

6. Conclusions and recommendations

6.1 Conclusions

Summing up the discussion in the previous chapters, the following items are reiterated as the conclusions:

(1) Roles of Sihanoukville Port in the economy of Cambodia

a. Historical background

Being the sole deep see port facing the Gulf of Thailand, Sihanoukville Port, since its start of operation 1964, has been the outlet of Cambodia. Though situated 240 km away from Phnom Penh, the Capital, the port was duly provided, at the beginning of its operation, with both the access road and railway from the commercial center of the country. The port was also intended to promote industrial and commercial activities in the port area, and thus large water and land areas are reserved in the port area.

The Sihanoukville City, where the port is situated, is one of the largest city in the coastal regions, and city infrastructures such as city roads, power and water supply have been provided, though their capacities seem to be insufficient to fulfill the growing demand in recent years. The city is rich in tourism resources and is also known as a coastal resort, and is expected to invite more tourists.

b. Project site

Located in Compong Som Bay, the port is well protected from both northeast and southwest monsoon. Typhoon attack is very rare, the sea is fairly calm throughout the year, except occasional local atmospheric disturbance which is accompanied by strong shower and wind.

With the consideration of the existing geographical and socioeconomic situations, the existing infrastructure of the city as well as in the port and the potential for the expansion with fairly large water and land areas, the site where Sihanoukville Port situated is concluded to be the best and single location for the project site for the development of the gateway port of the country.

c. Major functions of Sihanoukville Port

Practically, all the international seaborne cargoes are handled at Sihanoukville Port and Phnom Penh Port. Situated in the hart of the Capital and being the hub of the domestic transportation network composed of highway, railway and inland waterways, Phnom Penh Port has been the gateway of Cambodia. Sihanoukville Port, originated as an alternative gateway of the country in its history, however, will shoulder larger portion of the nation's international trade. Such a function of Sihanoukville Port shall be reinforced by the existing function of Phnom Penh

Port as the hub of the domestic transportation network.

In accordance with the characteristics of the two ports mentioned above, cargo sharing, which exists between the two ports, will be foreseen to become more clearly toward the future. The commodities and types of cargoes which are expected to be handled predominantly in Sihanoukville Port are:

- 1) container cargoes,
- 2) construction material(cement, steel, bitumen), machinery(heavy equipment and automobiles), fertilizers and sugar, which are import cargoes, and
- 3) agricultural and forestry products(wood product) which are export cargoes.

With the development projects of Sihanoukville Port, it is also expected to promote the private investment in the reserved area near the port, which will subsequently contribute to the promotion of the economy of the whole country.

(2) Cargo volumes

In accordance with the three scenarios, i.e., optimistic, intermediate, and conservative, three cases of cargo forecast are presented in Chapter 3: High, middle and low cases. According to the optimistic scenario(High case), the total cargo volume, excluding oil, expected to reach the level of 4,700,000 ton in 2015, which is about 8 times as large as the volume handled in 1995 at the port. For the case of Low forecast, the cargo volume is expected to be at the level of 3,300,000 tons, which is six (6) times as large as the present cargo volume.

(3) Long-term development plan

The long-term development plans are proposed as described in Chapter 5. The long term development plan comprises following items:

- a. Renovation of existing quarry wall in front of Shed No. 1 into a 400m long general cargo berth,
- b. Extension of the existing New Quay northwards for new full container terminal, which includes the reclamation as large as 16 ha and the construction of berth as long as 400m for High and Middle forecast cases, and 13 ha and 330 m respectively for Low forecast case.
- c. Construction of bulk terminal where fertilizer, cement and bitumen will be handled, which include the construction of a 300 m berth and the reclamation of 12 ha,
- d. Purchase of handing equipment, including four gantry cranes, transfer cranes and other heavy handling equipment.
- e. Dredge of the access channel and basin as deep as -11.0 m and -10.5 m respectively,

- and installment of navigation aids,
- f. Pavement of open storage, empty container stock yards and truck parking lots.
- g. Purchase of tug boats, and
- h. Construction of an administration building.

Two alternative facility layout plans, i.e. Plan-1 and Plan-2, are proposed. These alternative plans are named as follows.

- Plan H-1 and H-2: Alternative plans for High Cargo forecast case,
- Plan M-1 and M-2: Alternative plans for Middle forecast Case, and
- Plan L-1 and L-2: Alternative plans for Low Case.

These planes are exhibited in Fig. - 5.1.3-1 through Fig. - 5.1.3-4 in Chapter 5.

(4) Construction cost

The total construction cost is estimated to be 235 to 250 million US dollars for High Case, 230 to 245 million US dollars for Middle Case, and 191 to 212 million US dollars for Low Case.

(5) Preliminary economic evaluation

The Economic Internal Return of Revenue(EIRR) is roughly calculated on the basis of Cargo volume forecast and the cost estimates. The results show that the EIRR fall on the range between 14%(Low Case) and 18%(High Case). Thus, the project is evaluated economically viable.

(6) Selection of most recommendable alternative plan

It is the study team's view that the Plan-1 (H-1, M-1 or L-1), where the bulk terminal is constructed in the north of existing New Quay, is the preferred alternative, because the alternative is expected to give more incentive to promote the economy of the country.

(7) Construction plan

Of the various elements included in the Long-term Plan listed above (3), item, renovation of existing quarry wall into a wharf, should be implemented in earliest stage, i.e., before the year 2000. The construction of container terminal, Item b. will follow after the year 2000, and the construction of bulk terminal should be implemented in later stage, 2010 or later. Item d, purchase of equipment and e, dredging, should be implemented in accordance with the implementation of items a, b and c.

6.2 Recommendations

Recommendations have been given in detail in the previous chapters with respect to respective fields. The key items among others are reiterated herein:

(1) Legislative background of port area

At present, there is no legislative background of port area where the port authority, such as the Port of Sihanoukville, is given the authority to administrate the land area, property and various kind of activities. It is very important to define the port area for the smooth implementation of port development projects.

(2) Coordination with other government agencies

The water and land area enclosed by the breakwaters are presently utilized for various socioeconomic activities, and there are many public and private properties other than Sihanoukville Port: fishing villages, municipal port, ship repair and building, fish nursery, ice plant, shops, private houses, schools, and government offices, municipal roads, and etc.

Since Sihanoukville Port has not yet been given the authority to administrate the whole area mentioned above, the Port, in cooperation with the Ministry Public Works and Transport, has to take steps to formulate land use plan of the area which, by Sihanoukville Port, is claimed to be future port area. This may involve to organize an inter-ministerial committee, to discuss and negotiate to prepare a zoning plan among the representatives from various ministries concerned with the port development and the municipal government of Sihanoukville. The responsibilities of each ministries and the municipalities in the implementation of the project should be identified.

(3) Management and operation of the port

In 5.2 of this report, various items are recommended to promote the activities of the port. Among others, the importance of the following items should be reiterated:

a. Preparation of containerization at Sihanoukville

To cope with the rapid increase of container cargoes, the port should take steps to establish and control inventory of containers, in order to plan most efficient container allotment in the yard.

b. Enforcement of planning division

The follow up the development of the plan, the planning division should be enforced. As the implementation of a project proceeds, it is very important to ensure the financial resource and review the plan in the light of the changing situation of the cargo movement and the socioeconomic situation of the region and the country.

c. Statistics

Port statistics is vital element for not only for the operation of the port but also for reviewing and updating of the future expansion plan. Thus, all the effort should be made to complete port statistics.

7. Urgent improvement plan

7.1 Construction of alternative facilities to the Old Jetty

7.1.1 Concept of the Urgent improvement plan

As stated in 2.5.3 (1), the Old Jetty, which at present is mainly used for the cargo handling of bagged cargoes is heavily timeworn. Though how many more years the structure would be endurable with ordinary use is not determined definitely, it is quite sure that special care is needed during docking ships and cargo handling. This would result in low efficiency of cargo handling due to the restriction of the use of heavy handling equipment.

The damage of the structure is not superficial but extends over the main members of the beams of the pier, which is made of prestressed concrete. It is, therefore, concluded that either the entire replacement of the beams or the construction of an alternative facility to the structure is very necessary for running the port operation in normal manner.

The replacement work of beams needs substantial amount of construction cost and time, and it may also should require full or partial close of the operation of the Old Jetty. Without Old Jetty, it is obvious that heavy congestion of the New Quay will be unavoidable with increasing cargo volume at the port. Thus, it is recommended to construct an alternative facility for the handling of bagged cargoes and other general cargoes.

Possible alternative measures are:

- i) The extension of the existing New Quay to the west (the renovation of the existing revetment in front of the Shed No. 3), or
- ii) the extension of the New Quay to the north east.

Of these two, the former measure is recommended for the following reasons:

(1) Efficiency of cargo handling

While the existing New Quay is used for the handling of container cargoes, the major commodity handled at the alternative facility to the Old Jetty, which is called the additional quay hereafter, are bagged cargoes. If the additional quay is constructed in front of existing Shed No.3, the cargo handling efficiency at the berth can be easily improved by utilizing the Shed as a transit shed with the introduction of handling equipment such as belt conveyors and folk lifts.

On the other hand the additional quay is constructed, the distance between the new berth and the Shed is larger, and the traffic of both containers and bagged cargoes are mixed together.

(2) Construction cost

As described in the above chapters, the Proposed Long-term Plan intends to construct a new container terminal to the east of the existing New Quay, and the depth at the berth of the container terminal needs to be dredged deep enough to accommodate container carriers of which sizes tend to increase towards the future. The structure which is to be used as the alternative facility to the Old Jetty for the moment, thus, should be bearable up to a depth of water -10.5m or larger with the consideration of future deepening of the berth. This surely require additional cost.

As the concept of the additional quay, the following items are proposed:

1) The structural design

The quay structure should be bearable up to -9.0m with the consideration of the future deepening of the berth,

2) The length of the quay

The length of the quay should be 400 meters, which is the maximum extent that the berth is possible to be upgraded -9.0m berth in the future.

3) Berth depth for urgent measure

In consideration with the sizes of calling ships at present, the berth depth of the additional quay should be no less than -7.5m.

4) Other related work needed for urgent measure

- a. Open storage near the additional quay
- b. Pavement of the backyard of Shed No.4
- c. Truck parking area

7.1.2 Alternative facilities to the Old Jetty

(1) Layout plan of urgent improvement

Urgent improvement layout plan is given in Fig. - 7.1.2-1

(2) Quay construction plan

The arrangement of the quay structures for the scope of the urgent improvement plan was determined based on the High and/or Mid case plan of long term development plan. The combination of the structures is summarized in the table below.

- a. Dredging of Navigation Channel (-9.0m)
- b. Dredging of Port Basin (-8.5m to -6.5m)
- c. Road
- d. Empty Container Yard & Parking Area
- e. Renovation of "The New Quay" (-9.0m)
- f. General Cargo Berth (-9.0m)
- g. General Cargo Berth (-9.0m)

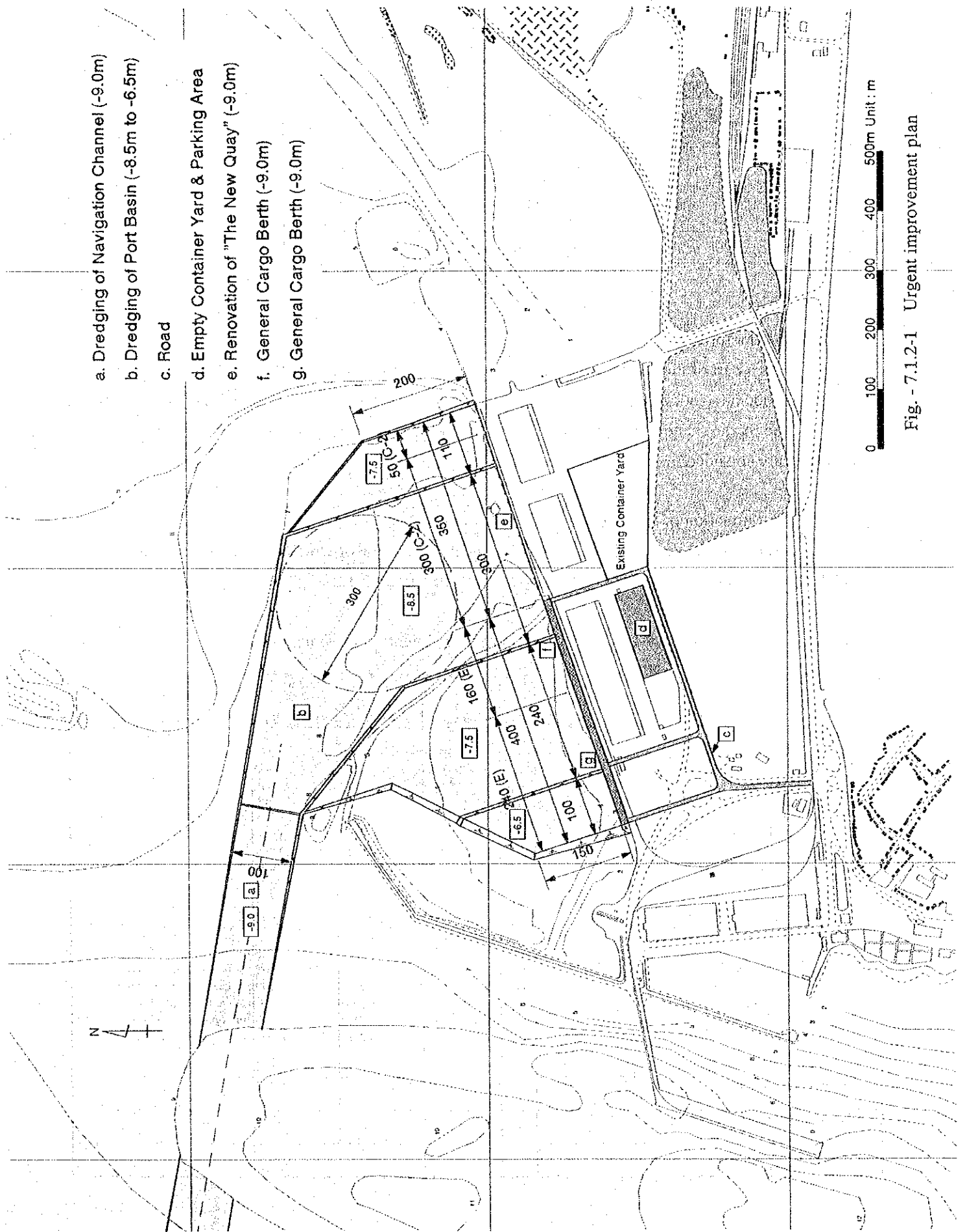


Fig - 7.1.2-1 Urgent improvement plan

Table - 7.1.2-1 Quay arrangement of Urgent improvement plan

Type of berth	Type of quay structure	length of quay (m)	Nominal water depth (m)	Berth water depth (m)	Remarks
General cargo	C-2	350	-9.0	-7.5 to -8.5	
	E	60	-9.0	-8.5	
	E	100	-9.0	-7.5/	
	E	140	-8.5	-7.5	
	E	100	-8.5	-6.5	
Total		750			

Note: For the typical section of individual type of quay structure, see Section 5.3.3

(3) Other facilities

As a part of the scope of the Urgent improvement measures, 716 thousand Cu.m dredging for 100m wide navigation channel and port basin, yard and road pavement with total area of 10,600 Sq. m, and cargo handling equipment consisting of roller conveyers, forklifts, trailers, and toplifters are considered.

(4) Cost estimation of the Urgent improvement plan

A cost estimation was made for above mentioned scope of works. The total cost thereof is US \$ 28.2 million. The cost breakdown is shown in Table - 7.1.2-2

Table - 7.1.2-2 Cost estimates for Urgent improvement plan

Description		Unit	Quantity	Unit cost (US\$)	Amount (1000 US\$)	Remarks
A.	Construction Cost					
	a. Dredging of Channel (-9.0 m)	cu.m	225,600	10	2,256	
	b. Dredging of Basin (-8.5~ -6.5 m)	cu.m	490,000	10	4,900	
	c. Road	sq.m	5,600	77	431	
	d. Empty Container Yard & Parking Area	sq.m	5,000	58	290	
	e. Renovation of the New Quay (-9.0 m)	l.m	350	2,100	735	Type C-2
	f. General Cargo Berth (-9.0 m)	l.m	160	31,215	4,994	Type E
	g. General cargo Berth (-8.5 m)	l.m	240	30,279	7,267	Type E
	h. Utilities	L.S	1	800,000	800	
	Subtotal				21,674	
B.	Procurement of Cargo Handling Equipment					
	a. Conveyer with rollers	set	3	15,000	45	for bagged cargo handling
	b. Forklift (3 ton)	no.	2	30,000	60	for bagged cargo handling
	c. Forklift (15 ton)	no.	1	100,000	100	for heavy cargo handling
	d. Tractor (yard)	no.	6	90,000	540	for container handling
	e. Trailer (yard)	no.	10	30,000	300	for container handling
	f. Top Lifter (40 ton)	no.	2	550,000	1,100	for container handling
	Subtotal				2,145	
C.	Engineering Services (8% of "A" + 3% of "B")				1,798	
D.	Physical Contingency (10% of A+B+C)				2,562	
	Grand Total				28,178	

7.2 Navigation channel and navigation aids

The completion of the North approaching channel is necessary to reduce the time wasted for waiting favorable tide needed by large calling vessels drawing over -7.5 m who are forecast to reach a certain number in the very near future. The channel should be the same as mentioned in 5.3.4 and Fig. - 5.3.4-3, and the navigation aids related to the channel should also be provided.

7.3 Operational improvement plan

After reviewing the present situation of port operation, following measures are pointed out for realizing a adequate port operation at the urgent stage.

(1) Improvement of cargo handling productivity

Efficient cargo handling is one of most important matters for port operation, but suitable cargo handling systems are vary by package type: container cargo, bagged cargo, break bulk cargo, etc.. In order to efficiently handle cargo, the following improvements should be made.

a. Improvement of ship's operation planning

In order to make the ship staying time at the terminal as short as possible, the ship's operation plan should be ready before the ship's berthing. The related sections can prepare everything in advance according to the plan and thus the highest cargo handling efficiency can be achieved. Success of the terminal operation depends on this operation planning.

In order to make a good ship's operation plan, the terminal planner should collect and study import/export information such as ship's schedule list, ship's stowage plan, manifest, dangerous cargo list, special cargo information etc. before scheduled ship's arrival. In addition, according to ship loading/unloading made plan, he should be the supervise entire operation.

b. Improvement of container yard operation planning

Containers to be loaded/unloaded pass through container yard once, and then are delivered/received to the consignee or from the shipper. The container yard which is a junction between sea and land transport, functions as both a delivery site and storage site for containers.

The aim of this planning is to efficiently store cargo within the limited space of the container yard and to perform smooth operation of ship's loading, or delivery to consignees. It is important for the yard planner to pay attention to yard container location and empty space in order to make the best yard plan.

c. Keeping the equipment in good condition

Problems with cargo equipment have a direct influence on the terminal operation. Therefore, to keep the equipment in good condition, maintenance inspection should be done regularly and a sufficient supply of all spare parts should be available. In addition, to avoid lengthy interruptions in cargo handling, mechanics should always be standing by, ready for trouble, while operation is carried out.

(2) Introduction of training programs

It is advisable to introduce training programs prepared by Sihanoukville Port immediately. In particular, training in cargo handling, operation and maintenance of port equipment should be carried out because operators can attain a higher level of skill which will increase the efficiency of port operation. Also, it is necessary to review and monitor the results of training and adjust contents of training courses accordingly.

(3) Improvement of cargo documentation flow

In order to achieve a smooth flow of all cargoes in the terminal, it is important to always keep contact with the shipping company, the shipper/consignee and the custom forwarder. Information and data should be delivered to every sections and results of operation also should be passed onto shipping company, the shipper/consignee and the custom forwarder. In order to carry out correct and speedy documentation, it is necessary to make a fixed form and to introduce several personal computers in the related sections.

APPENDICES

Appendix A:

Probability of occurrence of waves

Appendix B:

Initial environmental evaluation for the master planning
and feasibility study of the Sihanoukville Port
in the Kingdom of Cambodia

Appendix A

(Please refer to 5.3.2)

Probability of occurrence of waves

Table -A.1 Occurrence frequency of wave height by direction

Table -A.2 Occurrence frequency of wave period by direction

Table -A.1 Occurrence frequency of wave height by direction

year **1983-1996**

Frequency		N	NNE	SW	WSW	W	WNW	NW	NNW	Total
Wave height (m)										
0.00-0.24	n	696	23	391	8	721	3	347	3	2192
	%	22.3	0.7	12.5	0.3	23.0	0.1	11.1	0.1	70.1
0.25-0.49	n	203	8	26	1	334	9	104	8	693
	%	6.5	0.3	0.8	0.0	10.7	0.3	3.3	0.3	22.2
0.50-0.74	n	69	6	10		75	2	53	3	218
	%	2.2	0.2	0.3	0.0	2.4	0.1	1.7	0.1	7.0
0.75-0.99	n	4		3		7		3		17
	%	0.1	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.5
1.00-1.24	n					6		2		8
	%	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.3
1.25-1.49	n									0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50-1.74	n									0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.75-1.99	n									0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00-	n									0.0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	n	972	37	430	9	1143	14	509	14	3128
	%	31.1	1.2	13.7	0.3	36.5	0.4	16.3	0.4	100.0

- Notes: 1. Hindcasted by Bretshneider method
 2. n : number of occurrence
 3. At the entrance of Sihauoukville Port (At the opening of existing Breakwater)

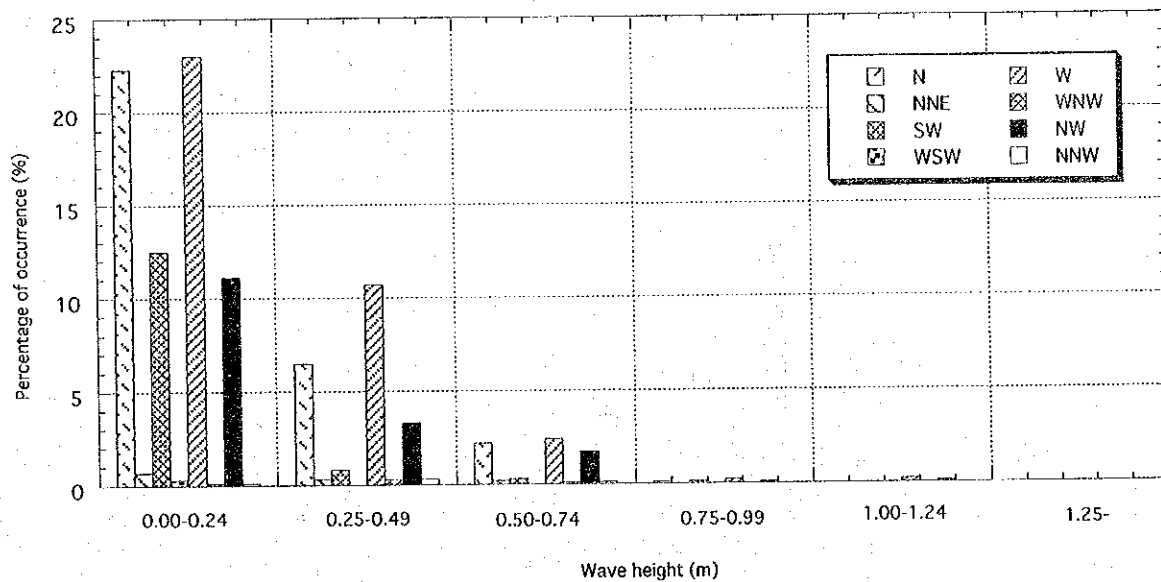
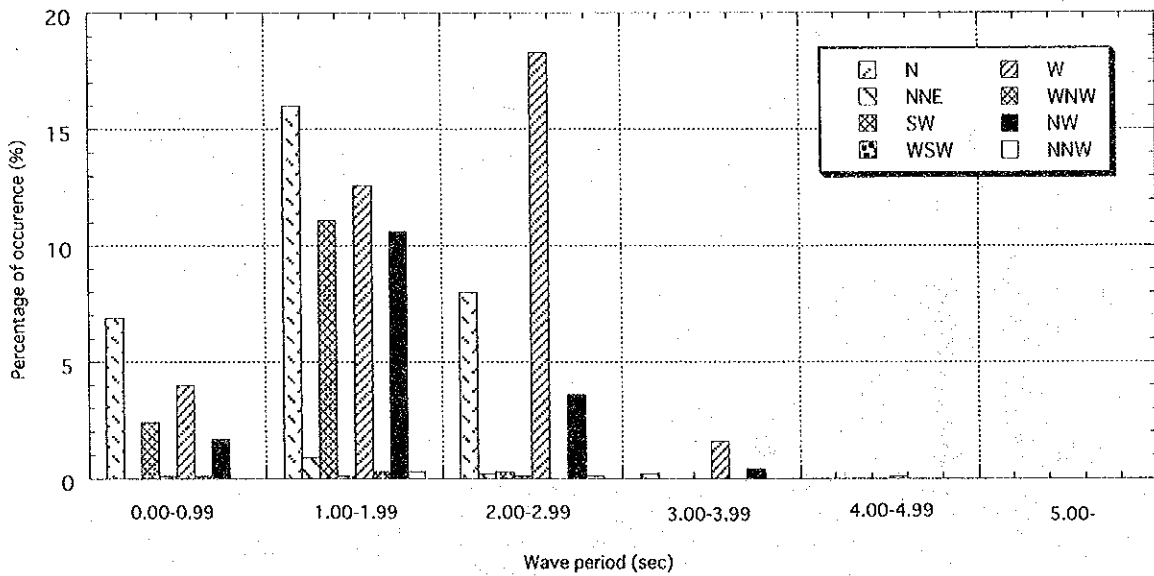


Table -A.2 Occurrence frequency of wave period by direction

year 1983-1996

Frequency		N	NNE	SW	WSW	W	WNW	NW	NNW	Total
Wave Preiod (sec)										
0.00-0.99	n	215	1	74	2	125	4	53	1	475
	%	6.9	0.0	2.4	0.1	4.0	0.1	1.7	0.0	15.2
1.00-1.99	n	502	28	348	4	394	10	331	10	1627
	%	16.0	0.9	11.1	0.1	12.6	0.3	10.6	0.3	52.0
2.00-2.99	n	249	7	8	3	572		114	3	956
	%	8.0	0.2	0.3	0.1	18.3	0.0	3.6	0.1	30.6
3.00-3.99	n	6	1			50		11		68
	%	0.2	0.0	0.0	0.0	1.6	0.0	0.4	0.0	2.2
4.00-4.99	n					2				2
	%	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
5.00-5.99	n									0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.00-6.99	n									0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.00-7.99	n									0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.00-	n									0
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	n	972	37	430	9	1143	14	509	14	3128
	%	31.1	1.2	13.7	0.3	36.5	0.4	16.3	0.4	100.0

- Notes: 1. Hindcasted by Bretshneider method
 2. n : number of occurrence
 3. At the entrance of Sihauoukville Port (At the opening of existing Breakwater)



Appendix B

(Please refer to 5.4)

INITIAL ENVIRONMENTAL EVALUATION
FOR
THE MASTER PLANNING AND FEASIBILITY STUDY
OF THE SIHANOUKVILLE PORT
IN THE KINGDOM OF CAMBODIA

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1. Summary of Project

There are presently two international trading ports in the Kingdom of Cambodia. One is the Phnom Penh Port and the other is Sihanoukville Port. Phnom Penh Port is located at the right bank of the Tonle Sap River and is 332 km away from the mouth of Mekong River in the capital. It was the only trading port until the start of operation of Sihanoukville Port in 1959.

Phnom Penh Port deals mainly in general cargo and oil products as the key port for international trading and is situated in the highest consumption area of the country. Phnom Penh Port is an inland river port and has the capability for 2,000 DWT ships in dry seasons. Being a river port and with the water depth in the river mouth being not so deep, ships of maximum 6,000 DWT are unable to enter this port.

On the other hand, Sihanoukville Port is an outpost and faces the Gulf of Thailand. It was constructed in 1959 and is accessible to 1,000 DWT class ships. The National Route No.4 (235 km) and a railroad (262.6 km) connects this port with Phnom Penh. Sihanoukville Port is comprised of a new port, an old port, and an oil port, and deals in miscellaneous goods, bulk cargo, and containers. It has a cargo capability of 1,600,000 tons per year (Refer to Fig. 08).

Considering the positive results of the election held under UNTAC operations, which are the political stabilization and reconstruction of economy, it is foreseen that cargo volume will increase rapidly in the country. Consequently, a master plan is urgently required which would include measures to increment its cargo capability as well as a study of life for the old port.

Based on this background, the Government of Cambodia requested a feasibility study for Short-term plan and preparation of master plan for Sihanoukville Port to the Government of Japan in 1994.

The objectives of the study are ;

- (1) To formulate a Master Plan for Sihanoukville Port over the period up to Year 2015,
- (2) To conduct a feasibility study for the Short-term plan for Sihanoukville Port over the period up to Year 2005 within the framework of the Master plan, and
- (3) To propose urgent measures to be done prior to the implementation of the Short-term plan, if those measures are deemed to be necessary.

Based on the above objectives, the JICA survey team prepared a report for both the Short-term plan (2005) and the Long-term plan (2015) including Urgent measures.

After the team's completion of field survey. The IEE report prepared by JICA and which is presented in this section describes the environmental impact of the port project based on the above Master Plan for Sihanoukville Port over the period up to Year 2015.

2. Project Description

2.1 Project Name

The Master Planning and Feasibility Study of Sihanoukville Port in the Kingdom of Cambodia

2.2 Background

Sihanoukville Port is the only port facing the ocean in the Kingdom of Cambodia. Due to the reconstruction of economy, it is foreseen that cargo volume will increase rapidly in the future. At present, the concrete structures of existing old port are deteriorated and repair works are being conducted through the special aid provided by ADB. It is also expected that the Long-term continuous use of the existing jetty would be very difficult. On the other hand, the port would require an increase in cargo capacity, improved working efficiency, and upgrading measures for large scale ships. Consequently, the preparation of Master Plan for the existing port is urgently needed.

(Refer to Section 1. Summary of Project)

2.3 Objectives

To formulate a Master plan for Sihanoukville Port over the period up to Year 2015 and to conduct a feasibility study for the Short-term plan over the period up to Year 2005 within the framework of the Master Plan.

2.4 Location

Sihanoukville Port and adjacent area

2.5 Executing Organization

Ministry of Public Works and Transportation, Sihanoukville Port Authority

2.6 Basic Conditions for Planning

Refer to Section-5 of Final Report (Volume 2)

3. Environmental Conditions of Project Location

3.1 Social Environment

3.1.1 Resettlement of Inhabitants

At present, there are 809 families and approximately 4200 habitants living at the fishing village in the project area forming the local community. In this fishing village, there are small local factories of ice, ship building, saw mill, soy sauce and bricks for building construction. There are public administrative functions in the fishing village such as municipality port office, custom house, quarantine, immigration office, police, fishery inspection office, quarter office, elementary school, and the like.

The Long-term Plan over the period up to Year 2015 is not required resettlement of inhabitants.

3.1.2 Economic Activities

The biggest industry in Sihanoukville City is agriculture, with 45 percent of workers engaged in agriculture. The semi-government company, Angkor Beer, is the biggest factory in the city employing 325 workers. There are also small-scale industries such as ice factory, saw mill, rattan factory, and garments factory.

Recently, visitors who seek beautiful coast lines have been increasing and 37 hotels have already been constructed for them. Hotel construction has increased after the election held by UNTAC in 1993.

As to fishery, the total fish catch of the province is recorded at approximately 9000 ton per year. Part of fish caught particularly shrimps are being exported to Thailand thus earning foreign currency.

3.1.3 Traffic and Life Facilities

Most major roads in the downtown area are paved by asphalt though it is observed that most require repair and maintenance. Access to Sihanoukville City by land is through National Route No.4 which leads to Phnom Penh. At present, transportation of cargo containers and oil products from Sihanoukville Port are through this road.

Most of the existing infrastructures (electricity and water) in the city still use the original facilities constructed many years back.

In recent years, increases in the power demand due to economic recovery of the country and the decrease in the capacity of facilities due to aging lead to remarkable shortage of power supply. Major hotels and factories in the city therefore have been using private power generator units as countermeasure.

3.1.4 Historical and Cultural Heritage

There are two temples, miscellaneous monuments and several seaside parks in the Sihanoukville City, though they are observed to be not of special historical and cultural heritage.

Radio antenna towers are constructed on the top of a small mountain in the city but no broadcasting is provided at present stage. As to local TV, broadcasting service is provided only a few hours a day, though major hotels in the city could receive programs from satellite such as CNN, Star-TV, and the like.

3.1.5 Water Right and Common Right

There are no water right and common right in sea area except the reservoir pond for the water supply authority and the nursery ponds. As to activities in the fishing village, no special organizations are observed at present stage.

3.1.6 Waste and Garbage

The waste and garbage of the city are collected in steel boxes installed at city streets. These boxes are then collected and transferred by big trucks of the Sihanoukville City. Raw garbages are disposed at and treated in the farms located in the suburbs.

3.1.7 Risks and Hazards

More than 500 mm/month rains are recorded during the rainy seasons, As to typhoon routes, most typhoons are passing far from the route of Indo-china peninsula, and as such, this area received no damages by typhoons. The damages by earthquake have not been observed in this area previously.

3.2 Natural Environment

3.2.1 Topography and Geology

The downtown of Sihanoukville city is expanding in a hillside having a gentle slope. There are several reforestation areas which are planted with trees such as eucalyptus and coconut tree, though due to the poor quality of soil and deforestation, a lot of areas are covered only with weeds.

Beautiful coastlines having long shallows are utilized as recreational areas by foreigners and citizens. Coastal area is comprised of a little rock beach and a sandy beach with no observed erosion troubles.

3.2.2 Underground Water

Due to the insufficient capacity of water supply system, many families utilize water from artesian wells of 5 m to 20 m deep. The water supply authority have 4 numbers of deep well in the town for back up during dry seasons. It is observed that many houses install jars outside to collect rain water for domestic water consumption.

3.2.3 Hydrological Regime for Rivers and Lakes

There are many damp areas inland though water is dried up in dry seasons. There are three rivers adjacent to the project area. One river is flowing to Prek Toek Sap Lake and is utilized for drinking water by the water supply authority. The second river is located 2 km far from break water and north of new port. The third river is flowing to the existing pond located beside the reservoir pond belonging to Sihanoukville Port. In addition to the above, during the rainy seasons, it is observed that there are small rivers which appear as drain channel after heavy rains.

3.2.4 Coastal Zone

There are many beautiful coasts in the downtown of the Sihanoukville City, and presently utilized by citizens as recreational areas. Recently, there is an increasing number of tourists coming from other provinces who pursue these beautiful coasts. Both development plans prepared by the central government and Sihanoukville City assign these coastal zones as resort areas and recreational areas.

3.2.5 Ecology ,Fauna, Flora

According to "Areas Designated as Protected Areas" prepared by Ministry of Environment, Ream, approximately 20 km far from Sihanoukville City and Bolum Sakor facing Kompong Saom Bay are designated as national parks. There was not observed precious fauna and flora in these areas.

3.2.6 Meteorology

Yearly mean temperature at Sihanoukville City is 25 °C to 30 °C while humidity is more than 70 % through out the year. By the tropical monsoon, December to April is dry season while May to November is rainy season. In the peak of rainy season, it was observed that there are many days with recorded rain fall of more than 100 mm /day.

3.2.7 Landscape

The downtown of Sihanoukville is located on a hillside having gentle slope. No high - rise buildings are observed with almost all buildings below five stories high. Sihanoukville Port is located at the tip of the peninsula and is a hinterland area having gentle hills and small mountains. There are seaside parks in the south of the port which are utilized as recreational area by citizens.

3.3 Pollutant

3.3.1 Air pollution

At present, only exhaust gas from automobiles are observed.

3.3.2 Water Pollution

All domestic sewage from habitants of the fishing village, port facilities and offices north of new port are discharged to water area at new port without any treatment. As there are no public sewage treatment facilities such as pipelines and sewage treatment plants, raw sewage from buildings are treated by individual septic tank and cesspool. The municipality does not have any construction plan for sewage treatment facilities at present.

3.3.3 Soil Contamination

It was not observed in the port area and there are no factories which may possibly cause soil contamination in the city.

3.3.4 Noise and Vibration

It was not observed except for the noise of automobiles and the noise of private generators operated at night time.

3.3.5 Land Subsidence

No land subsidence was observed.

3.3.6 Offensive Odor

In the fishing village, it was observed that offensive odor occurs from the soy sauce factory and from factories processing dry fishes. There are no chemical factories in the Sihanoukville City.

4. Target of Environmental Protection

At the first field survey stage, the basic environmental protection laws are still under preparation by the Ministry of Environment of the Kingdom of Cambodia. As such, the reference standards which have to be complied in this project are not presently available. With regards to Environmental Impact Assessment (EIA) and Initial Environment Evaluation (IEE), the basic rules and standards for necessity, standard formats for preparation, procedures for application, allowable value of pollutant, etc. are also not presently available.

Only the following two environmental laws are issued from the Government previously.

- a. Laws of environmental protection and national resource management
- b. Creation and designation of protected area

The laws for establishment of new organization of Ministry of Environment and the laws for basic environmental protection are still under deliberation at present stage. It is expected therefore that the details of laws and regulations concerning this port project will be issued in the next stage by concerned authorities.

It will be assumed in this study that it will take a lot of time for the promulgation of the related laws, and further that the details of content will not be cleared by that time. As such the standards of environment protection such as Japan, World Bank, United Nation, neighboring countries, etc. shall be applied for the study and evaluation for the project.

In the determination of the targets for environmental preservation, consideration shall be given to the special conditions of Cambodia and geographical features of this country (Refer to Table 4.1-1, 4.1-2, 4.1-3, 4.1-4, 4.1-5).

5. Evaluation and Prediction of Environmental Impact

5.1 Resettlement of Inhabitants

5.1.1 Existing Conditions of Fishing Villages

At present there are approximately 800 families and 4,200 habitants living in the coastal area which is under the control of Sihanoukville Port Authority and where the port development project is being planned. About 2,635 fishermen are settled here, according to the 1995 statistics of the Fishery Office (an office under the Ministry of Agriculture, Forestry and Fisheries). In this region, there is a municipal port administrated by Municipality in Sihanoukville, and the local community is comprised of fishermen, government officials, retailers and so on. It was learned that it was approximately 20 years ago when fishermen started settling in this region. However it is estimated that the population of fishermen has rapidly increased as the region has not been under the strict control of the government. The population has increased since many fishermen have settled near the north of the New Port's breakwater after the election of 1993 held under the control of the UNTAC (Refer to Table 5.1-1 and 5.1-2).

As to the nationalities of the fishermen's families living in this area the surveys taken by the Sihanoukville City (Quarter No.1 and No. 2) shows the distribution below:

<u>Nationality</u>	<u>Number of Families</u>
Cambodia:	754
Islam:	10
Vietnam:	32
Vietnam/Cambodia:	11
<u>Thai:</u>	<u>2</u>
Total:	809

It is supposed that after the civil war many fishermen have migrated from various places into this area as it has large port facilities, accessible and plentiful fisheries, and good climate conditions.

The number of fishing boats based at Sihanoukville Port was 1,243 in 1995 according to the Fishery Office's data (Refer to Table 5.1-3). As boats and fishermen temporarily get out of adjacent ports into the well-conditioned port, it was learned that many boats are being moored in this village. However the detailed data and information are not available.

Most of the habitants who live near the breakwater in the north of the New Port earn their

living mainly by fishery. Other people are also engaged in services such as retails of daily living necessities, street stalls, port-related services, small factories and so on. It was learned that some of the Cambodian people are earning their living here but have their own houses in the land area. They accordingly stay here only in the daytime for their business.

There is a terminal for a liner bound for Koh Kong with a capacity of 50 to 70 passengers. There are also various government office buildings such as the Ministry of Public Works and Transport (MPWT), custom, immigration, quarantine, police, etc. in the center of the New Port's Fishing Village. There are also small public facilities such as elementary school, liner's office, tracks for heavy cargo, etc. which form another local community equipped with port facilities and functions different from Sihanoukville Port (Refer to Table 5.1-4, Fig.1, Fig. 3).

Sihanoukville City has the following two development plans officially approved by concerned authority.

- a. "Master plan of land use" prepared by National Committee in 1990 (Refer to Fig. 10)
- b. "Land development plan" prepared by regional development department of Cabinet office in 1995.

In both master plans, the existing area belonging to and being controlled by Sihanoukville port authority at present stage is designated to be utilized continuously for port related lands. However, future master plan of the existing fishing village is not included in both reports.

5.1.2 Existing Infrastructures of Fishing Villages

There are approximately 4,200 habitants living in this area. However, public infrastructures have not been provided because the habitants have been illegally occupying the fishing village in the part of the port. Other existing infrastructures are as described hereinafter.

(1) Electricity

No electric power from the municipal power plant is being supplied. Small private power generation is utilized but is limited to government facilities and the like. In the future plans of power plant, electric power cable is planned to be laid through the Fishing Village to the Oil Port. It is undecided at present but it depends on the Government's final decision on whether or not electric power will be supplied to the Fishing Village.

(2) Water

No water from the municipal water lines is being supplied. The habitants buy water from retailers. The retailers transport municipal water and Boeng Prek Tup lake water by tank lorries, transfer it to small water tanks and then deliver it to the habitants by modified drums mounted on rear cars. Some of the habitants utilize water from artesian wells of 5 to 10 meters deep.

(3) Sewage

Basically there are no sewage treatment facilities in the area. The sewage water drains out without treatment to the sea in the port. Volume of the sewage water is estimated to be comparatively small because of the habitants' low standard of living but the sea in the port shows a trace of contamination. Further increase in the fishermen's population may lead to serious contamination of sea water in the New Port nearby. Sewage water from habitants living in the land region is drained out to the adjacent lowland but the impact against environment is comparatively small due to small population in the land region.

(4) Roads

Paved road of 6 meters width runs along the New Port through the center of the Fishing Village to the Oil Port. This road serves not only as a lifeline for habitants in the Fishing Village but also as an access road to oil companies (SHELL, SOKIMEX) in the Oil Port for delivery of oil products to the whole country. The present storage capacity of oil products is 134,000 tons. However, construction of large storage tanks is being planned by oil companies. This plan will bring about a large increase of traffic volume in the region. The municipality has a future plan to construct a road along the existing railroad from the Port via the Oil Port to Steng Haw.

(5) School

The elementary school located in the center of the fishing village area was constructed in 1984 and is being attended by 12 teachers and 643 Cambodian habitant's students. The classes are operated in 3 shifts as there are only 4 class rooms available. The students include many from the land region as there is only one school in the area along the railway (Refer to Table 5.1-5).

5.1.3 Resettlement Plan by Sihanoukville Municipality

The Ministry of Public Works and Transport (MPWT) and Ministry of Agriculture, Forestry and Fisheries officially acknowledge that the fishermen are illegally settled there and that it is not legally approved. In 1984, the Government decided on Steng Haw, located 23 kilometers north of Sihanoukville, as a place for the fishermen's relocation to try to move them but failed to settle them there. At present, the Municipality of Sihanoukville has a plan to move illegal occupants to the 3 areas of Steng Haw, Koh Rong and Koh Tyong (Refer to Fig. 4). The area has already been approved by the local Governor assigned to them. The timetable for the plan, however, is not yet known.

5.1.4 Existing Conditions of Areas Affected by Project

Project area is located in the south of the existing Fishing Village along with the oil port road and on the extended direction of the existing wharf in the new port. It was observed that approximately 100 numbers of small fishing boats are moored in this port area. There are living facilities such as approximately 70 numbers of family houses of wooden construction, small type restaurants, daily commodity shops, fish preserve, etc. In addition to the above, public office building for immigration police was observed in this area. There are also temporary houses selling daily commodities, fruits, fishes, soft drink, etc. on the groin; however, size of these shops are all small.

Ship building factories were observed at the entrance of the fishing village and these factories carry out the fabrication and repair of wooden made fishing boats.

Power supply cables are hanged on tree branches and building structure with the power coming from private generator units installed at the ice making factory. Electricity is being used only for restaurants, fish preserve, and several shops.

As public facilities, wooden made slipway with concrete floor and a wooden made jetty were observed in this area (Refer to table 5.1-6).

5.1.5 Measures for Resettlement of Inhabitants

In the areas needed for the Long-term Plan (2015), it is assumed that moorings having wooden made jetty and small groin (rubble mounted jetty) located in areas of Quarter No.3 will be not affected by the proposed project (Refer to Fig. 03, Fig. 05). However there are approximately 100 numbers of small fishing boats are moored in the port area, and there are living facilities such as approximately 70 numbers of family houses, restaurants, daily commodity shops, etc. At present,

the Municipality proceeding the resettlement plan for the habitants live in the fishing villages illegally near the New Port. This information is very important in the establishment of future plan. In the relocation plan scheduled for the present as well as for the previous one, no indemnity is considered and the Municipality has only to supply the land. Moreover, the post-moving utilization plan of the New Port and the existing governmental facilities has not been made yet. It is recommended that to collect information from concerned government agencies and carrying out of survey about resettlement plan are necessary.

5.2 Water Pollution

5.2.1 Sewage From Fishing Village in New Port

At present there are approximately 800 families and 4200 habitants living in the fishing villages. In this area, there are not only fisherman's housing but also government facilities, public facilities, retailers, street traders, etc. As no public sewage treatment facilities and pipelines are installed in this area, most domestic sewage are disposed to sea in the New Port. Due to the low living standard of the inhabitants, it is estimated that the total volume of sewage discharge is not much. However according to survey report conducted by JICA team, water pollution is already observed in the new port area (Refer to Table 5.2-4 and Table 5.2-5).

As this break water area is a closed area, an increase in the number of habitants having same life style will make the water pollution more serious in the future.

Regarding the habitants who live inland, it is supposed that all domestic sewage is discharged to damp area or penetrated underground. However, the population of inhabitant living in the land area is estimated to be lesser than that of the coastal zone. Thus the environmental impact is estimated to be relatively small.

There are small local factories such as ice, soy sauce, freezing, saw mill, and brick in the north of break water area in New Port. These factory are small scale and have relatively less workers. As such the environmental impact of these factories are expected to be relatively small.

5.2.2 Pollution from Oil Port

In the existing Oil Port, there are 12 numbers of oil tank having storage capacity of 13,400 m³ for the oil products. Since 1983, the facilities are operated by Shell (International oil capital company) and Sokimex (Local capital). For the operation of these facilities 45 workers from Sokimex and 15 workers from Shell are presently assigned.

These facilities were constructed as refinery plant for crude oil in 1967. After suspending operations due to the civil war, part of facilities have been utilized as storage tanks for a time for the oil products imported from Singapore. At present, oil products are being imported from Singapore once a week by tanker. The oil products are being unloaded by loading facilities installed at the existing jetty and stored in the tanks. To cope with the increment of demand at present stage, Sokimex has a construction plan for new storage tanks having capacity of 15,000 ton to 20,000 ton.

According to statistic data, sea pollution is caused by three items; oil spill during transportation, navigation and vessel accidents. Oil spill troubles account for 46% of all oil troubles in the sea area. The relations of oil transportation and its pattern are influenced seriously by conditions of international politics and economics.

According to the interview conducted in the oil port, the oil port has been in operation for thirteen years. It was learned that no oil spill through operations are recorded within this period. In the survey conducted by JICA team, evidence of oil pollution was found from the sampling data of soil sediment taken at ten survey points.

Oil products being handled in this port are gasoline, heavy fuel, jet fuel, and the like but not crude oil. In this case, if an oil spill occurs, spilled oil will be having high tendency of evaporation and diffusion within comparatively short period. According to visual inspection conducted by JICA team, sea pollution could not be observed obviously. However, the import of oil product through the oil port have been increasing the more in recent years due to the economic recovery of Cambodia after the election by UNTAC, and it is expected to increase more in the future (Refer to Table 5.2-1). Consequently, it is foreseen that the possibility of oil pollution will increase in proportion to the volume of imported oil through the port. According to a conducted interview, construction of new oil berth is being planned and studied by Shell company. By this it is expected that the existing superannuated facilities will be changed to new facilities having high safety devices in the future.

To prevent oceanic oil pollution, it is recommended that the following measures be requested to the operating and management company Shell and Sokimex ;

- (1) To provide periodic inspections on transportation of oil products and pipelines
- (2) To provide periodic water quality test for seawater
- (3) Preparation of safety devices for oil spill accidents (oil fence, oil sorbent)
- (4) To provide safety training to operation staff

There are two submerged pipelines (300 mm dia. and 200 mm dia.) under seabed which were utilized for crude oil lines for refinery plant previously. In the future project being planned by

Shell, there must be sufficient countermeasures to avoid the spill of the remaining oil from these pipelines.

If a big oil spill occurs from the oil port and with the conditions of oceanic current and meteorology (wind direction and wind speed), it is foreseen that the beautiful sandy beach of coastal zone located west side of the city will be affected in short period.

In general, if an oil spill occurred in tropical and temperate zone, 40% to 60% of low boiling point compound (boiling point : below 350 °C) will be evaporated within 2 or 3 days. Floating oils on surface of sea become oil film and diffused having diffusion area per liter of 0.004 km² to 0.04 km². The parameters which are affecting this diffusion area are considered to be the oceanic current and wind speed. Damages of oil pollution are mainly acute troubles in Long-terms since oil will continue its evaporation and diffusion and finally separated by microbes. Therefore, after an oil spill, it is necessary to collect at early stage to avoid emulsification and sedimentation (Refer to Fig. 06).

5.2.3 Drainage From Port Facilities

At present, there are approximately 1,000 operational workers working in facilities in Sihanoukville Port. Domestic sewage from these workers are discharged to the sea area of New Port directly through manholes and pipelines. In the port area, there are large scale warehouses, offices, restaurants, etc. with the headquarters of port office located at the other side of the road. The domestic sewage from headquarters is also disposed to sea area in Old Port through pipeline without treatment. In the case of an increase of cargo in the future, it is expected that operational workers will also increase.

At present, there are no public sewage treatment facilities (Sewage Treatment System, Pipeline, etc.) in the Sihanoukville City. As such, hotels and offices in the city installed septic tank and cesspool and treated raw sewage individually.

In the port area, there was not observed obvious water pollution troubles at present. However it is assumed that raw sewage from port facilities will increase in proportion to operational workers in the port. Thus the installation of primary sewage treatment system is recommended.

In the case of discharging sewage to New Port, to avoid affecting the quality of oceanic water, it is required to have water treatment system since New Port, although having wide area, becomes closed sea area by break water.

According to the survey report conducted by JICA team, there was observed a tendency of water pollution in this sea area (Refer to Table 5.2-4 and Table 5.2-5). At the construction stage, it is expected that many workers will get involved in this project. Considering the domestic sewage from these workers, special measures have to be taken to prevent water pollution arising from these

workers in the land and sea areas.

5.2.4 Pollution by the Port Construction Work

In the proposed Long-term Plan, it is planned to construct facilities such as breakwater, revetment, jetty, etc. and the works will include reclamation and the dredging of new port and channels. Due to the resulting disturbance of seabed soil during construction, it is anticipated that part of the dredged soils will become suspended solids in the sea. It will therefore be necessary to provide in advance adequate countermeasures to reduce pollution and the preparation of the necessary construction procedures (Refer to Fig. 7).

In this project, dredging works for the New Port and the channel for the new sea route located north of Kaoh Poah Island are included. Since the construction of the New Port in 1969, no real dredging work has ever been provided. According to the survey conducted by JICA, the sea depth of New Port measured approximately 5m to 9m. The total volume of required dredging for New Port is estimated to be approximately 3,000,000m³ (Case M-2).

The New Port area is enclosed by breakwater and is situated in a closed sea area. In the event of water pollution, it is foreseen that the environmental impact to the coastal zone is relatively small. Fishermen living in the fishing village do not conduct their operations in this port area and as such, impact to fishery is estimated to be small.

The construction work for the new north channel will include 903,000m³ (Case M-2) of dredging with an estimated period of approximately 6 months. In the expected dredging area, there are only few fishermen conducting their fishing operations and as such, the impact to fishery is estimated to be relatively small. However the coastal area located west side of the city is designated as a resort area, and many tourists are visiting this area in the new year (April). It is therefore necessary to adopt construction methods which will minimize the environmental impact to the coastal plain zone and the coastal sea area. Assessment of the environmental impact of pollution due to dredging require study and simulation of the area and period of pollution based on the seabed soil survey, soil survey, and tidal current survey conducted previously.

Items of study of the environmental impact of the dredging which will affect the fauna and flora of the sea are as follows ;

- (1) Impact to the physiology and ecology
- (2) Impact to the development of spawn
- (3) Impact to the fish directory
- (4) Impact to the sea moss and sea grass
- (5) Impact of the diffused obnoxious materials which will precipitate on seabed

Basically, the dredging work for the channel is expected to be 150m width, with the total length of approximately 2,500m. The diffusion area of pollution is influenced largely by the conditions of topography, depth of water, conditions of seabed, relations of geography between structures installed in the adjacent area, and the meteorological and oceanographic conditions such as tidal current, ocean waves and tide. It is therefore vital to get the accurate information on these factors.

In the rainy season, it is observed that the coastal sea area located in New Port and the west side of the city is being polluted by laterite flowing into the sea area with rain water. Laterite is a kind of soil covering the ground and having brown color.

As to the dredging for the north channel, there is currently no available sufficient data. However, it is foreseen that fishes and shell fishes will receive minimal damage due to the scale of required dredging works. In the shallow sea at the coast, there are observed table corals. It is therefore recommended to adopt proper construction method on dredging work.

This project will also include the reclamation of the New Port area. The reclamation will require huge volume of soil for filling and part of dredged soil will be utilized for them. The additional soil for reclamation will be taken from the mountain side in the suburbs. The water discharged from spillway in the reclamation area will require adequate environmental preservation measures to prevent diffusion of pollutants. To have a smooth and safe construction work, it is necessary to conduct studies with environmental implication such as the following ;

- (1) Soil quality, meteorology and oceanography for the expected reclamation area
- (2) Procurement method of soils for reclamation
- (3) Reclamation method
- (4) Design of bulkhead
- (5) Construction method
- (6) Improvement of reclamation area

Based on the studies of the above, work procedures shall be laid out for the construction work of the port reclamation (Refer to Fig. 11).

5.2.5 Pollution by Ship's Bilge

The types of waste oil occurring during ordinary operations of a ship are mainly bilge, ballast water and tank-cleaning water. Bilge is the waste oil that accumulates at the bottom of a ship. It is composed of fuel and lubricating oil leaking from the engine mixed with water used to wash out these fuel and oil.

Ballast water is the water loaded in the cargo hold or fuel tank to balance the ship. It is usually sea water, got mixed up with the oil remaining at the bottom of the tank, adhesive oil on the wall of tank and so on.

Based on the number of ships coming to Sihanoukville port, ship's bilge which are necessary for treatment are expected to increase in the future. There is however no bilge treatment facilities in the port. It is anticipated that it will be very difficult to construct such facilities due to economic reasons and maintenance problems. According to statistics record, almost all ships coming to Sihanoukville come from the ports of Singapore and Bangkok. As these big scale ports have bilge treatment facilities, it is recommended that basically the ship's bilge of those which visited the port shall be treated by them. Since the distance from Singapore Port to Sihanoukville is only approximately 900 km, taking only three days by ship, this treatment scheme will not alter the port operation.

Aside from bilge, there are also other causes of pollution generated from ship such as ballast water, tank cleaning water, collect oil, slop oil, sludge, etc.

The general treatment system for these waste oil is shown in Table 5.2-2 and 5.2-3. The Marpol 73/78 treaty is not confirmed by the government of Cambodia.

5.2.6 Pollution by Effluent from the Existing Pond

Rain water had been flowing from inland to New port area directly through the river. However this river became pond due to damming up during the construction of the New Port. The water that accumulates in the pond flows to the New Port through 12 pipelines and a box type culvert installed at 3 locations along the coast and discharging to the sea area (Refer to Fig. 1). There is not observed obvious effluent in the dry season. However, in the rainy season, remarkable rain water flows to the New Port area. As the rain water contains laterite component generated by soil erosion in the basin of the river, water in the New Port changes color to brown. Also after heavy rain, pollution by rain water containing laterite is observed in almost all areas in the coastal zone in the west side of the city. It is quite remarkable after heavy rain in rainy season, though this phenomenon disappears with the passage of time. The time necessary to remove pollution caused by laterite brought about by the rainfall is estimated generally to take half day to one day.

In the preparation of the basic plan for the port, it is necessary that sufficient considerations be given to the above conditions.

5.3 Tourism Development

The Sihanoukville City now takes a positive attitude to tourism development. The beautiful beach in the outskirts of the city is a scenic place which not only the citizens but also many tourists will appreciate. In some development master plans prepared by the Government and the Municipality, the beach in the west of the city is designated as a Beach Park or Recreation Zone.

There are 37 hotels in the city whose number has increased after the election held by the UNTAC. The number of tourists visiting here is increasing year by year as the economic reconstruction proceeds (Refer to Table 5.3-1, Table 5.3-2).

The Island of Kaoh Poah (called Snake Island), is also located in this project area. The island is a tropical, jungly and unmanned island with a beautiful beach in its northern portion. According to the information obtained from the Ministry of Tourism in Phnom Penh, the Malaysian company of Ariston has the right to its development.

According to the Sihanoukville City's authority, the details of the development plan is unknown and that the Governor is the negotiator. Based on the information gathered by the JICA Site Survey Team, the following plans are being made:

- (1) Development of Kaoh Poah Island.
- (2) Modification and repair of an existing government hotel (called Independence Hotel which had been utilized by the Army but is not serving now).
- (3) Construction of an aerial ropeway from the main land to the island.
- (4) Construction of resort hotels.
- (5) Expansion of Sihanoukville Air Port.
- (6) Construction of casinos in Kaoh Poah Island.

Details for the above plans such as commencing date of construction, etc. were not available from any public organizations. Impact on the courses planned in this project should be studied because their courses are located adjacent to the Kaoh Poah Island.

The most important impact on the project is the course of ferry boat to the island. However there is no special problem if an aerial cableway is applied.

The impact on port safety when small and medium boats run across the course in the future will be negligible due to the smallness of their sizes.

5.4 Infrastructure in the City

Most of the existing infrastructures in the City of Sihanoukville were constructed many years back. In recent years, increases in the demands due to economic recovery and decrease in their capacities due to aging and deterioration lead to remarkable shortage of capacity.

Utilities such as electricity, water, and the like, which will be required in the port facilities planned in this project, shall therefore be designed taking the following factors into consideration:

- (1) Sufficient and stable supply of electric power and water to this project,
- (2) Application of stand-by units for stable port operation,
- (3) Energy saving (Application of energy-saving type units) and so on.

In addition, a system should be designed so that such a large scale of port development project may not give much negative impact on the life of habitants living within the area.

5.4.1 Electric Power Supply

The electricity consumed in the city is generated by diesel engine-driven power plants adjacent to the port. The existing power plants were constructed with the assistance of the Soviet Union. The total capacity is 3,700 KVA (1,000 KVA x 3 + 350 KVA x 2) and remarkably declining due to deterioration. Power generated by the existing plants was basically supplied to 47,000 habitants living in the city. However, private power generators are provided in major hotels and the like since economic recovery had led to shortage of power supply. Electricity shut-down is inevitable for periodic inspection and maintenance of the existing diesel-driven power generators. Electricity shut-down occurred frequently due to the inadequacy of the existing power plant's capacity.

To satisfy the increasing demand in electric power, new power plants of about 5,000 KVA is being planned with the assistance of the ADB. The construction of these plants will start in 1997 and will be completed in 1998. In the Long-term plan, more power plants of 5,000 KVA are planned to be added.

To obtain a stable supply of electric power, 2 power generators of 350 KVA are being constructed by Sihanoukville Port. After completion, the total capacity will reach 860 KVA including the existing power generators of 100 KVA and 60 KVA (Refer to Table 5.4-1).

5.4.2 Water Supply System

Waterworks in the City of Sihanoukville are being operated by the Water Authority and it has 2 kinds of water sources. The main source is the lake water in the Boeng Prek Lake located south of the port. The other one is the ground water from 4 deep wells of 100 meters deep in the city to back up the shortage of water supply due to drying up of lake water during the dry season (Refer to Fig.12).

The existing water supply system has a capacity of 2,000 cubic meters per day and was constructed from 1958 to 1960 by the Soviet Union. The maximum consumer is a beer plant (Angkor Beer) in the city which consumes 1,000 cubic meters per day. The remaining 1,000 cubic meters per day is supplied to general consumers.

Considering that the city has such a large population of 47,000, the supply rate is absolutely short. The shortage is therefore backed up by artesian wells with depth of 5 to 20 meters. The Water Authority supplies the water of 500 cubic meters per month to the port facilities. To compensate the absolute shortage of water, the Water Authority is planning a new water system of 4,000 cubic meters per day and will start its construction in 1997.

Drinking water is not supplied to visiting ships due to lack of water as described above. However, it is assumed that drinking water for visiting ships will be required in future, and it is advisable that a water supply system to visiting ships be considered in the Long-term port plan (Refer to Table 5.4-2, 5.4-3).

5.4.3 Roads

The National Route of No. 4 is a main road leading to the Sihanoukville City by land. The highway is a fairly well-paved road which leads to Phnom Penh. The fact that the highway can gain access to the port directly without passing through the city streets means that mass transportation of cargoes can be carried out by land. Large volumes of construction goods and materials can also be transported through the highway without passing through the city streets. Impacts on the community can also be eliminated with such a layout of existing roads.

5.4.4 Telecommunication

At present, the telecommunication facilities consist of 200 lines belonging to the government company and approximately 300 sets of movable phones belonging to private company (Samart) in the Sihanoukville City, with only the latter being used for communications to overseas. As to facsimile communications, only several lines are available in the city with its charges

relatively high. After the recovery of the Cambodia's economy, demand for telephone in business is increasing in recent years in the whole country but it can not be satisfied with the present facilities. This situation similarly applies to Sihanoukville.

The government telephone company has a plan to install 1000 lines exchanger for the next year. The existing exchanger was expanded in 1993 for UNTAC operations and is still on service continuously. Movable type telephones without cables remarkably expanded in recent year and are being dealt by major private telephone companies (4-5 companies). In the city, Samart company has the highest sales records having 90 % share of the movable type phones (Refer to Table 5.4-4). For the port communication system, two government telephone cables, internal telephone system, movable type telephones, and transceivers are being used.

5.5 Economic Activities

The Province of Sihanoukville has a port and is composed of the 3 districts of Mittapheap, Stung Hay and Prey Nup. Sihanoukville has a population of 120,782, number of families of 21,742 (Municipal statistics in 1995) and area of 1,283 square kilometers (Refer to Table 5.5-1). The Port of Sihanoukville is located at the outskirts of the city and is comprised of 3 existing ports, the Old Port (constructed in 1956 to 1959), the New Port (commenced to construct in 1967, suspended to construct in 1969 up to present) and Oil Port. The city is divided into 4 districts called "Quarter" and the fishing village area is designated as Quarters 1 and 2 (Refer to Fig. 02).

According to the municipal statistics in 1995 (Refer to Table 5.5-2), the occupational ratios of the industries in Sihanoukville are as follows:

Agriculture:	45 %
Fisheries:	15 %
Commerce:	25 %
<u>Government officer and staff:</u>	<u>15 %</u>
Total:	100 %

5.5.1 Agriculture

Rice, potato, banana, sugar cane, vegetable, etc. are mainly cultivated in the Province of Sihanoukville. Rice has the largest proportion among them. Rice is cultivated mainly in the rainy seasons. In 1995, rice fields of 8,807 hectares were cultivated and the crop was about 16,000 tons. Crops of potato and vegetable were about 191 tons and 151 tons respectively. From the fact that

importation through Sihanoukville Port is about 32,000 tons in 1995, about a half of imported rice was produced in this province (Refer to Table 5.5-3). The nearest rice field to the urban area is located at the edge of urban area along the National Route of No. 4 .

5.5.2 Fisheries

About 15 % of the population in this province are engaged in the fishing industry. The province has an annual catch of about 9,100 tons (in 1995) including shrimp of 814 tons and other raw fish of 7,231 tons. The annual catch in 1995 increased by about 5 % compared to 1994. For primary products, fish oil of 196,000 liters was manufactured. There are 67 fish farms in this province with the total area of 206,480 square meters (Refer to Table 5.5-4 and 5.5-5).

It is supposed that most families in the fishing village earn their living mainly by fishery. At present, there are 820 fishing boats with engine and 423 without engine in the province according to data in the Department of Fishery.

Fish caught are being sold mainly through 2 routes. One route is by sea through the Thai's fishing boats while the other is to the land via Sihanoukville Port and then through domestic routes. The latter is being done in 2 ways; one way is to pack in ice and then export and the other way is to supply to domestic factories and markets.

According to the statistics of Ministry of Agriculture, Forestry and Fisheries in 1994, the total sales in Cambodia was US \$ 4,800,000 with sales in Sihanoukville City of US \$ 439,600 for 8,700 tons of catch.

5.5.3 Commerce and Industry

According to the statistics of the city, the item of industry belongs to commerce due to small scale of the activities. The biggest business in the city is tourism. There are now 37 hotels and 778 rooms in the city. Sihanoukville City and the central government take a positive attitude to tourism development, as visitors and tourists are increasing in recent years.

The biggest factory in the city is Angkor Beer. In addition, there are factories of ice, brick for building, rattan, plywood, garment, and so on but all of small scale. According to the statistics of the Industrial Office in 1995, the workers belonging to constructions are 376 personnel. The proposed Long-term Plan of this project will require a maximum of approximately 200 to 300 workers per day. As it will be very difficult to procure them in the local market it is expected that workers will be hired from adjacent regions or from Phnom Penh.

As the port project will have a high ratio of civil and architectural works, many materials will be procured in the local market and will also require much manpower. The execution of this

project is expected to bring high impact in the activation of the local economy even in a short period.

5.6 Impact of the Disposal of Dredged Materials to the Sea Area

This project is expected to generate large volumes of dredged material. On the other hand, large volumes of soil for reclamation will be required. According to the survey data conducted by JICA, only a part of dredged materials will be utilized for reclamation since dredged soils contain high ratio of silt and sand having small particles which are not suitable for reclamation.

As there are several possible places of disposal in the sea area adjacent to the project area, it is necessary therefore to conduct a site survey of these proposed areas.

Presence of corals are already confirmed in this coastal sea area and as such it is necessary to conduct environmental survey and study beforehand. In disposing dredged materials to sea area, the following items of environmental impact are expected ;

- (1) Water pollution by disposed soils
- (2) Influence to fauna and flora living in adjacent sea area
- (3) Influence to fishery
- (4) Influence to coastal zone

For the confirmation of the expected influence and conditions, it is necessary to conduct the following additional site investigations in the next phase of site survey ;

- (1) Oceanographic phenomena (current survey etc.)
- (2) Topographical surveying by divers
- (3) Survey of fauna and flora in the sea

5.7 Traffic and Life Facilities

5.7.1 Traffics

A huge amount of materials will be required in the construction of port project. Most materials utilized in the existing port facilities were imported from overseas. As to locally procured materials, sand and aggregate for concrete, rocks for the foundation of jetty, and the like are

expected to be transported by large size trucks. Considering the traffic operations for the construction, entry through the main gate is foreseen to interfere with the port operation. It will therefore be necessary to conduct sufficient discussion and consultation with concerned department of Sihanoukville Port beforehand. Basically, almost all materials that will be procured in the local market will be transported through National Route NO.4. This route can gain access to the construction site of the port directly without passing through the city streets and as such, impact to citizens is minimal.

The effect to the existing traffic by the construction vehicles can be divided into two items; one is to the tank lorry transporting oil products from oil port, the other is to the trucks belonging to the port and transporting cargo and containers. Since the trucks operate through National Route No.4 and can gain access directly, traffic influence by material transportation is expected to be small with similar minor interference to the existing transportation system.

5.7.2 Living Facilities

There are approximately 47,000 citizens living in the center of Sihanoukville City. The power supply system is in so tight a condition that to resolve this problem construction of 5000 KVA power plant is being planned through ADB assistance in 1998. As to water supply, the existing system has a capacity of 2,000 ton/day. There is a plan to construct new facilities having 4,000 ton/day in 1998 through ADB assistance. The conditions of these infrastructures and the minimized influence to the citizens' lives should be conducted in the development plan of port construction. Gantry cranes for the port facilities will require high electricity consumption. For the safe operation of the port, a study of the power supply including installation of emergency generator is necessary. Capacity will change depending on the future plan of power plant and domestic demand for electricity.

Regarding water supply, Sihanoukville Port purchases 500 m³/month of water from the water supply authority of the city. Due to the high water supply conditions, water is used in the port only for living consumption. Under the present conditions, it is very difficult to supply city water to visiting vessels. In case it will be required to supply city water to visiting vessels as drinking water in the Short-term Plan, minimizing of influence to the citizens' lives should be considered. Water source for the port shall be studied after due consideration with the future plan of Water Authority and the trend of water demand.

5.8 Coastal Zone

The coastal zone faces the Kampong Saom Bay and the west side of Sihanoukville City having beautiful seaside. There are several cape covered by rocks, though almost all areas are situated in sand coast and utilized by citizens and visitors as bathing and scenic place. This area is designated as resort area according to the development plan and city planning prepared by central government and Municipality.

There is an existing channel beside the island of Kaoh Poah (called Snake Island). The coastal line of this island is covered with rocks except for a part of the north beach. The island has a tropical jungle and is unmanned island. The Malaysia Company of Ariston has the development plan for this island (Refer to Section 5.3 Tourism Development).

Considering the above, it is necessary to minimize the influence to the utmost for the coastal zone in this project. Dredging and reclamation which will be done at the coastal zone should take into consideration the environment of the coastal sea area, and should conduct a study of the proper construction methods.

5.9 Impact of Other Items

5.9.1 Division of Regional Area

The proposed facilities required in this project will be constructed in the existing port area. The port area is located along the coastal shore and beside a road from New Port to Oil Port. This port area is under the control of Sihanoukville Port Authority and belongs to them. As such there will be no division of regional area.

In both the Long-term and Short-term plans, the external road of the port area is planned to be provided with additional road. However, the habitants living in the fishing village will be able to access directly. As such no regional separation will occur.

5.9.2 Historical and Cultural Heritage

There are two Buddhist temples in Sihanoukville. One is Watt Crown constructed in 1960's and with a Buddhism school, the other one is Watt Lew constructed in 1970's. It is observed that there are no other special cultural heritage except the above.

There are lot of monuments in the city though these have been constructed in new epoch. In the proposed project area and adjacent area, there are no valuable cultural heritage so that no

damages and no loss of value will occur. The development of tourism which has been carried out by Sihanoukville Municipality does not utilize the cultural heritage. The plan is for the preparation of the resort area and recreational facilities to attract a lot of tourists from overseas.

5.9.3 Water Right and Common Right

It seems that the city water authority has the water right for the Prek Toec Sap Lake which is used for the source of city water. There are a lot of fishing villages in the area of Sihanoukville district, and according to the statistics report in 1994, fish catches of approximately 7,000 to 9,000 ton are recorded though no right to fishing was observed.

There are a lot of nursery plants utilizing the coastal area having an area of 206,480 km². It is supposed that only the nursery plants have the water right inevitably. However these locations are far from project site and no environmental impact will occur.

Regarding the fishing village, it is supposed that since 1980's the fishermen have been resettled and have lived in the port area and have established local communities. According to the statistics report of the city, 809 families and approximately 4,200 habitants are living in port area presently. Basically the living right in this area is not approved officially (Opinion of MPWT and Ministry of Agriculture and Fishery).

Resettlement of habitants is not required in the Long-term Plan for the port development project.

5.9.4 Hygiene and Health

The garbage generated in the port area are treated by the Municipality. The garbage disposed from each office are taken out by garbage wagons coming for receiving 3 to 4 times in a week. Wooden materials used for packaging which are possible for reuse are treated by the port.

In the fishing village and adjacent area, it is observed that there are a lot of living articles, cans, pet- bottles, vinyl bags, plastic bags, and the like which are disposed to and floating in mooring area in the break water area. In addition, as there is no garbage collection system established in the fishing village, it is observed that a lot of places are littered with living garbage by the habitants. At present, the resettlement plan for habitants living in project area have been established by the Municipality. Upon completion of this plan, it is expected that the conditions of sanitary and garbage will improve.

In the city area there is already a established garbage collection system and installed garbage box made of steel in each street of the city. However it is observed that several places are still littered with garbage.

5.9.5 Risks and Hazards

In the rainy season and after heavy rain, it is observed that torrential stream of surface water occurs in lot of areas in the city. As there is no surface drainage system in the city, the roads seem to become stream channels generating the torrential stream from high land to low place. As the existing port area is located at the end of the city and with the hills and small mountains as hinterland, the water flows to port area easily.

According to statistics in 1994, there are 1,224 ships in the fishing village. The increase in the number of ships in the future proportionate to the increase in handling of cargoes and containers is expected to be leading the influence affecting port operation. In addition, export and import of daily use commodities are being carried out in the existing municipal port. There are a lot of ships observed in this port. It is necessary to minimize the influence in the operation of these fishing boats and small and medium type of trading ships.

The Malaysia company of Ariston is proceeding with the development plan of Kaoh Poah Island. However there is an existing channel adjacent to the island and a new channel of north route is planned at the north side of the island (Refer to Section 5.3 of IEE).

5.9.6 Topography and Geology

The port facilities that are planned for construction in this project will be located in the sea area in the New Port. The geographical features of the project area consist of small hilly section as hinterland extending to the coastal lines with a 6 m wide road along the coastal line leading to oil port. It is observed that there are no high trees and natural forest in the hinterland area adjacent to project site. A part of coastal line in the New Port is covered with rocks though almost all of the coast area is situated in sand beach. Due to calm wave conditions, it is observed that there are no signs of change in the geographical features since the construction of the New Port.

There is a pond along the road to the oil port beside the reservoir pond for the water supply to vessels. The old river running into the New Port have been dammed by the road construction of the New Port generating this pond. It has been observed that it does not dry up even in dry season.

5.9.7 Soil Erosion

In the Long-term Plan, only the sea area in New Port surrounded by breakwater will involve reclamation of land and it is expected that there is no environmental impact due to the land preparation. There are no high trees and natural forest in the small hills situated hinterland of the

port instated of which are observed weeds and scrubs. It is supposed that the covering surface soil laterite flows out with rainwater during heavy rain in rainy season.

Sand and aggregate for the concrete work will be procured in the local market at Kampong Spoe. At present, it is observed that the quarry located at the north side of the city and along National Route NO. 4 shows sign of surface soil erosion by rain. In this project there will be required lot of sand and aggregate for the concrete and rocks for revetment work. Consideration therefore for the preservation of environment should be provided about conditions after mining.

5.9.8 Underground Water

Due to the tight conditions of water supply in the Sihanoukville City and with only a limited number of pipelines for city water installed, a lot of families are using artesian wells. Half of city water is being consumed by Angkor Beer factory. Considering that a population of 47,000 is living in the city, it can be expected that a lot of artesian wells are being utilized in this city. In the fishing village, the water source have been through tank lorry taking water from pond and artesian wells and through collection of rain water by jars. Through the UNTAC operation in 1993, a lot of artesian wells (approximately 20 m depth) were constructed in the city to resolve water shortage. It is anticipated that construction work for the project will just have a minor effect on the water supply (Refer to Fig.12).

5.9.9 Hydrological Regime for Rivers and Lakes

There is a reservoir pond at Prek Toek Sape Lake used as water source for the city. It is 4 km from the proposed project area. The Prek Toek Sape Lake has a tributary river which is 3 km long. Several gates are installed at sea side and over flow water is released to the coastal area through these gates. It was learned that there are cases where the water is being transported by tank lorry illegally to be used for domestic consumption. There are two ponds in the proposed project area. One is the reservoir pond which supplies water to ships. This is under the control of port and was constructed in the 1960's at the time of New Port construction. As there are no installed filtration and sterilization, the use of the supply is limited. The other pond is located beside the reservoir pond and is situated along the road to oil port. During the construction of the New Port, the river flow into the New Port was dammed by the new road thus creating this pond. It has been observed that it does not dry up during dry season though its water lowers remarkably. Water lilies and hydrophyte propagate observed in this pond.

In the dry season, only one small river is observed near the project area. This river is 2 km north of the breakwater. Its stream has clear water flowing continuously to the coastal sea area.

In the rainy season, it is observed that several rivers like stream channels appear in the coastal area in west side of the city.

There are 12 culverts (pipelines) for drainage installed across the road leading to the oil port. In the rainy season, the rain water that accumulates in the river basin and pond flows into the coastal sea area through these culverts. It is anticipated that the environmental impact of the project to rivers and lakes is relatively small.

5.9.10 Ecology, Fauna and Flora

Due to the lack of data on fauna and flora, evaluations can not be conducted as to the effect on ecology of the coastal area. However based on the interviews and field survey conducted, it was learned that there are no distinctive animals and vegetation in the project area. As to the "Areas Designated as Protected Areas" issued by the Ministry of Environment, the area of Ream is designated as a National park but this is 20 km far from Sihanoukville (Refer to Fig. 9). At present, there is a development plan for the park and resort area with the assistance from overseas fund.

5.9.11 Meteorology

The temperature of Sihanoukville is fairly uniform throughout the year. The average annual mean temperature is about 25 °C to 30 °C. The regions with the highest temperature in Cambodia are the areas on the hill side facing the Gulf of Thailand. The period from December to April is known as the dry season characterized by high temperatures and day length of more than 8 hours.. The period from May to October is called rainy season characterized by high humidity. Rainfall from May to November is estimated to be more than 100 mm/day. The tropical monsoon from October to April brings north wind or north east wind while from May to September brings south east wind.

According to statistics, typhoons (tropical Cyclone) veer away from the Indo-China Peninsula. In the rainy season, concreting works might get affected as there may be a decrease in actual working days. This factor should be considered in the establishment of full time schedule for construction. It is anticipated that no environmental impact to meteorology will result from this project.

5.9.12 Landscape

The city area of Sihanoukville is located on the hill side a short distance from the port.

There are several facilities and parks such as seaside park, retail shops along the road, power plants, railroad station and the like. The hills and the mountainside of hinterland of the New Port are covered with shrubs and weeds. No high trees were observed in this area. In the port, there are big scale warehouse, cranes, containers yard, offices, and well maintained coastal park, and creating landscape of a peculiar port.

In the areas from New Port to oil port, there was not observed any big factory. There are only simple frame houses for fishermen, soy source factory, saw mill, ice factory, ship build factory, restaurant, elementary school, government facilities, etc. In both development plans prepared by the central government and the Municipality, the project area is designated as a port area. It is anticipated therefore that no environmental impact to landscape will result from this project.

5.9.13 Air Pollution

At present, no environmental impact is observed that can be attributed to the air pollution generated by port operation. Though there are several factories such as ice, saw mill, soy source etc. around the port, these factories are too small to cause considerable air pollution. With the increase of cargo in the future, vehicles for transportation will also increase. There will also be increase in the future of tank lorry from oil port. However, it is anticipated that exhaust gas from these vehicles will not have a considerable environmental impact due to the small scale.

5.9.14 Soil Contamination

Dredged materials and soils needed for reclamation will be transported from suburbs in this project. Based on the survey report conducted by JICA, it was observed that seabed soils contain several chemicals and are having tendency of pollution. (Refer to Table 5.2-4 and table 5.2-5). In the actual construction work, it is necessary to conduct a detailed survey based on each area in order to confirm that the seabed soil to be utilized for reclamation does not contain injurious pollutant. There were no report of soil contamination in the past. There was also no experience of soil contamination from cargoes handled in the port. The chemicals and lubricants which will be utilized for the construction work in this project should be applied and disposed as per manufacturer's instructions to avoid soil contamination.

5.9.15 Noise and Vibration

In this project there are two elements of noise and vibration which will have an environment impact ;

- Generated by vehicles from Sihanoukville Port and oil port
- Generated by construction equipment during construction

Due to the increase of cargo handled in the port and increase in domestic oil consumption, it is foreseen that the use of National Route NO.4 by large scale trucks will certainly increase in the future. At present, the Municipality has a plan to construct an industrial area around the port area. If this plan is executed a new road from the city to Steng Haw through the oil port and along the railroad will be constructed. The completion of this road will increase the oil volume that can be transported from the oil port, thus reducing the vehicles and the ensuing noise and vibration at National Route No. 4. As to the noise and vibration which will occur during construction, a proper construction method will minimize its effect to the habitants which are approximately 70 fisherman's houses adjacent to project area.

5.9.16 Land Subsidence

The extension of the existing jetty in New Port is included in the Long-term Plan. This will require a space for handling to be located behind the proposed jetty. A part of dredged material will be utilized for this reclamation. To avoid land subsidence several considerations should be provided on selection of soils for reclamation, particularly the quality and particle size of soils, etc. which may require preliminary check and study. Based on the survey report conducted by JICA, it was observed that seabed soils contain several chemicals and are having tendency of pollution. However, before utilizing dredged materials for reclamation, it is necessary to conduct soil analysis in detail at each area. Moreover, to avoid problems of land subsidence, it is recommended that in the construction of handling yard where heavy loads are expected sufficient period shall be provided for curing (Refer to Fig. 11).

5.9.17 Offensive Odor

There is no factor which will generate offensive odor in this project. Chemical products included in the cargo are transported in selected containers. Damage to vessels has a possibility of generating offensive odor though this probability is small and the impact to environment is expected to be very minimal.

6. Result of IEE for the Port Project

Refer to Table 6-1

7. Conclusion and Recommendations

In the preparation of the IEE report which is based on execution of the Long-term Plan for Sihanoukville Port, we obtained many data in the first site survey. We recommend however the following additional studies and survey for the second site survey stage which is planned in the next phase of the project for the completion of the EIA report.

(1) Resettlement of habitants

The resettlement of habitants is not necessary in the Long-term Plan. At present, the Municipality is proceeding with its resettlement plan for the habitants who live in the Fishing Villages illegally near the New Port. This information is very important in the establishment of Long-term Plan including land utilization of Fishing Village. Collecting of information from concerned government agencies and carrying out of survey about resettlement plan are therefore necessary. In addition to the above, there are 70 family houses adjacent to the project area in the Long-term Plan. It is necessary to carry out interview of these habitants and conduct additional survey for the collection of detail information of these families.

(2) Coastal Zone

As to dredging and disposing of dredged materials expected in the Short-term Plan and urgent measure, it is necessary to conduct a study of the environment impact to coastal sea area and coastal plain by simulation and to carry out a survey of natural conditions in the coastal sea area necessary for simulations.

(3) Fauna and Flora

In the proposed place for disposal of dredged materials, we observed corals living in this coastal sea area. Additional survey of fauna and flora living in this area and a study of the environmental impact to them are necessary.

(4) Water Pollution

The dredging work for the New Port, new channel, and existing channel, and the consequent disposal work to coastal sea area are expected to cause water pollution

to the coastal sea and coastal plain. A study of the environmental impact to coastal sea area and coastal plain by simulation and a survey of natural conditions in coastal sea area needed for simulations are therefore necessary. As to the location for the disposal of dredged materials, several proposed sites shall first be selected. These sites shall be surveyed visually by divers as to topography and geology including investigations of fauna and flora as described in item (3) of this Section. From these site shall be selected only one suitable location.

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37	FIG. 09	Areas Designated as Protected Areas
38	FIG. 10	Master Plan of Land Use, 1990
39	FIG. 11	Procedures of Reclamation
40	FIG. 12	Water Supply System in Sihanoukville
41	FIG. 13	Matrix of Element for Environmental Impact
42	FIG. 14	Location MAP of Seawater and Seabed Quality Survey

TABLE 4.1-1 ENVIRONMENTAL WATER QUALITY STANDARDS IN JAPAN

Items related to the protection of human health

Items	Standard Values	
	Cadmium	0.01
Total cyanide	Not detectable	Not detectable
Lead	0.01	mg/l or less
Chromium (IV)	0.05	mg/l or less
Arsenic	0.01	mg/l or less
Total mercury	0.0005	mg/l or less
Alkyl mercury	Not detectable	Not detectable
PCBs	Not detectable	Not detectable
Trichloroethylene	0.03	mg/l or less
Tetrachloroethylene	0.01	mg/l or less
Carbon tetrachloride	0.002	mg/l or less
Dichloromethane	0.02	mg/l or less
1, 2-Dichloroethane	0.004	mg/l or less
1,1,1-Trichloromethane	1	mg/l or less
1,1-2-Trichloroethane	0.006	mg/l or less
1,1-Dichloroethylene	0.02	mg/l or less
cis-1, 2-Dichloroethylene	0.04	mg/l or less
1, 3-Dichloropropene	0.002	mg/l or less
Thiram	0.006	mg/l less
Simazine	0.003	mg/l or less
Thiobencarb	0.02	mg/l or less
Benzene	0.01	mg/l or less
Selenium	0.01	mg/l or less

Note : The yearly average values. But with regard to total cyanide, standard value is based on maximum value.

TABLE 4.1-2 EFFLUENT STANDARDS IN JAPAN

Substance Related to the Protection of Human Health

Toxic substances	Permissible Limits mg/l	Testing methods
Cadmium and its compounds	0.1	JIS K 0102.55.2,55.3,55.4 or Method determined by Minister of Environmental Agency (JIS K 0102.38.1.2 and 38.3) or (JIS K 010 2.38.1.2 and 38.3)
Organo phosphorus compounds (parathion, methyl parathion, methyl demeton and EPN only)	1	Method determined by Minister of Environmental Agency
Lead and its compounds	0.1	JIS K 0102.54.2,54.3,54.4 or Method determined by Minister of Environmental Agency
Sesivalent chrome compounds	0.5	JIS K 0102.65.2.1
Arsenic and its compounds	0.1	JIS K 0102.61 or Method determined by Minister of Environmental Agency
Total mercury	0.005	Method determined by Minister of Environmental Agency
Alkyl mercury compounds	Not detectable	Method determined by Minister of Environmental Agency
PCBs	0.003	JIS K 0093 or Method determined by Minister of Environmental Agency
Trichloroethylene	0.3	JIS K 0125.5 or Method determined by Minister of Environmental Agency
Tetrachloroethylene	0.1	JIS K 0125.5 or Method determined by Minister of Environmental Agency
Dichloromethane	0.2	Method determined by Minister of Environmental Agency
Tetrachloromethane	0.02	JIS K 0125.5 or Method determined by Minister of Environmental Agency
1, 2-Dichloroethane	0.04	Method determined by Minister of Environmental Agency
1, 1-Dichloroethylene	0.2	Method determined by Minister of Environmental Agency
cis-1, 2-Dichloroethylene	0.4	Method determined by Minister of Environmental Agency
1,1,1-Trichloroethane	3	JIS K 0125.5 or Method determined by Minister of Environmental Agency
1,1,2-Trichloroethane	0.06	JIS K 0125.5 or Method determined by Minister of Environmental Agency
1,3-Dichloropropene	0.02	Method determined by Minister of Environmental Agency
Thiram	0.06	Method determined by Minister of Environmental Agency
Simazine	0.03	Method determined by Minister of Environmental Agency
Thiobencarb	0.2	Method determined by Minister of Environmental Agency
Benzene	0.1	Method determined by Minister of Environmental Agency
Selenium and its compounds	0.1	JIS K 0102.67 or Method determined by Minister of Environmental Agency

JIS : JAPAN INDUSTRIAL STANDARD

K 0102 : Testing Method for industrial waste water

TABLE 4.1-3 EFFLUENT STANDARDS IN JAPAN

Items Related to the Protection of the Living Environment

Item	Permissible Limits	Testing Method
pH	5.3 to 8.6 for effluent discharged into public water bodies other than coastal waters/5.0 to 9.0 for effluent discharged into coastal waters	JIS K 0102.8
BOD, COD	160 mg/l (daily average 120 mg/l)	JIS K 0102.16 JIS K 0102.13
SS	200 mg/l (daily average 150 mg/l)	-
N-hexane extracts	5 mg/l (mineral oil) 30 mg/l (animal and vegetable facts)	- -
Phenols	5 mg/l	JIS K 0102, 20.1, 20.2
Copper	3 mg/l	JIS K 0102. 37.2
Zinc	5 mg/l	JIS K 0102. 38.2
Dissolved iron	10mg/l	JIS M 0202.3.1.4.(2) and JIS K 0102.47.2
Dissolved manganese	10 mg/l	JIS M 0202.3.1.4.(2) and JIS K 0102. 46.2
Chrome	2 mg/l	JIS K 0102. 5.1.1.1.
Fluorine	15 mg/l	JIS K 0102. 28.
Number of coliform groups (per cc)	3,000 (daily average)	Method of water analysis for treated waste water
nitrogen*	120 mg/l (daily average 50mg/l)	JIS K 0102 45.1 or 45.2
phosphorus*	16 mg/l (daily average 8 mg/l)	JIS K 0102 46

* see (5)

Note : The discharge standards in this table are applied to the effluents from industrial plants and other places or business whose volume of effluents per day is not less than 50 m³.

The discharge standards for BOD are applied to public waters other than coastal waters and lakes, while the discharge standards for COD are applied only to effluents discharged into coastal water and lakes.

TABLE 4.1-4 LIVING ENVIRONMENT STANDARD IN JAPAN (1)

Coastal Waters

Category / Purposes of water use		Standard Values				
		pH	COD	DO	Number of Coliform Groups	N-hexane Extracts (oil content etc)
A	fishery, class 1 ; bathing conservation of natural environment, and uses listed in B-C	7.8-8.3	2 mg/l or less	7.5 mg/l or more	1000 MPN/100 ml or less	Not detectable
B	fishery, class 2 industrial water and the uses listed in C	7.8-8.3	3 mg/l or less	5 mg/l or more	-	Not detectable
C	conservation of the environment	7.0-8.3	8 mg/l or less	2 mg/l or more	-	-

(COD : Chemical Oxygen Demand, OD : Dissolved Oxygen)

- Notes :
1. With regard to the water quality of fishery, class 1 for cultivation of oysters, the number of coliform groups shall be less than 70 MPN/100ml.
 2. Conservation of natural environment
 - Conservation of scenic points and other natural resources.
 3. Fishery, class 1
 - For aquatic life, such as red sea-bream, yellow tail, seaweed and for those of fishery class 2.

Fishery, class 2

 - For aquatic life, such as gray mullet, laver, etc.
 4. Conservation of the environment
 - Up to the limits at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

TABLE 4.1-5 LIVING ENVIRONMENT STANDARDS IN JAPAN (2)

Coastal Waters

Category	Purpose of water use	items	Standard values	
			Total nitrogen	Total phosphorus
I	Conservation of natural environment and use listed in II - IV (excluding fishery class 2 and 3)		0.2 mg/l or less	0.02 mg/l or less
II	Fishery class 1 : bathing and uses listed in III - IV (excluding fishery class 2 and 3)		0.3 mg/l or less	0.03 mg/l or less
III	Fishery class 2 and listed in IV (excluding fishery class 3)		0.6 mg/l or less	0.05 mg/l or less
IV	Fishery class 3 : industrial water and conservation of habitable environment for marine lives		1.0 mg/l or less	0.09 mg/l or less

Note : 1. Standard values are set in terms of annual averages

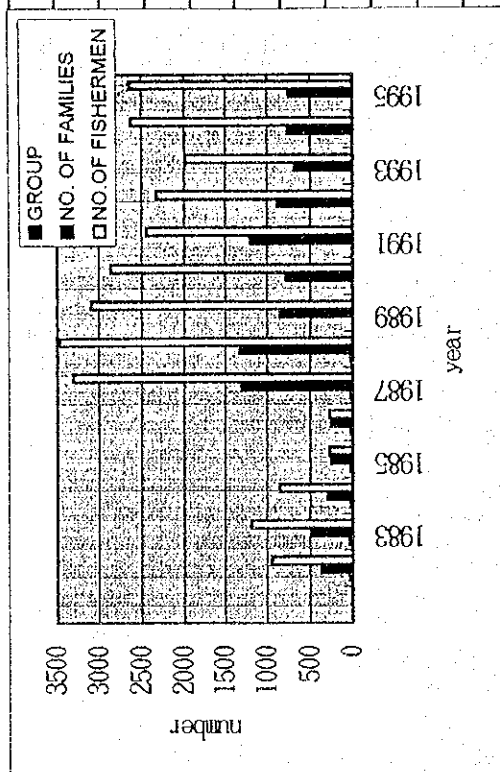
2. Standard values are applicable to sea areas where extraordinary growth of phytoplankton may occur.
3. Conservation of natural environment
 - Conservation of scenic points and other natural resources
4. Fishery class 1
 - In these sea areas, a variety of marine lives including bottom fish and shellfish can be caught well-balancedly and constantly.
5. Fishery class 2
 - In these sea areas, fishery products such as fish are rich except some species of bottom fish and shellfish.
6. Fishery class 3
 - In these sea areas, specific marine lives which are tolerable to the water pollution can be caught mainly.
7. conservation of habitable environment for marine lives
 - Up to the limits at which marine benthos, bottom fish and shellfish can live all the year.

SURVEY DATA

TABLE 5.1-1 NUMBERS OF FAMILIES AND FISHERMEN LIVING IN FISHING VILLAGE

YEAR	GROUP	NO. OF FAMILIES	NO. OF FISHERMEN	NOTES
1982	30	358	947	
1983	31	473	1,182	
1984	25	289	857	
1985	22	251	273	
1986	22	251	273	
1987	26	1,305	3,307	
1988	26	1,325	3,469	
1989	na	851	3,100	
1990	na	784	2,865	
1991	na	1,202	2,438	
1992	na	880	2,322	
1993	na	678	1,989	
1994	na	764	2,626	
1995	na	755	2,635	

na : not available



source : Fishery office in Sihanoukville

SURVEY DATA

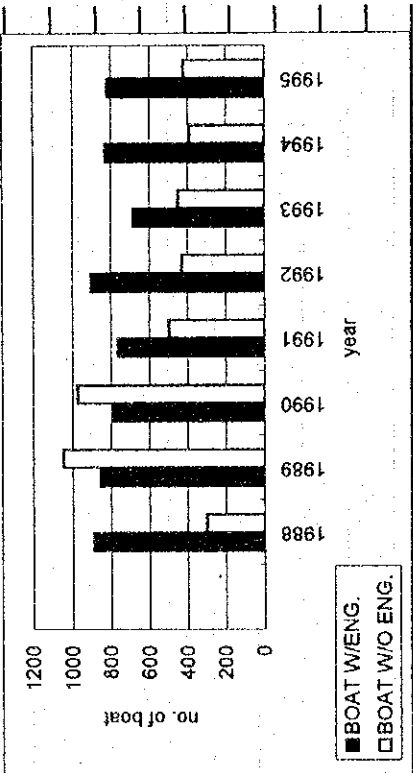
TABLE 5.1-2 NUMBER OF FAMILIES AND POPULATION IN FISHING VILLAGE

ITEM	CAMBODIA	ISLAM	VIETNAM	VIET./CAMB	THAI	TOTAL	NOTES
mixed							
QUARTER NO 1							
FAMILY	737	10	9	11	2	769	na : not available based on survey reports
POPULATION							
from 17 and older	3811	53	33	63	16	3976	
from 0 to 16	1954	30	21	33	10	2048	
	1857	23	12	30	6	1928	
QUARTER NO 3							
FAMILY	17	na	23	na	na	40	based on hearing data
POPULATION	na	na	na	na	na	na	
Quarter : refer to attached sketch FIG. 6.2							
TOTAL OF FAMILY	754	10	32	11	2	809	
source: survey report of Quarter no.1 and no.2.							

SURVEY DATA

TABLE 5.1-3 NUMBER OF FISHING BOATS WORKING IN SIHANOUKVILLE

YEAR	BOAT W/ENG.	BOAT W/O ENG.	TOTAL	NOTES
1988	892	303	1,195	BOAT W/O ENG. : boat without engine
1989	857	1,050	1,907	BOAT W/ENG. : boat with engine
1990	792	975	1,767	
1991	766	497	1,263	
1992	907	432	1,339	
1993	685	452	1,137	
1994	833	391	1,224	
1995	820	423	1,243	



source : Fishery office in Sihanoukville

SURVEY DATA

TABLE 5.1-4 LIST OF THE EXISTING FACILITIES IN FISHING PORT AREA

NO.	NAME OF FACILITIES	DESCRIPTION
COMMERCIAL FACILITIES		
1	Small shops of soft drinks	Temporary shop, displayed soft drink bottle on the table at roadside.
2	Small shops of daily use commodities	Small scale family house, selling many kind of daily use commodities in frontage
3	Drinking water shops	Receiving city water by tank rolly and keeping in small storage tank
4	Fruit shops	Small scale family house, selling banana and other fruits in frontage
5	Gasoline shops	Temporary shop, selling bottled gasoline at roadside.
6	Brick factory	Making bricks for building construction, having wide area and big chimney
7	Ticket shop	Selling ticket for ship
8	Fish shops	Small scale family house, selling several type of fishes in frontage
9	Miscellaneous open air shops	Selling fruits, fishes, meats, and daily use commodities
10	Small restaurant/food supply shops	Supply foods in the temporary house
11	Wooden timber shop	Selling wooden timbers for housing construction
12	Ice factory	Making ice cubes necessary for packing of fish and others
13	Ship build factory	For small type of fishing boat, including repair work
14	Mechanical factory	Installed several lathes and auxiliary equipment
PUBLIC FACILITIES		
1	MPWT office	Big scale building comparatively,
2	Elementary school	Student : 643 person, 4 class room, 3 shift, size : 19.35 m x 8.35m
3	Custom office	Constructed on the jetty
4	Regular passenger boat	Destination : Koh kong
5	Jetty	Constructed by wooden piles and wooden deck plates
6	Miscellaneous government buildings	There are permanent buildings used for the government branch office
7	Rails and small carriers	Installed manual type carrier for heavy cargos
8	Police station	Traffic police. Military police
9	Fishery office	Fishery inspection office

SURVEY DATA

TABLE 5.1-5 PRIMARY SCHOOL IN FISHING VILLAGE

ITEMS	DESCRIPTION
Teachers	Teachers : 12, Director : 1, all of government employee
Numbers of students	643 students(1996), 486 students(1994)
Construction	1984
Class rooms	Four class room
Shift	Three shift
Building specification	
floor area	19.35m x 8.35m
structure	wooden structure
external finishing	wood
roof	Corrugated asbestos sheets

