great potential for distributing toxic or hazardous substances and the generally greater capacity for dispersal. During Sihanoukville Port development the exhaust gases, smoke and soot will come from ships, vehicles and also from industrial development in the area close to the port. Exhaust gases, smoke and soot from traffic can cause major problems within Sihanoukville Port, and along the road from Sihanoukville to the capital city of Phnom Penh. Furthermore, problems can be generated when there is a high level of cargo being imported and exported, or when passenger ferries with their large number of passengers associated with cars operate within the port.

From the environmental point of view, the most important of the emissions from diesel engine ships are sulphur dioxide, carbon dioxide and nitrogen oxide, and also hydrocarbon and soot. The amount depends on the combustion and on the sulphur and aromatic hydrocarbon content in the fuel. In general, the smoke emissions in ports very often depend on variations in the load where the combustion is not good enough. The smoke from the main engines usually occurs when ships are manoeuvring in port at arrival or departure.

However, due to modern technology, highly efficient ships can generate relatively little of the carbon monoxide, hydrocarbons and smoke compared with trucks, and cars operated in port.

In addition, due to industrial development in the area, the industrial emission can also result in high levels of nitrous oxides, and sulphur oxides, depending on the type of activity taking place in the port complex.

Exhaust gases, soot and other particulate matter from ships and land transportation can contribute to the acid precipitation resulting from industrialisation, ozone layer destruction, gradual global warming, sea level rise, and the threatening of coastal low-lands, as well as disrupted food chains and mineral cycles. In addition, the extinction of plant and animal species can occur on a large scale.

In brief, the emissions from ships and land transport can affect ecological and human health in a number of ways. Exhaust gases can cause respiratory trouble and other illness, reduced visibility, soiling and erosion of material, damage to land based and marine plants and animals, and global warming.

5.3.2 Impact of dust from cargo handling

During the port operation, some cargoes and materials, such as coal dusts, bauxite, and phosphates being handled in the port may spill on the ground. Emissions of dust from bulk cargo handling and gases from cargo handling equipment can be sources of air pollution, because wind-blown dust can be a major problem in ports where dry bulk cargoes are being handled. Fertilisers, coal dust, grains, bauxite and cement are common materials which can result in major increases of this problem to the health of port employees and people who are living in the area close to the port, and can also cause damage to neighbouring residential property.

In addition, the dust from cargo handling can also create problems to the land surface of the area close to the port by introducing a new toxic layer on top of the natural one. This layer can destroy the soil quality and may affect the groundwater and seawater when it is washed off into the sea.

5.3.3 Impact of noise from ships and land traffic

One source of pollution that perhaps is not often thought about, but which can be very disturbing is the noise from the main engines of ships manoeuvring in port. When the ship increases the engine revolutions to make a turn or to go astern or stop, the low frequency noise can be considerable, especially at the height of the exhaust outlet.

Noise pollution has become an increasingly important issue in many countries, especially among residents who live near port or highways. Noise also disturbs the sleep of residents, but this effect is difficult to quantify.

After Sihanoukville development, the traffic will increase both by waterway and by road transport. The increase of traffic can generate noise, and may disturb the people who live in the village close to the port as well as the people who live along National Road No 4. According to the culture of the Cambodian people, they always build their house of wood or palms; therefore, the houses are not very noise resistant to prevent the noise. In addition, most of the houses are built close to National Road No 4, without a wall or landscaping for noise protection.

Furthermore, the handling of goods is nowadays known as a noisy business. The engines of the big trucks will create noise, and the forks of forklifts also create noise when lowered to the ground to pick up or put down cargo. Moreover, containers create noise when being put down or when their doors are closed, especially when they are empty.

On the other hand, underwater noise can likewise create a severe concern to the marine habitat in the area close to the Sihanoukville port.

5.4 Impact of wakes from ships traffic

An other environmental impact from Sihanoukville development may be caused by wakes from large ships or from high-speed craft traffic and from anchoring. Wakes from large ships or fast moving vessels can cause erosion and can destroy the vegetative and coral community along the route in shallow water. Wakes can cause strong waves that are capable of eroding shorelines or stirring up bottom sediment in shallow water. In this case vegetation can be disturbed both by erosion processes and by sedimentation resulting from wakes. Sedimentation reduces the amount of sunlight available for photosynthetic processes. Furthermore, the coral community is also susceptible to damage from sediments that have been suspended by the action of wakes. The impact of wakes is greatest during high traffic.

Moreover, anchors dropping from vessels can also cause local habitat damages. This damage occurs through direct physical disruptions, as anchors are dropped on the habitats and sometimes dragged through them.

In summary, port operation can cause pollution to the marine environment as well as air pollution in the region, and can disturb the marine habitats as well as the people living close to the port area, resulting in loss of land use and job opportunity to the people living in the project area. The pollution of the marine environment is caused by the discharging of solid waste and wastewater from ships, spillage of cargo during unloading/loading activities, storage operations and dumping sewage into the sea. In addition, pollution from land-based sources is also a serious problem along the coastlines and particularly in and around Sihanoukville Port where a major population engages in their business.

CHAPTER 6
INTERNATIONAL AND NATIONAL LEGAL ASPECT

6.1 International Conventions

During Sihanoukville Port construction and operation, environmental concerns to the marine and inland environment as well as airborne emissions will be created. Therefore, as the best way to reduce and mitigate all these concerns, port construction and operation should comply with the existing national and international instruments. Furthermore, close co-operation between related ministries and other agencies is also a good solution for avoiding pollution from the discharging of land-based wastes into the marine environment.

6.1.1 The International Convention for Prevention of Pollution from Ships (MARPOL 73/78)

Marine pollution from port development was recently identified in developing countries. The International Maritime Organization (IMO) is a specialized agency of the United Nations which is responsible for measures to improve the safety of international shipping and to prevent marine pollution from ships. It ha been involved in legal matters, including liability and compensation issues, and the facilitation of international maritime traffic, in which it has been paying attention to this problem.

Therefore, the International Convention for Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78) was adopted by IMO

and its member states to prevent marine pollution from shipping activities. It prohibits the discharge of any wastes and other substances into the water anywhere, and restricts the discharge of other forms of garbage, pollutants and substances within specified distances from shore. Its Annexes contain regulations for the prevention of pollution from all kinds of wastes from ships. This includes prohibition of discharge to the sea of oily waste, garbage, sewage, synthetic ropes, fishing nets, plastic bags, and other substances including airborne pollution into the atmosphere. In addition, the guidelines for the implementation of MARPOL request government to consider a series of measures, including reporting systems, record books on board ships, compliance incentive systems and educational programmes.

In order to comply with the Annexes of MARPOL countries will need to provide port reception facilities for wastes generated by shipping activities. At present, many countries lack such facilities. The lack of adequate port reception facilities could result in wastes being disposed of at sea, and being transported by wind and currents to shore, often in locations distant from the original source of the disposal and the discharge. It was estimated that ship generated wastes account for approximately 80% of solid wastes in the coastal areas.

However, MARPOL cannot be used as a mechanism for controlling land-based releases of all kinds of waste, pollutants and substances into the environment because the treaty applies only to releases at sea from ships and is not applicable to land-based sources. Signatory nations are obligated to provide facilities for the reception of wastes at ports. Therefore, the co-operation between IMO and the United Nations Environmental Programme (UNEP) is the best way to prevent the discharging of pollutants into the sea both from ships and from land-based sources.

6.1.2 The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention)

The development of a legal instrument on the prevention and control of marine pollution from land-based sources can be understood in the light of the expected costs imposed on the industries, municipalities, and agriculture of the prospective parties, since tight control measures, standards, surveillance and monitoring systems would have to be established. This is also the reason why the establishment legal applications and conventions on the protection of the marine environment from land-based sources of pollution seems unlikely, taking into account the many different stages of development in the various regions of the world.

To respond to matters related to the marine pollution from land-based sources, and to avoid the effects of the dredged materials on the marine environment and human health, the United Kingdom and the United Nations convened an Inter-Governmental Conference on the Convention on the Dumping of Wastes at Sea in November 1972. The Conference adopted the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, the so-called London Dumping Convention (LDC), now is London Convention (LC)**;** at that time Cambodia with the name Khmer Republic was one of the observers. The LC entered into force on 30 August 1975. Cambodia has not ratified the LC yet.

The LC has listed a large number of chemicals and chemical compounds which are deemed hazardous or potentially hazardous and therefore worthy of regulation. These include organohalogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, etc. The LC primarily regulates the dumping of chemical or industrial wastes into the marine environment and it considers adequate controlling and regulating of wastes disposal in the various regions. It has been noted that the LC draws attention to the need for the states with common interest in protection of the marine environment in a given geographical area to enter regional

agreements consistent with global conventions, but also to take particular account of the characteristic features of the area.

Regarding dredged materials and their disposal, in the dredged material guidelines of the LC, the dumping of all kinds of wastes into the marine environment is prohibited. For contaminated dredged materials, consideration should be given to the use of special methods to mitigate their impact, in particular with respect to contaminant inputs. Furthermore, in extreme cases of pollution, containment methods including land-based disposal may be required, but very careful consideration should be given to the comparative assessment of the factors affected in selecting the most appropriate option.

In brief, the aim of the LC is to prevent the major cause of contamination of sediments required to be dredged, which can emit of hazardous substances into internal and coastal water. Therefore, dredged materials disposal must be controlled by using disposal management techniques, which include the utilisation of natural physical, chemical and biological processes as they affect the dredged material in the sea.

6.2 Port reception facilities

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), which entered into force on 2 October 1983, used strong and more positive wording on the provision of reception facilities. Each party undertakes to ensure the adequate provision of facilities at ports and terminals to meet the needs of ships using them, without causing undue delay to ships. It also specifies the categories of ports and terminals which require reception facilities, together with their capacities.

Annex I of MARPOL obliges the government of each party to undertake to ensure the provision at oil loading terminals, repair ports, and other port in which ships have

oily residues to discharge. Facilities for the reception of such residues and oil mixtures as remain from oil tankers and other ships, should be adequate to meet the needs of the ships using them without causing undue delay to the ships.

Annex II of MARPOL also obliges the Government of each Party to the Convention to undertake to ensure the provision of facilities for residues and mixtures containing noxious liquid substances.

Annex IV of MARPOL obliges the Government of each Party to the Convention to undertake to ensure the provision of facilities at ports and terminals for the reception of sewage, adequate to meet the needs of the ships using them, without causing undue delay to the ships.

The most important features of Annex V are the strict prohibition of the disposal of plastics into the sea, and the severe restriction on the discharge of other garbage from ships into coastal water and Special Areas. Annex V also obliges governments to ensure the provision of facilities at ports and terminals for the reception of garbage.

Regarding Sihanoukville Port development, Port Reception Facilities should be established during or at the time of port construction to cover and receive the expected waste quantities. Therefore, the Sihanoukville Port development project should assess, and design port reception facilities for, expected wastes during port operation.

It is very expensive to build Port Reception Facilities and to raise the needed amount of fund to establish the facilities is, of course, quite a problem of its own. In addition, to produce guidelines and to train personnel on how to run the facilities is another problem, even IMO has established, in 1995, a manual on Port Reception Facilities to address the problem on how to deal with the wastes collected.

However, only Port Reception Facilities are not enough to solve the problem if Sihanoukville Municipality still does not have waste treatment facilities to treat all kinds of wastes and other substances from land-based activities, especially municipal sewage and industrial wastewater.

6.3 Government policy

Consideration of environmental issues in Cambodia is critical; therefore, the Royal Government of Cambodia (ROGC) established the Ministry of Environment of Cambodia in November 1993, given a broad mandate to protect the natural resources of the country and to prevent environmental degradation. This is a basic approach for the long term, in virtually every sector related to land and water resources, which consists of institutional strengthening of inter-agency co-operation and strategy planning within the agencies for concerted efforts in better resources management. In this case, agencies must improve their abilities for baseline evaluation, increase public awareness, and incorporate public investment in decision making to focus national properties. In addition, the government has also delegated an action agenda of provincial agencies, to develop policy powers where appropriate, and provide funding for projects and agency programmes, resources development and skills training.

The ROGC has also set up a coastal zone planning, local zoning, and development plans approach for the coastal region and local management plans. This is needed for specific types of activities that are expected in the near term, such as aquaculture development and onshore activities related to gas and oil production and tourist resort areas. Some aspects of the comprehensive plans, like Sihanoukville Port development, should be developed by the Ministry of Environment in conjunction with the Ministry of Public Works and Transportation and the National Committee for Land Use and Urbanisation.

Action items associated with development projects like Sihanoukville Port development will have multiple components: provision of local infrastructure and services including wastewater management, solid waste management, and water supply, and regulatory components to ensure that services are provided and maintained over the long term. Therefore, the plan should establish local institutions for the provision and maintenance of infrastructure compliance with environmental criteria, and surveillance of coastal zone activities.

6.4 Review of national legislation

Besides the international instrument, the national legal instrument is also a very effective way for contributing to the prevention, reduction, and control of marine pollution from the various sources, especially the pollution from land-based sources. At present, with regard to Sihanoukville Port development in Cambodia, the national legal instrument will also contribute to the prevention of marine pollution.

6.4.1 Environmental Protection and Natural Resource Management

The Law on Environmental Protection and Natural Resource Management (LEPNRM), which was adopted on 24 December 1996 by the Cambodian National Assembly, is the first Environmental Law in Cambodia.

The most important features in the LEPNRM regarding marine environmental management in Cambodia are the following requirements:

- to conduct on environmental monitoring, inspection and control of pollution programme in the Kingdom of Cambodia in collaboration with concerned ministries. The monitoring programme will determine the sources, types, and amounts or levels of pollutants, including toxic and hazardous substances; waste transport or discharge into the sea, which includes treatment of wastes; and the restriction or the reduction of exhaust gases, noise and vibration from ships, and

from industrial and land transport, in accordance with National Sub-Decrees and Regulations.

- to conduct the Environmental Impact Assessment (EIA) for all development projects with both private and public investment, including industrial development projects, which are considered to have potential impact on the environment. The aim of the EIA is to predict and evaluate the impact of the development projects on the natural resources as well as on human health, and then to design mitigation measures, and monitoring programme and implement environmental management plans. Regarding Sihanoukville Port development, to conduct the EIA is very important way to avoid the environmental effects from port location, port construction and port operation, to promote sustainable development.
- to develop a national and regional environmental plan for environmental protection and sustainable natural resource management and to identify important environmental issues and important natural resource management issues that are related to socio-economic development in the coastal area. These plans will be reviewed and revised at least once every five years.
- to ensure the rational and sustainable conservation, development, management, and use of the natural resources in the Kingdom of Cambodia and.
- to suppress any acts that cause environmental degradation. Any persons who commit a violation of the prescriptions of this law are subject to be fined, compensated, punished in accordance with the degree of the violation.

The law was developed in a very general way, and may seem to be very easy to conduct and apply, but the implementation of this law is very difficult because of political constraints, financial shortages for law instruction and enforcement, and lack of human resources. Furthermore, the law is not very detailed on the mandatory restrictions in specific matters because it will give priority to strict implementation and enforcement of each Sub-Decree, which will be established later.

This law gives priority to the Ministry of Environment (MOE), to its mandatory responsibility for environmental protection and natural resources management. However, according to the provisions of this law, the MOE cannot conduct the enforcement and controlling alone; the MOE has to co-ordinate with related ministries.

6.4.2 Sub-Decree on Water Pollution Control

A draft Sub-Decree on Water Pollution Control (WPC) has been prepared and developed since 1995. The draft has been reviewed and discussed many times with the concerned ministries and related organizations, and now it seems to be acceptable and will be sent to the government for consideration this year. The purpose of this Sub-Decree is to protect water and prevent water pollution by controlling and setting up rules and standards on effluent discharge from point sources of pollution into public water, to ensure the conservation of biodiversity and the protection of human health. This Sub-Decree concerns both freshwater and seawater.

Regarding Sihanoukville Port development, this Sub-Decree will play an important role in controlling all sources of pollution which can occur during Sihanoukville Port construction and operation. It will ensure that the construction and operation of Sihanoukville Port will not affect marine water or ground water quality.

6.4.3 Sub-Decree on Environmental Impact Assessment

It has been foreseen that the preservation of natural resources is critical; therefore, since 1997, the MOE has prepared to draft a Sub-Decree on Environmental Impact Assessment. The aim of this decree is to manage the environment in the Kingdom of Cambodia and to ensure the maintenance of biological diversity and the options for resources to be used by future generations.

As described in the LEPNRM, the specific rules and regulations for Environmental Impact Assessment (EIA) will be detailed in the Sub-Decree on EIA. At this time, the Sub-Decree on EIA is being drafted with the assistance of the United Nations Development Program (UNDP), United Nations Environment Programme (UNEP), and Asian Development Bank (ADB).

The Sub-Decree of EIA specifies that all development projects should be conducted under EIA in order to:

- promote conservation, protection and uses of natural resources in a rational and efficient manner while maintaining sustainable economic development, and enhance environmental quality including natural resources, public health, and social, cultural and economic values to satisfy current needs without compromising the needs of future generations,
- integrate development planning and decision making with environmental impact assessment and consideration at the earliest stage to avoid or minimise harmful impacts at present and in the future,
- implement an environmental impact assessment process in consonance with project planning,
- approve an environmental impact report for a project before the project is implemented, and
- foster public participation in the environmental impact assessment process, in recognition that the people of Cambodia are an available resource of environmental knowledge and that their concerns should be considered in the project decision-making process.

It is a need for Cambodia to develop an effective and comprehensive EIA process for protecting the environment and natural resources in Cambodia. Therefore, since 1996 the MOE, has opened some training courses funded by the ADB to train the officials of the MOE which include the officials from the other local provincial environmental services and concerned ministries. This training will enable the MOE

to conduct the EIA on the development projects which have significant impact on the environment. The assessment includes preliminary assessment of the resources to determine the requirement for necessary studies or information and to set conditions for conclusion in the granting of investment approvals.

In term of the Sihanoukville Port development project, MOE will closely co-operate with the MPWT to conduct EIA, because this project will have considerable effect on the environment, both marine and land-based, as well as on human health in the region.

6.4.4 Law on Lands Management, Urbanization and Construction

The Law on Lands Management, Urbanization and Construction (LLMUC) was adopted on 24 May 1994 by the National Assembly of the Kingdom of Cambodia. The LLMUC defines the importance of development and construction in coastal and marine zone management. The aim of the LLMUC is to promote the improvement of urban and rural areas of the Kingdom of Cambodia in order to ensure sustainable development.

The LLMUC also addresses matters directly related to the impact on the natural environment, which includes such co-operative tasks with concerned ministries and organisations as the following:

- A National Committee for Land Management, Urbanisation and Construction is to be formed along with under-committee in each province and city.
- Documents of Urbanisation are to protect patrimony, environment, economic development, and natural resources.
- Each Sub-Committee is to establish a Land Use Plan for each province.
- The National Committee is to specify the special Documents of Urbanisation to protect patrimony and the environment.

- The Plan of Urbanisation and Construction must respect the zones of protection of patrimony and the environment.
- The Royal Government of Cambodia can establish special prescriptions for the safe-keeping of areas of archaeological, historical, cultural, aesthetic or technical value,
- Construction work and installation must respect the protection of patrimony and the environment,
- All construction is subject to the obtaining of a building license, and a plan for construction must be prepared by a graduate architect or other approved person.
- Violation of building permits can result in prosecution, work stoppage and seizure of material.

The LLMUC is not specified exactly for the port development, but in general for the construction and land use, which need to maintain sustainable development. This means that all construction projects should be considered environmentally friendly.

6.5 Role of the Ministry of Environment of Cambodia

The role and responsibility of the Ministry of Environment of Cambodia was defined in a Sub-Decree on the Organization and Functioning of the Ministry of Environment signed by the Council of Minister in late 1997. As the MOE was established by the ROGC, the MOE has the authority to supervise and manage the environment in the Kingdom of Cambodia.

The main responsibilities of the MOE in coastal zone management in protecting and conserving the coastal natural resources and the environment are outlined in the Sub-Degree as follows:

- To exercise environmental policy for sustainable development and to propose the National and Regional Action Plans in co-operation with inter-ministries.

- To prepare and implement environmental legal instruments aiming to ensure sustainable development.
- To view and evaluate the Environmental Impact Assessment (EIA) of all proposed investment, and existing and ongoing projects and activities, both public and private.
- To advise relevant ministries on the conservation, development, and management of natural resources as prescribed in Article 59 of the Constitution of the Kingdom of Cambodia.
- To administer the National Protected Area System following the Royal Degree on the Creation and Designation of Protected Areas, and to propose new areas to be put into the system.
- To prepare inventories on the sources, nature, and amount of the pollutants, and to take measures to prevent, reduce and control environmental pollution.
- To prepare inspection procedures for controlling and supervising the ongoing operation of the environmental services throughout the country.
- To research, compile, analyse and manage environmental data.
- To initiate and prepare any proposals to the government to reach the goals of international agreement, convention, and memorandums of understanding related to environmental protection, and to implement such international instruments.
- To promote incentives to those investments which facilitate environmental protection and natural conservation.
- To co-operate with national organisations, non-governmental organisations (NGOs), international organisations, and international and local communities in order to conserve and protect the environment in the Kingdom of Cambodia.

Task implementations are shared between departments in the MOE. These departments are defined in the organisational chart (Figure 6.1).

In brief, in order avoid all kinds of pollution of the marine environment both from land-based sources and from ships, the Sihanoukville Port development project should comply with national and international instruments, especially the

international instruments that Cambodia has ratified. In addition, the Ministry of Environment has to co-operate with the Ministry of Public Works and Transportation, especially the Sihanoukville Port Authority, to research and evaluate environmental concerns that can have severe effects on the marine environment, regional and global.

CHAPTER 7
CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

The development of Sihanoukville Port in Cambodia can create many environmental constraints, socio-economic impact on the local community, and especially effects on human health by direct contact or indirect contact or on the food chain through food consumption.

Prevention of pollution from Sihanoukville Port development may be a very good way to maintain the sustainable development over a long-term period. In order to prevent pollution, Sihanoukville Port development has to apply national and international standards, especially IMO instruments. The most important of the IMO instruments regarding the prevention of marine pollution resulting from port development are MARPOL and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matters.

Furthermore, pollution will be reduced or will not be generated if Sihanoukville Port will construct, together with port reception facilities, waste treatment plants or facilities for both wastes from ships and the municipality.

The most important thing which should also be considered is to improve public participation, because public participation will help to reduce wastes from land-based concentration in the port area as well as into the marine environment. Therefore, the

Sihanoukville Municipality, especially the local environmental service should establish a programme for educating and training local people on how to prevent waste discharge into the marine environment, and what the results are of the wastes discharged into the sea, which can affect their health in direct and indirect ways.

7.2. Recommendations

- ***Location of port***

Careful selection of port location should be carried out to prevent adverse affects on the marine environment and the socio-economy in the region. In addition, Sihanoukville Port project should conduct EIA to ensure sustainable development.

Resettlement of local people in the project area should be very smooth to minimize the disturbance to the local community.

The characteristics of the marine ecology in the region should be carefully surveyed in order to avoid the effects of the construction and dredging activities on the marine environment and marine habitats as well as the local community. Therefore, a careful survey of the ecological characteristics of the project area is indispensable if the welfare of endangered and fragile species is to be considered and disruption of their spawning seasons and area migration is to be minimized.

The project should include the assessment of the potential impacts to shoreline vegetation, wetlands, coral reefs, fisheries, bird life, and other sensitive aquatic and near shore habitats.

The location of stationary installations, such as underwater cables, pipelines and wastewater out falls should be identified and incorporated into the dredging plan.

**** Water***

The Sihanoukville Port development project should consider a programme to minimise the impact on the marine environment, as well as on water quality.

The bottom sediment should be very careful surveyed before dredging. In particular, field investigations should be conducted to develop a dredging programme that minimises overall environmental impacts, which should also include physical and chemical analyses of sediments. If found that the sediments contain toxic substances, the dredged material should be treated in accordance with the provisions of the international conventions and relevant national regulations. Furthermore, selection of proper disposal site and disposal methods of dredged material plays a critical part in the preserving of the marine environment by minimising dispersal of re-suspended sediments. Therefore, the selected place for dredged material disposal should be evaluated to minimise the impacts to sensitive habitats and the marine ecosystem, ground water, land use and surface run off.

The methods and equipment use for dredging should also be considered to minimise the turbidity spread out.

Municipality should have a wastewater treatment plant to purify sewage and wastewater from ships.

Sihanoukville port should have sufficient reception facilities to receive residues, oily mixtures, and all kinds of wastes generated from ship operations, according to the provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

A collection and disposal system for ship generated waste should be established for ships alongside and at anchor. Furthermore, the Municipality of Sihanoukville should establish incineration to incinerate waste from ships as well as waste from the

municipality. If incineration cannot be established, the municipality of Sihanoukville should select a proper landfill for discharging wastes. For toxic and hazardous wastes, there should be a special place with a proper dumping site for them, such as with retaining walls that are designed against leakage of this waste into the ground water.

**** Land use***

The value of land destruction must be considered, particularly when alternative sites for construction materials are available.

In the exploitation of site materials like sand, gravel, and rock, the impact on adjacent land use should be considered to ensure that lands are adequately restored to acceptable standards after the operation of the Sihanoukville Port project is finished.

The plan for site materials exploitation should be developed and operated in accordance with the national rules and regulations to prevent the affects of pollution on the environment and human health. The potential impacts on air quality, ambient noise levels, water resources, and sensitive natural environments are to be minimised.

Vegetation should be planted to prevent erosion and encourage the self-sustaining development of a productive ecosystem.

**** Dust and exhaust gases***

Wind blown dust from stockpiles of bulk materials may be a major problem in Sihanoukville port and needs to be properly controlled using modern methods and technology. The proper equipment and procedures should be used for cargo handling and transport. Raw material storage areas should be covered or enclosed.

The simple way to bring down dust and exhaust gas emission is to use a better quality of fuel. For example, engines may be constructed with high efficiency in relation to the oil they burn, catalyst exhaust cleaning devices may be used or filtering devices may be fitted to the exhaust outlets.

Air pollution by dust can be reduced by water scattering on the construction site for controlling dust emission reduction. Furthermore, the proper selection of transportation means can also reduce or prevent dust emission.

**** Noise***

Port operation should considered and restricted during quiescent periods in the local community to minimize the impact on ambient noise levels.

Trucks could, of course, be supplied with more efficient silencers. The dock work could be careful instructed. If the problem cannot be solved in dock work noise we may have to build a high screens around the port or install with tree landscaping. Green plants around the port may be an effective means to mitigate adverse effects on terrestrial habitats. Apart from being the best way of preventing noise, tree landscaping also makes port area look nice and protects the view.

Installation of sound insulation fences or other equipment is needed in order to reduce noise and vibration. Furthermore, the limitation of working hours may be a possible means to mitigate the nuisances of construction activities.

**** Services***

When the project is authorised, Sihanoukville Port Authority should inform the contents of the plan and the construction schedule to the agencies concerned and local people, so that the conflicts may otherwise occurs can be avoided.

Port authority should also inform the fishermen of the schedule of the construction and routs of the working vessels to avoid accidents.

Sihanoukville Port development needs to have good services. In port will be required additional tugs, lighters, mooring and pilot boats. It should also be determined whether there is a need for ship repair facilities. Proper contingency plans, emergency plans procedures and equipment, and a prompt reporting system should be developed and put in place for preventing and combating the accidents that may occur in the future, especially oil and chemical spills, and fires during construction and operation of Sihanoukville Port and oil terminal.

Periodical clean up of floating wastes in the Sihanoukville port area should also be conducted to avoid the concentration of solid wastes sinking into the bottom of the sea.

The appropriate selection of the equipment for the construction operation should be considered to reduce the adverse effects to the marine environment and local community.

Proper regulations and detection of emission from ships are effective means to reduce discharges of pollutants.

Sihanoukville Port development should co-ordinate with government agencies responsible for port safety, including emergency response, especially the Municipality of Sihanoukville and Ministry of Environment, to develop a programme to co-ordinate port traffic with other marine activities, including signals, wind directional instruments and emergency procedures. Furthermore, the co-ordination should also establish procedure for cargo handling, storage and transport of hazardous materials.

Personnel involving in the construction and operation of the project must be trained on the hazards, safety procedures and emergency response plan associated with tasks in accordance with the national and international standards for safety and environmental matters. Included are oil and chemical spill combating and fire fighting equipment in the emergency response.

In the development of the new port, Cambodia should improve the vessel traffic control systems to ensure safe passage and minimise the possibility of collision, which can result in spilling as well as fires, explosions, and loss of life. Furthermore, in order to avoid accidents in the port area, there should also be proper procedures for cargo handling in port both from ships and from storage to land transport.

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Appendix 1

GDP growth rate forecasting from 2000 to 2015 (%)

Case	Sector	1995 (actual)	2000	2005	2010	2015	Average
High Case	Agriculture	3.0	5.0	5.0	5.0	5.0	5.0
	Industry	8.7	9.5	9.5	9.5	9.5	9.5
	Service	6.7	8.5	8.5	8.5	8.5	8.5
	Total	5.2	7.1	7.3	7.5	7.7	7.4
Middle Case	Agriculture	3.0	4.0	5.0	5.0	5.0	4.8
	Industry	8.7	8.0	9.5	9.5	9.5	9.2
	Service	6.7	6.5	8.5	8.5	8.5	8.1
	Total	5.2	5.7	7.3	7.5	7.6	7.1
Low Case	Agriculture	3.0	4.0	4.0	4.0	4.0	4.0
	Industry	8.7	8.0	8.0	8.0	8.0	8.0
	Service	6.7	6.5	6.5	6.5	6.5	6.5
	Total	5.2	5.7	5.8	5.9	6.0	5.8

Value of GDP

(Unit: Billion Riels)

Case	Sector	1995 (actual)	2000	2005	2010	2015
High Case	Agriculture	144.7	200.9	256.3	327.2	4.17
	Industry	60.9	99.1	156.0	245.5	386.5
	Service	119.2	185.9	279.5	420.3	632.0
	Total	324.8	485.8	691.8	993.0	1,436.0
Middle Case	Agriculture	144.7	184.3	235.2	300.2	383.1
	Industry	60.9	87.2	137.3	216.1	340.2
	Service	119.2	161.5	242.3	365.1	549.0
	Total	324.8	432.9	615.3	881.3	1,272.2
Low Case	Agriculture	144.7	182.5	222.1	270.2	328.7
	Industry	60.9	86.0	126.4	185.7	272.8
	Service	119.2	158.5	217.2	297.5	407.6
	Total	324.8	427.0	565.6	753.4	1,009.1

Source: JICA 1996

Appendix 2

Sectoral Allocation Targets for Public Investment from 1996 to 2000

Sector	Rural proportion %	Urban proportion %	Sector proportion %	Total US$ (in millions)
Agriculture	97	3	10	220
Manufacturing and Mining	25	75	4	88
Transport and Communication	85	15	23	506
Electricity	26	74	8	176
Water Supply and Sanitation	25	75	8	176
Education and Training	70	30	11	242
Health	75	25	10	220
Social and Community Services	70	30	7	154
Religious and Cultural Affairs	60	40	3	66
Administration	50	50	11	242
Programmes Unallocated	65	35	5	110
Total	65	35	100	2, 200

Source: Ministry of Public Works and Transport, the Kingdom of Cambodia