3.11 Environmental Examination

In Madagascar, there are a lot of precious species of animals and plants which must be preserved. In this Master Plan, it is required that development be compatible with the environment. It is only recently that the government has begun to deal with environmental issues.

The principal environmental policy is based on "The Environmental Charter", promulgated on 21st, December, 1990. At present, "The Environment Charter" is not applied in its strict sense because all relevant decrees and application details necessary for its application are currently in the preparatory stages.

The province of Antsiranana does not have its own separate regulations or policies regarding environmental issues.

As mentioned in the present situation of the port of Antsiranana, water quality in the Bay is excellent. However, sea pollution may possibly become a serious issue if the proper precaution are not taken. As population increases and people use more water, the amount of sewage water pouring into the bay increases, and consequently water pollution may result in future.

There seems to be no valuable fauna or flora to be protected around the Diego-Suarez bay.

In this IEE, the main issues taken into account are a hospital about 400 m away from the project site and the activities of the port and factories that will be promoted with the port development, which means an increase in the number of calling vessels, road traffic to/from the port and tuna to be handled.

According to the results of the IEE checklist, no serious problem will be generated because there is no valuable fauna or flora to be protected around the port. All environmental indicators are at good levels at present and impact on environment due to port development is rather small, judging from the scale or content of the Plan.

However, there is a hospital about 400 m away from the project site and the ongoing program to double production of the tuna canning factory, whose waste water is discharged into the port, so that it is thought that further examination on those issues is needed.

CHAPTER 4

SHORT-TERM DEVELOPMENT PLAN OF THE PORT OF ANTSIRANANA

4. SHORT-TERM DEVELOPMENT PLAN OF THE PORT OF ANTSIRANANA

4.1 The Basic Concept of the Short-Term Development Plan

The following points are essential in the formulation of the Short-Term Development Plan:

- to solve the present problems caused by the existing facilities, in particular, urgent problems such as superannuation or deterioration of quays

- to propose better services to smoothly handle forecasted cargoes in 1998

- to make best use of the existing facilities through rehabilitation work to minimize new construction works

- to set up a port facility plan and implementation program to ensure that port activities continue even during rehabilitation works

- to harmonize the expansion and rehabilitation works with the concept of the Master Plan with growth of the port activities

- to clarify responsibility and to build a cooperative relationship between the public and private sectors or construction and operational bodies

- to continue the ongoing project, that is to say, the quay extension southward, mainly for fishery boats, assisted by the French aid

4.2 Demand Forecast

Socioeconomic framework and the results of demand forecast in 1998 are assumed as follows.

(1) Population

The population of Madagascar and Antsiranana province in 1998 are summarized in the following table.

Table 4-2-1 Results of Population Forecast in 1998

		Population ('000 person)		Average increase rate (%)
		1992	1998	
Madagascar		11,797	14,180	2.7
Antsiranana province	Total	1,148	1,308	2.2
	West	434	494	
	East	714	814	

(2) GDP

The GDP of Madagascar in 1998 is summarized in the following table.

Table 4-2-2 GDP Forecast of Madagascar in 1998 (1990 price)

(UNIT:BILLION FMG,%)

		AGRICULT		INDUSTRY		SERVICE		TOTAL	
		PRICE	SHARE	PRICE	SHARE	PRICE	SHARE	PRICE	SHARE
GDP	1992	1383	33.6	577	14.0	2155	52.4	4115	100
	1998	1651	33.6	709	14.4	2554	52.0	4914	100
Average growth rate(%)		3.0		3.5		2.9		3.0	

(3) Handling Cargo Volume in the port of Antsiranana

The cargo volume handled in 1998 is forecast in the following table.

Table 4-2-3 Results of cargo Volume Forecast in 1998

(Unit:MT)

	1992				1998			
	Load	Unload	Tranship	Total	Load	Unload	Tranship	Total
Foreign	14,468	35,606	0	50,074	52,400	55,000	0	107,400
Tuna-related	6,059	1,458	0	7,517	15,200	8,000	0	23,200
Salt	753	0	0	753	17,200	0	0	17,200
Petroleum	0	24,269	0	24,269	0	29,700	0	29,700
Others	7,656	9,879	0	17,535	20,000	17,300	0	37,300
Domestic	27,176	32,471	0	59,647	37,200	66,900	0	104,100
Tuna-related	0	14,696	0	14,696	0	37,000	0	37,000
Salt	10,163	0	0	10,163	20,100	0	0	20,100
Petroleum	5,890	5,770	0	11,660	7,400	10,900	0	18,300
Others	11,123	12,005	0	23,128	9,700	19,000	0	28,700
Tranship	0	0	108,694	108,694	0	0	120,200	120,200
Tuna	0	0	51,841	51,841	0	0	52,000	52,000
Petroleum	0	0	56,853	56,853	0	0	68,200	68,200
Total	41,644	68,077	108,694	218,415	89,600	121,900	120,200	331,700
Tuna-related	6,059	16,154	51,841	74,054	15,200	45,000	52,000	112,200
Salt	10,916	0	0	10,916	37,300	0	0	37,300
Petroleum	5,890	30,039	56,853	92,782	7,400	40,600	68,200	116,200
Others	18,779	21,884	0	40,663	29,700	36,300	0	66,000

4.3 Required Port Facilities and Equipment

4.3.1 Forecast of Vessel Size by Type

In the formulation of the Short-Term Development Plan, 10,000 DWT class vessel is proposed as the maximum vessel size.

4.3.2 Required Number of Berths

The standard dimensions of vessels and berths and method employed in the Master Plan are also adopted here. The method considers the frequency of ship entry and cargo handling productivity.

As a result, the total required number of berths is four, of which, in principle, one berth will be assigned for international, coastal and fishery cargo handling respectively while the other will be used flexibly.

As to the basin for small crafts where vessels refuge, rest or are repaired by SECREN, the ongoing project should cope with this subject.

4.3.3 Required Scale of Facilities

(1) required Scale of Berths

As mentioned above, required scale of berths is as follows:

	maximum ship size (DWT)	number of berth	depth (m)	total length (m)
For international cargo	10,000	1	10	170
For coastal cargo	5,000	2	7.5	260
For fishery cargo	5,000	1	7.5	130

Note: Two berths for coastal cargo handling are flexibly assigned for both international and fishery cargo handling at high season.

Almost the entire area of the existing water basin is 8.5 m in depth. Considering the likely usage of the planned 7.5 m depth quay and the structural design, which is

the transition area between 7.5 m depth and 10 m depth, the depth of the transition area is proposed to be 8.5 m to 10 m.

(2) Required Scale of Water Basin

For over 5,000 DWT class vessels, in this case, 10,000 DWT class, maneuvering is assisted, in principle, by a tugboat. However, from the viewpoint of maneuvering technology, it is rather easy to turn without tugboats at the water area of a circle with a diameter of 2*L (L:overall length of maximum vessel size) in front of the 10 m depth quay under normal weather conditions.

As a result, the same water basin in front of 5,000 DWT and 10,000 DWT class quay is planned as that in the Master Plan.

(3) Required Scale of Storage Area

As mentioned in section 4.1, the existing sheds will be retained as much as possible. As a result, it is not necessary to plan any newly constructed transit sheds while existing sheds undergo necessary rehabilitation works.

As to open yard, the existing open yard is unpaved and undulated so that it is necessary to plan a newly paved open yard. The required area of yard for iron and metal products and container stacking is as follows:

For iron and metal products	100 m^2
For laden containers	3,275 m^2
For empty containers	1,650 m^2

4.3.4 Safety Back-up Facilities

In order to ensure safe navigation, it is necessary to plan a new light marker at the end of the extended quay and maintain the present system for navigation marks.

As to tugboats, they are deemed unnecessary.

The present pilotage system should be kept.

4.3.5 Cargo Handling System

Taking into account the handling situation, it is thought that CMDM will be able to cope with required handling productivity in 1998 without any additional investment,

on condition that adequate maintenance is carried out.

Corresponding to the extension plan of quay, pipeline of oil products transportation should be extended or replaced by SOLIMA.

4.3.6 Other Infrastructure and Utilities

It is proposed that some of the existing buildings, facilities etc. be replaced, extended or demolished as follows:

(1) Replacement of two residences for people working at the port and a warehouse attached to the Port Office

(2) Demolition of the above mentioned residences and warehouse

(3) Pavement of port road

(4) Extension and construction of new fence and gates

(5) Extension of oil supply pipeline and water supply pipeline (Part of the former will be rehabilitated)

Both of the above pipelines are owned by private sectors i.e. SOLIMA and JIRAMA. Therefore, those construction costs should be borne by them and those works should be done after coordination with other construction works of relevant port facilities.

4.4 Proposed Short-Term Development Plan

The Short-Term Development Plan should be recognized as the first stage of the Master Plan.

In reference to the above, the plan of the face line of quay and water basin is coincident with the Master Plan while the layout of the transit sheds, yards etc., is not, because as many of the existing facilities will be retained as possible.

For that reason, cargo handling flow lines are relatively long and may cross one another. It is preferable to become coincident with the Master Plan in the long run.

The proposed Short-Term Development Plan is shown in Figure 4-4-1.

In this Plan, it is proposed that port roads used in conveying cargo be created to make clear the division of the port facilities, allow cargo to be handled more smoothly and efficiently and promote orderly port management.

With reference to management and operation, it is thought that the principle of specified usage of each berth should be kept.

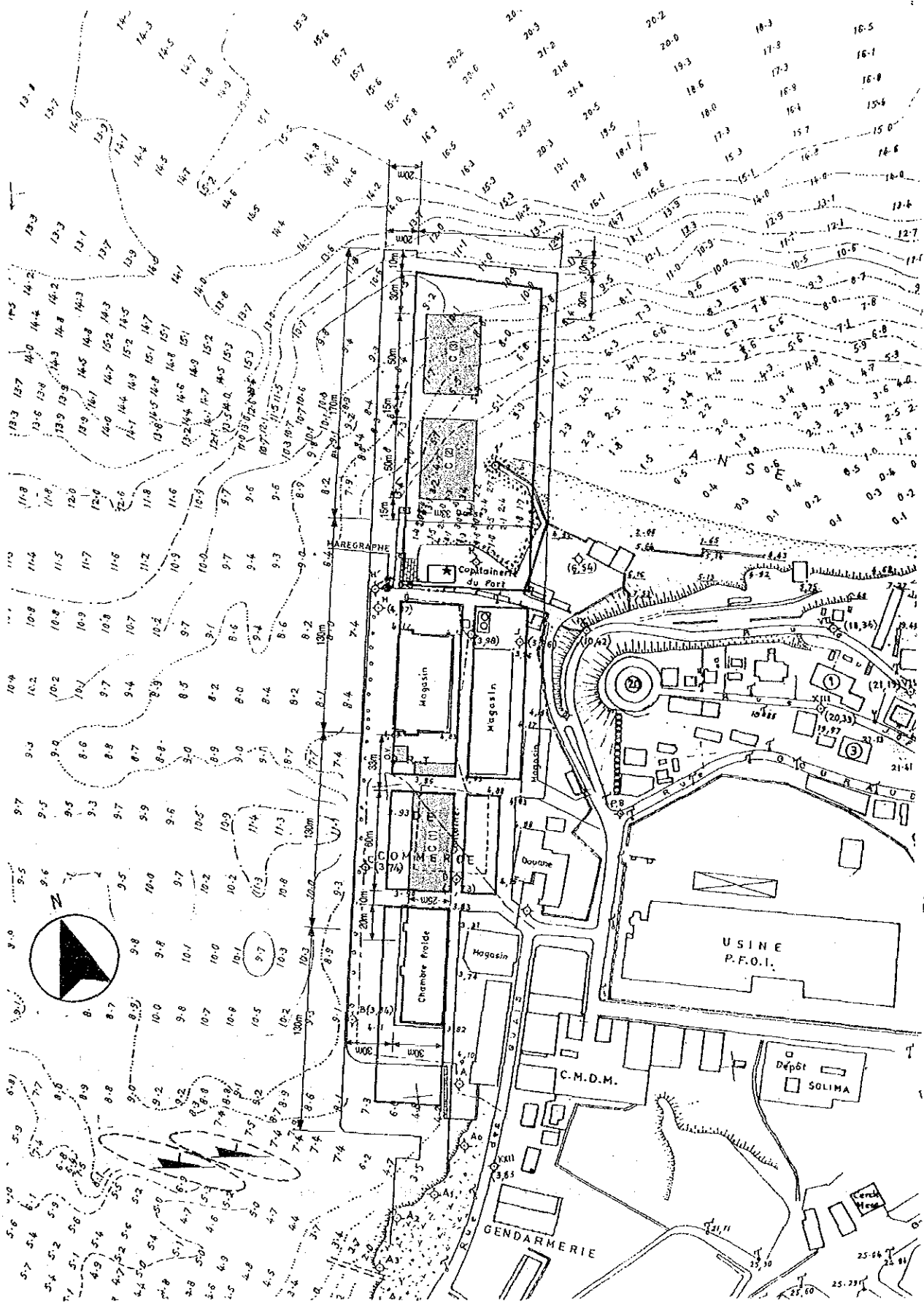

Figure 4-4-1 Proposed Short-Term Development Plan

4.5 Structural Design

4.5.1 Existing Port Facilities

(1) Design Conditions

Table 4-5-1 Design conditions

Item	Old Quay	New Quay
Water Depth	-8.5 m (-7.5 m)	
Object Vessel	5,000 DWT:Coastal Cargo Vessel	
Berth Length	120 m	181 m
Surcharge	2.0 tf/m^2	
Live Load	Forklift Truck: 20 to 40 tf Truck Crane: 40 tf	
Lifetime	20 years	

Note: The figure in parentheses refers to the Master Plan.

(2) Old Quay

The rehabilitation of the old quay is examined for the slab S2 of the superstructure. From the structural calculation, the stress of this slab is over the allowable stress at the load condition of the surcharge and the present load-carrying capacity will not be sufficient for the live load. The rehabilitation plan such as reconstruction of the slab S2 is shown in Figure 4-5-1.

(3) New Quay

For the rehabilitation of the quay, corrosion prevention of the steel sheet piles is considered to maintain the stability. The extent of application of corrosion can be divided into the area above the tidal zone and the portion in sea water. The galvanic anode method is adapted below M.L.W.L.. For the area above the tidal zone, corrosion protection is not planned but periodical inspection is required.

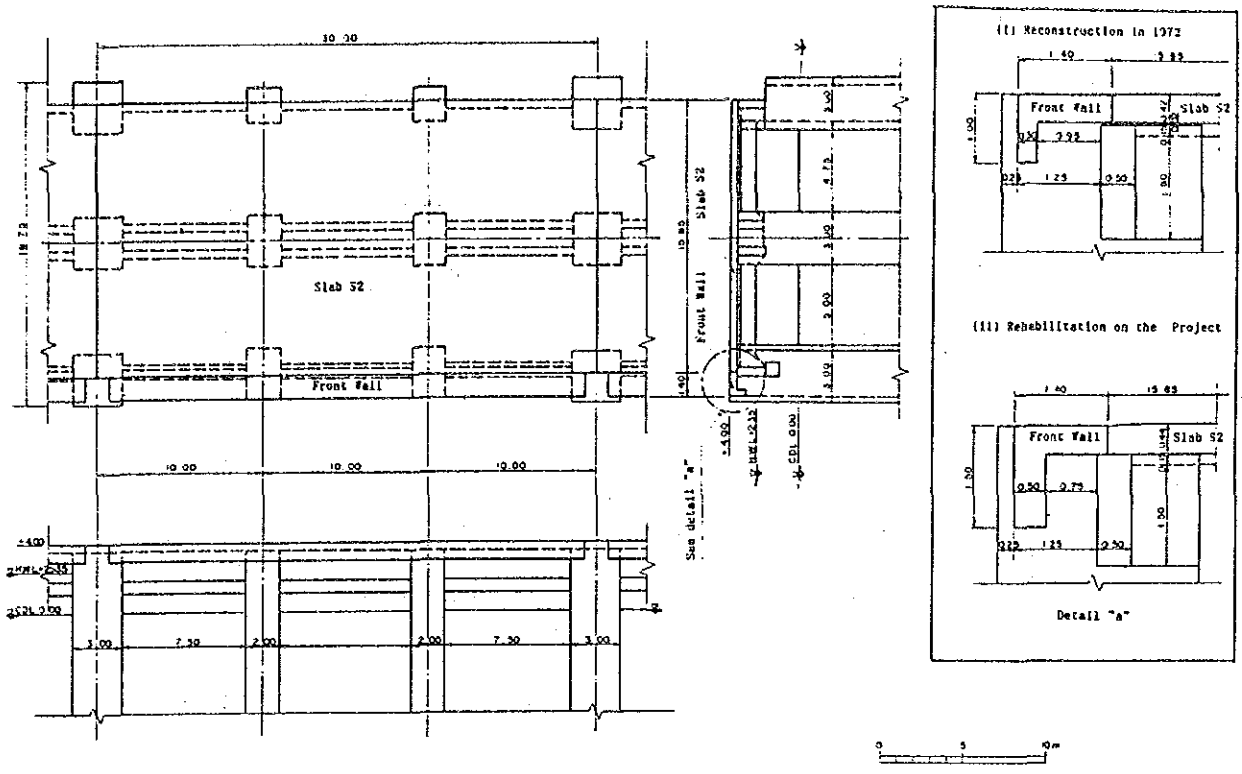

Figure 4-5-1 Superstructure of the Old Quay

4.5.2 Planned Port Facilities

Port facilities included in the Short Term Plan comprise two portions, namely the Public Portion to be furnished by the Government and the Private Sector Portion to be installed by the private companies relevant to port activities.

The Public Portion of the port facilities is composed of the fundamental items for the port activities as follows.

-Quay and Revetment
-Land and Road
-Aids to Navigation
-Dredging and Reclamation
-Building of Port Office

The Private Sector Portion comprises the facilities operated by the private sector, such as CMDM, CCI, SOLIMA and JIRAMA.

-Shed
-Water Supply Pipeline
-Oil Supply Pipeline

(1) Design Conditions

Table 4-5-2 Design conditions

Item	Planned Berth
Water Depth	-10 m
Object Vessel	10,000 DWT
Crown Height	+4.0 m
Berth Length	170 m : 1 Berth
Surcharge	2.0 tf/m^2
Live Load	Forklift Truck : 20 to 40 tf Truck Crane : 40 tf
Lifetime	50 years

The natural conditions are the same as shown in section 3.7.2.

(2) Design of Main Port Facilities

The three basic alternatives of the new berth, gravity type, steel sheet pile and steel pipe pile type, are compared. From the result of the comparison with execution conditions, construction costs and other related conditions, steel sheet pile type is adopted as the fundamental structure. A typical cross section of new berth for ocean-going cargo vessels is shown in Figure 4-5-2.

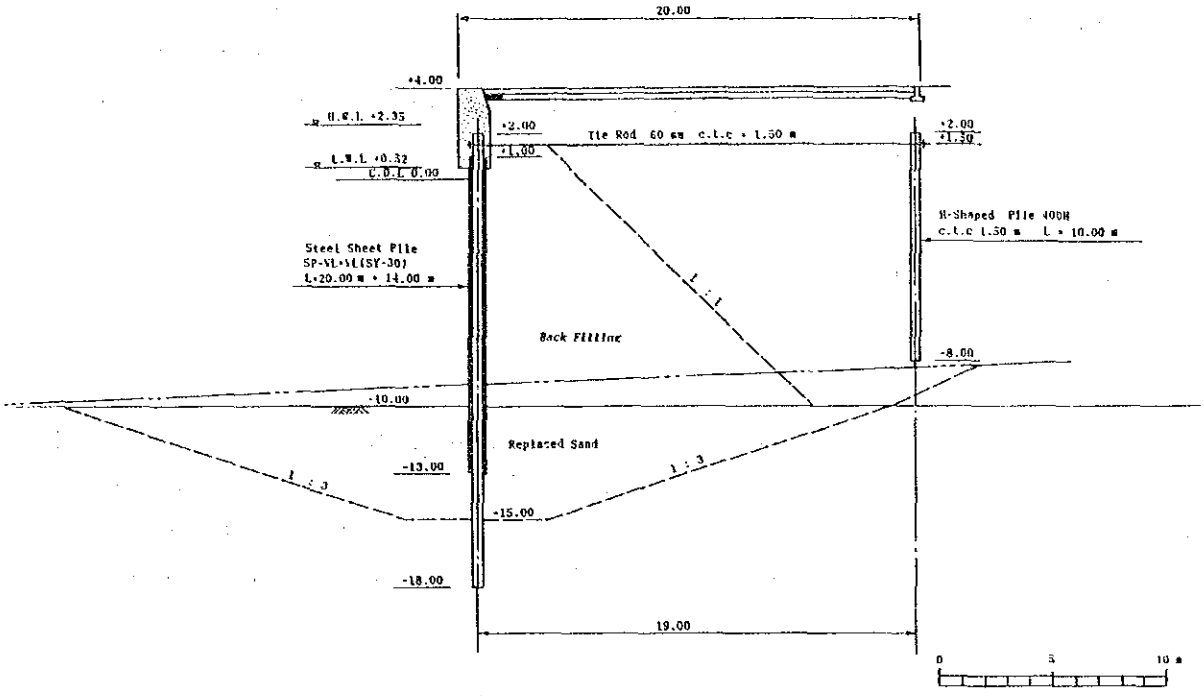

Figure 4-5-2 Typical Cross Section of New Berth

(3) Design of Other Facilities

1) Public Portion

Roads in the port are paved with concrete, 30 cm in thickness and have 2 lanes with 10 m width. Furthermore, in principal, the open yard is paved with concrete, 30 cm in thickness.

The structure of the revetment is selected as rubble-mound type, considering execution conditions, construction costs and other related conditions.

2) Private Sector Portion

The total area of existing sheds requiring rehabilitation works is estimated as 8,300 square meters for roofs and 4,000 square meters for walls. Roofs and walls are of colored steel sheet galvanized with zinc and aluminum as used on the existing sheds. Steel shutters are also replaced.

The total length of oil supply pipelines is estimated as 691 meters, including 431 meters of extension and 260 meters of rehabilitation. Steel pipes of extension pipelines are installed in a new pipe conduit. In case of a rehabilitation pipeline, however, only steel pipes are replaced using the existing pipe conduit.

The extension length of water supply pipeline is 585 meters, comprising a distribution pipeline of 464 meters and service pipelines of 121 meters. A distribution pipeline of 175 meters in length is installed in the conduit of oil supply pipeline and the other part is laid under the ground.

4.6 Construction Plan

4.6.1 Construction Schedule

The construction schedule of the Public Portion is presented in Table 4-6-1. The construction period of the Short-Term Development Plan is expected to be 3.5 years, from the last quarter of 1994 to the first quarter of 1998. The port facilities proposed in the Short-Term Development Plan will be constructed using the same methods as mentioned in the Master Plan.

Table 4-6-1 Construction Schedule (Short-Term Development Plan)

Facility		Construction Year				
Item	Sub Item	1994	1995	1996	1997	1998
1.Dredging	(1)-10.0m Berth					
	(2)Old Quay					
2.Reclamation	(1)Reclaimed by Transferred Material					
	(2)Reclaimed by Dredged Material					
	(3)Temporary Revetment					
3.Quays	(1)-10.0m Berth					
	(2)-8.5m to -10.0m Berth					
	(3)Revetment North					
	(4)Revetment East					
4.Rehabilitation of Existing Quays	(1)Old Quay					
	(2)New Quay					
5.Road	(1)Road					
	(2)Fence and Gate					
6.Buildings of Port Office	(1)Storage					
	(2)Residence					
7.Land	(1)Open Yard(No.1)					
	(2)Open Yard(No.2)					
	(3)Open Yard(No.3)					
	(4)Open Yard(No.4)					
8.Aids to Navigation	(1)Light Marker					
9.Demolition	(1)Maritime Structure					
	(2)Land Structure					

4.7 Cost Estimation

4.7.1 Estimation Basis

Some limits for the estimation are as follows:

i) The costs of the main port facilities proposed in the Short Term Plan are estimated.
ii) Estimation limits described in the Chapter of the Master Plan are also applied.

4.7.2 Estimation Result

The summary of the construction cost allocated to the Public Portion in the Short-Term Development Plan is presented in Table 4-7-1. The annual investment cost for each of the major facilities is listed in Table 4-7-2, according to the construction schedule and the construction costs.

Table 4-7-1 Construction Cost of the Facilities (Short-Term Development Plan)

Facility		Unit	Quantity	Construction Cost
Item	Sub Item			(US$)
1.Dredging	(1)-10.0m Berth	m^3	28,000	596,100
	(2)Old Quay	m^3	8,000	170,400
	Sub-total	LS	1	766,500
2.Reclamation	(1)Reclaimed by Transferred Material	m^3	70,000	1,216,400
	(2)Reclaimed by Dredged Material	m^3	52,000	242,400
	(3)Temporary Revetment	m	60	325,000
	Sub-total	LS	1	1,783,800
3.Quays	(1)-10.0m Berth	m	170	9,748,300
	(2)-8.5m to -10.0m Berth	m	41.5	2,859,400
	(3)Revetment North	m	90	2,348,800
	(4)Revetment East	m	155	1,723,500
	Sub-total	LS	1	16,680,000
4.Rehabilitation of Existing Quays	(1)Old Quay	m	120	1,906,300
	(2)New Quay	m	181	864,900
	Sub-total	LS	1	2,771,200
5.Road	(1)Road	m	1,062	2,089,600
	(2)Fence and Gate	m	300	113,900
	Sub-total	LS	1	2,203,500
6.Buildings of Port Office	(1)Storage	m^2	100	235,900
	(2)Residence	m^2	120	283,000
	Sub-total	LS	1	518,900
7.Land	(1)Open Yard(No.1)	m^2	1,625	257,200
	(2)Open Yard(No.2)	m^2	1,650	261,200
	(3)Open Yard(No.3)	m^2	1,650	261,200
	(4)Open Yard(No.4)	m^2	100	15,900
	Sub-total	LS	1	795,500
8.Aids to Navigation	(1)Light Marker	set	1	46,100
	Sub-total	LS	1	46,100
9.Demolition	(1)Maritime Structure	LS	1	53,200
	(2)Land Structure	LS	1	75,300
	Sub-total	LS	1	128,500
Total				25,694,000
Tax				540,000
Grand Total				26,234,000

Table 4-7-2 Annual Investment Cost (Short-Term Development Plan)

(thousand US$)

Facility		Unit	Quantity	Year					Total
Item	Sub Item			1994	1995	1996	1997	1998	
1.Dredging	(1)-10.0m Berth	m^3	28,000		198.8	397.3			596.1
	(2)Old Quay	m^3	8,000				170.4		170.4
	Sub-total	LS	1		198.8	397.3	170.4		766.5
2.Reclamation	(1)Reclaimed by Transferred Material	m^3	70,000			810.9	405.5		1,216.4
	(2)Reclaimed by Dredged Material	m^3	52,000		97.0	97.0	48.4		242.4
	(3)Temporary Revetment	m	60	325.0					325.0
	Sub-total	LS	1	325.0	97.0	907.9	453.9		1,783.8
3.Quays	(1)-10.0m Berth	m	170		3,249.4	6,498.9			9,748.3
	(2)-8.5m to -10.0m Berth	m	41.5	953.2	1,906.2				2,859.4
	(3)Revetment North	m	90			1,565.8	783.0		2,348.8
	(4)Revetment East	m	155		1,723.5				1,723.5
	Sub-total	LS	1	953.2	6,879.1	8,064.7	783.0		16,680.0
4.Rehabilitation of Existing Quays	(1)Old Quay	m	120			953.2	953.1		1,906.3
	(2)New Quay	m	181		864.9				864.9
	Sub-total	LS	1		864.9	953.2	953.1		2,771.2
5.Road	(1)Road	m	1,062				1,671.6	418.0	2,089.6
	(2)Fence and Gate	m	300				56.9	57.0	113.9
	Sub-total	LS	1				1,728.5	475.0	2,203.5
6.Buildings of Port Office	(1)Storage	m^2	100				235.9		235.9
	(2)Residence	m^2	120	283.0					283.0
	Sub-total	LS	1	283.0			235.9		518.9
7.Land	(1)Open Yard(No.1)	m^2	1,625			257.2			257.2
	(2)Open Yard(No.2)	m^2	1,650				261.2		261.2
	(3)Open Yard(No.3)	m^2	1,650				174.1	87.1	261.2
	(4)Open Yard(No.4)	m^2	100			15.9			15.9
	Sub-total	LS	1			273.1	435.3	87.1	795.5
8.Aids to Navigation	(1)Light Marker	set	1					46.1	46.1
	Sub-total	LS	1					46.1	46.1
9.Demolition	(1)Maritime Structure	LS	1			53.2			53.2
	(2)Land Structure	LS	1	37.6	37.7				75.3
	Sub-total	LS	1	37.6	37.7	53.2			128.5
Total				1,598.8	8,077.5	10,649.4	4,760.1	608.2	25,694.0
Tax				30.2	129.5	207.2	154.8	18.3	540.0
Grand Total				1,629.0	8,207.0	10,856.6	4,914.9	626.5	26,234.0

4.8 Management and Operation

4.8.1 Present situation of management and operations

(1) The relationship between the headquarters and local agencies of DTM

The tasks of local agencies are monotonous such as permission for port use, berth assignment and levy of port charge. The other tasks such as administration and maintenance, management policy, port planning are authorized by the headquarters of DTM, and local agencies must follow decisions of headquarters without exception.

It goes without saying that a local agency can best understand the local situation and should be given authority to make decisions on management and operations. At present, the Madagascar government is examining the possibility of entrusting local agencies with more authority. This is necessary for port management to cope accurately and timely with the social situation and actual state of the local area.

The port of Antsiranana has an important role for the distribution and production of goods that sustain life and bring prosperity to the region.
So it is also necessary for the local agency to have authority concerning future development. In addition, considering that it takes a long time and a large amount of money to develop the port, the Madagascar government should have long-term plans or clearly enunciated policies on port development, management and operation.

Therefore the headquarters should have clearly enunciated policies regarding the functional allotment of port, financial resources for investment and maintenance at every port by inviting the participation of local agencies.

(2) The relationship between public and private sectors in Antsiranana

As a number of organizations conduct operations at the port of Antsiranana, it is necessary that responsibility and allotment be clearly assigned to ensure smooth and efficient operations. The local agency should have the proper authority to deal with this situation.

(3) Level of port tariff

In Antsiranana, local agency levies port charges such as entering the port charge, wharfage charge, cargo handling charge, occupancy charge and receives royalties from private companies such as CMDM and pilot company.

The port sector needs to keep port charges at a reasonable level for managing the port and organization. But at the present tariff level it is impossible to manage the port

including the depreciation, renewal of port facilities and organization.

(4) Administration of port facilities

In Antsiranana, some of the port facilities are owned and administrated by private interests. These companies have not kept these port facilities in good condition.

In the Short-Term Plan, it is necessary to repair sheds, and lay pipe lines again to return the port facilities to good condition; expenses are to be paid by owners.

4.8.2 Recommendations on the present management and operation

(1) Strengthening of the Organization

At present, organization of Antsiranana has inadequate sections for accounting, statistics, etc, making it impossible to maintain port facilities in a good condition for port users.

Therefore, it is necessary to consider a new organization. Figure 4-8-1 shows a proposal of the organization and functions.

The new organization has sections for general affairs, port operation and technical matters to carry out port management and organization.

And the new organization must maintain a high morale among port workers.

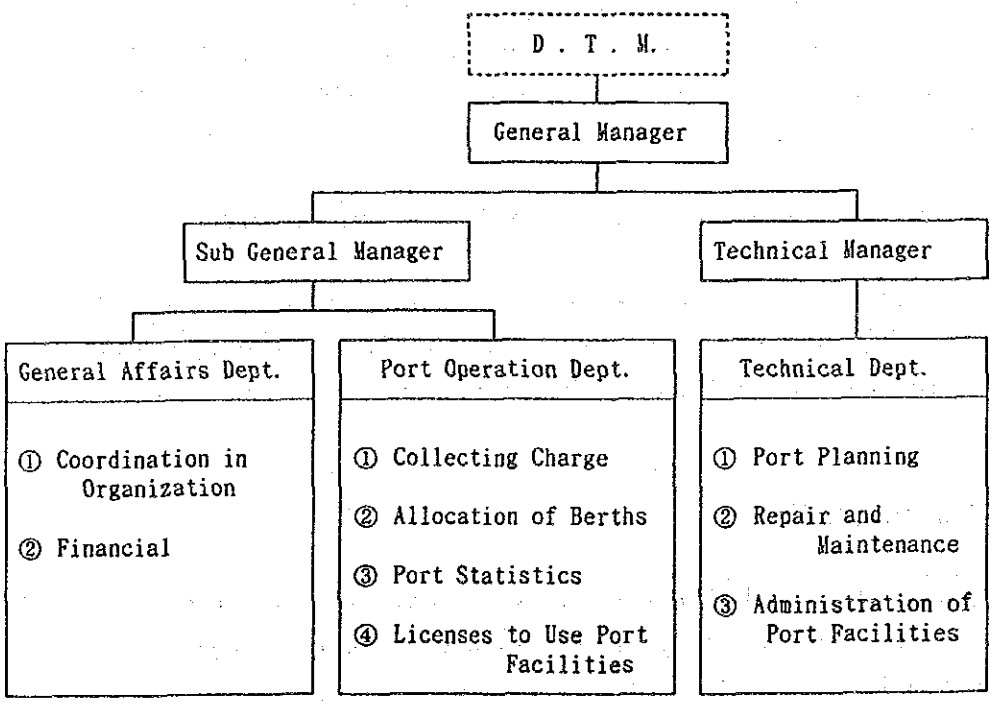

Figure 4-8-1 Proposal of the Organization and Functions

(2) Coordination among public and private sectors

It is beneficial to introduce new fields of communication and cooperation between public and private sectors for efficient operations. And, a policy of operation, system of maintenance and allocation of berths under control of local agency should be examined.

(3) Level and system of port tariff

The level of port tariff was examined comparing Antsiranana with Toamasina. Toamasina, the only main long distance carrier port, is managed and operated by SEPT which was created with government funds.

Table 4-8-1 Rate of revenue

Kinds of Vessels	Antsiranana		Toamasina		③ / ①	④ / ②
	Entering the Port ① ('000 FMG)	Wharfage ② ('000 FMG)	Entering the Port ③ ('000 FMG)	Wharfage ④ ('000 FMG)		
1,000D/W	2,724	3,496	556	31,468	0.20	9.00
	6,220		32,024		5.15	
5,600D/W	16,033	34,639	25,973	66,838	1.62	1.93
	50,672		92,811		1.83	
Total	56,892		124,835		2.19	

1,000D/w: General cargo(Domestic):Volume 2,800m3, Length 64m
Number of vessels 139, Staying time 45hr(98), 59hr(41)
5,600D/w: General cargo(Foreign):Volume 13,250m3, Length 112m
Number of vessels 121, Staying time 36hr

The above shows that if Antsiranana applies Toamasina's tariffs, Antsiranana's entering the port and wharfage revenue will increase by about 2 times more than the present level. In particular, Toamasina's wharfage charge is 9 times higher than Antsiranana's for small vessels, because Toamasina's tariffs are not classified according to volume of vessels. So that leads one to believe that the long staying time of vessels at Antsiranana is a result of the extremely low wharfage charge. This runs counter to effective port management, thus it is thought necessary to reconsider the port tariff level. As Toamasina has a tariff for foreign cargo which is higher than domestic cargo, it should be also examined to introduce a tariff for foreign cargo like Toamasina in line with the increase of foreign cargo.

Next, a port tariff system is recommended. At present, the local agency levies an occupancy charge on CMDM and a pilot company which occupies public ground.
In addition, it is reasonable to levy an occupancy charge on sheds (the Chamber of Commerce and Industry),water supply line (JIRAMA) and oil pipe line (SOLIMA). Also, local agency should levy an occupancy charge on users of the new open yard that will be constructed in the Short-Term Plan.

(4) Arrangement and repair of port facilities

Local agency should play a leading role in construction work of the Short-Term Plan. Following the Short-Term Plan, water supply line and oil pipe line must be laid under the new road. And sheds must be restored to good condition for efficient operation and service.

(5) Others

1) Port planning and investment

Long-term development and improvement plans are essential for the orderly development of port areas. Without long-range plans and clearly enunciated policies, haphazard construction is likely to take place which may disturb the future development of the ports.
It is necessary for the central office, local agencies and municipal corporations to work together.

In Madagascar, financial resources are limited because of delayed economic growth, so investment projects are financed by foreign cooperation capital.
In Japan, investment cost of port facilities is supplied by port users who benefit from the facilities.

2) Port statistics

In Madagascar,the present port statistics are insufficient.
Port statistics are important information for port planning and management.
The local agency should prepare timely and accurate port statistics.

3) Port marketing activities

To ensure the success of the new port, intensive port marketing must be carried out in cooperation with the central office, local agency and municipal corporations. Without a positive approach, clients may not be attracted to the port. In addition, it

should be noted that a reputation for prompt, reliable, economical and efficient service is essential for attracting clients.
To this end, a quick passage through customs, efficient immigration and quarantine procedures are also vital in attracting potential clients.

4.9 Economic Analysis

4.9.1 Prerequisites of the Economic Analysis

(1) Base Year

The base year is set as 1994.

(2) Project Life

The project life is assumed to be 30 years, taking into consideration the depreciation period of the main facilities and construction period.

(3) Foreign Exchange Rate

US$ 1.00 = 1,860 FMG

(4) "Without" case

Taking into consideration the extent of deterioration and past records of radical rehabilitation in the existing port facilities and the maintenance budget in local agency of DTM, "Without" case is set as follows.

Port facilities

Only new quay is available.
Only cold storage is available.

Cargo handling volume

According to the increase of handling cargo, ship waiting cost will increase and transportation cost of handling cargo will rise. Therefore, since competitive power of the port will be weakened, transhipment cargoes of tuna will not be handled and the cargo handling volume after 1998 is assumed to be the same as in 1998.

(5) Conversion factors

Standard Conversion Factor (SCF)

The standard conversion factor is used to determine the economic prices of certain goods which cannot be directly revalued at border prices. These goods include most non- tradable goods and services. 0.900 is adopted for the standard conversion factor.

Conversion Factor for Consumption (CFC)

This conversion factor is used to convert the market prices of consumption goods into the border prices. The CFC of 0.882 is adopted.

Conversion Factor for Labor (CFL)

For the economic analysis, labor costs are usually measured in terms of their opportunity costs, and here, the conversion factor for skilled labor is assumed to be 0.882 and the conversion factor for unskilled labor is assumed to be 0.569.

4.9.2 Costs of the Project

(1) Investment Costs

Investment costs are converted by multiplying the market costs using the above conversion factors. Based on the construction schedule, the annual construction costs at economic prices are given below.

Table 4-9-1 Annual Investment Costs

(Unit: '000 US$)

Year	1994	1995	1996	1997	1998
Costs	1,905	8,607	11,190	6,385	1,000

(2) Maintenance and Operation Costs

Maintenance Costs

Annual maintenance costs are considered to be 1.0% of the investment costs of structures and rehabilitated facilities. Economic prices are estimated to be US$ 265,000.

Personnel costs

The personnel costs in economic prices are estimated to be US$ 5,200.

Administration Costs

The administration costs are set at 60% of the personnel costs, and its economic prices are estimated to be US$ 3,200.

(3) Renewal Investment Costs

The renewal investment costs are shown in the following table.

Table 4-9-2 Renewal Investment Costs

(Unit: '000 US$)

Facilities	Lifetime (years)	Renewal costs
Light marker, Fence and gate, Shed, Oil pipe line, Water supply line	15	2529
Rehabilitated quay	20	2690
Total		5219

4.9.3 Benefits of the Project

(1) Kinds of Benefits

Considering the "With" and "Without" case, the following items are identified as major benefits of the short-term development plan for the port of Antsiranana from the viewpoint of the national economy.

1) Savings in ship staying costs.
2) Savings in interest of cargo costs.
3) Benefits of use of sheds.
4) Benefits of port service industries derived from handling of transhipment tuna.
5) Savings in transportation costs from other port.
6) Promotion of regional economic development.
7) Increase in employment opportunities and incomes.
8) Reduction of cargo damage and accidents at the port.

Of the above items, 1), 2), 3) and 4) are countable in monetary benefits. Item 5) is considered countable, but the monetary benefits are not calculated in this study.

(2) Calculation of Benefits

Results of calculation are shown as follows.

Table 4-9-3 Results of Calculation in Benefits

(Unit: '000 US$)

	1998	1999	2000	2001	2002	2003	2004 -2023
Ship staying costs	3956	3946	3934	3915	3907	3891	3875
Interest of cargo costs	368	366	364	362	359	356	353
Use of sheds	211	211	211	211	211	211	211
Handling of transhipment tuna	869	869	869	869	869	869	869
Fishery boat repair	510	510	510	510	510	510	510
Supply of gas oil	104	104	104	104	104	104	104
Supply of salt	247	247	247	247	247	247	247
Handling labor charge	8	8	8	8	8	8	8
Total	5404	5392	5378	5357	5346	5327	5308

4.9.4 Calculation of EIRR and Evaluation

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project. The EIRR of the Short-Term Plan is calculated as 14.2%.

(2) Sensitivity Analysis

In order to determine whether the project is feasible when certain conditions change, a sensitivity analysis is made for three alternatives.

Case A : The costs increase by 10%

Case B : The benefits decrease by 10%

Case C : The costs increase by 10% and the benefits decrease by 10%

The results of the sensitivity analysis are shown as follows.

Table 4-9-4 Results of Sensitivity Analysis

Case	EIRR (%)
Base Case	14.2
Case A	12.8
Case B	12.7
Case C	11.4

(3) Evaluation

There are various views concerning the appropriate EIRR level used to determine whether a project is feasible. The leading view is that the project is feasible if the EIRR exceeds the opportunity cost of capital.

In general, the opportunity cost of capital in various countries is considered to range from 8% to 12% according to the degree of development in each country. It is generally considered that a project with an EIRR of more than 10% is economically feasible for infrastructure or social service projects.

For this project, even though the economic calculation only takes into account the items which are easily quantified, the EIRR fairly exceeds 10%, and even in the case of (C) in which EIRR is minimized, it exceeds 10%.

Therefore, this Short-term Development Project is feasible from the viewpoint of the national economy.

4.10 Financial Analysis

4.10.1 Purpose and Methodology of the Financial Analysis

The purpose of the financial analysis is to examine the viability of the project of the Short-Term Development Plan.

The viability of the project is analyzed using the Financial Internal Rate of Return(FIRR) by means of the discount cash flow method. The FIRR is a discount rate that makes the costs and revenues during the project life equal.

The financial soundness of the implementation body is appraised based on its projected financial statements(Profit and Loss Statement, Cash Flow Statement and Balance Sheet). The appraisal is made from the viewpoints of profitability, loan repayment capacity and operational efficiency.

4.10.2 Prerequisites of the Financial Analysis

(1) Project life

Taking account of the conditions of the long-term loans and the service lives of the port facilities, the project life for the financial analysis is determined to be 30 years,including 5 years of detailed design and construction of port facilities.

(2) Base year

For the estimation, costs, expenditures and revenues analyzed quantitatively here, 1994 prices are predominantly used. Neither price inflation nor increases in nominal wages are considered during the project life.

(3) Cargo handling volume

Cargo handling volume is estimated based on the demand forecast. The berths in the short-term plan will reach the maximum handling capacity in 2004.(berth occupancy: 55%)

(4) Number of vessels

Number of vessels is calculated using cargo handling volume and cargo handling volume per vessel.

4.10.3 Revenue

The revenues from the port activities are calculated based on the present tariff level. The following charges are the sources of revenue generated from the operation.

(1) Entering the port charge
(2) Wharfage charge
(3) Cargo handling charge
(4) Occupancy charge
(5) Royalties

4.10.4 Investment costs

(1) Initial investment costs

Initial investment costs of the Short-Term Plan are estimated in Section 3-9.

(2) Renewal investment costs

The facilities and equipment will be renewed based on their service lives.

4.10.5 Operating expense

(1) Personnel cost

The annual personnel costs are estimated based on the organization proposed in section 4.8.2 and existing pay scales.

(2) Administration

Administration cost is 60 % of personnel costs based on the past condition.

(3) Maintenance and repair

The annual maintenance and repair costs for port facilities are calculated as 1% of the original investment coat.

4.10.6 Depreciation Costs

The annual depreciation costs of port facilities and equipment are calculated by the straight line method based on their service lives.
Residual values after all depreciations are estimated as zero. At the end of the project life, fixed assets are assumed to be sold at their residual values.

4.10.7 Fund raising

Eighty percent of initial investment costs is assumed to be raised by foreign fund and conditions are assumed as follow;

Soft loan
Loan period : 30 years
Grace period : 10 years
Interest rate : 2.6 %
(Note) These conditions are quoted from those of the OECF(Japan)

The remaining initial investment costs are assumed to be raised by government fund.

4.10.8 Appraisal of project

(1) Result of the FIRR calculation

The result of the FIRR calculation is - 4.1 %. Judging from the this analysis, the project is not regarded as financially feasible. This means that the existing tariff should be raised or more government funds should be employed in the investment costs to secure the viability of the project.

4.10.9 Comparison of alternative of FIRR

(1) Alternative cases

The following analysis is aimed to clarify the financially feasible rate of government fund.

Table 4-10-1 Alternative Cases of FIRR Calculation (1)

Case	Government Fund	Soft Loan	FIRR	Ave.Interest Rate
Case A	90 %	10 %	4.9 %	0.26 %
Case B	80 %	20 %	1.9 %	0.52 %
Case C	70 %	30 %	0.1 %	0.78 %

※ Operating Revenue and Cost are equal to base case

Analyzing the results of the FIRR calculation, Case A and Case B are feasible as the FIRR exceeds the average interest rate. Case C, however, is not feasible, which means that the level of government funds should be set over 80 % to ensure the viability of the project.

In the following analysis, operating revenues are raised based on section 4.8.2; entering the port charge and wharfage charge are 2 times the existing tariff levels. In this case, government fund is set at 70 %, a level which proved to be not feasible in Case C.
The result of the FIRR calculation is shown in Table 4-10-2.

Table 4-10-2 Alternative Case of FIRR Calculation (2)

Case	Government Fund	Soft Loan	FIRR	Ave. Interest Rate
Case D	70 %	30 %	0.8 %	0.78 %

※ Entering the port charge and Wharfage charge : Base case × 2
Costs are equal to Base case

In this case, FIRR is nearly equal to the average interest rate, so it is difficult to ensure financial feasibility.

(2) Financial soundness of the port management body

Case B is the minimum FIRR in which the average interest rate is exceeded (Case D is nearly equal), so Case B is appraised from the viewpoint of financial soundness of the port management body.

1) Profitability : The rate of return on net fixed assets
2) Loan repayment capacity : The debt service coverage ratios
3) Operational efficiency : The operating ratios and the working ratios

These indicators are not at favorable levels. It is presumed that there will be a problem with the operational efficiency of the organization and the efficiency of the routine operations.

4.10.10 Consideration of the result

According to the economic analysis, this project is valuable as a national development scheme. So it is desirable to implement the project as soon as possible.

However, judging from the result of the FIRR calculation, it is very difficult to ensure the financial feasibility of the project.
The main reason is that investment costs are much greater than operating revenues, but it is impossible to further trim the project costs.
To increase operating revenues, the port tariff level needs to be reconsidered, but it has a ceiling because port activities must be competitive with neighboring ports and alternative transportation.

In this case, subsidy from government or finance from foreign countries is introduced in general. But from the result of the FIRR calculation, the project is not viable even if the subsidy is 70 %. Further, subsidy from government is not expected because financial resources are limited in Madagascar. It is often possible to get

economic aids from foreign countries, but it is doubtful that they will shoulder all investment costs of the Short-Term Plan. While it is desirable to ensure completion of the entire Short-Term Plan, it may be worth examining the possibility of going ahead with part of the short-term plan in the process of the Short-Term Plan.

A technical examination of the above is shown later in 4.12 Urgent Improvement Plan.

4.11 Environmental Impact Analysis

4.11.1 Basic Concept

Through surveys and discussions with relevant people, it can be confidently said that the Master Plan will not cause any problem on natural environment, while the Plan has a positive effort on the socio-economy such as raising employment. However, a more detailed examination is necessary. So, a further environmental impact assessment, what is called, an Environmental Impact Analysis (EIA) will be implemented on items mainly indicated in IEE.

4.11.2 Impact on the Hospital (Noise and Vibration Generated by Construction Works)

In the construction stage, a pipe driving barge will generate the highest of noise. Naturally, the noise level declines with distance from the source. The noise level at the hospital, about 1,000 km away from the project site, is 60-70 dB(A), which corresponds to that inside a quiet car, in other words, that of a residence in the urban area.

According to the discussion, it was confirmed that the manager of the hospital recognizes that the noise at such a level will not bring about any problem.

Consequently, the impact by noise can be regarded as minor.

4.11.3 Environmental Impact Generated by Port Activities

At the operation stage after completion of the project, some environmental problems are likely to occur. In principle, shipping operators are responsible for problems they create.

Bilge and wastes generated by calling vessels should be treated by the shipping operators themselves. Their volume can be estimated so that relevant administration instruct or assist, if necessary, shipping companies so as to deal with them.

Air pollution and waste water generated by vessels will be negligible. The reasons are as follows: The total staying time at the port by calling vessels is estimated to decrease slightly compared with that in 1990 because higher cargo handling efficiency and shorter staying time in the port are expected in the operation phase, even though cargo volume will increase. In addition, this area is blessed with good natural conditions. Water quantity in the Diego-Suarez Bay is excellent and the Bay is vast. Dominant wind direction at the project site is from east-south-east to south-east while the central city is located on the windward side.

4.11.4 Environmental Impact Generated by Industrial Activities around the Port

Operation of the tuna canning factory has the largest impact on the environment around the port. The impact consists of water pollution, offensive odor and wastes.

As to water pollution, the results of the numerical analysis indicate that pollution range will be limited to alongside the quay and that a countermeasure such as an active sludge process will be effective. Therefore, no serious problem will result.

As to odor by tuna, there is no need to be nervous because odor is not so intense and this area is blessed with good natural conditions.

As to wastes generated in the process of producing food stuffs, the canning factory must deal with the disposal by itself. It is desirable that the local government or the port management body instruct and help the factory, if necessary.

4.11.5 Traffic Problems around the Port Associated with Port Activities

With the increase of cargo handling, road traffic volume around the port will increase. Noise, vibration, traffic jams and traffic accidents should be considered in the operation phase of the project. Traffic volume into or out of the port in the operation phase is calculated about 20 vehicles per hour in terms of 5 tonnage loaded truck, which means that the increase is only several vehicles.

Considering the present situation of road traffic, the proposed Plan will not bring about a serious problem on the above issues. To improve the situation, it is recommended that rehabilitation works or traffic control such as speed control be done.

4.11.6 Economic Effect Associated with the Short-Term development Plan

There will be a rise in employment opportunities both in the construction phase and in the operation phase of the project. That is a positive effect.

The major effects in the construction phase are as follows:

- About five hundred people in the district will be employed.
- A lot of materials will supplied from the region and relevant companies and people will earn revenue and wages.
- A lot of workers coming from other areas will stay at hotels in Antsiranana, buy daily goods, eat in restaurants etc.

In the operation phase, they are as follows:

- Additional employees will be required to handle the increase in cargo volume.
- Considerable number of people will be employed when production at the tuna canning factory is doubled.

On top of that, the increase in wages will benefit the regional economy.

4.11.7 Conclusion

As mentioned above, the implementation of the project in the Short-Term Development Plan will not cause any problem for the natural environment. On the contrary, it will bring positive effects to the socio-economic environment. Consequently, the Short-Term Development Plan is thought feasible in terms of the environment.

4.12 Urgent Improvement Plan

As mentioned in the financial analysis, the urgent improvement plan is examined. It will be the first step in the implementation of the whole Short-Term Development Plan and the basic concept should be as follows:

- Rehabilitation works should be completed.

- Consideration should be given to minimizing the influence to port activities as much as possible during rehabilitation works.

The proposed urgent improvement plan is shown in Figure 4-12-1. The main contents and characteristics of the urgent improvement plan are as follows:

- The length of quay extension is 120 m, the same as the existing "Old Quay".

- The construction cost of public portion including corresponding consultant fee is

estimated at about 16.9 million US dollars, about 64 % of the total construction cost for the Short-Term Development Plan.

- However, additional construction cost so as to implement the remaining parts of the whole Short-Term Development Plan is estimated at about 14.5 million US dollars, so that the total construction cost results in an increase of about 5.2 million US dollars, if the stage construction works are scheduled.

- The extension of the quay will be completed within two years from the commencement of the construction works.

- Rehabilitation works will not cause major problems for accommodating vessels.

- Judging from the record of calling vessels in 1990, it is estimated that about 54 % of ocean-going cargo vessels, 83 % of coastal cargo vessels and almost all fishery boats can be accommodated at the extended quay.

- The berth occupancy ratio in the urgent improvement plan is over 50 % in 1994, 64 % in 1998, whereas it is about 50 % in 1998 in the Short-Term Development Plan. The maximum berth occupancy for three berths recommended by UNCTAD is 55 %, which means that some congestion would be unavoidable in 1998 when the ratio will exceed 60 %.

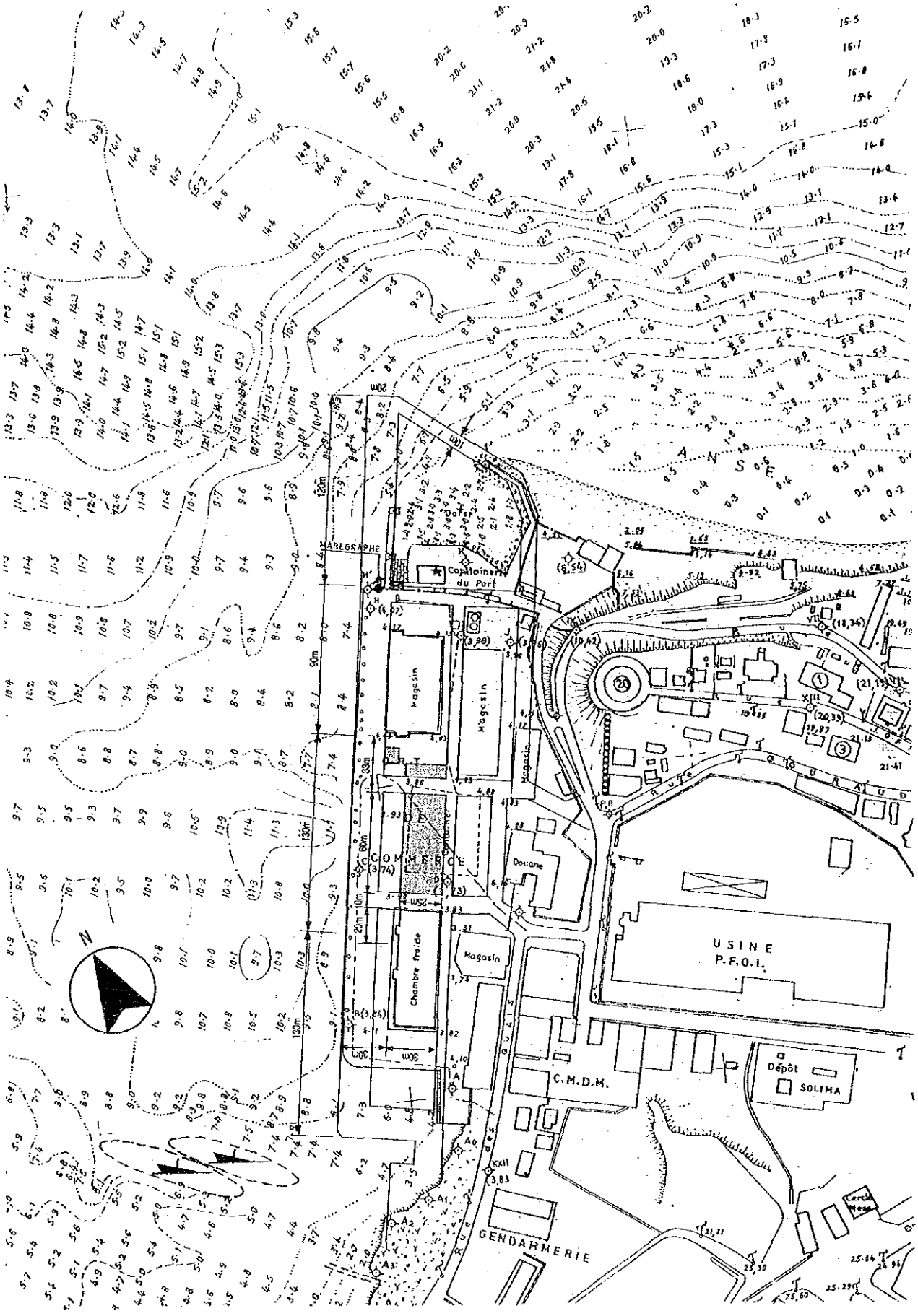

Figure 4-12-1 Proposed Urgent Improvement Plan

JICA