d. Coast at the Health Department

2) Port Improvement for;

a. Rehabilitation of the West breakwater in Avatiu Harbour,
b. Relocation and extension of the East breakwater in Avatiu Harbour,
c. Rehabilitation of the existing wharf,
d. Dredging work to widen the inner port basin,
e. Supply of a tugboat and cargo handling equipment.
f. Dredging works and wharf construction for marina in Avarua Harbour
g. Relocation and extension of the East breakwater in Avarua Harbour

16.4.3 "Without" Case

In the "without" case we should see the likely future scenario excluding the proposed project, assuming that all other conditions will be the same as those in the "with" case. The following conditions are adopted as the "without" case.

1) No additional coastal protection measures, such as preparing the parapet, concrete revetment and so on, will be taken.

2) The eroded coast will be restored to the condition it was before using sandy material and rocks as seen in the present coastline.

3) The existing wharves at Avatiu will be rehabilitated,

4) The existing damaged west breakwater at Avatiu will be rehabilitated within a few years,

5) No dredging works will be carried out.

16.4.4 Cargo Throughput

Cargo volume under the "with" case has already been forecast. The Short-term Plan is formulated in response to the cargo throughput expected in 1997.

Thus, for the economic analysis, it is assumed that capacity will not increase after 1997. The increment portion of the cargo volume after that year is to be dealt with by the following stages of the development plan.

16.5 Benefits

16.5.1 Benefit Items

Considering the "with" and "without" situations mentioned above, the following items are identified as benefits of the Short-term Plan for coastal protection and port improvement at Avatiu Harbour.

1) By Coastal Protection

- Decrease in land-loss by coastal protection,
- Maintaining economic activities,
- Protection of residential and public buildings,
- Decrease in maintenance cost of transport system (airport, road),
- Increase in land value
- Avoidance of Direct Damage to ILS

2) By Port Improvement at Avatiu Harbour

- Savings in waiting time by improvement of breakwater at Avatiu Harbour,
- Savings in waiting cost for gangs due to the decrease in the delay of ship arrival,
- Savings in interest payments,
- Decrease in operating cost by improvement of cargo handling efficiency,
- Decrease in working time of labours,
- Decrease of maintenance cost of breakwaters and wharves,
- Decrease in off-shore handling cost in the event of damage to wharf,
- Decrease in damage to port facilities.

3) Other Intangible Benefits

As for the other intangible benefits, please refer to Table 16-4 "Type of Benefits."

16.5.2 Decrease in Land Loss by Coastal Protection

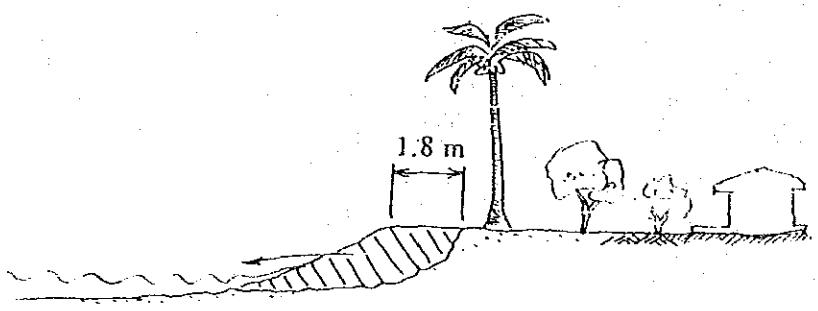
One type of coastal damage is land erosion caused by waves and surges. The lands protected by appropriate measures in the Short-term Plan will be secured against waves and surges during storm conditions.

According to the valuation by the Commissioner of Crown Lands (CCL), the present value of coastal lands in the Short-term Plan is summarized below:

Table 16-4 Value of Coastal Land

Location	Value (NZ$/m²)
Airport Area	44.6
Fuel Tank Yard	33.4
Avarua Area	45.7
East of Avarua	25.0
Health Department Area	48.1 & 27.5

In this study, coastal damage is defined as that which will be caused by waves and surges to land 1.8 m width.



The coastal areas to be protected in the Short-term Plan are as follows:

Table 16-5 Area to be Protected

Location	Length to be Protected (m)	Width to be Protected (m)	Area to be Protected (m²)
Airport Area	360	1.8	648
Tank Yard	350	1.8	630
Avarua Area	790	1.8	1,422
East Avarua	290	1.8	522
Health Dep.	150	1.8	270
	150	1.8	270
Total	2,090		3,762

Therefore, values secured by the coastal protection can be calculated as below.

Table 16-6 Value to be Secured

Location	Unit Value of Land ($/m²)	Area (m²)	Value ($)
Airport Area	44.6	648	28,901
Tank Yard	33.4	630	21,042
Avarua Area	45.7	1,422	64,985
East of Avarua	25.0	522	13,050
Health Dep.	48.1	270	12,987
	27.5	270	7,425
Total	41.2	3,762	148,390

The above estimated values represent the maximum case assuming a cyclone which has the return period of 30 years like "Sally". As stated in subsection 12.2.7, decrease in the amount of damage as a result of the coastal protection work is represented as the decreased number of model cyclones (equivalent to the strength of "Sally") during the project life. According to the above, the effect of the project during the project life is equivalent to 6.2 times of the damage by the model cyclone if the project were not implemented. Therefore, total effect, that is, benefit from this time, is NZ$920,018, and the annual benefit can be counted at NZ$30,700.

16.5.3 Maintaining Economic Activities

In general, after properties, such as offices, shops/stores utilities and so forth, are damaged, economic activities among people are limited.

When damage to property is reduced or no damage is involved, economic activities are maintained.

It is assumed that GDP will be used as an economic indicator.

GDP in 1990 : NZ$ 105,834,000
Population in 1990 : approx. 18,300 persons
GDP per capita : NZ$ 5,783

It is also assumed that restoration work will continue for about two weeks after damage is incurred and economic activities will be limited to half of

the usual activities. The amount expected to be lost by the "without" case is calculated as follows:

$$5,783 \times 10,000 \times \frac{1}{2} \times \frac{2}{52} = \text{NZ\$1,112,115}$$

where, the figure 10,000 is the population in Rarotonga Island (approx. 55% of the island's total population).

Therefore, the total of NZ$6,895,113 is for the project life, and the annual benefit can be counted at 229,800 NZ$/year.

16.5.4 Protection of Residential and Public Buildings/Decrease in Maintenance Cost of Transport System

Property losses by cyclone "Sally" were taken from M.O.W. report as shown in Table 16-7. (also refer to Chapter 5)

Among the damaged structures, some are situated in the center of the town (Avarua), and some are scattered around the island. The following factors are used in calculating the benefits:

Table 16-7 Property Damage by Sally

Source: the Report by M.O.W.

Descriptions	Damages Cost by Waves ($)
1) Public Sector:	
a. Government Buildings	1,151,000
b. Church Buildings	16,000
c. Clinic, Community Halls etc.	25,500
d. Water Supply	450,500
e. Roads & Drains	2,201,500
f. Bridges, Culverts etc.	4,375,000
g. Others	1,643,900
2) Private Sector	
h. Houses	946,000
i. Hotels, Motels	18,000
j. Shops, Stores	38,000
k. Others	200,400
Total	11,065,800

The ratios are assumed as the degree of concentration to the area to be protected in the Short-term Plan as follows:

a---------- 100%

b, c, d, e, f, i,---------- $\frac{\text{Length to be protected}}{\text{Total length of the Coast}} = \frac{2.090}{31.00}$

$= 6.74\%$

h, j,---------- $\frac{\text{Population in Urban area}}{\text{Total Population in Rarotonga}} = \frac{3741}{9826}$ (in 1986)

$= 38.1\%$

Accordingly, total amount needed to protect the island in the event of a cyclone Sally is NZ$2,404,241.

Then, total value for the project life is NZ$14,906,294 using the same procedures as above. Therefore annual benefit of this item can be regarded as 496,900 NZ$/year.

16.5.5 Increase in Land Value

With the coastal protection and the establishment of a Port-Park Complex having the dual function of a green zone and parking area, safety will be enhanced against cyclones; also the land will be more pleasing to the eye.

Consequently, the value of the land will be rise through the increase of demand for utilization.

Table 16-8 Rise in Land Value

Location	Unit Value of Land ($/m²)	Area (m²)	Value	10% of Value
Avarua area	45.7	1,422	64,985	6,499
East of Avarua	25.0	522	13,050	1,305
Health Dep.	48.1 27.5	270 270	12,987 7,425	1,298 742
Total		2,484	98,447	9,845

Note) Because there is no room for other purposes in airport area and tankyard, those areas are excluded from the above benefit items.

According to the results of the calculation as shown in Table 12-4 to 12-12 in Chapter 12, the rate of damage reduction is remarkable. However, the rising ratio of land value is determined at 10% under the assumption that the safety ratio and the reduction rate of damages are mutually correlated.

16.5.6 Savings in Ships' Waiting Costs

If the relocation and extension of the east breakwater is not carried out, ships will continue to wait outside the Avatiu Harbour due to when the sea is rough at the entrance.

Investment in the East Breakwater will reduce the waiting time of calling ships. This cost reduction is one of the benefits of the project.

The share of foreign ships calling at Avatiu Harbour is assumed to be 75% of the total. In this study it is assumed that 50% of the benefits attributed to foreign ship operators will be transferred to the Cook Islands economy as well as 100% of the benefits for the Kook Island's ship operators will accrues to the Cook Islands' economy. The ship cost can be estimated simply by totaling the various cost components such as depreciation, wages, maintenance cost and so forth. Although it is possible to estimate the ship cost based on the charter rate, this rate fluctuates sharply with market conditions, so it is not appropriate for use as the base for the economic price of the ship cost.

The formula used to calculate this benefit is as follows:

Savings in ships' staying costs	=	Difference in staying time between "With" & "Without" cases	x	Ship cost (Unit cost)	x	Share of benefits accruing to Cook Islands

After interviewing Japanese shipping companies having international routes, we chose to estimate the ship cost based on the hire rate.
The ship cost of approx. 2,600 DWT/115 TEU's (average) is approx. NZ$5,700/ship day. Waiting time due to rough sea at the entrance of the Harbour is to be 1 day. According to the information, about four or five ships waited for port entry in the past. This nearly equals 10% of the average ship calls (cargo vessels and tankers) over the recent five years. It is estimated that 54 ships will call in 1979. Therefore,

Savings in ships' staying costs	= (54 x 0.1) x 5,700 x 0.63
	= NZ$19,400 a year

16.5.7 Savings in Waiting Cost for Gangs Due to the Delay of Ship Arrival

According to the schedule of charges and fees of port, in case that there are any delays due to late arrival, equipment malfunctions, wet weather, etc., a fee of NZ$80.00 per hour will be charged per gang.

In the former section, the number of waiting ships are estimated as 10% of total calling ships; the waiting time of each vessel is estimated as one day.

Therefore, the total charge to be paid due to the delay of ship arrivals can be estimated as follows:

Savings in waiting cost for gang	= (54 x 0.1) x 24 x 80
	= NZ$10,400 a year

16.5.8 Savings in Interest Payments

Generally speaking, funds and time are critical ingredients in cargo transportation, and the savings in time can help reduce interest payments on funding. In this project, one of the benefits is derived from time savings between the "with" case and "without" case.

Most merchants or manufacturers borrow money for their transportation from banks. If the time between the receipt of orders and the payment for orders can be shortened, interest payments can be reduced; that is, if manufacturers can speed up their cash flow, interest payments can be trimmed.

The following is a practical way of calculating the savings in interest costs:

Savings in Interest Payments	= Q x V x I x D / 365

where, Q : Cargo volume (freight ton)
= 46,100 f.t. in 1997

D : Average difference of staying time between "Without and "With" case (days)
54 x 0.1 = 5.4 days

V : Average price of cargo (NZ$2,000/f.t. CIF) obtained from the past records.

I : Interest Rate (6.1%)
The interest rate is estimated at 6.1% per annum based on the London Interbank offered rate (LIBOR) in June 1991.

$$\text{Savings in Interest Payments} = 46{,}100 \times 2{,}000 \times 0.061 \times \frac{5.4}{365}$$
$$= \text{NZ\$83,200 a year}$$

16.5.9 Decrease in Operator Cost by Improvement of Cargo Handling Efficiency

In the Short-term Plan, some cargo handling equipment will be prepared and the cargo handling yard will be expanded to improve the cargo handling efficiency.

The cargo handling at present is inefficient because of the lack of trailers and forklifts needed for transferring containers. For example, it takes about 15 minutes to unload one container (4 TEU/hour).

This means that the current efficiency can be easily improved by implementation of the project. The improved rate of efficiency is estimated to be from 10% to 20%. The annual operating expense of WFC, especially the payments for labour, is estimated as NZ$ 282,500.

Therefore, the labour cost for cargo handling can be decreased to 80% - 90% of the current expense.

$$\text{Decrease in Operating Cost} = 282{,}500 \times 15\% = \text{NZ\$42,400 a year}$$

16.5.10 Decrease in Working Time of Labourers

The savings working time of labourers due to the decrease of delay of ship arrival will be the same as the saving cost for gangs. Amount to be saved from this item is included in the savings in subsection 16.5.7.

16.5.11 Decrease of Maintenance Cost of Breakwaters

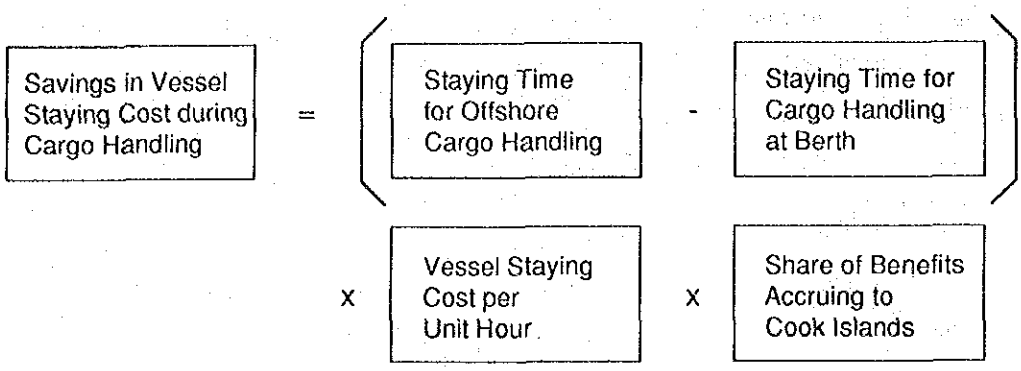
As aforementioned in "without case", though the rehabilitation of existing breakwater will be conducted in a few years, the breakwater will not be enlarged. Therefore, taking into consideration the primary shortage of scale of section, the West breakwater will sometimes be damaged by cyclones.

Maintenance costs of breakwaters in "with" and "without" case are considered in the cost and benefit calculations respectively.

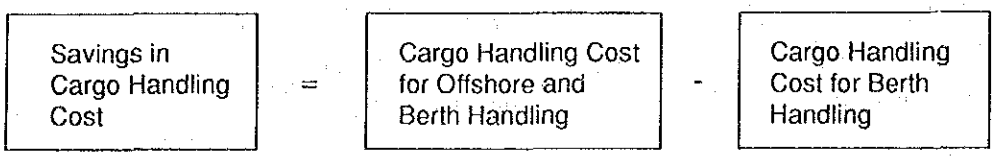
16.5.12 Decrease in Off-Shore Handling Cost in the Event of Damage at Wharf

Although the repair of the quay at Avatiu Harbour will be conducted in the short-term plan, some damage such as cracks, may occur during the project life because of the materials flowing out under the slab of the quay.
If the repair cost of the quay will be included as part of the maintenance cost, staying time of vessels and off-shore cargo handling will cost too much.

It is assumed that it takes about one month to repair the quay. Cost savings in offshore handling can be calculated as follows.



= 101,731 x 0.63 x 1/12 = NZ$5,300 a year



= 221,660 x 1/12 = NZ$18,500 a year

Table 16-9 Benefits from Saving in Ship Staying Cost and Saving in Cargo Handling Cost

Vessel staying cost			Cargo handling cost		
Without case	With case	Benefit	Without case	With case	Benefit
283,466	181,735	101,731	326,385	104,825	221,660

16.5.13 Decrease in Damages of Port Facilities

According to JICA report of 1987, total amount of damages of port facilities were estimated at NZ$1,625,000 as shown in Table 16-10 below. Among those damages, items marked "*" will be avoided by implementation of the short-term plan; total amount of those is NZ$805,000. These can be considered to be damages inflicted by waves and surges. Therefore, the annual benefits from this item can be counted at NZ$166,400 per year using the same calculation procedure as in 16-5-2.

Table 16-10 Damages in Port Facilities

Avatiu Harbour			
a.	Eastern Breakwater	220,000	*
b.	Western Breakwater	150,000	*
c.	Apron	150,000	*
d.	Reclamation	25,000	*
e.	Dredging	510,000	
f.	Pontoon & Barges	50,000	
g.	Miscellaneous	120,000	
	Sub-total	1,225,000	
Avarua Harbour			
h.		200,000	*
i.		60,000	*
j.		100,000	
k.		40,000	
	Sub-total	400,000	
	G. Total	1,625,000	
	Total for Items Marked '*'	805,000	

Note) Data Source: JICA Report on March 1987

16.5.14 Avoidance of Direct Damage to ILS (ILS: Instrument Landing System)

ILS has been installed at the west end of the runway of the Rarotonga International Airport. Seawalls and roads in this area were heavily damaged by "Sally"; in addition, smaller cyclones frequently cause damage. Direct damage to ILS has not been reported so far, however, direct damage can be anticipated some day if the current situation remains unchanged.

Direct damage to ILS affects landing during rough weather conditions but not during usual weather conditions. Sunshine rate around the airport is very high and poor visibility seldom occurs. From this point, the effect on landing in the event of damage to ILS is quite small. However, the ILS costs too much. The cost including installation of ILS is about NZ$8,000,000 in economic price.

Damage to seawalls and roads near ILS repeatedly occurred since 1973 when the airport opened, but no damage to ILS has been reported. It is considered that the probability of direct damage to ILS is quite low during the project life of 30 years. In this study, frequency of damage to ILS is assumed to be once in 60 years. Cost avoidance of re-installation of ILS due to the coastal protection of the Short-term Development Plan, i.e. the benefit, can be calculated as below.

NZ$8,000,000 x (30/60) x (1/30) = NZ$133,300 a year

16.5.15 Construction/Maintenance Cost in Without Case

As described in section 16.4 Prerequisites of the Economic Analysis, in the event of "without" case, i.e. the case in which the short-term plan is not implemented, damaged facilities caused by cyclones must be restored. Scale of restoration depends upon kinds of damages. As for coastal damages, restoration works will be carried out using sandy material for reclamation and armour rocks according to the present situation. No concrete structure such as parapet, drain ditch etc. shall be applied to the work. Therefore, on the basis of the construction costs of the short-term plan, construction /maintenance costs in without case are estimated as follow.

Table 16-11 Construction/Maintenance Cost in Without Case (Economic Price)

Construction Cost	NZ$956,500 per year
Maintenance Cost	NZ$ 28,700 per year
Total	NZ$985,200 per year

16.6 Costs

The items that are considered as costs of the project are; construction costs, administration costs, operating/maintenance costs, and renewal investment costs.

The construction costs are estimated in Chapter 15. The administration costs, operating/maintenance costs and renewal investment costs are described in subsections 16.6.2 and 16.6.3. Since all costs are shown in market prices, they have to be converted into economic prices using the conversion factors mentioned in subsection 16.3.3.

16.6.1 Construction Cost

In the economic analysis, construction costs have to be divided into the foreign currency portion and the local currency portion. Moreover, the local currency portion can be divided into skilled labour, unskilled labour, and others. Since the foreign currency portion is shown in CIF prices, there is no need for conversion into economic prices. The labour costs should be converted into economic prices by using the respective conversion factors. Table 16-12 shows the economic prices of construction costs.

Table 16-12 Economic Prices of Construction Costs

ITEM	Construction Cost	Foreign Portion	Local Portion			Overall Conversion Factor	Economic Prices
			Non Traded Goods	Skilled Labour	Unskilled Labour		
	(NZ$)	(1.00)	(0.86)	(0.92)	(0.69)		(NZ$)
Protection at Health Department	747,000	0.600	0.225	0.035	0.140	0.922	688,958
Avarua East Coast:Seawall/Reclamation	833,000	0.600	0.225	0.035	0.140	0.922	768,276
Avarua Central Coast:Upgrading of Seawall	392,000	0.576	0.249	0.035	0.140	0.919	360,224
-do- :Seawall/Reclamation	2,787,000	0.603	0.222	0.035	0.140	0.923	2,571,621
Avarua Harbour:East Breakwater	535,000	0.600	0.225	0.035	0.140	0.922	493,431
-do- :West Breakwater	414,000	0.600	0.225	0.035	0.140	0.922	381,832
-do- :Dredging	350,000	0.800	0.000	0.040	0.160	0.947	331,520
-do- :Marina Wharf	474,000	0.600	0.225	0.035	0.140	0.922	437,170
-do- :Quay/Berthing Jetty	371,000	0.600	0.225	0.035	0.140	0.922	342,173
-do- :Repair Work	495,000	0.600	0.225	0.035	0.140	0.922	456,539
Avatiu Harbour:East Breakwater	3,250,000	0.600	0.225	0.035	0.140	0.922	2,997,475
-do- :Inner Breakwater	57,000	0.596	0.229	0.035	0.140	0.922	52,539
-do- :West Breakwater	637,000	0.600	0.225	0.035	0.140	0.922	587,505
-do- :Dredging	1,400,000	0.800	0.000	0.040	0.160	0.947	1,326,080
-do- :Reclamation	154,000	0.597	0.228	0.035	0.140	0.922	141,970
-do- :Quay Repair	218,000	0.587	0.238	0.035	0.140	0.920	200,665
-do- :Slipway Repair	51,000	0.608	0.217	0.035	0.140	0.923	47,094
-do- :Utilities	63,000	0.792	0.083	0.025	0.100	0.955	50,635
-do- :Fishery Facilities	884,000	0.684	0.141	0.035	0.140	0.934	825,709
-do- :Tug Boat/Equipment	1,280,000	1.000	0.000	0.000	0.000	1.000	1,280,000
Airport East (Fuel Tank Yard)	1,157,000	0.602	0.223	0.035	0.140	0.923	1,067,425
Airport West:Seawall/Breakwater	1,102,000	0.800	0.225	0.035	0.140	0.922	1,016,375
Indirect Cost	3,616,000	0.650	0.300	0.010	0.040	0.945	3,416,397
TOTAL	21,257,000					0.933	19,841,612

16.6.2 Administration and Operating/Maintenance Costs

The administration and operating/maintenance costs are estimated taking into account the operating and maintenance cost of additional equipment.

The cost excludes the cost for personnels provided that the number of personnels in the organization remain unchanged in both "with" and "without" scenario.

16.6.3 Renewal Investment Costs

The facilities and equipment will be renewed according to their service lives. As described in subsection 16.9.3 (7), cargo handling equipment and a tug boat will be renewed based on a service life of ten and fifteen years respectively during the project life.

16.7 Calculation of EIRR

16.7.1 Annual Costs and Benefits

Annual costs and benefits in economic prices are shown in Table 16-13.

16.7.2 Calculation of EIRR

The economic internal rate of return (EIRR) based upon a cost-benefit analysis is used to appraise the economic feasibility of the project.

The EIRR is the discount ratio which makes the costs and benefits of a project during the project life equal. It is calculated by using the following formula:

$$\sum_{i=1}^{n} \frac{B_i - C_i}{(1 + r)^{i-1}} = 0$$

where, n: Period of economic calculation (Project life)

B_i: Benefit in i-th year

C_i: Cost in i-th year

r: Discount rate

The EIRR of Short-term Plan of the coastal protection and port improvement is calculated as 10.7 %. Calculation result of the EIRR is shown in Table 16-14.

Table 16-13 Annual Costs and Benefits in Economic Prices

(Unit:NZ$)

No.	Year	Costs				Benefits								
		With Case			Total Costs	Costs-Without Case		Decrease in Land Loss	Protection of Buildings	Economic Activities	Savings Ship Cost	Savings Interest Payment	Others	Total Benefits
		Construction	Equipment	Mainte. & Ope.		Construc-tion	Mainte-nance							
1	1993	7,936,644		0	7,936,644	956,500	28,700							985,200
2	1994	5,952,484		79,366	6,031,850	956,500	28,700	30,700	496,900	229,800			52,200	1,794,800
3	1995	4,410,084	1,542,400	138,891	6,091,375	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
4	1996			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
5	1997			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
6	1998			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
7	1999			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
8	2000			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
9	2001			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
10	2002			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
11	2003			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
12	2004			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
13	2005		216,900	229,264	446,164	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
14	2006			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
15	2007			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
16	2008			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
17	2009			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
18	2010		1,325,500	229,264	1,554,764	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
19	2011			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
20	2012			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
21	2013			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
22	2014			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
23	2015		216,900	229,264	446,164	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
24	2016			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
25	2017			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
26	2018			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
27	2019			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
28	2020			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
29	2021			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
30	2022			229,264	229,264	956,500	28,700	30,700	496,900	229,800	19,400	83,200	386,100	2,231,300
Total		18,299,212	3,301,700	6,408,385	28,009,297	28,695,000	861,000	890,300	14,410,100	6,664,200	543,200	2,329,600	10,863,000	65,256,400

Benefits Others:

1)	Increase in Land Value	9,800	NZ$/year
2)	Decrease in Ope. Cost	42,400	〃
3)	Savings in Waiting Cost for Gang	10,400	〃
4)	Decrease in Offshore Handling Cost	23,800	〃
5)	Decrease in Damages of Port Facilities	166,400	〃
6)	Avoidance of Damage to ILS	133,300	〃
	Total	386,100	NZ$/year

Table 16-14 EIRR Calculation - Base Case

EIRR = 10.7 %

(UNIT: NZ$)

YEAR	BENEFITS TOTAL	COSTS TOTAL	BENEFITS - COSTS		PRESENT VALUE IN 1992		
					BENEFITS	COSTS	DIFFERENCE
1993	985,200	7,936,644	-6,951,444	0	985,200	7,936,644	-6,951,444
1994	1,794,800	6,031,850	-4,237,050	1	1,620,890	5,447,383	-3,826,494
1995	2,231,300	6,091,375	-3,860,075	2	1,819,838	4,968,098	-3,148,260
1996	2,231,300	229,264	2,002,036	3	1,643,502	168,868	1,474,633
1997	2,231,300	229,264	2,002,036	4	1,484,252	152,505	1,331,746
1998	2,231,300	229,264	2,002,036	5	1,340,432	137,728	1,202,704
1999	2,231,300	229,264	2,002,036	6	1,210,549	124,383	1,086,166
2000	2,231,300	229,264	2,002,036	7	1,093,251	112,330	980,920
2001	2,231,300	229,264	2,002,036	8	987,318	101,446	885,872
2002	2,231,300	229,264	2,002,036	9	891,650	91,616	800,034
2003	2,231,300	229,264	2,002,036	10	805,252	82,739	722,513
2004	2,231,300	229,264	2,002,036	11	727,226	74,722	652,504
2005	2,231,300	446,164	1,785,136	12	656,760	131,324	525,436
2006	2,231,300	229,264	2,002,036	13	593,122	60,943	532,179
2007	2,231,300	229,264	2,002,036	14	535,650	55,038	480,613
2008	2,231,300	229,264	2,002,036	15	483,748	49,705	434,043
2009	2,231,300	229,264	2,002,036	16	436,874	44,888	391,986
2010	2,231,300	1,554,764	676,536	17	394,542	274,916	119,626
2011	2,231,300	229,264	2,002,036	18	356,313	36,611	319,702
2012	2,231,300	229,264	2,002,036	19	321,787	33,063	288,724
2013	2,231,300	229,264	2,002,036	20	290,607	29,860	260,747
2014	2,231,300	229,264	2,002,036	21	262,448	26,966	235,482
2015	2,231,300	446,164	1,785,136	22	237,018	47,393	189,624
2016	2,231,300	229,264	2,002,036	23	214,051	21,994	192,058
2017	2,231,300	229,264	2,002,036	24	193,311	19,862	173,448
2018	2,231,300	229,264	2,002,036	25	174,579	17,938	156,641
2019	2,231,300	229,264	2,002,036	26	157,663	16,200	141,463
2020	2,231,300	229,264	2,002,036	27	142,386	14,630	127,756
2021	2,231,300	229,264	2,002,036	28	128,589	13,212	115,377
2022	2,231,300	229,264	2,002,036	29	116,129	11,932	104,197
TOTAL	65,256,400	28,009,297	37,247,103		20,304,938	20,304,938	0

16.8 Conclusion

16.8.1 Evaluation of Base Case

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.

The opportunity cost of capital in the Cook Island is not known. However, the opportunity cost of capital in various countries is considered to range from 8% to 15%. The opportunity cost is estimated to be 12% in developing countries according to the IBRD and the ADB.

According to this standard, this project is considered feasible.

16.8.2 Sensitivity Analysis

To see if the project is still feasible when some factors vary, alternate cases are examined as follows.

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 tests are shown in Table 16-15.

Table 16-15 Sensitivity Analysis for EIRR

Case	EIRR (%)
Base Case	10.7
Case A	9.2
Case B	9.0
Case C	7.6

Calculation results of the sensitivity analysis for EIRR are shown in Tables 16-16 to 16-18.

Table 16-16 EIRR Calculation - Case A

EIRR = 9.2 %

(UNIT: NZ$)

YEAR	BENEFITS TOTAL	COSTS TOTAL	BENEFITS - COSTS		PRESENT VALUE IN 1992		
					BENEFITS	COSTS	DIFFERENCE
1993	985,200	8,730,308	-7,745,108	0	985,200	8,730,308	-7,745,108
1994	1,794,776	6,635,035	-4,840,259	1	1,643,621	6,076,235	-4,432,615
1995	2,231,300	6,700,513	-4,469,213	2	1,871,288	5,619,410	-3,748,122
1996	2,231,300	252,190	1,979,110	3	1,713,689	193,688	1,520,001
1997	2,231,300	252,190	1,979,110	4	1,569,363	177,376	1,391,987
1998	2,231,300	252,190	1,979,110	5	1,437,192	162,437	1,274,755
1999	2,231,300	252,190	1,979,110	6	1,316,152	148,757	1,167,396
2000	2,231,300	252,190	1,979,110	7	1,205,307	136,229	1,069,078
2001	2,231,300	252,190	1,979,110	8	1,103,796	124,755	979,041
2002	2,231,300	252,190	1,979,110	9	1,010,835	114,249	896,586
2003	2,231,300	252,190	1,979,110	10	925,703	104,627	821,076
2004	2,231,300	252,190	1,979,110	11	847,741	95,815	751,926
2005	2,231,300	490,780	1,740,520	12	776,344	170,759	605,585
2006	2,231,300	252,190	1,979,110	13	710,961	80,356	630,605
2007	2,231,300	252,190	1,979,110	14	651,084	73,588	577,496
2008	2,231,300	252,190	1,979,110	15	596,250	67,391	528,859
2009	2,231,300	252,190	1,979,110	16	546,034	61,715	484,319
2010	2,231,300	1,710,240	521,060	17	500,047	383,275	116,773
2011	2,231,300	252,190	1,979,110	18	457,934	51,757	406,176
2012	2,231,300	252,190	1,979,110	19	419,367	47,398	371,968
2013	2,231,300	252,190	1,979,110	20	384,048	43,407	340,641
2014	2,231,300	252,190	1,979,110	21	351,703	39,751	311,953
2015	2,231,300	490,780	1,740,520	22	322,083	70,843	251,240
2016	2,231,300	252,190	1,979,110	23	294,957	33,337	261,620
2017	2,231,300	252,190	1,979,110	24	270,116	30,530	239,587
2018	2,231,300	252,190	1,979,110	25	247,367	27,958	219,409
2019	2,231,300	252,190	1,979,110	26	226,534	25,604	200,930
2020	2,231,300	252,190	1,979,110	27	207,455	23,447	184,008
2021	2,231,300	252,190	1,979,110	28	189,984	21,473	168,511
2022	2,231,300	252,190	1,979,110	29	173,983	19,664	154,319
TOTAL	65,256,376	30,810,227	34,446,149		22,956,139	22,956,139	0

Table 16-17 EIRR Calculation - Case B

EIRR = 9.0 %

(UNIT: NZ$)

YEAR	BENEFITS TOTAL	COSTS TOTAL	BENEFITS - COSTS		PRESENT VALUE IN 1992		
					BENEFITS	COSTS	DIFFERENCE
1993	886,680	7,936,644	-7,049,964	0	886,680	7,936,644	-7,049,964
1994	1,615,298	6,031,850	-4,416,552	1	1,481,352	5,531,668	-4,050,315
1995	2,008,170	6,091,375	-4,083,205	2	1,688,930	5,123,024	-3,434,095
1996	2,008,170	229,264	1,778,906	3	1,548,878	176,829	1,372,049
1997	2,008,170	229,264	1,778,906	4	1,420,439	162,165	1,258,274
1998	2,008,170	229,264	1,778,906	5	1,302,651	148,718	1,153,933
1999	2,008,170	229,264	1,778,906	6	1,194,631	136,386	1,058,245
2000	2,008,170	229,264	1,778,906	7	1,095,568	125,076	970,492
2001	2,008,170	229,264	1,778,906	8	1,004,719	114,704	890,015
2002	2,008,170	229,264	1,778,906	9	921,404	105,193	816,212
2003	2,008,170	229,264	1,778,906	10	844,998	96,470	748,529
2004	2,008,170	229,264	1,778,906	11	774,928	88,470	686,458
2005	2,008,170	446,164	1,562,006	12	710,668	157,892	552,776
2006	2,008,170	229,264	1,778,906	13	651,737	74,406	577,331
2007	2,008,170	229,264	1,778,906	14	597,693	68,236	529,457
2008	2,008,170	229,264	1,778,906	15	548,130	62,578	485,552
2009	2,008,170	229,264	1,778,906	16	502,677	57,388	445,289
2010	2,008,170	1,554,764	453,406	17	460,993	356,910	104,083
2011	2,008,170	229,264	1,778,906	18	422,766	48,265	374,501
2012	2,008,170	229,264	1,778,906	19	387,709	44,263	343,446
2013	2,008,170	229,264	1,778,906	20	355,559	40,593	314,966
2014	2,008,170	229,264	1,778,906	21	326,074	37,226	288,848
2015	2,008,170	446,164	1,562,006	22	299,035	66,438	232,597
2016	2,008,170	229,264	1,778,906	23	274,238	31,309	242,930
2017	2,008,170	229,264	1,778,906	24	251,497	28,712	222,785
2018	2,008,170	229,264	1,778,906	25	230,642	26,331	204,311
2019	2,008,170	229,264	1,778,906	26	211,517	24,148	187,369
2020	2,008,170	229,264	1,778,906	27	193,977	22,145	171,831
2021	2,008,170	229,264	1,778,906	28	177,892	20,309	157,582
2022	2,008,170	229,264	1,778,906	29	163,140	18,625	144,515
TOTAL	58,730,738	28,009,297	30,721,441		20,931,122	20,931,122	0

Table 16-18 EIRR Calculation - Case C

EIRR = 7.6 %

(UNIT: NZ$)

YEAR	BENEFITS TOTAL	COSTS TOTAL	BENEFITS - COSTS		PRESENT VALUE IN 1992		
					BENEFITS	COSTS	DIFFERENCE
1993	886,680	8,730,308	-7,843,628	0	886,680	8,730,308	-7,843,628
1994	1,615,298	6,635,035	-5,019,737	1	1,500,652	6,164,111	-4,663,459
1995	2,008,170	6,700,513	-4,692,343	2	1,733,225	5,783,124	-4,049,899
1996	2,008,170	252,190	1,755,980	3	1,610,209	202,214	1,407,995
1997	2,008,170	252,190	1,755,980	4	1,495,924	187,861	1,308,062
1998	2,008,170	252,190	1,755,980	5	1,389,750	174,528	1,215,222
1999	2,008,170	252,190	1,755,980	6	1,291,112	162,141	1,128,971
2000	2,008,170	252,190	1,755,980	7	1,199,475	150,633	1,048,842
2001	2,008,170	252,190	1,755,980	8	1,114,342	139,942	974,400
2002	2,008,170	252,190	1,755,980	9	1,035,251	130,009	905,242
2003	2,008,170	252,190	1,755,980	10	961,774	120,782	840,992
2004	2,008,170	252,190	1,755,980	11	893,512	112,209	781,302
2005	2,008,170	490,780	1,517,390	12	830,094	202,868	627,226
2006	2,008,170	252,190	1,755,980	13	771,178	96,846	674,332
2007	2,008,170	252,190	1,755,980	14	716,444	89,973	626,471
2008	2,008,170	252,190	1,755,980	15	665,594	83,587	582,007
2009	2,008,170	252,190	1,755,980	16	618,353	77,654	540,699
2010	2,008,170	1,710,240	297,930	17	574,465	489,238	85,227
2011	2,008,170	252,190	1,755,980	18	533,692	67,022	466,670
2012	2,008,170	252,190	1,755,980	19	495,813	62,265	433,548
2013	2,008,170	252,190	1,755,980	20	460,623	57,846	402,777
2014	2,008,170	252,190	1,755,980	21	427,930	53,740	374,190
2015	2,008,170	490,780	1,517,390	22	397,558	97,160	300,398
2016	2,008,170	252,190	1,755,980	23	369,341	46,383	322,958
2017	2,008,170	252,190	1,755,980	24	343,127	43,091	300,036
2018	2,008,170	252,190	1,755,980	25	318,773	40,032	278,741
2019	2,008,170	252,190	1,755,980	26	296,148	37,191	258,957
2020	2,008,170	252,190	1,755,980	27	275,129	34,551	240,578
2021	2,008,170	252,190	1,755,980	28	255,602	32,099	223,503
2022	2,008,170	252,190	1,755,980	29	237,460	29,821	207,639
TOTAL	58,730,738	30,810,227	27,920,512		23,699,229	23,699,229	0

16.9 Preliminary Financial Analysis

16.9.1 Purpose of the Financial Analysis

The purpose of the financial analysis is to appraise the financial feasibility of the short-term development plan. The analysis focuses on the viability of the project itself and the financial soundness of the port management body during the project life.

16.9.2 Methodology of the Financial Analysis

The viability of the project is analyzed using the Discount Cash Flow Method and appraised by the FIRR (financial internal rate of return). The FIRR is a discount rate that makes the costs and the revenues during the project life equal, and it is calculated using the following formula;

$$\sum_{i=1}^{n} \frac{B_i - C_i}{(1 + r)^{i-1}} = 0$$

where; n : Project life
B_i : Revenues in the i-th year
C_i : Costs in the i-the year
r : Discount rate

Cost and benefits which are taken into account for the calculation of the FIRR are summarized as follows:

Cost	Benefit
1) Total investment cost including initial capital and reinvestment for renewal	1) Port operating revenue
2) Operating cash expenses	2) Residual value of the fixed assets at the end of the project life

Costs and revenues not used in calculating the FIRR are summarized as follows:

Cost	Benefit
1) Depreciation cost	1) Fund management income
2) Repayment of the principal loan	
3) Interest on loans	

When the calculated FIRR exceeds the weighted average interest rate of the total funds for the investments of the project, the project is regarded as financially feasible.

16.9.3 General Prerequisites of the Financial Analysis

1) Scope of the Analysis

The Short-term Plan covers the East Breakwater, Repair of Quay, Dredging and the procurement of necessary equipment in Avatiu Harbour; Seawall, East Breakwater, Temporary Jetty, Marina Wharf and Dredging in Avarua Harbour.

The financial analysis considers the port management body (consisting TLT and WFC) as an implementation body. Therefore, the focus of the analysis is as follows.

a) A part of TLT's operating expenses are included in the analysis

b) The tug boat service is included in the analysis because we assume that it will be provided by the port management body.

2) Project Life

Taking into account the service lives of the port facilities and the conditions of the long-term loans, the project life for the financial analysis is determined to be 30 years, including 3 years for the construction of the facilities.

3) Base Year

For the estimation of cost, expenditure and revenues, analyzed quantitatively here, 1991 prices are predominantly used. Neither price inflation nor increases in nominal wages are considered during the project life.

4) Cargo Handling Volume

The cargo handling volume is estimated based on the demand forecast. The volume is shown in Table. 16-19.

Table 16-19 Cargo Handling Volume in Avatiu Harbour

Year	1997		
	Domestic trade	International trade	Total
Total cargo (tons)	2,400	46,057	48,457
Break bulk cargo	2,400	32,455	34,855
Conventional cargo (tons)	2,400	11,655	14,055
Container cargo (tons)	0	20,800	20,800
Liquid bulk cargo (tons)	0	13,602	13,602
Number of Container (TEUs)	0	2,780	2,780

5) Port charges and revenues

The revenue from the port activities are calculated based on the present tariff compared with actual revenues and the cargo handling volume presented in the above listed Table.

6) Cost of Initial Investment (Port Improvement)

The initial investments of the Short-term Plan and costs included in the financial analysis are shown in Table 16-20.

Table 16-20 Initial Investment

(Unit: NZ$)

No.	Description	Direct Costs
1	Avarual Harbour : Dredging	350,000
2	- do - : Marina Wharf	474,000
3	- do - : East Breakwater	535,000
4	- do - : West Breakwater	414,000
5	- do - : Quay/Berthing Jetty	371,000
6	- do - : Repair Work	495,000
7	Avatiu Harbour : East Breakwater	3,250,000
8	- do - : Inner Breakwater	57,000
9	- do - : West Breakwater	637,000
10	- do - : Dredging	1,400,000
11	- do - : Reclamation	154,000
12	- do - : Quay Repair	218,000
13	- do - : Slipway Repair	51,000
14	- do - : Utilities	53,000
15	- do - : Fishery Facilities	884,000
16	- do - : Tug Boat/Equipment	1,280,000
	Summary : Direct Costs	10,623,000
	: x 1.205 (With Contingency)	12,800,000

7) Reinvestment

The facilities and equipment will be renewed based on their service lives which are shown as follows;

a) depreciable assets excluding cargo handling equipment and tugboat: 50 years
b) cargo handling equipment: 10 years
c) tugboat: 15 years

The funds for reinvestment will be financed by the consolidated fund or internal resources of the port management body.

8) Maintenance Repair Costs

The annual maintenance and repair costs for the port facilities are calculated as follows;

a) depreciable assets excluding cargo handling equipment and tugboat: 1 % of the original construction cost
b) cargo handling equipment: 3 % of the original procurement cost
c) tug boat: 3 % of the original procurement cost

Table 16-21 Rough Estimation of Port Revenues

Unloaded Cargo	Stevedoring Charge			Remarks
	Rate $	Q'ty	Total	
Conventional	$\frac{15+9}{2}$	2,400	28,800	Full stevedoring 50% On shore stevedoring 50%
Container	$\frac{100+60}{2}$	1,390	111,200	Full stevedoring 50% On shore stevedoring 50%
Liquid Bulk Cargoes	-	13,602	-	

Unloaded Cargo	Devanning Charge			Remarks
	Rate $	Q'ty	Total	
Container		417		30% of containers will need devanning

Unloaded Cargo	Equipment Charges			Remarks
	Rate $	Q'ty	Total	
Conventional	$\frac{37.5+45}{2}$ /hour	11,655	480,768	Small Folklift 2.5t :50% 15t/hour 5.0t :50% 30t/hour
Container	67.5	1,390	93,825	25t Folklift on wharf 6 TEU/hour
Container	85	1,390	118,150	100% of container

Unloaded Cargo	Wharfage			Remarks
	Rate $	Q'ty	Total	
Conventional	3.25	15,392	50,024	11,655 + 20,800 * 0.3 = 15,392
Container	40.0	973	38,920	1,390 * 0.7 = 973
Liquid Bulk	2.25	13,602	30,604	

Import Total 952,291

Loaded Cargo	Stevedoring Charge			Remarks
	Rate $	Q'ty	Total	
Conventional	$\frac{15+9}{2}$	2,400	28,800	Full stevedoring provided by WFC 50% On shore stevedoring only 50%
Container	$\frac{100+60}{2}$	1,390	111,200	Full stevedoring 50% On shore stevedoring 50%

Loaded Cargo EX.	Wharfage			Remarks
	Rate $	Q'ty	Total	
Conventional	$\frac{3.25+0}{2}$	2,400	3,900	50% of Conventional Cargo are Foods the rest: All other good
Container	40.0	1,390	55,600	

Loaded Cargo	Storage			Remarks
	Rate $	Q'ty	Total	
Conventional	In 7 days - after 7 days	-	-	As for the export cargo, they would be exported with in 7 days.
Container	In 7 days - after 7 days 20	-	0	

Loaded Cargo	Equipment Charge			Remarks
	Rate $	Q'ty	Total	
Conventional	37.5$/hour	2,400	6,000	15t/hour can be handled
Container (Empty)	45.0$/hour	1,390	6,255	15t/hour can be handled

Export Total 211,755

G.T. 1,164,046

Table 16-22 Assumed Operating/Maintenance Cost

TLT	Actual Average Expense	Case 1		Case 2		Case 3	
		%	Cost	%	Cost	%	Cost
Harbour Admi	348,862	100	348,862	50	174,431	0	0
Shipping	111,662	100	111,662	50	55,831	0	0
Harbour Cons	214,092	100	214,092	100	214,092	100	214,092
Harbour Eng. Div.	58,000	100	58,000	100	58,000	100	58,000
WFC							
Operation	437,000	100	437,000	100	437,000	100	437,000
Administration	244,042	100	244,042	100	244,042	100	244,042
Others	8,015	100	8,015	100	8,015	100	8,015
TOTAL	1,421,673		1,421,673		1,191,411		961,149
Maintenance	58,800		58,800		58,800		58,800
TOTAL	1,480,473		1,480,473		1,250,211		1,019,949

TLT	Actual Average Expense	Case 4		Case 5		Case 6	
		%	Cost	%	Cost	%	Cost
Harbour Admi	348,862	50	174,431	50	174,431	0	0
Shipping	111,662	50	55,831	50	55,831	0	0
Harbour Cons	214,092	50	107,046	50	107,046	100	214,092
Harbour Eng. Div.	58,000	50	29,000	50	29,000	100	58,000
WFC							
Operation	437,000	100	437,000	70	305,900	70	305,900
Administration	244,042	70	170,829	70	170,829	100	244,042
Others	8,015	70	5,611	70	5,611	100	8,015
TOTAL	1,421,673		979,748		848,648		830,049
Maintenance	58,800		58,800		58,800		58,800
TOTAL	1,480,473		1,038,548		907,448		888,849

9) Operating and Administration Costs

The annual operating and maintenance costs are estimated based on the actual budget and other financial statements.

The annual operating and administration costs, are calculated based on the 1989 and 1990 actual costs.

Estimated port revenues and assumed operation/maintenance cost are shown in Table 16-21 and 16-22.

16.9.4 Conclusion

To make the project feasible from the financial viewpoint, the following conditions should be fulfilled.

1) The operation/maintenance cost should be decreased to 60% or less of the current state.

2) The current port tariff should be raised to conduct sufficient port operation/maintenance.

The results of FIRR calculation are shown in Table 16-23 taking into account the above operation/maintenance cost (60% of the current state and the variation of the port tariff.

Table 16-23 Results of FIRR

FIRR	Tariff
-	present
1.3%	30% up
3.9%	50% up
6.0%	70% up

Because the aforementioned conditions may seem difficult to carry out promptly, a phased financial improvement plan should be considered. For example, the operation/maintenance cost should be decreased to the target value, namely 60% of the current state in the first 5 years; after that, the possibility of raising the port tariff will be examined considering the other ports' tariffs and national economic conditions such as transportation and labor cost. In addition, the establishment of a proper port authority should be examined as soon as possible.

Though this project may not seem feasible from the financial point of view if the institutional framework will not be improved, this project should not be evaluated merely on the basis of this result because this project should not be considered as profit-oriented one. The fact that significant economic benefits would obviously result should be considered in the evaluation of this project.

Chapter 17: Organization for Project Implementation

Chapter 17: Organization for Project Implementation

This chapter deals with an organization and its duties for project implementation.

17.1 Executing Agency

The executing agency of this study is MOPED under which a steering committee forms a supervisory group. The committee consists of various related governmental organizations including:

(a) Ministry of Planning and Economic Development (MOPED)
(b) Ministry of Works (MOW)
(c) Department of Trade, Labour and Transport (TLT)
(d) Conservation Service Department
(e) Survey Department

In addition to the above, the following governmental agencies are related to the study:

(f) Waterfront Commission (WFC)
(g) Customs Department
(h) Ministry of Marine Resources
(i) Tourism Authority
(j) National Police
(k) Meteorological Service (MET)
(l) Treasury

For the next phase of project implementation, it is reported that MOW was nominated by the cabinet in December 1991 to be the executing agency for managing the project.

17.2 Cooperative Management

The project covers various fields including:

(a) Fisheries Sector
(b) Commercial Port Sector
(c) Tourism Sector
(e) Environmental Sector, and
(f) Coastal Protection Sector

It is recommended that the project be implemented orderly and systematically. Cooperation in the project by various agencies should be maintained for its economical execution. It is reported that a multi-discipline taskforce (MDT) will be established for the same purpose as the steering committee, to make decisions concerning project.

MDT may be made up of selected governmental agencies that are directly involved in the project.

The following is a possible project implementation organization:

(1) Total project management will be conducted by MOW in collaboration with MDT, MOPED and the Treasury

(2) Coastal protection work will directly be executed by MOW.

(3) Port improvement work will be executed by TLT and WFC. MOW will act as the liaison office. The Ministry of Marine Resources will cooperate with TLT in respect matters relating to fishery work.

17.3 Operation and Maintenance

After implementation, facilities constructed will be utilized by users. Therefore, the proper operations of facilities should be maintained throughout their service life.

When damages are found, prompt repair work should be provided. To recover initial investment costs, facilities should be utilized for a certain length of time. The average service life assumed here is about thirty years. Facilities may not only be damaged by natural forces such as by waves and surges, but by incidental breakdowns through normal use. It is recommended that appropriate repair work should be accomplished from time to time.

Thus, it is important that responsible agencies observe and monitor the facilities to determine if they are being operated properly. TLT and MOW should be responsible for this post project care.

(1) TLT will be responsible for covering all of the port facilities. The Ministry of Marine Resources will be responsible for covering the on land fishery facilities.
The Waterfront Commission will be responsible for all onland port facilities other than the fisheries.

(2) MOW will be responsible for all of the the coastal protection work.

Refer to section 13.3 of port operation and management.

17.4 Communications

When a cyclone that possibly might affect the island is sighted, all information pertaining to it will be collected by MET, through the meteorological center Nadi in Fiji. The Hurricane Safety Committee chaired by the National Police issues an appropriate warning to the people and the public sector. The warning includes the estimated grade of the cyclone, its possible course, and the recommended action people should take.

Cyclone warning are essential for various coastal activities in order for them to take proper precautions.

The warning system functions in cooperation with various governmental agencies such as MET, the National Police and the Cook Radio Service.

According to the National Police, this system seems to be working well at the present time. It is reported that the police could speed up their services if their communication system and vehicles were improved.

It is also reported that there is little correlation between the knowledge of cyclone damage recorded by the police and the actual coastal protection work. Such information could be utilized in the coastal protection work.

Chapter 18: Environmental Consideration

Chapter 18: Environmental Consideration

This chapter deals with environmental considerations to the proposed project. Since one of the most valuable and vulnerable resources here is the natural scenery consisting of blue, white and green colours, i.e. the marine ecology together with the blue sea, breaking waves on reef with beach sand and healthy plantation on the hill.

It is also important to remind that tourism industries here are simply based on these natural resources.

18.1 General Description

Within certain limits, nature has the power to recover from adverse environmental impacts. If the impacts override this natural sustaining capacity, the ecosystem will change gradually. The costs required for maintaining the present ecosystem could be much lower than that for recovering the environment after being severely damaged.

Although there is no actual environmental data available, it seems that the island's urbanized coastal area is affected by pollution although impact is minor.

Additionally, the project may have an impact on the environment, during the construction and after operation.

18.2 Environmental Control of Coastal Areas

This section deals with possible environmental impacts at the coastal areas.

18.2.1 Water Quality

1) Existing Situations

Surface water from the hills accumulates once in the swamp and marshy land behind the beach road. Various domestic effluents are also discharge here. When it rains, the water here overflows to the open sea through streams. In the urbanized area, other effluents having high organic loads enter the streams.

In rural areas, households treat their effluents by means of primitive septic tanks. Thus, concentrations of effluents in the underground water

appears not to have happened, since the households are scattered throughout the area.

Although sample tests have not been conducted, the sea water quality at the rural site generally seems good. This may be due to following reasons.

a. Load intensity in rural areas is rather low.

b. Water circulation in lagoon is maintaining by tidal current, thus discharged water to lagoon can easily propagate to the offshore.

c. Natural sandy beach may have self-purification effect to discharged loads.

To be discussed here is the seawater quality at the inner port basin that is covered by the existing breakwater. Although the seawater circulation through the armour rock dike may take place to some extent, the rate of dilution here is lower than that of the lagoon.

The marine ecosystem is strongly related to the seawater quality. However, no data here is available on this subject.

On the second site visit in February 1992, the study team observed oil spills in front of the foreign cargo wharf at Avatiu Harbour. The source of this leakage has not been confirmed.

2) Necessity of Control

The rate of urbanization is currently moderate; it is not anticipated that rapid urbanization will occur by year 2000. Thus, rapid increase of load discharge by villagers will not happen.

Cargo volume to be handled in the harbour is also moderate and the number of vessel calls is limited. It is assumed that the present load level will continue for foreseeable future. Therefore, an expensive centralized sewerage treatment plant will not be required. Thus, minimum treatment countermeasures should be scheduled in order to maintain the present environmental level.

3) Scope of Protection Measures

It is proposed that the following water quality improvements be taken into consideration.

- Enforcement of an individual sewerage treatment facility if the load source is located within a certain distance from the beach front.
- Enforcement of effluent control by vessels.

18.2.2 Scenery

1) Existing Situation

The most beautiful sight in the coastal region is that of waves breaking on the reef. The contrast between the light blue sea water and the white waves can be seen all along the coast.

2) Necessity of Control

To maintain this spectacular sight, high wall structures along the coastline should not be constructed. Plantations with rural fragment dike along the coast harmonizes with the blue sea. These will be barriers against cyclone wave and wind.

Character of artificial structures along the coastline should carefully be controlled so as not to disturb the existing landscape. If possible, coastal protection work should not consist of concrete structure but natural materials such as, coral fragment and rocks.

18.3 Environmental Consideration to the Project

1) Seawater Quality in the Harbour Basin

It is recommended that regulations be issued prohibiting the discharge of domestic organic material into the inner port basin.

Incinerators will be provided in the port area to cope with the solid wastes generated there. Septic tanks will be provided for handling the polluted water in the fisheries sector.

2) Crown Top of the Coastal Protection Wall

Where an open view is required, the crown top of the seawall parapet should be limited in height so that people can see the horizon and the breaking waves from the beach road.

Minimum access from the existing roadway to the new coastal protection line will be provided for villagers and tourists.

3) Material of Artificial Structures

Where a natural landscape is required, the surface material and its finish should harmonize with nature. The appearance of concrete structures seem too harsh, and shall only be built when no alternative structure is proposed.

4) Recovery of Nature in the Reclamation Area

Plantations and lawns will be provided on the areas to be reclaimed for cyclone buffer zones.

18.4 Future Prospect

To maintain sustainable environmental conditions, it is recommended that continuous efforts be made to provide coastal area with a better future environment. This section deals with necessary actions to be taken by now.

1) Investigation and Monitoring

It is recommended that periodical investigations be made of the seawater quality including, BOD, COD, HP and coliform bacteria. It is also recommended to establish environmental standards by which surveyed data can be evaluated.

2) Enforcement

It is reported that Conservation Department is preparing water quality regulations that will require the private sector to provide their own septic tanks if they are located within thirty meters of the high water mark.

It is also recommended that large-scale coastal developments be assessed to minimize environmental impacts that may severely damage the existing environmental conditions and that measures to mitigate the impacts be instituted.

3) Advertising

At present, the island environment is generally good. It is, however, recommended that necessary environmental information be passed on to the villagers for better understanding of the island to sustainable living.

Chapter 19: Preparation for Project Implementation

Chapter 19 Preparation for Project Implementation

This chapter deals with preparation work necessary for project implementation. The aim of this report is not only to generate the project's technical work but to pave the way for construction. The necessary preparatory arrangements prior to the construction are given herewith.

19.1 Administrative Aspects

As described in Chapter 17, it is recommended that an organization for project implementation be established. Since the project covers various technical fields, participation of the related governmental agencies will be needed.

The project will be managed by a project executing agency under the multi-discipline taskforce (MDT) which consists of representatives from related agencies.

19.2 Technical Aspects

The executing agency should manage the detailed design of project components together with the preparation of Tender Documents.

(1) Detailed Design

In any case, the detailed design should be completed before construction begins. The detailed design works will include:

a. Topographic Survey
b. Hydrographic Survey
c. Geotechnical Investigation
d. Environmental Investigation
e. Preparation of drawings
f. Design calculations
g. Preparation of the Bill of Quantities, or list of work with quantities specified by technical description
h. Technical Specification
i. Cost Estimates
j. Tender Documents and Contract Form
k. Prequalification Document, if required

(2) Preparation of Coastal Land Use Master Plan

At present, there is no firm city master plan for the Avarua Urbanized Area. The utilization of the new reclamation area should meet the concepts of city planning. MOW may be the leading ministry for this task. Other public sectors and private sectors should also participate in this arrangement.

The newly reclaimed area is not only used as a cyclone buffer zone but is for improving land resources that face the open sea. Maximum utilization of this land should be performed accordingly.

19.3 Financial Aspects

The proposed Short-term Development Plan costs about 21.26 million Cook dollars, 8.46 million for coastal protection and 12.80 million for port improvements.

As shown in Chapter 14, it will take about three years to complete the construction work. Thus, approximately seven million Cook dollars should be paid to the contractor every year.

If the government intends to obtain financial assistance from an external monetary source, necessary arrangements should be made to meet the construction schedule. Since the project components in the proposed Short-term Development Plan covers work that is urgently required for coastal protection and port improvement, it is recommended that the government contacts with such source as soon as possible.