FIGURES

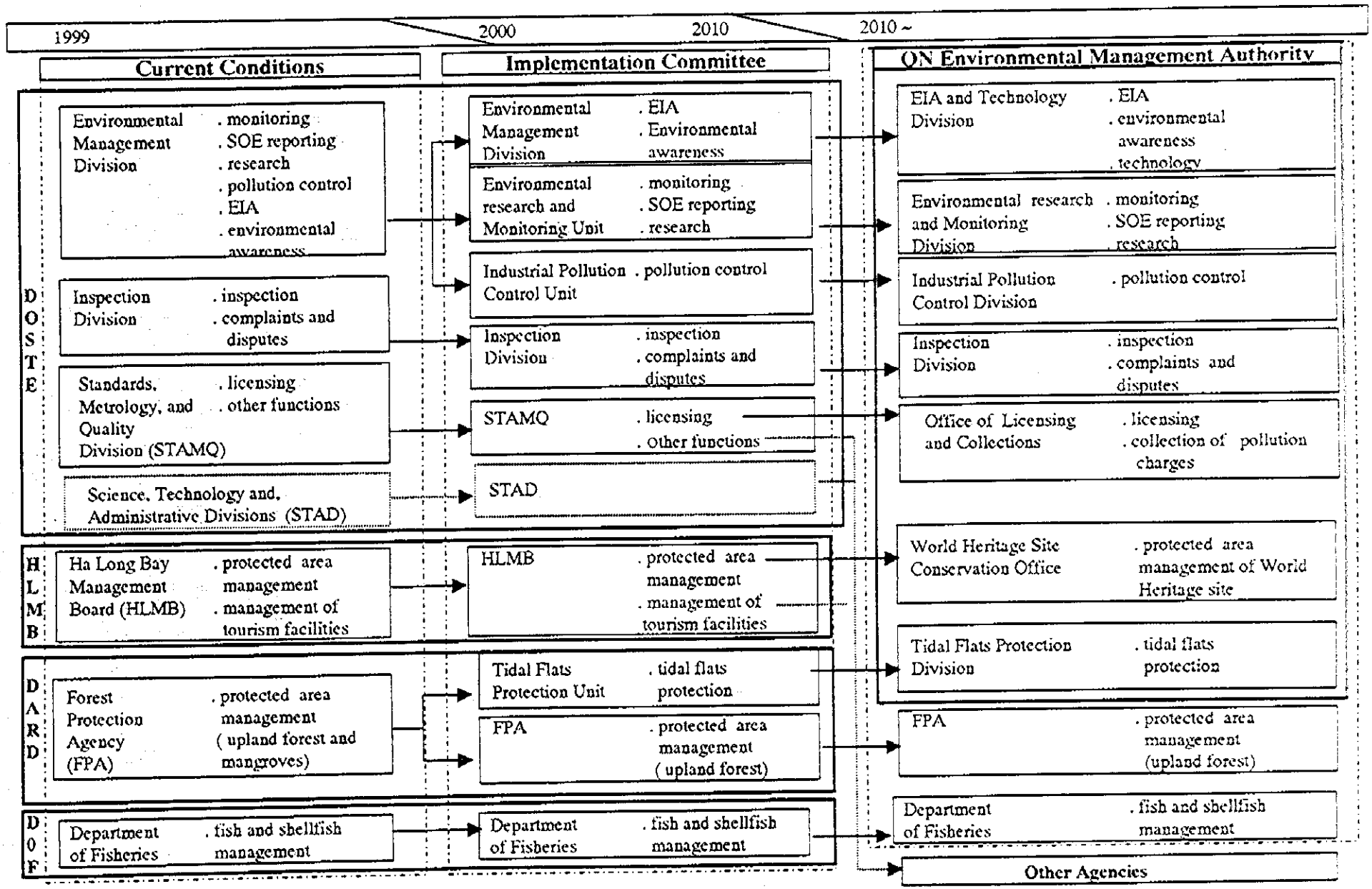
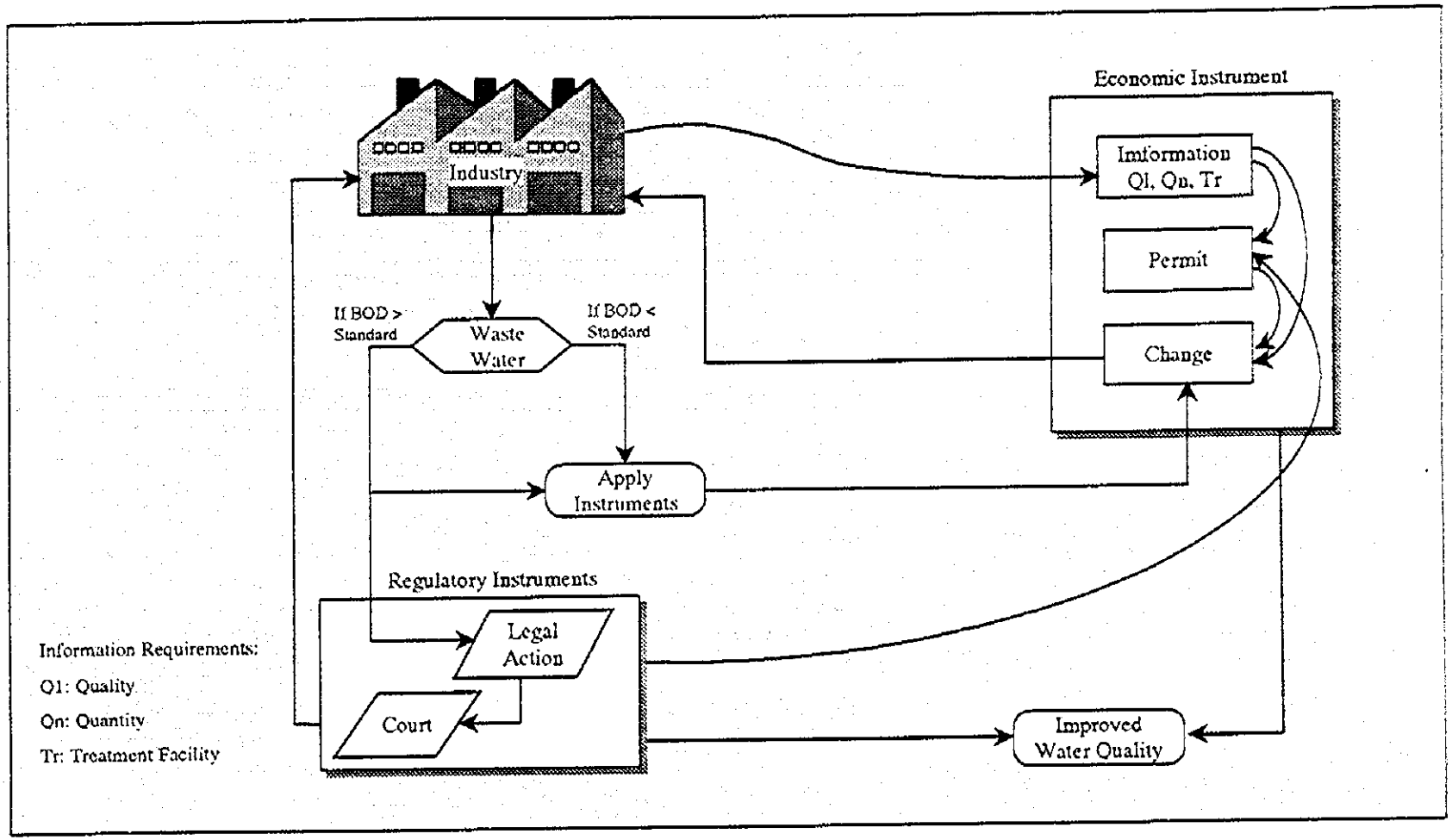
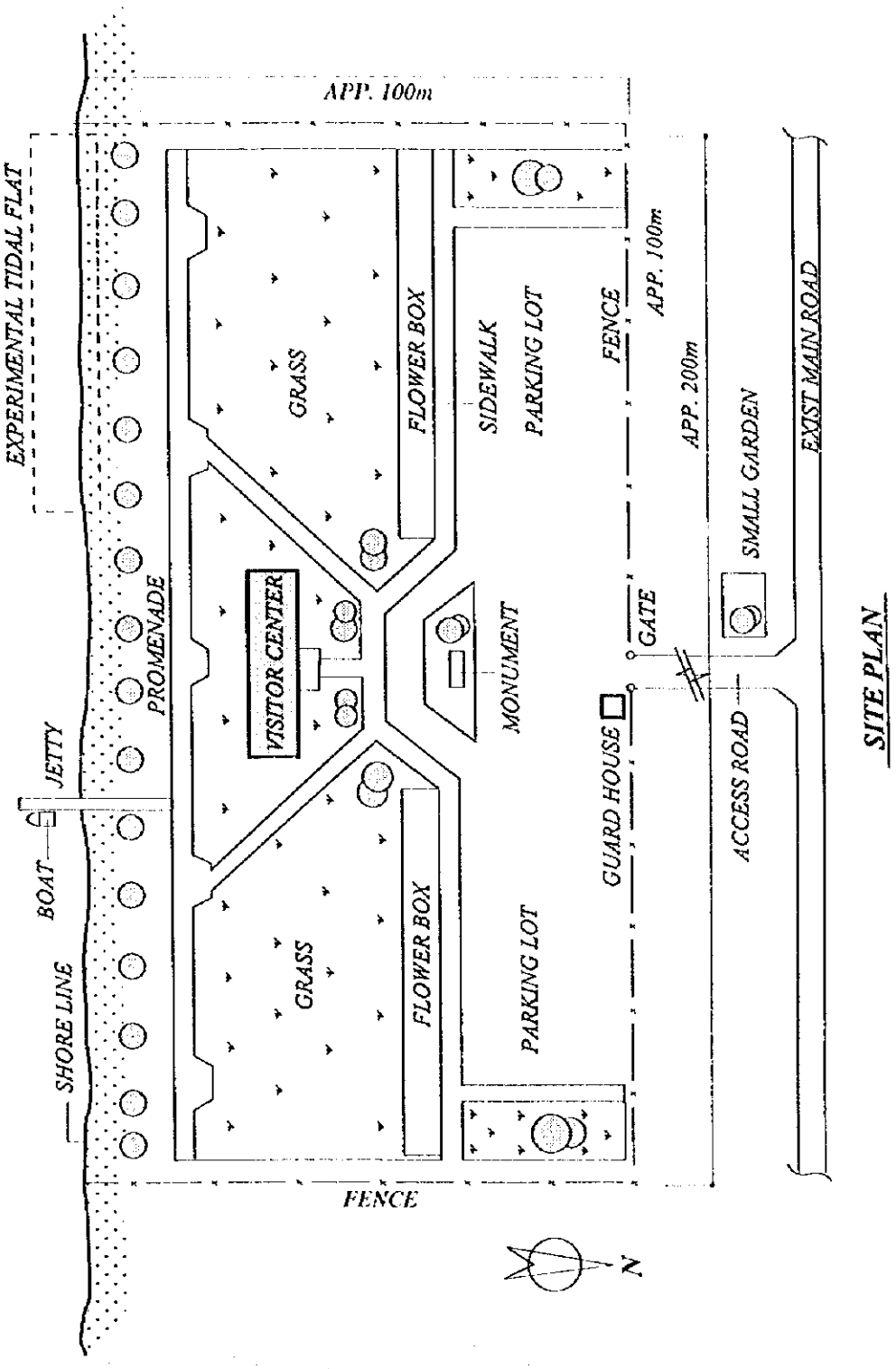


Figure 21.2.3 Timeline of the Agencies Responsible for EMP

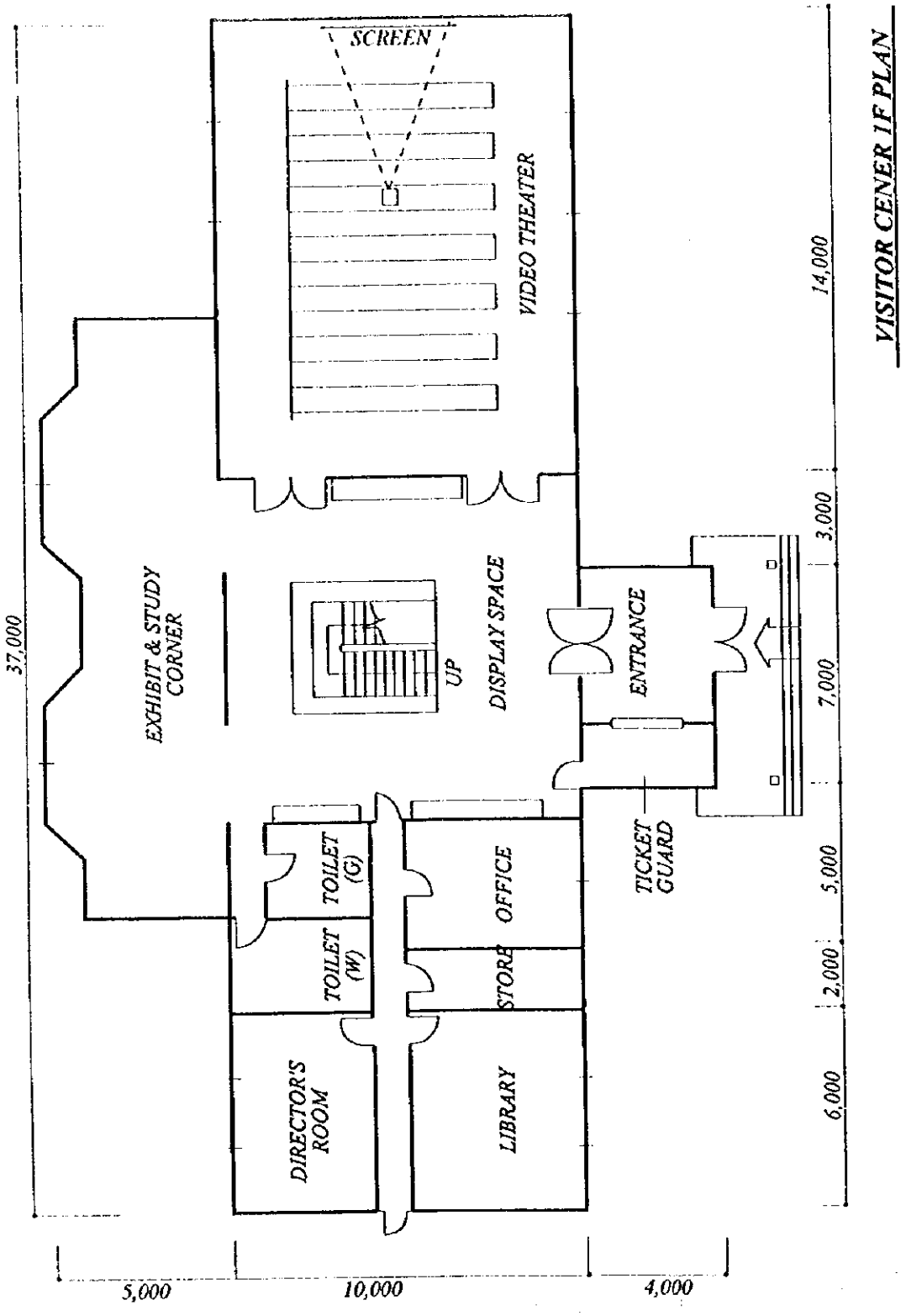


Source : Incorporating Environmental Considerations into Investment Decision-making in Vietnam, UNDP, Dec.1995

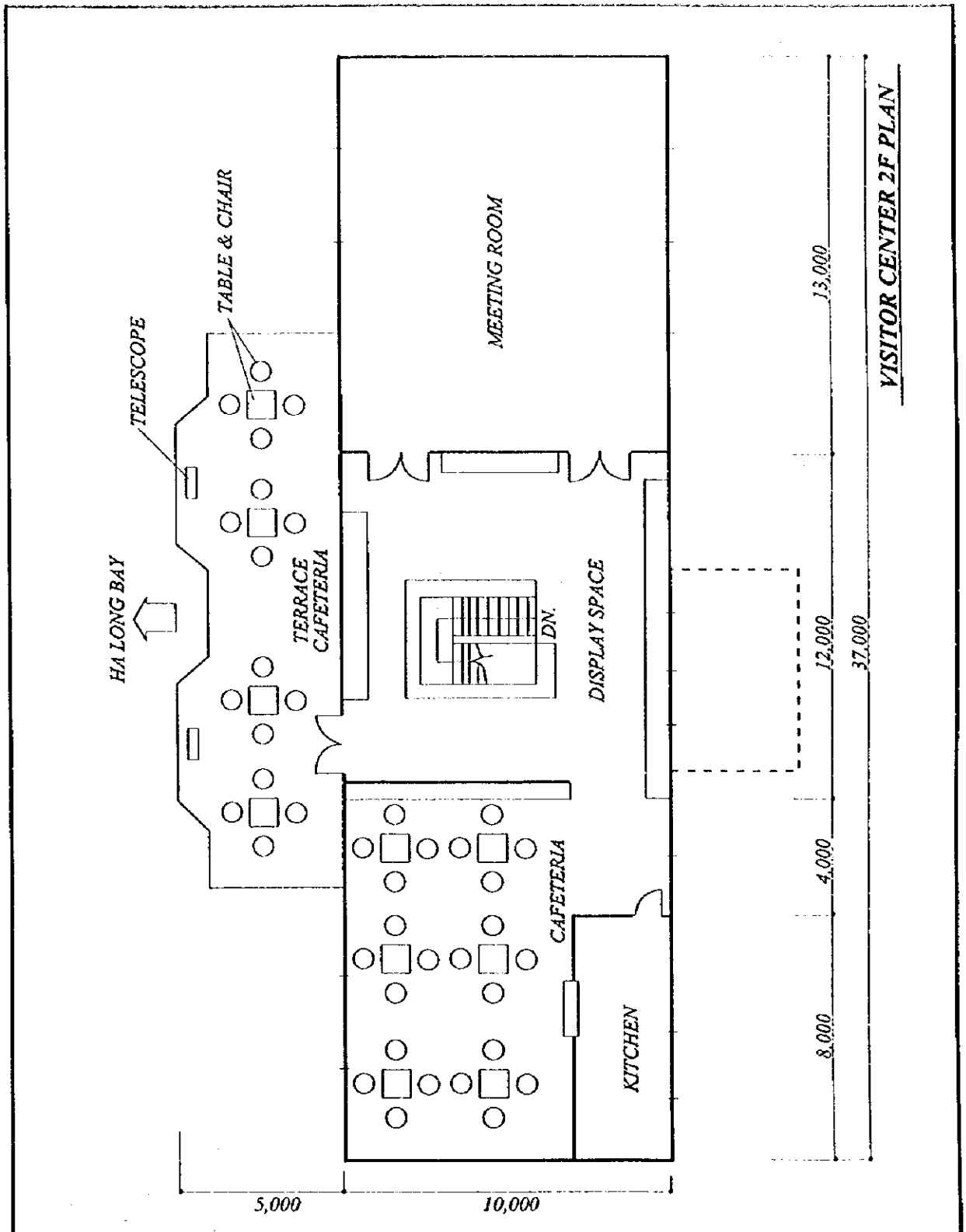
Figure 21.3.1 Combination Example of Regulatory & Economic Instruments



The Study on Environmental Management for Ha Long Bay in the Socialist Republic of Vietnam	Figure 21.4.2 (1) Proposed Visitor Center
Japan International Cooperation Agency	



The Study on Envionmental Management for Ha Long Bay in the Socialist Republic of Vietnam	Figure 21.4.2 (2) Proposed Visitor Center
Japan International Cooperation Agency	



The Study on Envionmental Management for Ha Long Bay in the Socialist Republic of Vietnam	Figure 21.4.2 (3) Proposed Visitor Center
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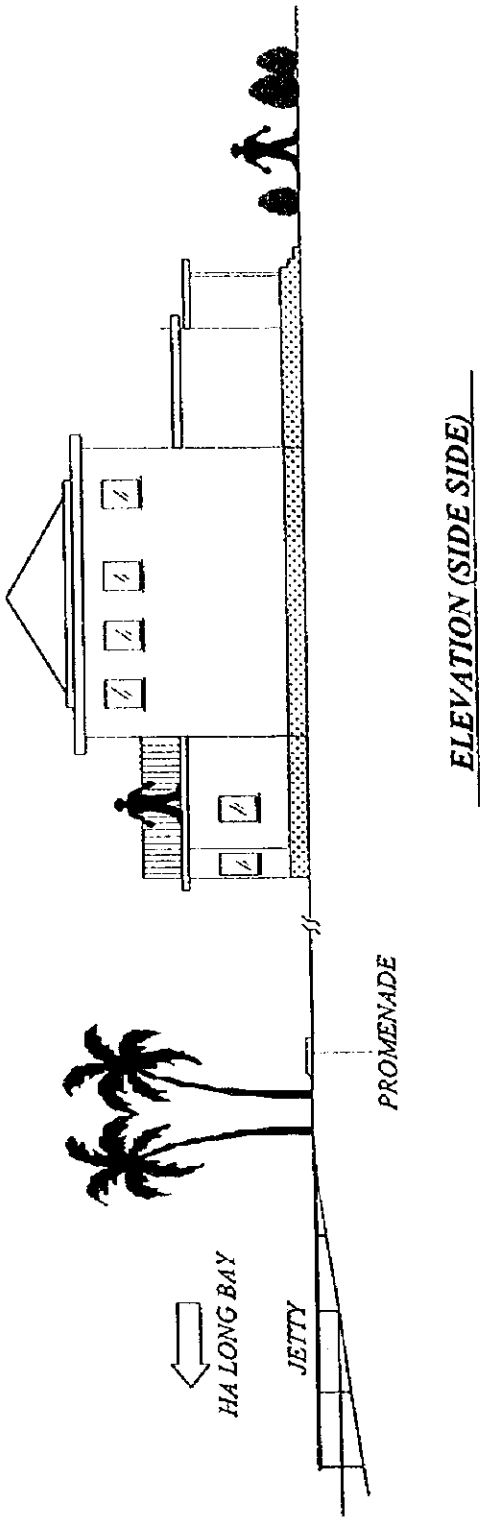
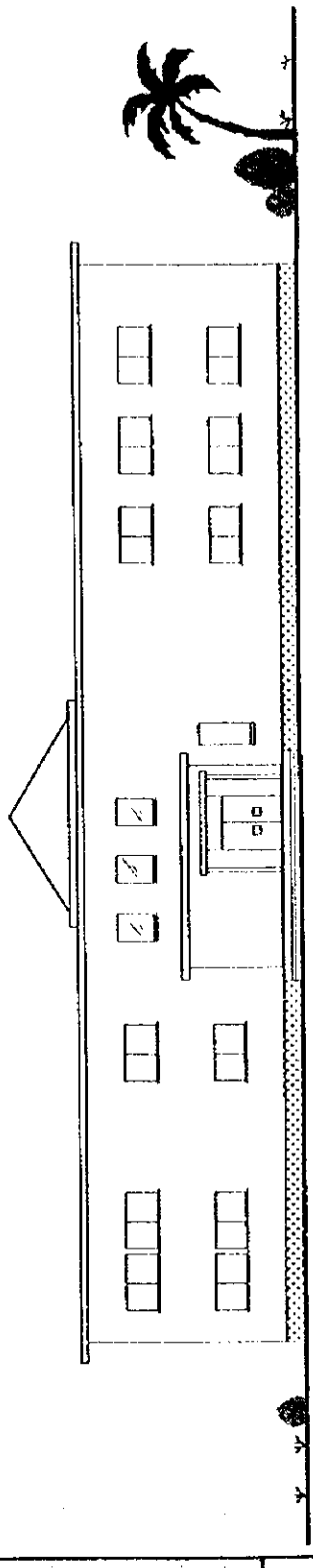


The Study on Envionmental Management for Ha Long Bay in the Socialist Republic of Vietnam	Figure 21.4.2 (4) Proposed Visitor Center
Japan International Cooperation Agency	



ELEVATION (FRONT SIDE)

The Study on Enviornmental Management for Ha Long Bay in the Socialist Republic of Vietnam	Figure 21.4.2 (5) Proposed Visitor Center
Japan International Cooperation Agency	

CHAPTER 22

CHAPTER 22 PROPOSED ENVIRONMENTAL MANAGEMENT PLAN

22.1 Proposed Environmental Measures

22.1.1 Projects and Programs of the EMP

The conservation criteria for the EMP should be achieved through an array of environmental measures which are broadly classified into "structural measures" and "non-structural measures". Structural measures include projects to control specific pollution sources, and non-structural measures are to implement environmental monitoring and other soft measures. The following environmental measures, projects and programs, including the environmental monitoring plan and institutional development are proposed to achieve the conservation criteria set for the EMP.

(1) Sanitation Measures

The optimum combination of measures of domestic wastewater treatment and industrial wastewater treatment were selected to achieve the conservation criteria of the water quality in Bai Chay bay area in 2010. The proposed sanitation measures consist of domestic and industrial wastewater systems, and domestic and industrial solid wastes management systems as shown below:

1) Domestic wastewater treatment

Project/Program Name	Descriptions
- Don Dien WWTP	· Sewered population 98,500 (in 2010) · Additional main collectors including pump station 13 km · Oxidation ditch treatment
- Deo Sen WWTP	· Sewered population 164,000 (in 2010) · Additional main collectors including pump station 12 km · Oxidation ditch treatment with side stream phosphorus removal
- Bach Dang WWTP	· Sewered population 120,000 (in 2010) · Sequencing batch reactor
- Cam Pha WWTP	· Sewered population 45,000 (in 2010) · Main collectors including pump station 13 km · Interception structure · Oxidation ditch treatment · Local sewerage 40,000 (in 2010)

2) Industrial wastewater treatment

Project/Program Name	Descriptions
- Cai Lan Industrial WWTP	• Collection system including pump station 5.4 km • Main pump station • Wastewater treatment plant to be prepared by industrial park
- Hoanh Bo Industrial WWTP	• Collection system including pump station 5.4 km • Main pump station • Wastewater treatment plant to be prepared by industrial park
- Lan Bang Industrial WWTP	• Collection system including pump station 2.9 km • Wastewater treatment plant with capacity of 2,600 m^3/day

3) Domestic solid wastes management

Project/Program Name	Descriptions
- Procurement of solid wastes collection vehicles and equipment	• Collection capacity of 98,000 tons/year
- Extension of Quang Hanh landfill site	• Extension volume of 450,000 m^3
- Hospital solid wastes incinerator	• Treatment capacity of 3,700 tons/year

4) Industrial solid wastes management

Project/Program Name	Descriptions
- Procurement of solid wastes collection vehicles and equipment	• Collection capacity of 34,500 tons/year
- Extension of landfill sites	• Extension volume of 94,000 m^3 up to 2010
- Hazardous solid wastes incinerator	• Treatment capacity of 5,500 tons/year

(2) Measures for Mining

The proposed environmental measures for mining consist of structural and non-structure measures as shown below. Because comprehensive measures are required, the proposed measures include development plan and pilot project.

Project/Program Name	Descriptions
- Environmental plans for mining	• Development of environmental plan for the entire region and each mine
- Pilot project on rehabilitation	• Pilot study to establish rehabilitation technologies
- Measures for mine wastewater	• Installation of 50 wastewater treatment facilities
- Measures for coal processing plants	• Improvement of drainage system to intercept runoff
- South Deo Nai dumping site rehabilitation	• Rehabilitation and landslide prevention of a large dumping area
- Rehabilitation of river basins (Mong Duong, Dien Vong, Ha Tu, Hong Gai, Cam Pha, Cua Ong)	• Basin-wise rehabilitation of mining sites through combination of revegetation, drainage improvement, and dust control
- Dredging	• Routine and emergency dredging of affected area such as rivers and irrigation system

(3) Measures for Tourism

The proposed environmental measures for tourism consist of structural and non-structure measures as shown below.

Project/Program Name	Descriptions
- Environmental plans for tourism	• Development of environmental plan for tourism
- Improvement of sanitation condition - Phase 1	• Improvement of sanitation conditions on tourism boats and island is providing solid wastes/wastewater collection services, and construction of toilets
- Improvement of sanitation condition - Phase 2	• Second phase of sanitation project for tourism boats and islands
- Reinforcement of patrolling capability	• Reinforcement of patrolling with six boats and 30 staff members by 2010

(4) Measures for Environmental Resources

The proposed environmental measures for environmental resources consist of those for natural environment and landscape as shown below:

Project/Program Name	Descriptions
- Measures for natural environment	• Reforestation in bare areas • Rehabilitation of mangrove swamps • Fishing activity management program
- Measures for landscape	• Preparation of landscape management guideline • Reinforcement of patrolling capability for shipping activities

(5) Environmental Monitoring

The projects and programs of the environmental monitoring consist of ambient environmental monitoring and inspection. The measures include reinforcement of monitoring capability such as procurement of facility and equipment, staff training. The proposed measures are as follows:

Project/Program Name	Descriptions
- Environmental monitoring	• Water quality monitoring (water quality, bottom sediment quality, and dust), environmental resources (natural environment and landscape) monitoring, including reinforcement of monitoring capability
- Environmental inspection	• Inspection of factories and enterprises ships, including reinforcement of inspection capability

(6) Institutional Development

The proposed projects and programs for the institutional development are as follows, while reinforcement of ERMU and ID are involved in measures of

environmental monitoring and inspection, respectively. Also, reinforcement of staff of TFMU is involved in the measures of environmental resources.

Project/Program Name	Descriptions
- Reinforcement of environmental management capability	• Reinforcement of staff in EMD • Training for staff (Lecture, OJT on site and abroad, training at relation institutes) • Procurement of facility and equipment (Computers, vehicles)
- Establishment of visitor center	• Visitor center building and related facilities • Procurement of facility and equipment (Exhibition, Environmental education tool, Computers)

22.2 Cost Estimation

22.2.1 Basic Assumptions for Cost Estimation

The construction or investment costs and operation and maintenance (O&M) costs for the projects and programs of the EMP are estimated on the following assumptions: 1) total construction cost consists of direct construction cost, government administration cost, land acquisition cost, engineering service, and physical contingency, while price contingency is excluded from this cost estimation, 2) all the costs were estimated in US dollars (exchanged rates applied are:US$ = Yen 120 = VN Dong 13,900), 3) cost of imported machinery, equipment and materials excludes imported tax and duties since such taxes are not imposed for this project, and 4) labor costs applied are the prevailing wage rates in Ha Noi city and Ha Long city. All project and program costs are estimated at middle 1999 levels.

22.2.2 Estimated Costs of the Environmental Measures

Total estimated incremental costs required for the proposed environmental measures of the EMP are about US$ 168 million from 2000 to 2010, before adjustment of discount rate. The estimated costs of each environmental measure of the EMP are as shown in the next table.

Proposed Environmental Measures and Estimated Costs of the EMP up to 2010

Category	No.	Projects and Programs	Costs (million US$)
1. Sanitation			
1.1 Domestic Wastewater Management	1	Don Dien WWTP including collection system in Dong Dang area	31.2
	2	Deo Sen WWTP	36.9
	3	Bach Dang WWTP	11.1
	4	Cam Pha WWTP	7.5
		Subtotal	86.7
1.2 Industrial Wastewater Management	5	Cai Lan Industrial WWTP (collection and convey system)	13.2
	6	Hoanh Bo Industrial WWTP (collection and convey system)	
	7	Lang Bang Industrial WWTP	1.7
		Subtotal	14.9
1.3 Domestic Solid Wastes Management	8	Procurement of solid wastes collection vehicles and equipment	8.3
	9	Extension of Quang Hanh landfill site	4.3
	10	Clinical solid wastes incinerators	1.2
		Subtotal	13.8
1.4 Industrial Solids Wastes Management	11	Procurement of solid wastes collection vehicles and equipment	1.7
	12	Extension of landfill sites	1.0
	13	Hazardous solid wastes incinerators	2.0
		Subtotal	4.7
Total			120.1
2. Measures for Mining	14	Development of environmental plan for mining	0.9
	15	Pilot project on rehabilitation	1.8
	16	Measures for mine wastewater	2.2
	17	Measures for coal processing plants	1.7
	18	South Deo Nai dumping site rehabilitation	3.4
	19	Rehabilitation of river basins (Mong Duong, Dien Vong, Ha Tu , Hong Gai, Cam Pha, and Cua Ong)	11.5
	20	Dredging	13.3
		Total	34.8
3. Measures for Tourism	21	Development of environmental plan for tourism	0.1
	22	Improvement of sanitation condition-Phase 1	1.5
	23	Improvement of sanitation condition-Phase 2	1.2
	24	Reinforcement of patrolling capability	1.0
		Total	3.8
4. Measures for Environmental Resources	25	Reforestation in bare areas	1.5
	26	Rehabilitation of mangrove swamps	1.0
	27	Fishing activity management program	0.1
	28	Measures for landscape	0.1
		Total	2.7
5. Environmental Monitoring	29	Environmental monitoring (water quality, environmental resources)	0.8
	30	Environmental inspection	0.1
		Total	0.9
6. Institutional Development	31	Reinforcement of environmental management capability (staff, training programs, procurement of equipment)	2.5
	32	Establishment of Visitor Center	3.0
		Total	5.5
Grand total			167.8

Notes: 1) WWTPs include accompanied collection systems including pump stations and local collector sewers in densely populated areas.
2) Costs include those of O&M during 2000-2010.

22.3 Financial Plan

22.3.1 Consideration of Cost Recovery of the EMP

(1) Basic Principles of Cost Recovery for the EMP

Under the national and local socioeconomic and financial background, the following three basic principles were set out for considering how to recover the costs necessary for the EMP implementation.

1) Extra financial source for the EMP should be developed.

GD 175/CP recognizes the obligations of GOV to contribute financially to environmental protection. Its Article 32 discusses the sources of financing for environmental protection activities, such as the state budget allocated for it. However, because the existing financial source of the Vietnamese central and provincial governments are quite limited, some other financial sources have to be found ignoring too much rely on the existing national and local state budgets.

2) Public and private polluters of the Ha Long bay area should pay to recover their pollutant loads (Polluter Pays Principle, PPP)

GD 175/CP also recognizes the obligations of those who exploit the environment to contribute financially to its protection. The PPP is a non-subsidy principle. Its premise is that, in general, a polluter should not receive public subsidies to control the pollution he generates (e.g. grants or tax allowances for pollution control equipment, below-cost charges for public services, etc.).

3) Users of or beneficiaries from the Ha Long bay should contribute based on their payable capacity (User Pays Principle, UPP)

Another guiding principle of sustainable development, which encompasses PPP as a special case, is the UPP. This principle concerns the allocation of and charges for resource use. Its premise is that all resource users should pay the full long-run marginal social cost of using a resource and related services, including any associated cost for treatment, etc. Thus, UPP is applied both when resources are

consumed and when their wastes are discharged back into the environment. In the latter case, the user is in fact the polluter as discussed under PPP.

(2) Potential Financial Sources for Cost Recovery for the EMP

Applying these three basic principles, the following five types of sources could be considered as major ones to jointly finance the EMP implementation.

1) World Heritage Fund under UNESCO (Soft loan or grant)

According to the "Operational Guidelines for the Implementation of the World Heritage Convention" (updated in March 1997, UNESCO World Heritage Center), financial and technical assistance under the World Heritage Fund will be available to protect the World Heritage sites including Ha Long bay which is the major target area of the EMP.

Available Assistance Forms	Maximum Monetary Amount (US$ 1,000/case)
i. Preparatory assistance	15
ii. Emergency assistance	75
iii. Training	20
iv. Technical co-operation	30
v. Assistance for promotional activities	10
Total	150

Actually, the Ha Long Bay Management Board (HLMB) has obtained UNESCO's financial support amounting to US$ 24,000 in 1997 and US$ 25,700 in 1998 (HLMB, Feb. 1999). There will be some possibility for additional financial support to the EMP, especially for training and technical co-operation related to environmental monitoring and institutional activities.

2) Environmental Fund of VINACOAL (UNDP proposal basis)

VINACOAL's funding system for its own and local community's environmental protection has partially commenced. Indeed, VND 20 billion (about US$ 2 million) was spent by VINACOAL for environmental protection in QNP (QN DOSTE, Aug. 1998). The rules of VINACOAL Environmental Fund proposed by UNDP in 1998 (Appendix 3.4.1 for more detail) include possible financial support for local environment as below, although the rules are still under revision of VINACOAL:

- Distribution to VINACOAL companies for environmental restoration projects outside of VINACOAL boundaries (40% of Fund assets), and
- Distribution to QNP for use in general environmental management activities (10% of Fund assets)

3) Grant or loan from bilateral or multilateral donors

A certain portion of costs for the EMP can no doubt be financed from foreign borrowing, taking account of the OECD/DAC policy putting emphasis on assistance for environmental sector as well as the past donors' technical and financial cooperation to Vietnam as follow :

- US$ 5.6 million to Vietnam for environmental sector in 1995 (Table 3.4.2)
- US$ 2.6 billion for on-going and planned port and waterway projects in the northern region (Table 3.4.1)
- 85 billion yen (about US$ 700 million) of Japanese OECF loan assistance to Vietnam for all sectors in 1997, 14% of which was purely for environmental sector (OECF Hanoi office, April 1998)

4) Public and private industrial enterprises as polluters

Major public and private enterprises including VINACOAL can be largely categorized into three types as below. The PPP in line with the Vietnamese laws, these enterprises should control and manage pollutants from their economic activities. This obligation will be realistic to the enterprises whose future prosperity is most likely, locating in an economic zone emphasized at the national level. It thus implicates that the enterprise polluters are quite competitive self-financial sources of the EMP.

a) Industrial factories and coal mining industry

A major difference of the study area from most of the country is that the area resides within one of the national economic development zones, which means that the study area is one of Vietnam's priority areas for economic growth as well as domestic and foreign investment. Industrial production accounts for 78% of the province's general industrial and agricultural production. In particular, the major contributor to the regional economy is

coal production under VINACOAL, which has possibility to contribute 50% of its Environmental Fund assets for its companies' own environmental activities (Appendix 3.4.1).

b) Hotel and other tourism industry including tourist boats

In 1997, the revenue and the levy from tourism in the Quang Ninh province were VND 89 billion and VND 9 billion respectively, as shown in the next table. Moreover, a forecast has estimated for 2010 that annual tourists even only to Ha Long bay reach up to 605,000 Vietnamese visitors and 800,000 foreign tourists. Simply multiplying the 1997 revenue figure by tourist increase ratio of 2.8 (= (605,000 + 800,000) / (357,868 + 150,582)), the tourism revenue in 2010 will amount approximately to VND 250 billion (US$ 22 million) in 1997 price.

Indicators Related to Tourism in Quang Ninh Province between 1990 and 1997

Year	Total Visitors	Foreign Visitors	Tourism Revenue (VND million)*	Levy from Revenue (VND million)*
1990	48,763	12,020	13,781	882
1991	71,162	14,533	15,267	1,087
1992	80,150	26,336	33,510	3,091
1993	268,670	66,453	34,786	5,883
1994	303,490	122,321	75,213	7,960
1995	335,179	154,239	86,125	11,446
1996	350,867	127,811	87,952	9,884
1997	357,868	150,582	88,789	9,264
Average increase rate (%/year)	33	43	31	40
1997/1990 ratio	7.3	12.5	6.4	10.5

Note: * Figures are in current price of each year.
Source: Report on the Situation of Tourism Development 1990 ~ 1997 and Forecast for the Period from Now to 2010, Tourism Department of Quang Ninh Province, April 1998

c) Ships going through or stopping by Ha Long bay

Development of the Cai Lan port and large scale industries is being carried out in Bai Chay bay, by the government and private investors. The GOV is placing the future importance of the study area as a transportation hub of the northern economic development area.

5) Users and beneficiaries of the EMP

Under the UPP basis, the following three users or consumers of environmental resources in the study area can be considered:

a) Local residents

On a per capita basis, the study area's GDP is substantially larger than Vietnam as a whole and Hai Phong city. Besides, the Quang Ninh province itself is economically growing at a faster rate than the national average of 8 to 9%. Under this economic background, there will be potential space for local people to contribute some money for the EMP. Indeed, as mentioned in Section 23.2.4, local residents living in the province expressed the willingness to pay (WTP) to conserve the study area as below.

- Average WTP for the EMP of QNP residents = $0.1/resident/year
- When this WTP could collected in some proper way, it would amount to $122,000 in 2010 (= 0.1 x 1,219,900 as 2010 QN population).

On the other hand, local people in Vuon Dao, Hung Thang and Yet Kieu in the study area have presented the following WTP for domestic wastewater treatment:

Area	WTP for Treated Wastewater (VND/m^3)
Vuon Duo	225
Hung Thang	195
Yet Kieu	615
Average	345

Source: Ha Long City Water Supply & Sanitation Project, Sanitation Feasibility Study, Vol.IIIB, April 1998

Taking 16,753,500 m^3 as treated wastewater volume in 2010 under the EMP's domestic wastewater treatment project (refer to Chapter 18), potential money collected from the beneficiaries amounts to some US$ 438,000 (= VND 345/m^3 x 16,753,500 m^3 / VND 13,200/US$) in 2010.

b) Tourists

Likewise, WTPs of foreign and Vietnamese visitors to Ha Long city were examined in Section 23.2.4. When these WTPs could be collected in an

appropriate manner like extra accommodation fee of hotels, they would be a large financial source for the EMP within the tourists' economic constraint.

- Average WTP for the EMP of foreign tourists = $3.1/tourist/year
- Possible amount of money collected from foreign tourists 2010
  = $ 2,480,000 (= 3.1 x 2010 foreign tourists)
- Average WTP for the EMP of Vietnamese tourists = $0.3/tourist/year
- Possible amount of money collected from Vietnamese tourists 2010
  = $ 182,000 (= 0.3 x 2010 Vietnamese tourists)

c) Fishermen

Another major beneficiaries using environmental resources in Ha Long bay are fishermen. In 1997, total marine and aquaculture production in the province was 18,556 tons, which translates to an export monetary value of almost US$ 11 million (i.e. US$ 3.5 million from sea products, and US$ 7.5 million from fish source). In the whole province, it is estimated that about 10,000 people are involved in the fishing industry. As far as the study area is concerned, marine fish caught from Ha Long bay has been reported to be 4,500 tons/year (Department of Fisheries, June 1998).

(3) Appropriate Financial System for Funding the EMP

1) Typical methods

How to collect or use money available from those potential financial sources is important for financial management for the EMP. Typical methods which have been applied for this purpose in Vietnam or other countries are environmental tax or fee, revolving funding system, and effluent charges. In addition, the following methods have been applied too.

a) International assistance

Most of them are called "economic instruments" described more in Section 21.3. In addition, more regulatory or self-regulatory oriented methods can be considered, as below:

b) Self-management control by private and public enterprise:

This method is to force the enterprises to control and manage their pollutants by funding from their own revenues, following the PPP basis. So any governmental bodies do not need to consider financial arrangement.

c) Penalty levy against environmental degradation and breach activities through inspection:

Article 32 of GD 175/CP says that finances for environmental protection shall also come from fines for breaches of the environmental laws. And in the Guidelines on Penalties for Administrative Violations of Environmental Protection Law (Decree No.26/CP, 1996), fine rates for environmental violation are established for the whole nation including the Quang Ninh province. The DOSTE staff of the Quang Ninh province have often carried out environmental inspection, following charging violators. The results of inspection during July 8 ~ October 18, 1997 was reported in "Summing-Up Report on the Far-Flung Inspection with Reference to Environment Protection in 1997" (DOSTE). The summary of the inspection including the total amount of violation charge is :

- Inspected establishments : 113 in total
  (80 state enterprises, 11 private enterprises, 13 hospitals/medicine centers, 8 markets, and 1 joint-venture company)
- Establishments that were fined : 27
- Total sum of fine : VND 16,500,000

DOSTE informed in August 1998 that DOSTE charged about VND 300,000 and VND 22,500,000 including the above in 1996 and 1997 respectively, for environmental violation activities.

d) Official charges to environmental license and monitoring services for enterprises:

Article 32 of GD 175/CP says that finances for environmental protection shall also come from charges for the evaluation of EIAs according to the fees and rules established by the MOF.

e) Environmental lottery:

For example, a calamity lottery has been carried out under QNPP, collecting VND 12 billion in 1997 and VND 11 billion in 1998 from local people (Financial Department, Feb.1999).

2) Appropriate methods

In the Vietnamese budget system, a large part of money collected on a local level through the methods of environmental tax and fee, effluent charges, penalty levy, and official charges to environmental license has generally gone to the central governmental reserves. And then each provincial budget is usually controlled and re-allocated based on the central governmental financial policies. It means that all the collected money as provincial revenue does not necessarily come back for the local expenditures including environmental protection. For example, the next table shows an overall revenue-expenditure balance sheet of the Quang Ninh province as a whole. It looks like the province still has some surplus. However, under such central government's budget control, many public service offices including DOSTE have a lack of budget even for their routine works.

Revenue and Expenditure of Quang Ninh Province

(Unit: VND billion)

Financial Item	1995	1996	1997	1st Half of 1998
1. Revenue	1,262	1,442	1,642	856
2. Expenditure	329	437	565	266
3. Balance (1 - 2)	+ 933	+ 1,005	+ 1,077	+ 590

Source: DOSTE of Quang Ninh Province, November 1998

Therefore, unless the central government could arrange special additional budget for the EMP implementation from the central reserves, some special financial system for funding the EMP should be proposed applying the methods of revolving funding and environmental lottery in cooperation with foreign financial

assistance. And the self-management control by private and public enterprise is definitely appropriate as a funding tool for the EMP, considering the PPP rule and the future economic background of the study area.

22.3.2 Establishment of Financial Plan to Implement the EMP

Considering the potential financial sources and procurement methods to collect and manage money necessary for the measures in the EMP, a combination of these is proposed as in Table 22.3.1. This financial plan is also based on the three basic principles for cost recovery mentioned in Section 22.3.1. Although initial construction costs for industrial components of wastewater and solid wastes managements as well as for coal mining rehabilitation should be paid for by industrial sectors and VINACOAL in line with the PPP principle, these costs are proposed to be covered by donors' soft-loan at first and then be recovered gradually by charging a certain amount of annual repayment to them. This arrangement is to mitigate negative impacts on their financial management as much as possible.

Most of the initial investment rely on the international donors' soft-loan because of their large amount of necessary investment, while O&M costs are covered by environmental and wastewater fees from local residents and tourists as users of Ha Long Bay's environment. On the other hand, the major costs related to the coal mining environment is supposed to be charged to VINACOAL while the industrial part of the costs for wastewater and solid wastes management are planned to be charged to the industrial sectors concerned in line with the PPP concept. And costs for the proposed software works, such as planning, surveys, training and equipment, are suitable to grant assistance from possible donors.

(1) Financial Plan for each the EMP Measure

The following are detail description on financial planning for each the EMP measure.

1) Wastewater management

This measure consists of domestic (public) and industrial (private) wastewater treatment facilities, costing more than half of the total cost of the EMP implementation. Most of construction costs for the facilities are initially invested through foreign donors' soft-loan, while 30% of construction cost of domestic facilities is expected to be covered with donors' grant assistance because of its nature of public utility. Environmental/wastewater fees collected from the provincial residents and tourists will contribute to recover O&M costs and repayments of the loan for the domestic facilities. On the other hand, the whole O&M costs and repayments of the loan for the industrial facilities will be recovered through charges to industrial sectors based on the PPP principle.

2) Solid wastes management

This measure's components are also public and industrial treatment facilities for solid wastes. Therefore, in the same manner as the wastewater management, initial investment for construction is arranged through foreign donors' soft-loan. And loan repayment and O&M costs will be recovered with environmental fees from local residents and tourists for domestic facilities, and charges to industrial sectors for industrial facilities. No grant assistance is expected.

3) Measures for mining

Environmental planning costs and construction costs for the pilot project are expected to be financed with donors' grant. But the other construction costs are arranged through donors' soft-loan, and the O&M costs and repayments are all recovered with charges to VINACOAL.

4) Measures for tourism

Except for O&M costs, the remaining costs such as management planning and construction investment are all granted by donors. The O&M costs will be recovered through visitor center entrance fees from foreign and Vietnamese tourists.

5) Measures for environmental resources

All the costs for facilities as well as construction (reforestation and rehabilitation) works will be financed with donors' grant. On the other hand, O&M costs should be recovered with visitor center entrance fees from tourists.

6) Environmental monitoring

Investment for necessary equipments is arranged using donors' grant, while O&M costs for monitoring and inspection are financed with visitor center entrance fees collected from tourists.

7) Institutional development

For costs of the training and facilities (visitor center, computers and vehicles), grant can be expected from donors. All the O&M costs will be recovered using visitor center entrance fees from tourists.

(2) Financial Plan

The next table is a summary of the financial plan by the EMP measure and type of financial arrangement. Under this financial plan, over 55% of the total cost for the EMP accruing between 2000 and 2050 is proposed to be financed domestically without donors' financial assistance. But, approximately 11% and 33% of the cost are expected to be arranged by means of foreign donors' grant and soft-loan, respectively.

Summary of Financial Plan

Measures under the EMP	Total Cost by Financial Arrangement (US$ mil.)				Major Method of Cost Recovery for Soft-loan and Domestic Financing
	Grant (%)	Soft-loan (%)	Domestic-financing (%)	Total (%)	
1. Wastewater Management	23.8 (13)	68.2 (37)	94.0 (50)	186.0 (100)	- Environmental/wastewater fees - Charge to industries
2. Solid Wastes Management	0.0 (0)	13.1 (19)	54.2 (81)	67.3 (100)	- Environmental/wastewater fees - Charge to industries
3. Measures for Mining	2.5 (5)	26.5 (49)	24.7 (46)	53.7 (100)	- Charge to VINACOAL
4. Measures for Tourism	1.5 (22)	0.0 (0)	5.2 (78)	6.7 (100)	- Environmental fees - Visitor center entrance fees
5. Environmental Resources Management	2.5 (54)	0.0 (0)	2.1 (46)	4.6 (100)	- Environmental fees - Visitor center entrance fees
6. Environmental Monitoring	0.4 (9)	0.0 (0)	4.3 (91)	4.7 (100)	- Environmental fees - Visitor center entrance fees
7. Institutional Development	5.2 (68)	0.0 (0)	2.4 (32)	7.6 (100)	- Environmental fees - Visitor center entrance fees
Total	35.9 (11)	107.8 (33)	186.9 (56)	330.6 (100)	...

As for the domestic financing component for the EMP, the average annual expenditure amounts to about US$ 3.7 million (= US$ 186.9 million / 51 years). Compared with the total GDP of Quang Ninh province of US$ 269.6 million (equivalent to VND 2,974 billion) in 1996, this annual domestic expenditure accounts for 1.4% (= US$ 3.7 million / US$ 269.6 million) of the provincial GDP. Referring to the fact that OECD countries have spent 1 ~ 2% of their GDP as expenditures for environmental management, the proposed ratio of domestic financing is reasonable and essential to conserve even the local environment of the Ha Long bay.

TABLE

Table 22.3.1 Financial Plan and Cost Recovery for EMP Implementation

Measures under the EMP	Cost Component	Year	Amount (US$ mil.)	Financial Arrangement	Cost Recovery	
					Major Source	Major Method
1. Wastewater Management			186.0			
1-1. Domestic (Public) Management	Construction (30 %)	2000-2009	23.8	Grant	---	---
	Construction (70 %)	2000-2009	55.6	Soft-loan	QN residents, and tourists	Environmental/wastewater fees
	O&M	2003-2050	72.8	Domestic financing	QN residents, and tourists	Environmental/wastewater fees
1-2. Industrial (Private) Management	Construction	2001-2010	12.6	Soft-loan	Industrial sector	Charge to industries
	O&M	2002-2050	21.2	Domestic financing	Industrial sector	Charge to industries
2. Solid Wastes Management			67.3			
2-1. Public Sector	Construction	2001-2010	10.0	Soft-loan	QN residents, and tourists	Environmental fees
	O&M	2003-2050	35.7	Domestic financing	QN residents, and tourists	Environmental fees
2-2. Private Sector	Construction	2001-2008	3.1	Soft-loan	Industrial sector	Charge to industries
	O&M	2003-2050	18.5	Domestic financing	Industrial sector	Charge to industries
3. Measures for Mining			53.7			
3-1. Environmental Plan	Planning	2000-2002	0.8	Grant	---	---
3-2. River & Basins Rehabilitation	Construction	2001-2010	11.1	Soft-loan	VINACOAL	Charge to VINACOAL
	O&M	2003-2039	16.9	Domestic financing	VINACOAL	Charge to VINACOAL
3-3. Dredging	Construction	2000-2010	13.3	Soft-loan	VINACOAL	Charge to VINACOAL
3-4. Coal Processing Plants	Construction	2001-2004	0.2	Soft-loan	VINACOAL	Charge to VINACOAL
	O&M	2005-2039	5.7	Domestic financing	VINACOAL	Charge to VINACOAL
3-5. Mine Wastewater	Construction	2003-2006	1.9	Soft-loan	VINACOAL	Charge to VINACOAL
	O&M	2007-2039	1.9	Domestic financing	VINACOAL	Charge to VINACOAL
3-6. Pilot Project	Construction	2000-2002	1.7	Grant	---	---
	O&M	2003-2006	0.2	Domestic financing	VINACOAL	Charge to VINACOAL
4. Measures for Tourism			6.7			
4-1. Environmental Plan	Planning	2000-2006	0.1	Grant	---	---
4-2. Sanitation Management	Construction	2000-2006	1.2	Grant	---	---
	O&M	2003-2024	3.0	Domestic financing	Tourists	Visitor Center entrance fees
4-3. Patrol Capacity Reinforcement	Construction	2002-2010	0.2	Grant	---	---
	O&M	2003-2024	2.2	Domestic financing	Tourists	Visitor Center entrance fees
5. Measures for Environmental Resources			4.6			
	Construction & Facilities	2000-2010	2.5	Grant	---	---
	O&M	2001-2050	2.1	Domestic financing	Tourists	Visitor Center entrance fees
6. Environmental Monitoring			4.7			
	Equipments	2001-2007	0.4	Grant	---	---
	O&M (monit. & inspec.)	2000-2050	4.3	Domestic financing	Tourists	Visitor Center entrance fees
7. Institutional Development			7.6			
	Const., Training & Facilities	2000-2010	5.2	Grant	---	---
	O&M	2002-2050	2.4	Domestic financing	Tourists	Visitor Center entrance fees
Total Amount of EMP Implementation Cost			330.6			

CHAPTER 23

CHAPTER 23 EVALUATION

23.1 Approach and Methodology of Evaluation

As technical evaluation of the proposed the Environmental Management Plan (EMP) had been already carried out through formulating it and its proposed projects, the EMP is evaluated here only from economic and financial points of view.

The main goal of the EMP is environmental conservation of the study area, so the key components for the economic evaluation are environmental goods or services, which have been conventionally ignored in the usual economic evaluation in monetary terms. At the same time, the environmental management doesn't generates direct marketable products, which would be important factors to evaluate the financial validity of projects. Under such unique characteristics of the EMP, the following analytical approaches and methods were applied in the Study while the conventional cost-benefit analysis with the Economic Internal Rate of Return (EIRR) or the Financial Internal Rate of Return (FIRR) were utilized:

a) To evaluate environmental benefits in monetary terms as much as possible, by reviewing the evaluation methods already developed or proposed by environmental economists,

b) To collect and make use of any related data from the existing case studies in economic analysis on environmental projects/programs in other regions/countries, in order to set out scientific and reasonable assumptions for evaluation,

c) To implement a questionnaire survey to local residents and tourists around the Ha Long bay to collect more reliable baseline information useful in applying "Contingent Valuation Method (CVM)" for difficult calculation of intangible environmental functions, and

d) To focus on how to recover the implementation cost of the proposed environmental management measures without significant marketable products, examining any possibility of economic instruments such as environmental taxation and environmental funding system in association with foreign financial assistance.

23.2 Economic Evaluation

23.2.1 Conceptual Framework of Cost Benefit Analysis

The economic analysis is integrated into the evaluation of the EMP by including not only direct costs of equipment, operation and maintenance, but also the benefits and "damage costs" avoided in the uses of environmental resources in and around Ha Long bay. This analysis builds on the environmental economic capabilities developed so far, aiming at evaluating feasibility of the EMP's implementation from the socioeconomic point of view.

For evaluation of socioeconomic feasibility, "Cost Benefit Analysis" approach, which is internationally common and accepted, is applied with its general conceptual framework of evaluation equation as below:

$$NB = Bd + Be - Cd - Cp - Ce$$

where NB : Net benefit generated by implementation of the plan/project
Bd : Productive benefit directly generated
Be : Environmental benefit
Cd : Direct cost necessary for the implementation
Cp : Cost for preventive measures for environmental conservation, if applied
Ce : Cost as environmental damage due to the project implementation

In many cases of productive or infrastructual sector projects, conventionally, "Be" and "Ce" have been ignored as "external economic item" and "external diseconomic item" respectively, both of which are regarded as unmeasurable in monetary terms.

A major part of the EMP's "Bd" is equivalent to "Be", and "Cd" equals "Cp". This is because its main targets are originally to conserve a good quality of environment or to further improve the environmental quality. On the other hand, "Ce" hardly accrues from the EMP for the same reason. Therefore, the most proper cost-benefit equation for the EMP is as below:

$$NB = Be - Cp$$

If "Be" of the EMP is still left unmeasured as conventional, any cost-benefit analysis of calculating "NB" can not be carried out. In this context and nature of the EMP's benefits, the study team considered "Be" calculation as most essential.

23.2.2 Points of Analytical Approach

With increasing knowledge of both the economic and environmental values of Ha Long bay's ecosystems, cost benefit analysis can serve as a useful tool in analyzing conservation alternatives for these ecosystems. The evaluation is being carried out on various important aspects of the bay, namely, fishery and forestry resources, biodiversity, science, culture, landscape, and tourism.

(1) Use of Social Cost and Benefit

Economic data, namely "social cost/benefit", reflecting real scarcity and consumption of local resources should be utilized, not nominal market prices used in the financial analysis.

(2) Application of EIRR

Among the three typical evaluation criteria, i.e. EIRR, net present value (NPV), and benefit-cost ratio (B/C), EIRR is applied to finally examine the economic viability, because there is no trouble in selecting discount rates from the very beginning with it.

(3) Determination of Proper Discount Rate

Opportunity cost of capital, government borrowing rate, and social rate of time preference are examined in defining discount rates and determining the trade offs between present and future values of the related goods or services.

(4) Appropriate Time Horizon for Analysis

The economic analysis has to cover all the period when any cost or benefit accrue from the EMP's implementation consisting of both construction and operation

stages. The EMP's benefits will last long beyond the period requiring direct costs of management. However, about 60-year is used as the time horizon subject to the economic analysis, since any costs and benefits accruing beyond such a period are discounted into present value of extremely small amount.

(5) With-project/Without-project Framework

The analysis is carried out based on the net costs and benefits, identifying incremental costs/benefits generated purely due to the EMP's implementation. Natural degradation of environment, measured in the "without-project" framework, has to be distinguished from that under the "with-project" situation. In the same way, any cost and benefit related only to other local plans and projects for urban development, infrastructural arrangement and tourism promotion should be discriminated from those of the EMP. This is because the economic analysis within the current study framework is defined for the environmental management, not for such existing development projects which are the given conditions in formulating the EMP.

23.2.3 Monetary Evaluation Methods for Environmental Benefits

Value of Ha Long bay which is a main area for environmental management under the current Study has been described rather qualitatively, in Table 23.2.1. The main purpose to apply the monetary evaluation methods is to qualitatively measure the benefits from the EMP's implementation, not to measure the Ha Long bay's value as a whole. Benefits from the EMP's implementation for Ha Long bay can be largely classified into the following 7 categories:

- Increase of adequate water supply,
- Conserved water quality,
- Strengthened erosion and flood control capacity,
- Conserved air quality,
- Conserved aesthetic and recreational amenity,
- Improved forestry resources, and
- Conserved fishery resources

Potential methods for estimating the monetary value of environmental resources and benefits, which may result from the EMP's implementation, were examined. The next table presents a menu of valuation techniques, which have been developed so far in environmental economics field, as well as examples of the types of effects valued.

Menu of Valuation Methods for Environmental Effects

Valuation Method	Typical Effects Valued
A. Objective Valuation Approaches (OVA)	
1) Change in Productivity	Productivity
2) Cost of Illness	Health (morbidity)
3) Human Capital	Health (mortality)
4) Replacement (Restoration) Cost	Capital assets, and natural resource assets
B. Subjective Valuation Approaches (SVA)	
1) Preventive (mitigative) Expenditure	Health, productivity, capital assets, and natural resource assets
2) Hedonic Approaches	
- Property (Land) Value	Environmental quality, and productivity
- Wage Differential	Health
3) Travel Cost (TCM)	Natural resource assets, and touristic assets
4) Contingent Valuation (CVM)	Any effects including biological and aesthetic values

Source: Economic Analysis of Environmental Impacts, ADB/WB, 1994

A. Objective Valuation Approaches

The first set of methods in the table are the Objective Valuation Approaches (OVA) that are based on physical relationships that formally describe cause and effect relationships and provide objective measures of effects resulting from various causes. OVA use "damage functions" which relate the level of offending activity to the degree of physical damage to a natural or man-made asset, or to the degree of health impact. OVA in general provide measures of the gross benefits, in the sense of losses avoided, of preventive or remedial actions. The important assumptions for OVA are:

- The net value of averting damage is at least equal to the cost which would be incurred if the damage actually occurred; and
- Rational individuals, in order to prevent some damage from occurring, would be willing to pay an amount less than or equal to the costs arising from the predicted level of environmental effects.

B. Subjective Valuation Approaches

In contrast to OVA, the second set of approaches in the table, Subjective Valuation Approaches (SVA), are based on more subjective assessments of possible damage expressed in real or hypothetical market behavior. Using revealed behavior involves examination of real markets for goods or services which are affected by environmental impacts, such as air or water pollution, in which people actually make trade offs between the environmental impact and other goods or income. In other cases environmental impacts cannot be valued, even indirectly, through market behavior. The alternative is to construct hypothetical markets for various options to reduce environmental damages, and to ask directly a sample of people to express how much they would be willing to pay for various reductions in environmental impacts. These are the so-called Contingent Valuation Methods (CVM).

The choice of a particular method of measurement obviously depends on what is being measured. Figure 23.2.1 presents a valuation flowchart that suggests where an analysis might be begin. The figure starts with any environmental impact and determines whether or not there is a measurable change in production, or if the primary effect of the impact is change in environmental quality. According to this flowchart and availability of necessary data for monetary calculation, the most applicable evaluation methods to the 7 kinds of benefits categorized could be selected as follows:

(1) Adequate Water Supply

The water that is consumed by coal mines and processing plants may be assumed to equal the value that the same water would have if it were used by the residents of each district for other purposes. For example, if a mining operation diverts one cubic meter per second from a stream that is used as a potable water supply, the value of water is equal to the cost of obtaining one cubic meter per second of water from another source. This cost would likely include construction of additional intakes, distribution piping and even pumping facilities for supplying the extra one cubic meter per second.

Adequate water supply -> Change in environmental quality -> Human habitat

-> **Replacement Cost Method**

[Benefit] = [Incremental supply of clean water] × [Supply cost per unit water volume]

= [Incremental supply of clean water] × [Unit cost for construction & operation of water supply intake]

If the mining operation diverts one cubic meter per second of irrigation water, the value of the water is equal to the value of crops which could not be produced as a result of the loss of the water.

Adequate water supply -> Measurable change in production -> Non distorted market prices

-> **Change in Productivity Method**

[Benefit] = [Incremental irrigated area] × [Amount of incrementally cultivated rice] × [Unit market price of rice]

(2) Conserved or Improved Water Quality

The value of water quality can be assessed to be the incremental cost of treating the water so that it is suitable for downstream uses. The level of treatment depends on the downstream use. For example, irrigation water does not require the same level of purity as drinking water, so the cost of treating water for use in agriculture would be less than drinking water supply.

Removal of suspended solids is the largest incremental cost for restoring coal mine drainage to suitable quality for downstream users. The incremental cost can be calculated as the extra alum or lime, filter capacity, treatment plant operation costs, etc. needed to treat the excess suspended solids, as compared with the quantities needed to treat the suspended solids that are naturally present in the water.

Conserved or improved water quality -> Change in environmental quality -> Water quality

-> **Replacement Cost Method or Preventive Expenditure Method**

[Benefit by preventive expenditure method]

= [Reduced water pollutants]

× [Unit cost for construction & operation of water filter plant to remove the pollutants]

Health expenditures and worker productivity costs are also associated with decreased water quality since the river is used by local populations as a source of

fresh water for bathing, cooking, and drinking. The incidence of morbidity and mortality inevitably increases as water quality deteriorates.

Conserved or improved water quality → Change in environmental quality → Water quality
→ Health effects → Sickness → **Loss of Earnings Method**
[Benefit] = [Reduced incidence of sickness] × [(Cost of treatment) + (Lost wage)]

Conserved or improved water-quality → Change in environmental quality → Water quality
→ Health effects → Death → **Human Capital Method**
[Benefit] = [Reduced incidence of death] × [Value of life]

(3) Strengthened Erosion and Flood Control Capacity

Coal mining contributes to increased flooding in two ways. First, tree cutting, removal of overburden and other land disturbances reduce the water holding capacity of the soil, causing larger peak flows of drainage after rain storms. Second, the sediment that erodes from the disturbed land fills the beds of rivers, allowing flood water to rise above the river banks. The value of flood damage resulting from coal mining can be estimated as the value of the incremental amount of increased flooding, or decreased flood control capacity, that is caused by the mining activities.

The incremental amount may be determined by comparison to conditions in undisturbed catchment areas that have similar topography, soil types, and rainfall patterns. For example, the incremental flooding for a stream in a catchment area in Cam Pha town can be determined by comparison with a stream of similar morphology in an undisturbed catchment area in Tien Yen district. The amount of siltation of the river channel and flooded land in Cam Pha town, that is greater than the naturally-caused amount in Tien Yen, may be attributed to mining activities.

When land and buildings are damaged, the measure of damage should be calculated as the cost to restore them to their original condition. The cost may include removal of mud and dust, repairing of buildings, paddy dikes and other improvements to the land, the cost of finding temporary accommodation while the buildings are being repaired. Roads, bridges, pipelines, electrical power lines and

other public infrastructure can be damaged by mud slides and flooding associated with development such as mining activities. The value of the damage in these cases can be calculated as cost to rebuild or relocate the damaged infrastructure.

Strengthened erosion and flood control capacity → Change in environmental quality
→ Human habitat → **Replacement Cost Method**

[Benefit] = [Reduced cost to rehabilitate damages due to mud-slide and flooding]
= [Cost to restore damaged land & building] + [Cost to remove mud & water]
+ [Repair cost of paddy dikes]+ [Cost to rebuild or relocate damaged infrastructure]
+ [Other expenditure in rehabilitation]

Strengthened erosion and flood control capacity → Measurable change in agricultural production
→ Non-distorted market prices → **Change-in-Productivity Method**

[Benefit] = [Agricultural area protected from erosion] × [Incremental products]
× [Unit market price of product]

This equation reflects that the loss of revenue from lost farm production is a value of the strengthened erosion- and flood-control capacity when paddy land is covered by mud slides.

(4) Improved Air Quality

Dust is the most significant air quality problem resulting from coal mining. Dust damages local human health, and covers roads and buildings. The decreased value of air quality is the value of income losses and the cost to sweep dust from roads and buildings. Not all dust is caused by mining though. Some dust occurs naturally, some is due to other industries, and some is caused by farming.

Improved air quality → Change in environmental quality → Air quality
→ **Replacement Cost Method**

[Benefit] = [Reduced cost to rehabilitate physical damages due to air pollution]
= [Cost to sweep dust from roads and buildings] + [Cost to rebuild or relocate damaged public goods] + [Other expenditure in rehabilitation]

Improved air quality → Change in environmental quality → Air quality → Health effects
→ Sickness → **Loss of Earnings Method**
[Benefit] = [Reduced incidence of sickness] × [(Cost of treatment) + (Lost wage)]

Improved air quality → Change in environmental quality → Air quality
→ Health effects → Death → **Human Capital Method**
[Benefit] = [Reduced incidence of death] × [Value of life]

Improved air quality → Measurable change in agricultural production
→ Non distorted market prices → **Change in Productivity Method**
[Benefit] = [Agricultural area protected from air-pollutants] × [Incremental products]
× [Unit market price of product]

(5) Conserved or Improved Aesthetic and Recreational Amenity

The value of the aesthetic quality of the natural environment is difficult to calculate in monetary terms, because it depends on the subjective preference of each individual person. One approach to assigning a monetary value to aesthetic qualities is to estimate how much the people living in an area would pay to preserve them (willingness to pay, WTP). The cumulative regional WTP can be interpreted to be equal to the overall value of restoring the aesthetic quality of the environment. It is likely that most people in the Quang Ninh province would be willing to pay some small amount to preserve aesthetic quantities.

Conserved or improved aesthetic quality → Change in environmental quality
→ Aesthetics → **Contingent Valuation Method**
[Non-use benefit including existence value]
= [Average WTP of non use value of local households] × [Number of local households]
+ [Average WTP of non use value of tourists] × [Number of tourists]

In addition, it is likely that the thousands of Vietnamese and international tourists who visit the Ha Long bay area each year would also be willing to pay some small amount of money such as a surcharge on hotel room rates for preserving the aesthetic quantities of the region. The cumulative WTP of all the households and tourists in Quang Ninh would be a large value.

Conserved or improved aesthetic quality -> Change in environmental quality
-> Recreation -> **Travel-Cost Method or Contingent-Valuation Method**

[Use-benefit by travel cost method]
= [Average travel cost of tourists] × [Incremental number of tourists]
+ [Average travel cost of local visitors] × [Incremental number of local visitors]

[Average travel cost] = [Transportation fee] + [Time cost] + [Opportunity cost]

[Use-benefit by contingent-valuation method]
= [Average WTP of use value of local households] × [Number of local households]
+ [Average WTP of use-value of tourists] × [Number of tourists]

Tourism accounts for a high percentage of the trade of goods and services in Ha Long city. By far the majority of tourists visiting Ha Long bay can be classified as 'Adventure and Ecotourists', they come to enjoy the natural landscape of the bay. Apart from cruising through the islands, Ha Long bay offers little in the way of ecotourism activities.

Conserved or improved aesthetic quality -> Measurable change in production
-> Non distorted market prices -> **Change in Productivity Method**

[Benefit] = [Incremental tourists due to environmental improvement or conservation]
× [incremental net profit of tourism sector per tourist]

(6) Improved Forestry Resources

Forests provide several valuable qualities, including wood products, flood control by stabilizing soil, aesthetic quality and habitat for wildlife. Potential methods for calculating the value of the loss of flood control and aesthetic quality are mentioned in Items (3) and (5) above. The value of wildlife habitat can be considered to be an aesthetic quality, similar to the value of a scenic view or a clear river.

The value of loss of timber and other wood products can be estimated as the overall income that would be derived from harvesting, processing, and selling the products on a sustainable basis. This income can be estimated by comparing the income from sustainable logging on land of similar area, tree types, proximity to roads and factories, etc. in a district where development such as mining does not occur.

Improved forestry resources -> Measurable change in production -> Non distorted market prices -> **Change in Productivity Method** [Benefit] = [Incremental forest land] × [Amount of incremental forest goods] × [Unit market price of rice]

(7) Conserved or Improved Fishery Resources

Siltation of river beds, coastal mangrove areas, sea grass beds and other fish habitat is the main source of environmental damage that the coal industry causes to fishery resources. Overburden dumps and waste coal storage piles erode during heavy rain, and the sediment drains into these sensitive aquatic areas, decreasing their ability to support fish life. The value of the damage to fishery resources may be estimated as the loss of fishing income caused by the siltation of fish habitat. Acid drainage with low pH from mines can also harm fish life. But, in the Quang Ninh coal mining region, siltation causes much greater harm.

The loss of fishing income may be estimated directly or indirectly. If historical records are available, it may be possible to directly estimate the reduction in fishing income. For example, income from fishing in a particular area in 1988 could be compared with the income in the same area in 1998. But these results may be unreliable because such factors as the affect of improved fishing techniques and boats, increase in the sale price of fish, and increases in the number of people who work in the fishing industry must all be considered. In addition, this direct estimate may unfairly bias against the coal industry, because other factor such as over-harvesting and pollution from other industries may have contributed to the decline in fishing.

Consequently, an indirect method of comparison would probably give better results. Siltation that is caused by the coal industry can be isolated from other factors by comparing present day fishing revenues in an estuary that is polluted by drainage from a mine or coal processing plant with revenues from a nearby estuary that is not.

Conserved or improved fishery resources → Measurable change in production
→ Non distorted market prices → **Change in Productivity Method**

[Benefit] = [Improved or conserved water area]
× [Amount of incrementally caught fish and marine products]
× [Unit market price of such fishery products]

23.2.4 Questionnaire Survey for Environmental Value

It was identified that evaluation of environmental benefits, especially for the aesthetic value and the recreational amenity was quite constrained only with valuation methods based on the existing socioeconomic data.

So a questionnaire survey was conducted by the Consultants Center for Science, Technology and Environment of Quang Ninh (CONSTE) under technical supervision of the JICA study team, from mid-November 1998 through mid-January 1999. The detail of survey specification and analytical results are presented in Appendix 23.2.1 and the Data Book. The following is an outline of the survey as well as brief analytical results based on the final report of the survey presented by CONSTE.

(1) Objective of the Questionnaire Survey

This survey aims at collection of enough data and information on Willingness-To-Pay (WTP) for environmental conservation of Ha Long bay area of both tourists and local residents. Some data on their impression of Ha Long bay, on their socioeconomic characteristics, and on tourists' activity tendency were also collected for the cross analysis.

These collected data and information significantly contributed to the current JICA Study, in particular to benefit calculation of conserved aesthetic & recreational amenity of Ha Long bay in addition to consideration on potential financial sources for the EMP implementation.

(2) Sample Interviewees for the Survey

The survey was carried out by means of direct interview with the questionnaire sheets (included in the Data Book) to 290 tourist and 215 local resident samples, as detailed in the tables below. These sample numbers are approximately equivalent to 0.1 % of annual tourists visiting Ha Long city and 0.1 % of total households in Quang Ninh province at present, respectively. The 505 questionnaire sheets were properly filled in by the CONSTE surveyors through direct interview.

Number of Sample Interviewees of Tourists to Ha Long City

Tourist Category	Vietnamese Tourists	Foreign Tourists	Total of Samples
Number of Samples	145	145	290

Number of Sample Interviewees of Local Residents in Quang Ninh Province

City/Town/District	Number of Samples	City/Town/District	Number of Samples
Ha Long	37	Dong Trieu	34
Cam Pha	32	Yen Hung	27
Binh Lieu	4	Van Don	7
Quang Ha	16	Co To	3
Mong Cai (Hai Ninh)	12	Uong Bi	20
Tien Yen	8	Hoanh Bo	12
Ba Che	3	Total of Samples	215

(3) Summary Results of the Questionnaire Survey and Analysis

WTP of tourists to Ha Long city and local residents in Quang Ninh province for environmental conservation of Ha Long bay area could be estimated mainly based on the interviewees' answers to Questions No. 9 ~ 14 in the questionnaire for tourists as well as Questions No. 2, 4, 5 and 8 ~ 10 in the questionnaire for local residents, as presented in the next table. These calculated WTPs correspond with the conservation measures under the proposed EMP.

Average WTP of Tourists and Local Residents for the EMP

Items	Units	Foreign Tourists	Vietnamese Tourists	Residents in QNP
(1) Average WTP for non-use value	US$/HH/year	6.2	1.2	0.3
Item(1) / Item (4) =	US$/person/year	1.8	0.3	0.1
(2) Average WTP for use value	US$/HH/year	12.5	1.0	1.1
Item (2) / Item (4) =	US$/person/year	3.6	0.2	0.3
(3) Average WTP in total				
Item (1) × Item (5) + Item (2) × Item (6)	US$/HH/year	10.9	1.4	0.4
= Item (3) / Item (4) =	US$/person/year	3.1	0.3	0.1
(4) Average HH members	persons/HH	3.5	4.6	4.2
(5) Ratio expressing WTP for non-use value	%	14	21	53
(6) Ratio expressing WTP for use value	%	61	53	30
(7) Total Ratio expressing WTP either for non-use or use value = Item (5) + Item (6)	%	75	74	83

Notes: 1) HH = household
2) Figures are rounded and not perfectly consistent with each other, as more exact data were used during the actual calculation process.

About 75 % of tourists (both foreign and Vietnamese) and over 80 % of local residents in Quang Ninh province were identified to have some WTP to conserve the Ha Long Bay's environment. Foreign tourist, Vietnamese tourist, and Quang Ninh people expressed total WTP of around US$ 3.1, 0.3, and 0.1/person/year on average, respectively. These figures sound reasonable taking different income levels of the three types of interviewees into account. It is also noted that local residents in Quang Ninh province put more importance on the non-use value than use value of Ha Long environment, while the tourists did not. These data were applied to the benefit calculation.

23.2.5 Results of Environmental Benefit Calculation

In accordance with these theoretical and measurement frameworks as well as the WTPs estimated from the questionnaire survey, values of the benefits (Be) from the EMP's implementation were calculated in monetary terms (Tables 23.2.2 ~23.2.8). The results summarized in Table 23.2.9 are on an annual basis of 2010 which is the target year of the EMP.

This estimation of the annual benefits amounts to approximately US$ 14 million (VND 190 billion) in 1998 price, which is equivalent to 12 % of the 1995 total GDP of the study area (US$ 120 million or about VND 1,570 billion). Environmental benefits generated through conserved water quality account for

nearly 63 %, followed by benefit from conserved aesthetic and recreational amenity (around 16 %). This result is in compliance with the EMP's direction putting the most importance on water quality management.

23.2.6 Results of Cost-Benefit Analysis

(1) Condition and Assumption for Analysis

Inputting the estimated data of benefits in addition to costs for the proposed measures under the EMP, which are summarized in Section 22.2, the cost-benefit analysis was carried out. The conditions and assumptions shown below were applied to the analysis.

1) Project life

The environmental benefits are supposed to occur even after 2010 in the long term, while effects of discounting are almost zero without any present values beyond two generations. Thus, project life under analysis was set at 2000 ~ 2060 (61 years).

2) O&M costs

Most of the O&M costs that occurred in 2010 should be also expended every additional year through the project life, in order to keep the same environmental quality level as in 2010.

3) Environmental benefits

The environmental benefits commence to occur in 2001, in a proportional way toward 2010, and then is constant from 2010 to the end of the project life.

4) Costs of the EMP

Costs of the EMP are corresponding to the estimated environmental benefits.

(2) Calculated EIRR

In Table 23.2.10, the annual breakdown of the costs by measure is presented and an overall spread sheet to compare costs and benefit is shown. EIRR based on this spreadsheet was calculated at 7.1 %. To assess socioeconomic feasibility of the EMP, this EIRR figure has to be compared with "social rate of time preference" which is usually difficult to calculate so that donor agencies are using "opportunity cost of capital" as its approximation to evaluate economic feasibility of their aid projects, such as:

World Bank : 12 % ADB : 10 % USAID : 8 % Japan : 7 %

Compared with these rates, the EMP's EIRR is more than the Japanese rate at least. The EMP implementation is economically feasible and acceptable from social viewpoint of the study area, both because the social rate of time preference is theoretically lower than the opportunity cost of capital and because intangible benefits of the EMP such as scientific, ecological, and educational values have not been counted in the cost-benefit analysis. In other words, it will bring incremental net welfare to the society concerned, with social benefits outweighing social costs.

23.3 Financial Evaluation

Objective of the financial evaluation is to analyze viability of the financial plan for the EMP proposed in Section 22.3, examining whether there will be enough money available to recover the estimated costs for the EMP implementation. Money necessary for the EMP implementation can be largely classified into:

- Money to be input for initial investment (buildings, physical measures, facilities and equipment), and
- Money for running costs (maintenance and operation of measures and staff salary).

Main components of the financial evaluation, under this objective, consist of:

- Identification of the financial internal rate of return (FIRR), comparing the incremental costs and potential revenues for the EMP,

- Formulation of cost recovery schedule for loan including interests and repayment in accordance with the financial plan, and
- Examination on viability and feasibility of the proposed financial plan, by calculating balance based on the cash flow.

23.3.1 FIRR Calculation

(1) Financial Conditions for Calculation

FIRR for the EMP was calculated, simply comparing the incremental costs and potential revenues, based on the following financial conditions :

1) Project life for financial evaluation is from 2000 to 2050 (51 years). This is because of the long repayment period and necessity of continuous O&M cost even after 2010 to maintain the 2010 the EMP goals.

2) All the costs for the EMP are free from any taxation obligation.

3) From 2010 on, the following environmental fees can be collected from local residents in Quang Ninh province as well as Vietnamese/foreign tourists, based on the average WTP identified through the questionnaire survey. It is assumed that population in Quang Ninh province and numbers of visitors to Ha Long bay are constant even after 2010.

Potential Environmental Fees Collected from Residents and Tourists in 2010

Sources	a. Average WTP (US$ / person)	b. Population/Visitors	c. Total Collected Fees (= a x b)
QN Residents	0.1	1,219,900	122,000
Vietnamese Tourists	0.3	605,000	182,000
Foreign Tourists	3.1	800,000	2,480,000

4) From 2010 on, the following wastewater fees can be collected from local residents in the study area, based on the average WTP for domestic wastewater treatment. It is assumed that the domestic wastewater volume is constant even after 2010.

Potential Wastewater Fees Collected from Residents in the Study Area in 2010

Items for Calculation	Estimation
a. Average WTP for domestic wastewater treatment	* VND 345 / m^3
b. Treated amount of domestic wastewater under the EMP	16,753,500 m^3
c. Foreign exchange rate in 1998	VND 13,200 / US$
d. Total collected fees (= a x b / c)	US$ 438,000

Note : * This figure is cited from "Ha Long City Water Supply & Sanitation Project, Sanitation Feasibility Study, Vol. IIIB" (April 1998)

5) Amount of these environmental fees and wastewater fees collected increases proportionally from 2000 to 2010.

6) Annual charge from 2010 to the industrial sector in the study area is calculated so that the total charges are slightly more than the total costs (US$ 61.6 million) necessary for the industrial wastewater and solid wastes management. The charges increase proportionally from 2001 to 2009.

7) The annual charge to VINACOAL is US$ 1,919,000 (= US$ 202 million x 0.95 x 0.01), which is calculated based on the total production cost of VINACOAL, assuming that its 95 % is generated within the study area and that its 1 % is contributed to the proposed environmental rehabilitation for coal mining activities. It is also assumed that the production cost is constant during the project life.

8) Since 2003 after completion of the construction of the proposed visitor center, the following entrance fees for the center are collected from tourists to the Ha Long bay area, assuming that all the predicted foreign and Vietnamese tourists enter into the center.

Predicted Tourists and Entrance Fees

Year	Predicted Tourists and Fees				Equation for Annual Revenue
	(1) Foreign	(2) Fee	(3) Vietnamese	(4) Fee	
2003	300,000	US$ 1	269,000	US$ 0.1	(1) × (2) + (3) × (4)
2004 ~ 2009	Proportional between 2003 and 2010		Proportional between 2003 and 2010		
2010 ~	800,000		605,000		

Note: 2000's data are used as tourists' figures for 2003, because predicted data for 2003 is not available.

(2) Calculated FIRR

The breakdown of costs and revenues accrued from the EMP are tabulated in Table 23.3.1 year by year. The revenues consist of environmental fees, wastewater

fees, charges to industrial sectors, charges to VINACOAL, and visitor center entrance fees. The total revenue (about US$ 350 million) between 2000 and 2050 overwhelms the total cost (about US$ 330 million) before discounting. Its FIRR is 0.54 %, which is much lower than the market interest rate in the country (7.5 %/year on US$ currency basis) authorized by the Vietnam National Bank (March 1999).

This low FIRR figure is not acceptable for usual commercial or productive projects carried out by profit-oriented enterprizes so that money should be invested to more profitable projects. However, all the measures and projects proposed under the EMP are for environmental conservation hardly generating monetary profits, and are implemented by non-profit public agencies. Therefore, from viewpoint of the public implementing agencies, the EMP could be regarded as is financially feasible, as its FIRR is over 0 % at least.

23.3.2 Cost Recovery Schedule and Balance Sheet for the EMP

The cost recovery schedules for the measures of the EMP are formulated as shown in Tables 23.3.2 ~ 23.3.8 in accordance with the financial plan proposed in Table 22.3.1 and the following financial conditions:

- Interest rate of donor's soft loan: flat rate of 1%
- Maximum repayment period of the donor's soft loan: 40 years (including 10-year grace period)
- Payment during the grace period: only interest payment
- Tax duty: all the costs for the EMP free from any taxation obligation
- Duration for cost recovery: 2000 ~ 2050 (51 years)

The schedules include interest, repayment, and O&M cost, all of which amount to the total cash outflow to be recovered. Grant portion is excluded from the cash outflow.

These cash outflows in the cost recovery schedules were compared with the potential revenues estimated in Table 23.3.1, as summarized in Table 23.3.9. It

shows that revenues through 2000 to 2050 will be enough to cover the cash outflow as a whole, summing up to more than US$ 25 million as a balance. Therefore, the proposed financial plan is appropriate to realize a sound financial management for the EMP.

23.4 Recommendations on Economic and Financial Aspects

23.4.1 Follow-up Study for Accurate Estimation of Environmental Benefits

Many assumptions are introduced for benefit calculation, which are identified in Tables 23.2.2 ~ 23.2.8, so that further basic study on social and natural science fields around the study area should be carried out to convert the assumed data to actually reliable ones. This basic study also has to include some additional questionnaire survey idealistically for all seasons in order to collect more reliable data and information on WTP.

23.4.2 Establishment of Environmental Bonds

In future legislative initiatives relating to liability under the Environmental Protection Law, a system of environmental bonds should be introduced which would ensure that, where liability arises, financial resources are immediately available for necessary environmental rehabilitation.

23.4.3 Promotion of Public Participation for Environmental Control

Public participation in the gathering of environmental information and its evaluation should be promoted to reduce the costs of implementation. Implementation of environmental controls can also be enhanced through public participation in pollution monitoring and in the formulation and implementation of local plans.

23.4.4 Appropriate Combination of Environmental and Economic Policies

The problem of financing pollution control investments should be considered in relation to the broader problem of financial sector reform and the need to increase

the access of non-state domestic enterprises to bank credit. Firms may be very reluctant to borrow money to finance pollution control investments unless the combination of environmental and economic policies favors such investments.

23.4.5 Control of the Fiscal Deficit

While a certain portion of funds can no doubt be financed from foreign borrowing, GOV should control the fiscal deficit in order to contain inflation and maintain capital prices that are conductive to the vigorous growth of private domestic investment. Given the competing demands on government resources, it will be critical that government expenditures for environmental protection be disciplined and, wherever possible, self-financing.

23.4.6 Special Arrangement to Finance the EMP

The central government should make a special arrangement so that all the proposed environmental fees and wastewater fees, to be collected from tourists to Ha Long bay and from local residents in the Quang Ninh province, can be used only for the EMP implementation.

TABLES

Table 23.2.1 Universal Value of Ha Long Bay as Natural and Cultural Properties

(1) Aesthetic Value
Ha Long is beautiful not only by the shape of its mountains, the color of its water, of the sky but also by the fine content of its name. Ha Long bay is a wonderful artistic work of the nature. It is a sophisticated coordination of sculpture and painting, of strength, grace and picturesqueness. Ha Long is not a static piece of art work but incessantly changes in its appearance and colors with the time. Its appearance is also changed when looked at from different angles, creating unusual scenarios, making visitors feel surprised. With regard to movies, Vietnamese and foreign cameramen from other countries such as Cuba, France, Japan, Hungary, Russia and Germany have made artistic documentary films on Ha Long. The system of grottos in multiform islands in the bay are really heavenly palaces in the world.
(2) Geological Value
Ha Long terrain comprises islands, mountains alternated with sea depressions which are salted flat expanses of mangroves, and abrupt limestone islands. This is a quite contradictory relief. The terrain is the most ancient one of the territory of North Vietnam. 18,000 years ago, the last glacier raised the ocean water level called the Flandrian marine transgression, drawing the plain of the bay into the sea and returning to the relief of mountain islands alternated with sea depressions. After the marine transgression reached the maximum level about 3,000 years ago, the sea gradually retreated and the present table level has been maintained. So the transformations of the earth's crust over 250 million years from the Hersinian orogency have left traces at different levels on the bay, in which the present relief of the bay is the most ancient remaining terrain of North Vietnam.
(3) Biological Value
The distinguishing features of Ha Long lie also in that it has a rich, rare precious fauna and flora, and may be considered a zoological and botanical garden. The formation of stone island forests in the bay turns it into a gigantic pond which suits the living conditions of many fish species. On the other hand, ephemera pouring from estuaries into the bay constitutes abundant feed for fish. Ha Long has many bird species in its tropical forests, such as leafbird, dove, pheasant, picus, halcyon, black-collared starling and little egret. The vegetation cover of the islands is quite diversified, including primitive and artificial forests, with precious woods and flower species.
(4) Cultural Value
So far, archaeologists have discovered traces of primitive man in Ha Long, from the Mesolithic age to the late Neolithic age. Today, according to archaeological research, it is still a symbol of an ancient culture, Ha Long culture. So there are archaeologists looking for a national cultural heritage. The outstanding characteristic of Ha Long culture is expressed by the presence of stone production instruments. With Ha Long culture, Vietnam becomes the meeting-place of many typical stone ax types. Carved images on Ha Long pottery have their own special style. Van Don, now belonging to Vai Hai archipelago, lying in the southeast of Ha Long, was the most ancient foreign trade seaport of Vietnam. For Vietnamese people, Ha Long bay is also a sacred and long-standing symbol of the country. Visiting Ha Long bay, travelers can see the remains left by primitive people at the last 20,000 years. Three famous prehistory cultures continuously developed in this landscape from the late Paleolithic age to early metal age. They are the Soi Nhu culture, Cai Beo culture and Ha Long culture.

Source: Ha Long Bay : A World Heritage, Quang Ninh province, 1995

Table 23.2.2 Benefit from Increase of Adequate Water Supply

Beneficial Function: Increase of adequate water supply

Qualitative Description

* The water that is consumed by coal mines and processing plants may be assumed to equal the value that the same water would have if it were used by the residents of each district for other purposes. For example, if a mining operation diverts one cubic meter per second from a stream that is used as a potable water supply, the value of water is equal to the cost of obtaining one cubic meter per second of water from another source. This cost would likely include construction of additional intakes, distribution piping and even pumping facilities for supplying the extra one cubic meter per second.
* If the mining operation diverts one cubic meter per second of irrigation water, the value of the water is equal to the value of crops which could not be produced as a result of the loss of the water.

Selected Evaluation Method and Typical Equation

Water supply for domestic use => Change in environmental quality => Human habitat => **Replacement Cost Method**

[Benefit related to domestic use]

= [Incremental supply of clean water] x [Supply cost per unit water volume]

= [Incremental supply of clean water] x [Unit cost for construction & operation of water supply intake]

Water supply for irrigation => Measurable change in production => Non distorted market prices => **Change in Productivity Method**

[Benefit related to irrigation] = [Incremental irrigated area] x [Amount of incrementally cultivated rice]

x [Unit market price of rice]

Data and Assumption

(a) Unit value of incremental water-supply through improved water retention at mine sites

= $ 25/ha/year = 0.0025 $/m2/year (1996 price)

(Source : Coastal and Marine Environmental Management for Ha Long Bay : Final Report, ADB, August 1996)

(b) Estimated mine wastewater generated in the study area in 2000 (Unit : m3)

Area	Wastewater in 2000
Hong Gai	6,972,000
Cam Pha	20,506,000
Total	27,478,000

(c) Estimated mine wastewater generated in the study area in 2010 (Unit : m3)

Area / Method	Wastewater in 2010
Hong Gai	8,244,000
Cam Pha	19,956,000
Total	28,200,000

(Source of b and c : IMSAT, 1999)

(d) Assumed depth of the retention land = 1.5 m

(e) Assumed wastewater volume to be treated under EMP in 2010 = c - b = 722,000 m3

(f) Predicted total pure bare land area within the sub-catchment having target coal mining sites for 2010 (Unit : ha)

Sub-catchment No.	6	9	11	12	14	Total
Gross Bare Land (including coal mining area)	2,776	1,043	498	294	2,529	7,140
Coal Mining Area	2,694	1,022	458	213	2,488	6,875
Pure Bare Land	82	21	40	81	41	265

(Source : Progress Report (2), March 1999)

(g) Assumed ratio of incremental irrigatable area within (f) = 20 % = 20 / 100 = 0.2

(h) Average local productivity of rice between 1995 and 1997 (Unit : kg/ha/yea about 2,800 kg/ha/year

City/Town/District	1995	1996	1997	Average among years
Ha Long City	2,840	2,940	3,010	2,930
Cam Pha Town	2,670	2,590	3,030	2,763
Yen Hung District	2,670	3,160	3,130	2,987
Hoanh Bo District	2,320	2,560	2,490	2,457
Average among places	2,625	2,813	2,915	2,784

(Sources : Planning Division of Agriculture & Rural Development of QNP, February 1999 ;
Annual Statistics 1996, QNP Statistics Department ; and
Statistical Data of Agriculture, Forestry and Fishery 1985 - 1995,
Statistical Publishing House, 1996)

(i) Price of rice in Ha Long and Cam Pha = VND 2,200 - 3,000 /kg on average 2,600 VND/kg (1997 price)

(Source : QNP Financial Department, 1998)

Applied Equation and Estimated Benefit

[Benefit related to domestic use in 2010]

= [Incremental supply of clean water] x [Supply cost per unit water volume]

= [Incremental supply of clean water] x [Unit-cost for construction & operation of water supply intake, etc.]

= a x e / d = 1,203 US$/year (1996 price)

[Benefit related to irrigation]

= [Incremental irrigated area] x [Amount of incrementally cultivated rice] x [Unit market price of rice]

= f x g x h x i = 385,840,000 VND/year (1997 price)

Total Benefit from Adequate Water Supply in 2010

30,473 US$/year (1998 price) = 402,243,160 VND/year

Using the financial data as such :

Year	1995	1996	1997	1998
Average General Commodity Price Index in Vietnam	102.5	102.9	103.2	104.0
Average Foreign Exchange Rate (VND/US$)	11,025	11,031	11,400	13,200

(Sources : Vietnam 1996 Statistic Yearbook ; Vietnam 1997 Statistic Yearbook ;
and Quang Ninh Post Office No.168)

Table 23.2.3 Benefit from Conserved Water Quality

Benefited Function: Conserved water quality

Qualitative Description

* The value of water quality can be assessed to be the incremental cost of treating the water so that it is suitable for downstream uses.
* The incremental cost can be calculated as the extra alum or lime, filter capacity, treatment plant operation costs, etc. needed to treat the excess pollutants, as compared with the quantities needed to treat the suspended solids that are naturally present in the water.
* Health expenditures and worker productivity costs are also associated with decreased water quality since the river is used by local populations as a source of fresh water for bathing, cooking and drinking. The incidence of morbidity and mortality inevitably increases as water quality deteriorates.

Selected Evaluation Method and Typical Equation

Conserved water quality => Change in environmental quality => Water quality => Replacement Cost Method

[Benefit from pollutant abatement]

= [Reduced water pollutants] x [Unit cost for construction & operation of water filter plant to remove the pollutants]

Conserved water quality => Change in environmental quality => Water quality => Health effects => Sickness => Loss of Earnings Method

[Benefit due to reduced patients] = [Reduced incidence of sickness] x [(Cost of treatment) + (Lost wage)]

Conserved water quality => Change in environmental quality => Water quality => Health effects => Death => Human Capital Method

[Benefit due to reduced death] = [Reduced incidence of death] x [Value of life]

Data and Assumption

(a) Run off Water Pollution Loads into the Ha long Bay in 2010 without EMP

Pollutant	BOD	COD	Suspended Solids (SS)	Total Nitrogen (T-N)	Total Phosphorus (T-P)
Loads (kg/day)	12,930	30,230	272,200	19,960	6,750

(b) Run off Water Pollution Loads into the Ha long Bay in 1996-97

Pollutant	BOD	COD	Suspended Solids (SS)	Total Nitrogen (T-N)	Total Phosphorus (T-P)
Loads (kg/day)	7,220	21,880	241,000	15,530	6,040

(Source of a and b : Progress Report (2), March 1999)

(c) Pollutant abatement in 2010 necessary to conserve the 1996/97 water quality level of the Ha Long Bay = (a) - (b)

Pollutant	BOD	COD	Suspended Solids (SS)	Total Nitrogen (T-N)	Total Phosphorus (T-P)
Loads (kg/day)	5,720	8,350	31,200	4,430	710

(d) Patients of water related diseases in Ha Long city and Cam Pha town in 1997 = 2,232 persons/year

(Source : QNP Health Department, August 1998)

(e) Total population of Ha Long city and Cam Pha town in 1996 = 291,889 persons

(f) Predicted total population of Ha Long city and Cam Pha town in 2010 = 571,877 persons

(Source of e and f : Table 13.3.1, Interim Report of JICA Study, December 1998)

(g) Predicted patients of water related diseases in Ha Long city and Cam Pha town in 2010 with EMP implementation = d x f / e = 4,373 persons/year

(h) Average increase ratio of run off water pollution loads into the Ha Long bay between 1996/97 and 2010 without EMP implementation

Pollutant	BOD	COD	SS	T-N	T-P	Average
Increase Ratio = a / b	1.79	1.38	1.13	1.29	1.12	1.34

(i) Predicted patients of water related diseases in Ha Long city and Cam Pha town in 2010 without EMP implementation = g x h = 5,860 persons/year

(j) Assumed average days of hospitalization of the patients = 7 days/patient

(k) Assumed average visits to doctors for medical treatment = 4 visits/patient

(l) Average cost for hospitalization around Ha Long City = 410,000 VND/day (1998 price)

(m) Average medical treatment cost in the province = 25,000 VND/visit (1998 price)

(n) Average wage rate around Ha Long city = 410,000 VND/month (1998 price) (or VND 4,750/hour)

(Source for l – n : QNP Financial Department, 1998)

(o) Ratio of labor force (over 15 years old) of the patients = 47.7 % = 47.7 / 100 = 0.477 (in 1998)

(p) Rate of death out of water related diseases patients = 0.13 % = 0.13 / 100 = 0.0013 (in 1998)

(Source of o and p : QNP Health Department, Feb.1999)

(q) Average Unit Cost to Abate Water Pollution Load through Simple Treatment Facilities (in 1998 price)

Pollutant	BOD	COD	Suspended Solids (SS)	Total Nitrogen (T-N)	Total Phosphorus (T-P)
Cost (US$/kg)	4	9	0.004	6	49

(Sources : Adjusted for Vietnamese economic situation taking account of different foreign exchange rates, commodity price levels and domestic product levels, based on data from the studies on treatment costs for rural area (1995), Kiwa lake (1992) in Japan and the Min river in China (1997) as well as "Coastal and Marine Environmental Management for Ha Long Bay : Final Report", ADB, August 1996)

(r) Vietnamese life value = Average life value in developed countries x 10 % accounting different GDP = 5,454,961,793 VND/life (1998 price)

Source	Life Value in Developed Countries	Value in 1998 VND price
1. WB/ADB (1994)	4,500,000 US$/life (1991 price)	56,548,440,000 VND/life
2. World Bank (1995)	3,000,000 US$/life (1992 price)	34,008,000,000 VND/life
3. Small and Kazimi (1995)	6,550,000 US$/life (1994 price)	73,992,413,293 VND/life
Average		54,849,617,931 VND/life

(Sources : 1. Economic Analysis of Environmental Impacts, ADB/WB, 1994
2. The Cost of Inaction : Valuing the Economy-wide Cost of Environmental Degradation in India, WB, 1995
3. Small and Kazimi, On the Costs of Air Pollution from Motor Vehicles, Journal of Transport Economics and Policy, Vol. 29)

(s) Reduction rate of water related diseases through improved water supply and sanitation = 25 % = 25 / 100 = 0.25

(t) Reduction rate of water related deaths through improved water supply and sanitation = 65 % = 65 / 100 = 0.65

(Source of s and t : WHO studies in 1991, The Cost of Inaction : Valuing the Economy-wide Cost of Environmental Degradation in India, WB, 1995)

(u) Recovered mangrove area under EMP implementation in 2010 = 1,320 ha

(v) Pollutant Abatement capacity of Well Preserved Natural Wetlands (Mangroves) in Ha Long Bay

1. Exchanged water volume at wetland = 1.3 m³/ha/day =	1,300 l/ha/day			
Pollutant	BOD	SS	T-N	T-P
2. Range of Content in Bay (mg/l)	0.1 - 2.2	10 - 81	28 - 62	11 - 24
3. Average Content in Bay (mg/l)	0.8	45	45	15
4. Range of Abatement Rate (%)	30 - 70	60 - 80	20 - 60	40 - 80
5. Average Abatement Rate (%) / 100	0.5	0.7	0.4	0.6
6. Abatement Amount (kg/ha/day) = 1 x 3 x 5)	0.052	4.095	2.34	1.17

(Source : Task and Data Requirements of Land Uses and Reclamation Study, HIO, 1997)

(w) It is assumed that loads of COD, T-N and T-P are also reduced together with BOD abatement in a similar rate. So abatement cost for COD, T-N and T-P are ignored to prevent multiple counting.

Applied Equation and Estimated Benefit

[Benefit from pollution abatement]

= [Reduced water pollutants] x [Unit cost for construction & operation of water filter plant, etc. to remove the pollutants]

= (c x q + u x Item 6 of v x q) x 365 day (Only for BOD and SS) = 8,504,858 US$/year (1998 price)

[Benefit due to reduced patients]

= [Reduced incidence of sickness] x [(Cost of treatment) + (Lost wage)]

= (i - g) x s x (j x l + k x m + o x j x n / 25 days) = 1,115,730,004 VND/year (1998 price)

[Benefit due to reduced death]

= [Reduced incidence of death] x [Value of life] = (i - g) x t x p x r = 6,891,936,767 VND/year (1998 price)

Total Benefit from Conserved Water Quality in 2010

9,111,500 US$/year (1998 price) = 120,271,796,120 VND/year (1998 price) (VND 13,200/US$)

Table 23.2.4 Benefit from Strengthened Erosion and Flood Control Capacity

Beneficial Function	Strengthened erosion and flood control capacity
Qualitative Description	• Coal mining contributes to increased flooding in two ways. First, tree cutting, removal of overburden and other land disturbance reduces the water holding capacity of the soil, causing larger peak flows of drainage after rain storms. Second, the sediment that erodes from the disturbed land fills the beds of rivers, allowing flood water to rise above the river banks. The value of flood damage resulting from coal mining is the incremental amount of increased flooding, or decreased flood control capacity, that is caused by the mining activities. • The incremental amount may be determined by comparison to conditions in undisturbed catchment areas that have similar topography, soil types, and rainfall patterns. For example, the incremental flooding for a stream in a catchment area in Cam Pha town can be determined by comparison with a stream of similar morphology in an undisturbed catchment area in Tien Yen district. The amount of siltation of the river channel and flooded land in Cam Pha town, that is greater than the naturally-caused amount in Tien Yen, may be attributed to mining activities. • When land and buildings are damaged, the measure of damage should be calculated as the cost to restore them to their original condition. The cost may include removal of mud and dust, repairing of buildings, paddy dikes and other improvements to the land, the cost of finding temporary accommodation while the buildings are being repaired. Roads, bridges, pipelines, electrical power lines and other public infrastructure can be damaged by mud slides and flooding associated with development such as mining activities. The value of the damage in these cases can be calculated as cost to rebuild or relocate the damaged infrastructure. • The loss of revenue from lost farm production is a value of the strengthened erosion- and flood-control capacity when paddy land is covered by mud slides.
Selected Evaluation Method and Typical Equation	Strengthened erosion and flood control capacity => Change in environmental quality => Human habitat => **Replacement Cost Method** [Benefit due to reduced damage] = [Reduced cost to rehabilitate damages due to mud-slide and flooding] = [Cost to restore damaged land & building] + [Cost to remove mud & water] + [Repair cost of paddy dikes] + [Cost to rebuild or relocate damaged infrastructure] + [Other expenditure in rehabilitation] Strengthened erosion and flood control capacity => Measurable change in agricultural production => Non-distorted market prices => **Change in Productivity Method** [Benefit related to agriculture] = [Agricultural area protected from erosion] x [Incremental products] x [Unit market price of product]
Data and Assumption	(a) It is assumed that during the heavy rain storm, erosion of soil from several deforested areas including overburden dumping site resulted in heavy siltation of the river, clogging of water-supply intakes, and severely damages on local houses and roads. Deforested catchment area has raised the river bed below to the small stream junction, and has resulted in much greater quantities of runoff during heavy rain storms. Then, it contributes to flooding on some agricultural land. (b) Average occurrence of the heavy rain storms like (a) between 1995 and 1997 = 2 events/year (Source of b,c,e,h and r : Sub-department of Calamity Prevention and Dyke Management of QNP, February 1999) (c) Average number of water-supply intakes damaged by storms in the study area between 1995 and 199 12 intakes/event (d) Estimated average repair-work cost for intakes = 15,000,000 VND/intake (1997 price) (Source : Sample Methods for Estimating Environmental Damages for the Coal Mining Industry in Quang Ninh Province, a seminar material, UNDP/VINACOAL, June 1998) (e) Average number of houses totally damaged by storms in the study area between 1995 and 1997 = 113 houses/event (f) Assumed average area of the damaged houses = 80 m2/house (g) Average unit price for housing construction (in 1996 price) (Source : Ha Long City Water Supply and Sanitation Project : Sanitation Feasibility Study, Vol.IIB : EIA for Proposed Waste Water Treatment Sites, DANIDA, April 1998) (h) Average length of roads totally damaged by storms in the study area between 1995 and 1997 = 6 km/event (i) Average total cost of road relocation = 50,000 $/km (1996 price) (Source : Coastal and Marine Environmental Management for Ha Long Bay : Final Repon, ADB, August 1996) (j) Average exchange rate in 1996 = 11,031 VND/US$ (k) General commodity price index in end 1996 (when 100 for 1992) = 102.9 (l) General commodity price index in end 1997 (when 100 for 1992) = 103.2 (Source for j ~ l : Quang Ninh Post Office Services No.108, August 1998) (m) Predicted suspended solids into the Ha long Bay in 2010 without EMP implementation = 272,200 kg/day (n) Suspended solids into the Ha long Bay in 1996/97 = 241,000 kg/day (Source of m and n : Progress Report (2), March 1999) (o) Suspended solids reduction in 2010 necessary to conserve the 1996/97 water-quality level of the Ha Long Bay = m - n = 31,200 kg/day (p) Incremental extent of erosion and flood in 2010 without EMP implementation = m / n = 1.13 times (q) Assumed reduction rate of soil erosion and flood like (a) in 2010 due to watershed management including replantation = o / m = 0.11 (r) Average paddy area totally damaged by storms in the study area between 1995 and 1997 = 869 ha/event (s) Average local productivity of rice between 1995 and 1997 = about 2,800 kg/ha/year (Sources : Planning Division of Agriculture & Rural Development of QNP, February 1999 ; Annual Statistics 1996, QNP Statistics Department ; and Statistical Data of Agriculture, Forestry and Fishery 1985 ~ 1995, Statistical Publishing House, 1996) (t) Average price of rice in Ha Long and Cam Pha = VND 2,200 ~ 3,000 /kg on average 2,600 VND/kg (1997 price) (Source : QNP Financial Department, 1998)
Applied Equation and Estimated Benefit	[Benefit due to reduced damage] = [Reduced cost to rehabilitate damages due to mud-slide, flooding, etc.] = [Cost to restore damaged land & building] + [Cost to remove mud & water] + [Repair cost of paddy dikes] + [Cost to rebuild or relocate damaged infrastructure] + [Other expenditure in rehabilitation] = [h x (c x d x k / l + e x f x g + h x i x j)] x p x q = 2,153,914,339 VND/year (1996 price) [Benefit related to agriculture] = [Agricultural area protected from erosion] x [Incremental products] x [Unit market price of product] = (h x r x s x t) x p x q = 3,572,723,152 VND/year (1997 price)
Total Benefit from Strengthened Erosion and Flood Control Capacity in 2010	284,989 US$/year (1998 price) = 3,761,854,467 VND/year Using the financial data as such :

Year	1995	1996	1997	1998
Average General Commodity Price Index in Vietnam	102.5	102.9	103.2	104.0
Average Foreign Exchange Rate (VND/US$)	11,025	11,031	11,400	13,200

(Sources : Vietnam 1996 Statistic Yearbook ; Vietnam 1997 Statistic Yearbook ; and Quang Ninh Post Office No.108)

Table 23.2.5 Benefit from Conserved Air Quality

Beneficial Function	Conserved air quality
Qualitative Description	• Dust is the most significant air quality problem resulting from coal mining. Dust damages local human health, and covers roads and building. The decreased value of air quality is the value of income losses and the cost to sweep dust from roads and buildings. Not all dust is caused by mining though. Some dust occurs naturally, some is due to other industries, and some is caused by farming.
Selected Evaluation Method and Typical Equation	Improved air quality => Change in environmental quality => air quality => **Replacement Cost Method** [Benefit due to reduced damage] = [Reduced cost to rehabilitate physical damages due to air pollution] = [Cost to sweep dust from roads and buildings]+ [Cost to rebuild or relocate damaged public goods] + [Other expenditure in rehabilitation] Improved air quality => Change in environmental quality => Air quality => Health effects => Sickness => **Loss of Earnings Method** [Benefit due to reduced patients] = [Reduced incidence of sickness] x [(Cost of treatment) + (Lost wage)] Improved air quality => Change in environmental quality => Air quality => Health effects => Death => Human Capital Method [Benefit due to reduced death] = [Reduced incidence of death] x [Value of life] Improved air quality => Measurable change in agricultural production => Non distorted market prices => **Change in Productivity Method** [Benefit related to agriculture] = [Agricultural area protected from air-pollutants] x [Incremental products] x [Unit market price of product]
Data and Assumption	(a) Assumed total expenditure to be spent to sweep the constant truck-traffic roads in Cam Pha town = 6,000,000 VND/year (1998 price) (b) Assumed total expenditure to be spent to clean dust on the walls of public buildings in Cam Pha town 4,000,000 VND /year (1998 price) (Source of a and b : Sample Methods for Estimating Environmental Damages for the Coal Mining Industry in Quang Ninh Province, a seminar material, UNDP/VINACOAL, June 1998) (c) Assumed decremental rate of the coal-related truck traffic through the environmental regulation = 0.1 (10 %) (d) Assumed decremental rate of the dust from coal mining area by means of revegetation = Item 3 / Item 0.31 (31 %)
	(Source : Progress Report (2), March 1999)
	(e) Patients of respiratory diseases in Ha Long city and Cam Pha town in 1997 = 4,624 persons/year (Source : QNP Health Department, August 1998)
	(f) Total population of Ha Long city and Cam Pha town in 1996/97 = 291,889 persons (g) Predicted total population of Ha Long city and Cam Pha town in 2010 = 521,877 persons (h) Coal mining production in 1997 (Hong Gai and Cam pha) = 7,720,000 tons (i) Predicted coal mining production in 2010 (Hong Gai and Cam Pha) = 11,750,000 tons (Sources of f ~ i : Progress Report (2), March 1999 ; IMSAT, 1999 ; and production data by Pham et al. 1997) (j) Increase ratio of air-pollution loads between 1997 and 2010 without EMP implementation = i / h 1.52 (k) Predicted patients of air-related diseases in Ha Long city and Cam Pha town in 2010 with EMP implementation = e x g / f = 9,059 persons/year (l) Predicted patients of air-related diseases in Ha Long city and Cam Pha town in 2010 without EMP implementation = j x k = 13,770 persons/year (m) Assumed average days of hospitalization of the patients = 7 days/patient (n) Assumed average visits to doctors for medical treatment = 4 visits/patient (o) Average cost for hospitalization around Ha Long City = 410,000 VND/day (1998 price) (p) Average medical treatment cost in the province = 25,000 VND/visit (1998 price) (q) Average wage rate around Ha Long city = 410,000 VND/month (1998 price) (or VND 1,750/hour) (Source for o ~ q : QNP Financial Department, 1998) (r) Ratio of labor force (over 15 years old) of the patients = 60.9 % = 60.9 / 100 = 0.609 (in 1998) (s) Rate of death out of air-related diseases patients = 0.35 % = 0.35 / 100 = 0.0035 (in 1998) (Source of r and s : QNP Health Department, Feb.1999)
	(t) Assumed reduction rate of rice production due to dust from coal mining industry = 0.08 % = 0.08 / 100 0.0008 (Source : Van der Eerden, 1987)
	(u) Assumed affected area of paddy land along the road under the situation like (t) = 0 ha (Source : QNP Transportation Department, Feb.1999)
	(v) Average local productivity of rice between 1994 and 1996 = about 2,800 kg/ha/year (Sources : Planning Division of Agriculture & Rural Development of QNP, February 1999 ; Annual Statistics 1996, QNP Statistics Department ; and Statistical Data of Agriculture, Forestry and Fishery 1985 ~ 1995, Statistical Publishing House, 1996)
	(w) Average price of rice in Ha Long and Cam Pha = VND 2,200 ~ 3,000 /kg on average 2,600 VND/kg (1997 price) (Source : QNP Financial Department, 1998)
	(y) Vietnamese life value = Average life value in developed countries x 10 % accounting different GDP : 5,484,961,793 VND/life (1998 price) (Sources : ADB/WB, 1994 ; WB, 1995 ; and Small and Kozlaki,1995)
Applied Equation and Estimated Benefit	[Benefit due to reduced damage] = [Reduced cost to rehabilitate physical damages due to air pollution] = [Cost to sweep dust from roads and buildings] + [Cost to rebuild or relocate damaged public goods] + [Other expenditure in rehabilitation] = a x c + b x d = 1,840,000 VND/year (1998 price) [Benefit due to reduced patients] = [Reduced incidence of sickness] x [(Cost of treatment) + (Lost wage)] = (l - k) x (m x o + n x p + r x m x q / 25) = 14,321,031,685 VND/year (1998 price) [Benefit due to reduced death] = [Reduced incidence of death] x [Value of life] = (l - k) x s x y x c = 9,043,879,253 VND/year (1998 price) [Benefit related to agriculture] = [Agricultural area protected from air-pollutants] x [Incremental products] x [Unit market price of product] = (u x v x w) x t = 0 VND/year (1997 price)
Total Benefit from Conserved Air Quality in 2010	1,770,208 US$/year (1998 price) 23,366,750,338 VND/year (VND 13,200/US$)

Table 23.2.6 Benefit from Conserved Aesthetic and Recreational Amenity

Beneficial Function	Conserved aesthetic and recreational amenity
Qualitative Description	* The value of the aesthetic quality and recreational amenity is difficult to calculate in monetary terms, because it depends on the subjective preference of each individual person. One approach to assigning a monetary value to beauty and amenity is to estimate how much the people living in an area would pay to preserve them (willingness to pay, WTP). The cumulative regional WTP can be interpreted to be equal to the overall value of restoring the aesthetic quality and amenity. It is likely that many people in the Quang Ninh province would be willing to pay some small amount to preserve these environmental qualities. * In addition, it is likely that the thousands of Vietnamese and international tourists who visit the Ha Long bay area each year would also be willing to pay some small amount of money such as a surcharge on hotel room rates for preserving the aesthetic quantities of the region. The cumulative WTP of all the households and tourists in Quang Ninh would be a large value. * Tourism accounts for a high percentage of the trade of goods and services in Ha Long city. By far the majority of tourists visiting Ha Long bay can be classified as "Adventure and Ecotourists", they come to enjoy the natural landscape of the bay. Apart from cruising through the islands, Ha Long bay offers little in the way of ecotourism activities.
Selected Evaluation Method and Typical Equation	Conserved aesthetic and recreational amenity => Change in environmental quality => Aesthetics => Contingent Valuation Method [Non-use benefit including existence value] = [Average WTP of non use value of local households] x [Number of local households] + [Average WTP of non use value of tourists] x [Number of tourists] Conserved aesthetic and recreational amenity => Change in environmental quality => Recreation => Contingent Valuation Method [Use-benefit] = [Average WTP of use value of local households] x [Number of local households] + [Average WTP of use-value of tourists] x [Number of tourists]
Data and Assumption	(a) Predicted population of the whole Quang Ninh Province in 2010 = 1,219,900 persons (Source : Urban Development Plan in Quang Ninh Province 1995~2010, 1995) (b) Predicted number of Vietnamese tourists to the study area in 2010 = 605,000 persons (c) Predicted number of foreign tourists to the study area in 2010 = 800,000 persons (Source of b and c : estimated from data of QNP Tourism Department, February 1999) (d) Average household (HH) member of Quang Ninh province = 4.2 persons/HH (e) Average household (HH) member of Vietnamese tourists = 4.6 persons/HH (f) Average WTP of QNP resident household for conserved amenity existence of the study area = 0.3 US$/HH/year (1998 price) (g) Average WTP of Vietnamese tourist household for conserved amenity existence of the study area = 1.2 US$/HH/year (1998 price) (h) Ratio of the QNP households which put existence value to the conserved amenity in the study area = 0.53 (53 %) (i) Average household (HH) member of foreign tourists = 3.5 persons/HH (j) Average WTP of foreign tourists for conserved amenity existence of the study area = 6.2 US$/HH/year (1998 price) (k) Ratio of the Vietnamese tourist households which put existence value to the conserved amenity in the study area = 0.21 (21 %) (l) Ratio of the foreign tourist households which put existence value to the conserved amenity in the study area = 0.14 (14 %) (m) Average WTP of QNP resident household for use of the conserved amenity of the study area = 1.1 US$/HH/year (1998 price) (n) Average WTP of Vietnamese tourist household for use of the conserved amenity of the study area = 1.0 US$/HH/year (1998 price) (o) Ratio of the QNP households which put use value to the conserved amenity in the study area = 0.30 (30 %) (p) Average WTP of foreign tourists for use of conserved amenity of the study area = 12.5 US$/HH/year (1998 price) (q) Ratio of the Vietnamese tourist households which put use value to the conserved amenity in the study area = 0.53 (53 %) (r) Ratio of the foreign tourist households which put use value to the conserved amenity in the study area = 0.61 (61 %) (Source of d ~ r : estimated data based on the results of "Questionnaire Survey on Willingness to Pay for Environmental Value", JICA study team, January 1999) (s) It is assumed that all the tourists visit Ha Long bay region with their families. (t) It is assumed that the same ratio of population in Hanoi as item (k) has the same WTP for the existance value as item (g), at least. (u) Estimated population in Hanoi as of 2010 = 2,820,000 persons
Applied Equation and Estimated Benefit	[Non-Use Benefit including Existence Value in 2010] = [(Average willingness-to-pay of non-use value of local households) x (Number of local households)] + [(Average willingness-to-pay of non-use value of tourists) x (Number of tourists)] = f x h x a /d + g x k x b / e + j x l x c / i + g x k x u / e = 432,212 US$/year (1998 price) [Use-Benefit in 2010] = [(Average willingness-to-pay of use-value of local households) x (Number of local households)] + [(Average willingness-to-pay of use-value of tourists) x (Number of tourists)] = m x o x a / d + n x q x b / e + p x r x c / i = 1,908,413 US$/year (1998 price)
Total Benefit from Conserved Aesthetic and Recreational Amenity in 2010	2,340,625 US$/year (1998 price) = 30,896,254,140 VND/year (VND 13,200 US$)

Table 23.2.7 Benefit from Improved Forestry Resources

Beneficial Function	Improved forestry resources
Qualitative Description	* Forests provide several valuable qualities, including wood products, flood control by stabilizing soil, aesthetic quality and habitat for wildlife. Potential methods for calculating the value of the loss of flood control and aesthetic quality are mentioned in EMP Benefits (3) and (5). The value of wildlife habitat can be considered to be an aesthetic quality, similar to the value of a scenic view or a clear river. * The value of loss of timber and other wood products can be estimated as the overall income that would be derived from harvesting, processing and selling the products on a sustainable basis. This income can be estimated by comparing the income from sustainable logging on land of similar area, tree types, proximity to roads and factories, etc. in a district where development such as mining does not occur.
Selected Evaluation Method and Typical Equation	Improved forestry resources => Measurable change in production => Non distorted market prices => **Change in Productivity Method** [Benefit of forest resources] = [Incremental forest land] x [Amount of incremental forest goods] x [Unit market price of rice]
Data and Assumption	(a) Incremental reforested land for watershed management and mining site rehabilitation for the overall environmental management of the study area in 2010 = 5,430 ha

Measures under EMP	Reforested Land (ha)
Tree planting sites for mining	2,730
Reforestation for natural resources (excluding mangrove)	2,700
Total incremental reforested land (= with EMP - without EMP)	5,430

(b) Assumed growth duration of trees to have commercial value = 15 years

(c) Assumed rate of commercial selling of forests = 1 / b = 6.7 % / year = 6.7 / 100 = 0.067 /year

(d) Assumed commercial value of forest goods = 77,212 VND/m^3 (1994 price)

Data for Quang Ninh province	1995	1996	Average
Wood-cutting production (m3)	36,000	36,874	36,437
Wood production value (VND in 1994 price)	2,851,000,000	2,774,000,000	2,812,500,000
Unit value of wood production (VND/m3)	79,194	75,229	77,212

(Sources : Annual Statistics 1996, QNP Statistics Department ;
Statistical Data of Agriculture, Forestry and Fishery 1985 ~ 1995, Statistical Publishing House, 1996)

(e) Average volume of reforested land = 40 m^3/ha

Forest Type	Low (m^3/ha)	High (m^3/ha)	Average (m^3/ha)
Sonneratia forest	14	23	18.5
Rhizophora forest	57	66	61.5
Overall average			40

(Source : Papers for National Workshop on the Relationship between Mangrove Rehabilitation and Coastal Aquaculture in Vietnam, CRES, Hue University and ACTMANG, 1997)

Applied Equation and Estimated Benefit	[Benefit of forest resources] = [Incremental forest land] x [Amount of incremental forest products] x [Unit market price of forest products] = a x c x d x e = 1,118,026,887 VND/year (1994 price)
Total Benefit from Improved Forestry Resources in 2010	86,785 US$/year (1998 price) = 1,145,564,495 VND/year (VND13,200/US$)

Table 23.2.8 Benefit from Conserved Fishery Resources

Beneficial Function: Conserved fishery resources

Qualitative Description

- Siltation of river beds, coastal mangrove areas, sea grass beds and other fish habitat is the main source of environmental damage that the coal industry causes to fishery resources. Overburden dumps and waste coal storage piles erode during heavy rain, and the sediment drains into these sensitive aquatic areas, decreasing their ability to support fish life. The value of the damage to fishery resources may be estimated as the loss of fishing income caused by the siltation of fish habitat. Acid drainage with low pH from mines can also harm fish life. But, in the Quang Ninh coal mining region, siltation causes a much greater harm.
- The loss of fishing income may be estimated directly or indirectly. If historical records are available, it may be possible to directly estimate the reduction in fishing income. For example, income from fishing in a particular area in 1988 could be compared with the income in the same area in 1998. But these results may be unreliable because such factors as the affect of improved fishing techniques and boats, increase in the sale price of fish, and increases in the number of people who work in the fishing industry must all be considered. In addition, this direct estimate may unfairly bias against the coal industry, because other factor such as over harvesting and pollution from other industries may have contributed to the decline in fishing.
- Consequently, an indirect method of comparison would probably give better results. Siltation that is caused by the coal industry can be isolated from other factors by comparing present day fishing revenues in an estuary that is polluted by drainage from a mine or coal processing plant with revenues from a nearby estuary that is not.

Selected Evaluation Method and Typical Equation

Conserved fishery resources => Measurable change in production => Non distorted market prices => **Change in Productivity Method**

[Benefit of fishery resources] = [Conserved water area] x [Amount of incrementally caught fish and marine products] x [Unit market price of such fishery products]

Data and Assumption

(a) Average market price of fish and shellfish produced from mangrove area

Fish Product	Source 1	Source 2	Average
Fish (VND/kg in 1998 price)	12,631	10,107	11,370
Shellfish (VND/kg in 1998 price)	---	10,107	10,107

(b) Average productivity of fish from mangrove area

Fish Production	Source 1	Source 2	Average
(kg/ha)	50	300	175

(Sources of a and b : 1. N.H. Tri et al, Issues in the Economic Valuation of Mangrove Restoration in Vietnam, Mangrove Economic Research Center in Hanoi and CSERGE, University of East Anglia, 1996
2. Task and Data Requirements of Land Uses and Reclamation Study, HIO, 1997)

(c) Average productivity of shellfish in mangrove

Shellfish / Place	Tuan Chau	Cua Luc	Vuon Qua	Bai Chay	Cong Tay	Average
Crustacean (kg/ha)	76	21	225	5	432	152
Mollusks (kg/ha)	92	33	135	450	328	208
Total (kg/ha)	168	54	361	455	760	360

(Source : Task and Data Requirements of Land Uses and Reclamation Study, HIO, 1997)

(d) Average market price of fish caught in ocean

Place	Hanoi	HCM city	Average
Fish (VND/kg in 1998 price)	11,500	10,000	10,750

(Source : Vietnam News, August 1998)

(e) Estimated productivity of fish caught in the Ha Long bay = 4,500,000 kg/year
(Source : Fishery Department of QNP, June 1998)

(f) Recovered mangrove area under EMP implementation in 2010 = 1,320 ha

(g) Estimated ratio of negatively effected fish habitat in the Ha Long bay in 2010 without EMP = 0.443 (44.3 %)
(Source : Estimation based on a simple model in "Ecological Study for Chubu International Airport", Japan, 1998)

(h) Suspended solids load into the Ha Long bay in 1996/97 = 241,000 kg/day

(i) Predicted suspended solids load into the Ha Long bay in 2010 without EMP implementation = 272,200 kg/day
(Source of h and i : Progress Report (2), March 1999)

(j) Assumed decrease rate of fishery catch from the Ha Long bay in 2010 without EMP implementation
= g x (i - h) / h = 0.057 (5.7 %)

Applied Equation and Estimated Benefit

[Benefit of fishery resources]
= [Improved or conserved water area] x [Amount of incrementally caught fish and marine products] x [Unit market price of such fishery products]
= (a x b + a x c) x f + d x e x j) = 10,181,368,003 VND/year (1998 price)

Total Benefit from Conserved Fishery Resources in 2010

771,316 US$/year (1998 price) = 10,181,368,003 VND/year (VND 13,200 / US$)

Table 23.2.9 Sumary Result of Environmental Benefit Calculation

Benefit Item	Direct EMP Measures	Major Effect	Evaluation Method	Benefit in 2010 (in 1998 price) VND mil./year	US$ 1,000/year	%
1. Increase of Adequate Water Supply	Drainage system improvement of coal mining & processing	Treated wastewater of 0.7 mil. m3/year	Replacement cost	13.4	1.0	
		Incremental paddy irrigatable area of 53 ha/year	Change in productivity	388.8	29.5	
		Subtotal		402.2	30.5	0.2
2. Conserved Water Quality	Wastewater management, sanitation program, and mangrove reforestation	Abated BOD (5,720 kg/day) and SS (31,200 kg/day), and incremental mangrove of 1,320 ha	Replacement cost	112,264.7	8,504.9	
		25 % reduction of potential 1,487 water-related patients/year	Loss of earnings	1,115.7	84.5	
		65 % reduction of about 2 potential water-related deaths/year	Human capital	6,891.9	522.1	
		Subtotal		120,272.3	9,111.5	63.3
3. Strengthened Erosion & Flood Control Capacity	Revegetation and drainage system improvement of coal mining & processing, river & reservoir rehabilitation, and reforestation	11 % reduction of heavy storm damages on intakes, houses and roads	Replacement cost	2,176.9	164.9	
		11 % reduction of heavy storm damages on potential 870 ha paddy land	Change in productivity	1,584.9	120.1	
		Subtotal		3,761.8	285.0	2.0
4. Conserved Air Quality	Revegetation of coal mining, and dust control of coal processing & transportation	10 % reduction of dust damage on roads, and 31 % reduction of dust damage on buildings	Replacement cost	1.8	0.1	
		Prevention of potential 4,711 air-related patients/year	Loss of earnings	14,321.1	1,084.9	
		10 % reduction of about 16 potential air-related deaths/year	Human capital	9,043.9	685.1	
		Subtotal		23,366.8	1,770.2	12.3
5. Conserved Aesthetic & Recreational Amenity	Solid waste management, tourism management, environmental management of world heritage area, and landscape protection	Conservation of non-use value of local residents, local tourists and foreign tourists ($ 0.3, 1.2 and 6.2/HH/year, respectively)	Contingent valuation	5,705.0	432.2	
		Conservation of use value of QN residents, local tourists and foreign tourists ($ 1.1, 1.0 and 12.5/HH/year, respectively)	Contingent valuation	25,190.9	1,908.4	
		Subtotal		30,895.9	2,340.6	16.3
6. Improved Forestry Resources	Revegetation of coal mining, and reforestation of forest land	2,730 ha tree planting for mining, and 2,700 ha natural reforestation	Change in productivity	1,145.6	86.8	0.6
7. Conserved Fishery Resources	Wastewater management, and mangrove reforestation	1,320 ha recovered mangrove area, and prevention of 5.7 % reduction of potential fishery products	Change in productivity	10,181.4	771.3	5.4
		Grand Total		190,026.1	14,395.9	100.0

Table 23.2.10 Result of Cost Benefit Analysis

No.	Year	Incremental Cost of EMP (US$)							Incremental Benefit of EMP (US$)								Net Benefit
		Wastewater	Solid Waste	Cost Mgmt.	Tourism	Environmental Resources	Monitoring	Institution	Total Cost	Water Supply	Water Quality	Erosion & Flood	Air Quality	Aesthetic & Amenity	Forestry	Fishery	Total Benefit	
0	2000	2,250,000	0	2,192,000	79,000	96,000	120,000	666,000	5,363,000	0	0	0	0	0	0	0	0	-5,363,000
1	2001	3,402,000	677,000	2,791,000	241,000	293,000	15,000	807,000	8,224,000	3,050	911,150	28,500	177,020	238,000	8,660	77,180	1,443,560	-6,780,440
2	2002	4,860,000	800,000	4,302,000	308,000	211,000	30,000	2,224,000	15,735,000	6,100	1,822,300	57,000	354,040	404,120	17,360	154,260	2,815,180	-12,919,820
3	2002	6,885,000	800,000	4,302,000	308,000	211,000	30,000	2,224,000	15,760,000	6,100	1,822,300	85,500	531,060	707,140	26,040	231,390	4,318,730	-11,441,270
4	2003	11,770,000	2,511,000	2,656,000	190,000	266,000	107,000	62,000	17,573,000	9,150	2,733,450	128,250	796,590	936,240	34,720	308,520	5,756,360	-11,816,640
5	2004	14,870,000	4,008,000	3,037,000	406,000	332,000	65,000	431,000	23,049,000	12,200	3,644,600	114,000	1,062,120	1,248,320	43,400	385,650	7,197,950	-7,664,050
6	2004	14,870,000	4,008,000	3,037,000	406,000	250,000	176,000	125,000	14,882,000	15,250	4,555,750	142,500	885,100	1,170,300	43,400	385,650	7,197,950	-7,684,050
7	2005	8,905,000	1,297,000	3,706,000	436,000	270,000	134,000	452,000	15,199,000	18,300	5,466,900	171,000	1,062,120	1,404,360	52,080	462,780	8,637,540	-6,561,460
8	2006	10,810,000	1,393,000	3,564,000	537,000	270,000	134,000	452,000	17,160,000	21,350	6,378,650	199,500	1,239,140	1,638,420	60,760	539,910	10,077,330	-6,645,870
9	2007	11,070,000	1,908,000	2,767,000	343,000	306,000	60,000	50,000	16,523,000	24,400	7,289,200	228,000	1,416,160	1,872,480	69,440	617,040	11,516,720	-6,816,280
10	2008	14,611,000	2,061,000	2,903,000	389,000	272,000	49,000	50,000	20,335,000	24,400	7,289,200	256,500	1,593,180	2,106,540	78,120	694,170	12,956,310	-6,163,690
11	2009	13,311,000	1,669,000	3,215,000	360,000	274,000	32,000	50,000	19,120,000	27,450	8,200,350	256,500	1,593,180	2,340,600	86,800	771,300	14,395,980	-4,724,020
12	2010	3,714,000	2,023,000	3,164,000	414,000	227,000	94,000	124,000	9,810,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	4,585,980
13	2011	2,112,000	1,222,000	1,113,000	306,500	46,000	94,000	50,000	5,080,500	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,315,480
14	2012	2,112,000	1,222,000	1,113,000	357,000	46,000	94,000	50,000	4,994,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,401,980
15	2013	2,112,000	1,222,000	1,113,000	344,500	46,000	94,000	50,000	4,981,500	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,414,480
16	2014	2,112,000	1,222,000	1,113,000	335,000	46,000	94,000	50,000	4,969,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,426,980
17	2015	2,112,000	1,222,000	1,113,000	319,500	46,000	94,000	50,000	4,956,500	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,439,480
18	2016	2,112,000	1,222,000	1,066,460	281,200	46,000	94,000	50,000	4,873,780	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,522,200
19	2017	2,112,000	1,222,000	1,023,960	243,100	46,000	94,000	50,000	4,791,060	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,604,920
20	2018	2,112,000	1,222,000	979,440	204,900	46,000	94,000	50,000	4,708,340	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,687,640
21	2019	2,112,000	1,222,000	934,920	166,700	46,000	94,000	50,000	4,625,620	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,770,360
22	2020	2,112,000	1,222,000	890,400	128,500	46,000	94,000	50,000	4,542,900	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,853,080
23	2021	2,112,000	1,222,000	845,880	102,400	46,000	94,000	50,000	4,472,060	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,923,920
24	2022	2,112,000	1,222,000	801,360	77,100	46,000	94,000	50,000	4,402,460	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	9,993,520
25	2023	2,112,000	1,222,000	756,840	51,400	46,000	94,000	50,000	4,332,240	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,063,740
26	2024	2,112,000	1,222,000	712,320	25,700	46,000	94,000	50,000	4,262,020	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,133,960
27	2025	2,112,000	1,222,000	667,800	0	46,000	94,000	50,000	4,191,800	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,204,180
28	2026	2,112,000	1,222,000	623,280	0	46,000	94,000	50,000	4,147,280	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,248,700
29	2027	2,112,000	1,222,000	578,760	0	46,000	94,000	50,000	4,102,760	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,293,220
30	2028	2,112,000	1,222,000	534,240	0	46,000	94,000	50,000	4,058,240	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,337,740
31	2029	2,112,000	1,222,000	489,720	0	46,000	94,000	50,000	4,013,720	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,382,260
32	2030	2,112,000	1,222,000	445,200	0	46,000	94,000	50,000	3,969,200	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,426,780
33	2031	2,112,000	1,222,000	400,680	0	46,000	94,000	50,000	3,924,680	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,471,300
34	2032	2,112,000	1,222,000	356,160	0	46,000	94,000	50,000	3,880,160	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,515,740
35	2033	2,112,000	1,222,000	311,640	0	46,000	94,000	50,000	3,835,640	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,560,260
36	2034	2,112,000	1,222,000	267,120	0	46,000	94,000	50,000	3,791,120	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,604,780
37	2035	2,112,000	1,222,000	222,600	0	46,000	94,000	50,000	3,746,600	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,649,300
38	2036	2,112,000	1,222,000	178,080	0	46,000	94,000	50,000	3,702,080	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,693,820
39	2037	2,112,000	1,222,000	133,560	0	46,000	94,000	50,000	3,657,560	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,738,340
40	2038	2,112,000	1,222,000	89,040	0	46,000	94,000	50,000	3,613,040	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,782,860
41	2039	2,112,000	1,222,000	44,520	0	46,000	94,000	50,000	3,568,520	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,827,380
42	2040	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
43	2041	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
44	2042	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
45	2043	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
46	2044	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
47	2045	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
48	2046	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
49	2047	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
50	2048	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
51	2049	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
52	2050	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
53	2051	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
54	2052	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
55	2053	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
56	2054	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
57	2055	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
58	2056	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
59	2057	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
60	2058	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	30,500	9,111,500	285,000	1,770,200	2,340,600	86,800	771,300	14,395,980	10,871,900
Total		207,152,000	79,647,000	55,736,000	6,723,000	5,181,000	5,004,000	4,103,000	365,958,000	1,692,750	505,666,250	15,817,500	98,246,100	129,903,300	4,817,460	42,807,150	798,972,450	433,014,450

B/C Ratio (6 %) = 1.1 | B/C Ratio (7 %) = 1.0 | B/C Ratio (8 %) = 0.9 | EIRR = 7.1% | NPV (6 %) = 16,539,449 | NPV (7 %) = 1,544,275 | NPV (8 %) = -9,077,168

Table 23.3.1 Spread Sheet of EMP Costs and Revenues

No.	Year	Incremental Financial Cost of EMP (US$)								Potential Revenue from EMP (US$)							Financial Net Revenue
		Wastewater	Solid Wastes	Coal Mining	Tourism	Environmental Resources	Monitoring	Institution	Total Cost	Environmental Fee Collected from Users *			Wastewater Fee *	Charge to Industrial Sector **	Charge to VINACOAL ***	Entrance Fee for Visitor Center ****	Total Revenue	
										GN Residents	VN Tourists	Foreign Tourists						
0	2000	2,200,000	0	2,192,000	79,000	92,000	136,000	664,000	5,363,000	103,320	80,700	930,000	39,618	0	1,919,000	0	3,072,638	-2,310,162
1	2001	3,402,000	677,000	2,791,000	241,000	291,000	15,000	807,000	8,224,000	105,168	84,720	961,000	79,636	135,400	1,919,000	0	3,284,944	-4,939,056
2	2002	6,880,000	800,000	4,802,000	308,000	211,000	36,000	2,728,000	15,765,000	107,056	68,740	992,000	119,455	270,800	1,919,000	0	3,497,051	-12,267,949
3	2003	11,770,000	2,511,000	2,656,000	199,000	268,000	107,000	62,000	17,573,000	108,924	92,760	1,023,000	159,273	406,200	1,919,000	326,900	4,036,057	-13,536,943
4	2004	14,870,000	4,006,000	3,037,000	406,000	232,000	65,000	431,000	23,049,000	110,792	96,780	1,054,000	199,091	541,600	1,919,000	403,129	4,324,391	-18,724,609
5	2005	8,905,000	1,297,000	3,706,000	434,000	239,000	176,000	125,000	14,882,000	112,660	100,800	1,085,000	238,909	677,000	1,919,000	479,357	4,612,726	-10,269,274
6	2006	10,819,000	1,393,000	3,564,000	537,000	270,000	134,000	452,000	17,169,000	114,528	117,040	1,364,000	278,727	812,400	1,919,000	555,506	5,161,281	-12,007,719
7	2007	11,070,000	1,908,000	2,787,000	343,000	305,000	60,000	50,000	16,523,000	116,396	133,280	1,643,000	318,545	947,800	1,919,000	631,814	5,709,836	-10,813,164
8	2008	14,611,000	2,061,000	2,905,000	369,000	272,000	49,000	50,000	20,335,000	118,264	149,520	1,922,000	358,364	1,083,200	1,919,000	708,043	6,258,390	-14,076,610
9	2009	13,311,000	1,869,000	3,215,000	369,000	274,000	32,000	50,000	19,120,000	120,132	165,760	2,201,000	398,182	1,218,600	1,919,000	784,271	6,806,945	-12,313,055
10	2010	3,714,000	2,023,000	3,164,000	414,000	277,000	94,000	124,000	9,810,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	-2,454,500
11	2011	2,112,000	1,222,000	1,113,000	369,500	46,000	94,000	50,000	5,006,500	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,349,000
12	2012	2,112,000	1,222,000	1,113,000	357,000	46,000	94,000	50,000	4,994,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,361,500
13	2013	2,112,000	1,222,000	1,113,000	344,500	46,000	94,000	50,000	4,981,500	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,374,000
14	2014	2,112,000	1,222,000	1,113,000	332,000	46,000	94,000	50,000	4,969,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,386,500
15	2015	2,112,000	1,222,000	1,113,000	319,500	46,000	94,000	50,000	4,956,500	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,399,000
16	2016	2,112,000	1,222,000	1,068,480	281,300	46,000	94,000	50,000	4,873,780	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,481,720
17	2017	2,112,000	1,222,000	1,023,960	243,100	46,000	94,000	50,000	4,791,060	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,564,440
18	2018	2,112,000	1,222,000	979,440	204,900	46,000	94,000	50,000	4,708,340	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,647,160
19	2019	2,112,000	1,222,000	934,920	166,700	46,000	94,000	50,000	4,625,620	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,729,880
20	2020	2,112,000	1,222,000	890,400	128,500	46,000	94,000	50,000	4,542,900	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,812,600
21	2021	2,112,000	1,222,000	845,880	102,800	46,000	94,000	50,000	4,472,680	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,882,820
22	2022	2,112,000	1,222,000	801,360	77,100	46,000	94,000	50,000	4,402,460	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	2,953,040
23	2023	2,112,000	1,222,000	756,840	51,400	46,000	94,000	50,000	4,332,240	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,023,260
24	2024	2,112,000	1,222,000	712,320	25,700	46,000	94,000	50,000	4,262,020	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,093,480
25	2025	2,112,000	1,222,000	667,800	0	46,000	94,000	50,000	4,191,800	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,163,700
26	2026	2,112,000	1,222,000	623,280	0	46,000	94,000	50,000	4,147,280	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,208,220
27	2027	2,112,000	1,222,000	578,760	0	46,000	94,000	50,000	4,102,760	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,252,740
28	2028	2,112,000	1,222,000	534,240	0	46,000	94,000	50,000	4,058,240	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,297,260
29	2029	2,112,000	1,222,000	489,720	0	46,000	94,000	50,000	4,013,720	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,341,780
30	2030	2,112,000	1,222,000	445,200	0	46,000	94,000	50,000	3,969,200	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,386,300
31	2031	2,112,000	1,222,000	400,680	0	46,000	94,000	50,000	3,924,680	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,430,820
32	2032	2,112,000	1,222,000	356,160	0	46,000	94,000	50,000	3,880,160	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,475,340
33	2033	2,112,000	1,222,000	311,640	0	46,000	94,000	50,000	3,835,640	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,519,860
34	2034	2,112,000	1,222,000	267,120	0	46,000	94,000	50,000	3,791,120	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,564,380
35	2035	2,112,000	1,222,000	222,600	0	46,000	94,000	50,000	3,746,600	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,608,900
36	2036	2,112,000	1,222,000	178,080	0	46,000	94,000	50,000	3,702,080	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,653,420
37	2037	2,112,000	1,222,000	133,560	0	46,000	94,000	50,000	3,657,560	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,697,940
38	2038	2,112,000	1,222,000	89,040	0	46,000	94,000	50,000	3,613,040	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,742,460
39	2039	2,112,000	1,222,000	44,520	0	46,000	94,000	50,000	3,568,520	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,786,980
40	2040	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
41	2041	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
42	2042	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
43	2043	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
44	2044	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
45	2045	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
46	2046	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
47	2047	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
48	2048	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
49	2049	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
50	2050	2,112,000	1,222,000	0	0	46,000	94,000	50,000	3,524,000	122,000	182,000	2,480,000	438,000	1,354,000	1,919,000	860,500	7,355,500	3,831,500
Total		186,032,000	67,427,000	53,738,000	6,723,000	4,571,000	4,664,000	7,563,000	330,718,000	6,119,260	8,572,100	114,855,000	20,148,000	61,607,600	97,869,000	39,169,600	348,339,960	17,621,960

Notes :

* The revenues through environmental and wastewater fees are estimated based on the WTP data.

** The Total charges are slightly more than the total costs necessary for the industrial wastewater and solid waste management.

*** The Annual charge to VINACOAL = Total VINACOAL revenue in 1998 x 95 % x 1 %

**** Total fees are calculated with US$ 1 for foreign tourists and US$ 0.1 for Vietnamese tourists.

FIRR = 0.54%

Table 23.3.2 Cost Recovery Schedule for Wastewater Management

No.	Year	Incremental Cost of EMP Activities for Wastewater Management (Unit : US$)						Total	Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)	Repayment for Domestic Construction
		Domestic (Public) Management			Industrial (Private) Management									
		Construction Cost	O & M Cost	Sub-Total	Construction Cost	O & M Cost	Sub-Total							
0	2000	1,000,000	0	1,000,000	1,200,000	0	1,200,000	2,200,000	1,900,000			0	0	300,000
1	2001	1,800,000	0	1,800,000	1,602,000	0	1,602,000	3,402,000	4,762,000	19,000		0	19,000	540,000
2	2002	6,800,000	0	6,800,000	0	80,000	80,000	6,880,000	9,522,000	47,620		80,000	127,620	2,040,000
3	2003	11,600,000	90,000	11,690,000	0	80,000	80,000	11,770,000	17,642,000	95,220		170,000	265,220	3,480,000
4	2004	14,700,000	90,000	14,790,000	0	80,000	80,000	14,870,000	27,932,000	176,420		170,000	346,420	4,410,000
5	2005	6,245,000	780,000	7,025,000	1,800,000	80,000	1,880,000	8,905,000	34,103,500	279,320		860,000	1,139,320	1,873,500
6	2006	7,552,000	780,000	8,332,000	2,407,000	80,000	2,487,000	10,819,000	39,469,900	341,035		860,000	1,201,035	2,265,600
7	2007	8,294,000	1,138,000	9,432,000	1,200,000	438,000	1,638,000	11,070,000	45,713,700	394,699		1,576,000	1,970,699	2,488,200
8	2008	11,359,000	1,176,000	12,535,000	1,602,000	474,000	2,076,000	14,611,000	55,267,000	457,137		1,650,000	2,107,137	3,407,700
9	2009	10,000,000	1,637,000	11,637,000	1,200,000	474,000	1,674,000	13,311,000	62,741,000	552,670		2,111,000	2,663,670	3,000,000
10	2010	0	1,638,000	1,638,000	1,602,000	474,000	2,076,000	3,714,000	64,343,000	627,410		2,112,000	2,739,410	0
11	2011		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
12	2012		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
13	2013		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
14	2014		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
15	2015		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
16	2016		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
17	2017		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
18	2018		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
19	2019		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
20	2020		1,638,000	1,638,000		474,000	474,000	2,112,000	64,343,000	643,430		2,112,000	2,755,430	0
21	2021		1,638,000	1,638,000		474,000	474,000	2,112,000	62,198,233	643,430	2,144,767	2,112,000	4,900,197	0
22	2022		1,638,000	1,638,000		474,000	474,000	2,112,000	60,053,467	621,982	2,144,767	2,112,000	4,878,749	0
23	2023		1,638,000	1,638,000		474,000	474,000	2,112,000	57,908,700	600,535	2,144,767	2,112,000	4,857,301	0
24	2024		1,638,000	1,638,000		474,000	474,000	2,112,000	55,763,933	579,087	2,144,767	2,112,000	4,835,854	0
25	2025		1,638,000	1,638,000		474,000	474,000	2,112,000	53,619,167	557,639	2,144,767	2,112,000	4,814,406	0
26	2026		1,638,000	1,638,000		474,000	474,000	2,112,000	51,474,400	536,192	2,144,767	2,112,000	4,792,958	0
27	2027		1,638,000	1,638,000		474,000	474,000	2,112,000	49,329,633	514,744	2,144,767	2,112,000	4,771,511	0
28	2028		1,638,000	1,638,000		474,000	474,000	2,112,000	47,184,867	493,296	2,144,767	2,112,000	4,750,063	0
29	2029		1,638,000	1,638,000		474,000	474,000	2,112,000	45,040,100	471,849	2,144,767	2,112,000	4,728,615	0
30	2030		1,638,000	1,638,000		474,000	474,000	2,112,000	42,895,333	450,401	2,144,767	2,112,000	4,707,168	0
31	2031		1,638,000	1,638,000		474,000	474,000	2,112,000	40,750,567	428,953	2,144,767	2,112,000	4,685,720	0
32	2032		1,638,000	1,638,000		474,000	474,000	2,112,000	38,605,800	407,506	2,144,767	2,112,000	4,664,272	0
33	2033		1,638,000	1,638,000		474,000	474,000	2,112,000	36,461,033	386,058	2,144,767	2,112,000	4,642,825	0
34	2034		1,638,000	1,638,000		474,000	474,000	2,112,000	34,316,267	364,610	2,144,767	2,112,000	4,621,377	0
35	2035		1,638,000	1,638,000		474,000	474,000	2,112,000	32,171,500	343,163	2,144,767	2,112,000	4,599,929	0
36	2036		1,638,000	1,638,000		474,000	474,000	2,112,000	30,026,733	321,715	2,144,767	2,112,000	4,578,482	0
37	2037		1,638,000	1,638,000		474,000	474,000	2,112,000	27,881,967	300,267	2,144,767	2,112,000	4,557,034	0
38	2038		1,638,000	1,638,000		474,000	474,000	2,112,000	25,737,200	278,820	2,144,767	2,112,000	4,535,586	0
39	2039		1,638,000	1,638,000		474,000	474,000	2,112,000	23,592,433	257,372	2,144,767	2,112,000	4,514,139	0
40	2040		1,638,000	1,638,000		474,000	474,000	2,112,000	21,447,667	235,924	2,144,767	2,112,000	4,492,691	0
41	2041		1,638,000	1,638,000		474,000	474,000	2,112,000	19,302,900	214,477	2,144,767	2,112,000	4,471,243	0
42	2042		1,638,000	1,638,000		474,000	474,000	2,112,000	17,158,133	193,029	2,144,767	2,112,000	4,449,796	0
43	2043		1,638,000	1,638,000		474,000	474,000	2,112,000	15,013,367	171,581	2,144,767	2,112,000	4,428,348	0
44	2044		1,638,000	1,638,000		474,000	474,000	2,112,000	12,868,600	150,134	2,144,767	2,112,000	4,406,900	0
45	2045		1,638,000	1,638,000		474,000	474,000	2,112,000	10,723,833	128,686	2,144,767	2,112,000	4,385,453	0
46	2046		1,638,000	1,638,000		474,000	474,000	2,112,000	8,579,067	107,238	2,144,767	2,112,000	4,364,005	0
47	2047		1,638,000	1,638,000		474,000	474,000	2,112,000	6,434,300	85,791	2,144,767	2,112,000	4,342,557	0
48	2048		1,638,000	1,638,000		474,000	474,000	2,112,000	4,289,533	64,343	2,144,767	2,112,000	4,321,110	0
49	2049		1,638,000	1,638,000		474,000	474,000	2,112,000	2,144,767	42,895	2,144,767	2,112,000	4,299,662	0
50	2050		1,638,000	1,638,000		474,000	474,000	2,112,000	0	21,448	2,144,767	2,112,000	4,278,214	0
Total		79,350,000	72,849,000	152,199,000	12,613,000	21,220,000	33,833,000	186,032,000	Total	19,397,996	64,343,000	94,069,000	177,809,996	23,805,000

Notes : 1. Assumed interest rate for donors' soft loan = flat rate of 1 % = 0.01

2. Maximum repayment (depreciation) period for the donors' soft loan = 40 years (10 years of which are grace period)

Table 23.3.3 Cost Recovery Schedule for Solid Wastes Management

No.	Year	Incremental Cost of EMP Agencies for Solid Waste Management (US$)						Total	Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)
		Public Sector			Private Sector								
		Construction Cost	O & M Cost	Sub-Total	Construction Cost	O & M Cost	Sub-Total						
0	2000	0	0	0	0	0	0	0	0			0	0
1	2001	407,000	0	407,000	270,000	0	270,000	677,000	677,000	0		0	0
2	2002	500,000	0	500,000	300,000	0	300,000	800,000	1,477,000	6,770		0	6,770
3	2003	1,801,000	29,000	1,830,000	646,000	35,000	681,000	2,511,000	3,924,000	14,770		64,000	78,770
4	2004	2,524,000	332,000	2,856,000	1,107,000	45,000	1,152,000	4,008,000	7,555,000	39,240		377,000	416,240
5	2005	801,000	385,000	1,186,000	0	111,000	111,000	1,297,000	8,356,000	75,550		496,000	571,550
6	2006	801,000	447,000	1,248,000	0	145,000	145,000	1,393,000	9,157,000	83,560		592,000	675,560
7	2007	801,000	517,000	1,318,000	400,000	190,000	590,000	1,908,000	10,358,000	91,570		707,000	798,570
8	2008	801,000	597,000	1,398,000	400,000	263,000	663,000	2,061,000	11,559,000	103,580		860,000	963,580
9	2009	801,000	690,000	1,491,000	0	378,000	378,000	1,869,000	12,360,000	115,590		1,068,000	1,183,590
10	2010	801,000	799,000	1,600,000	0	423,000	423,000	2,023,000	13,161,000	123,600		1,222,000	1,345,600
11	2011		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
12	2012		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
13	2013		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
14	2014		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
15	2015		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
16	2016		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
17	2017		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
18	2018		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
19	2019		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
20	2020		799,000	799,000		423,000	423,000	1,222,000	13,161,000	131,610		1,222,000	1,353,610
21	2021		799,000	799,000		423,000	423,000	1,222,000	12,722,300	131,610	438,700	1,222,000	1,792,310
22	2022		799,000	799,000		423,000	423,000	1,222,000	12,283,600	127,223	438,700	1,222,000	1,787,923
23	2023		799,000	799,000		423,000	423,000	1,222,000	11,844,900	122,836	438,700	1,222,000	1,783,536
24	2024		799,000	799,000		423,000	423,000	1,222,000	11,406,200	118,449	438,700	1,222,000	1,779,149
25	2025		799,000	799,000		423,000	423,000	1,222,000	10,967,500	114,062	438,700	1,222,000	1,774,762
26	2026		799,000	799,000		423,000	423,000	1,222,000	10,528,800	109,675	438,700	1,222,000	1,770,375
27	2027		799,000	799,000		423,000	423,000	1,222,000	10,090,100	105,288	438,700	1,222,000	1,765,988
28	2028		799,000	799,000		423,000	423,000	1,222,000	9,651,400	100,901	438,700	1,222,000	1,761,601
29	2029		799,000	799,000		423,000	423,000	1,222,000	9,212,700	96,514	438,700	1,222,000	1,757,214
30	2030		799,000	799,000		423,000	423,000	1,222,000	8,774,000	92,127	438,700	1,222,000	1,752,827
31	2031		799,000	799,000		423,000	423,000	1,222,000	8,335,300	87,740	438,700	1,222,000	1,748,440
32	2032		799,000	799,000		423,000	423,000	1,222,000	7,896,600	83,353	438,700	1,222,000	1,744,053
33	2033		799,000	799,000		423,000	423,000	1,222,000	7,457,900	78,966	438,700	1,222,000	1,739,666
34	2034		799,000	799,000		423,000	423,000	1,222,000	7,019,200	74,579	438,700	1,222,000	1,735,279
35	2035		799,000	799,000		423,000	423,000	1,222,000	6,580,500	70,192	438,700	1,222,000	1,730,892
36	2036		799,000	799,000		423,000	423,000	1,222,000	6,141,800	65,805	438,700	1,222,000	1,726,505
37	2037		799,000	799,000		423,000	423,000	1,222,000	5,703,100	61,418	438,700	1,222,000	1,722,118
38	2038		799,000	799,000		423,000	423,000	1,222,000	5,264,400	57,031	438,700	1,222,000	1,717,731
39	2039		799,000	799,000		423,000	423,000	1,222,000	4,825,700	52,644	438,700	1,222,000	1,713,344
40	2040		799,000	799,000		423,000	423,000	1,222,000	4,387,000	48,257	438,700	1,222,000	1,708,957
41	2041		799,000	799,000		423,000	423,000	1,222,000	3,948,300	43,870	438,700	1,222,000	1,704,570
42	2042		799,000	799,000		423,000	423,000	1,222,000	3,509,600	39,483	438,700	1,222,000	1,700,183
43	2043		799,000	799,000		423,000	423,000	1,222,000	3,070,900	35,096	438,700	1,222,000	1,695,796
44	2044		799,000	799,000		423,000	423,000	1,222,000	2,632,200	30,709	438,700	1,222,000	1,691,409
45	2045		799,000	799,000		423,000	423,000	1,222,000	2,193,500	26,322	438,700	1,222,000	1,687,022
46	2046		799,000	799,000		423,000	423,000	1,222,000	1,754,800	21,935	438,700	1,222,000	1,682,635
47	2047		799,000	799,000		423,000	423,000	1,222,000	1,316,100	17,548	438,700	1,222,000	1,678,248
48	2048		799,000	799,000		423,000	423,000	1,222,000	877,400	13,161	438,700	1,222,000	1,673,861
49	2049		799,000	799,000		423,000	423,000	1,222,000	438,700	8,774	438,700	1,222,000	1,669,474
50	2050		799,000	799,000		423,000	423,000	1,222,000	0	4,387	438,700	1,222,000	1,665,087
	Total	10,038,000	35,756,000	45,794,000	5,123,000	16,510,000	21,633,000	67,427,000	Total	4,010,265	13,161,000	54,266,000	71,437,265

Notes : 1. Assumed interest rate for donors' soft loan = flat rate of 1 % = 0.01

2. Maximum repayment (depreciation) period for the donors' soft loan = 40 years (10 years of which are grace period)

Table 23.3.4 (1) Cost Recovery Schedule for Environmental Rehabilitation of Coal Mining

No	Year	Incremental Cost of Environmental Rehabilitation Projects for Coal Mining Industry (US$)															
		Environmental	South Dee Nai Dumping Site Rehabilitation			Ha Tu River Basin Rehabilitation			Mong Duong River Basin Rehabilitation			Dien Vong River Basin Rehabilitation			Hong Gai South Basin Rehabilitation		
		Planing	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total
0	2000	202,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2001	374,000	144,000	0	144,000	0	0	0	90,000	0	90,000	83,000	0	83,000	0	0	0
2	2002	259,000	2,736,000	0	2,736,000	0	0	0	90,000	0	90,000	83,000	0	83,000	0	0	0
3	2003	0	0	62,000	62,000	90,000	0	90,000	575,000	97,000	672,000	278,000	36,000	314,000	26,000	0	26,000
4	2004	0	0	62,000	62,000	90,000	0	90,000	513,000	115,000	628,000	377,000	56,000	433,000	26,000	0	26,000
5	2005	0	0	62,000	62,000	219,000	41,000	260,000	288,000	157,000	445,000	390,000	89,000	479,000	65,000	12,000	77,000
6	2006	86,000	0	62,000	62,000	234,000	49,000	283,000	287,000	175,000	462,000	294,000	121,000	415,000	86,000	18,000	104,000
7	2007	0	0	62,000	62,000	172,000	58,000	230,000	232,000	193,000	425,000	342,000	154,000	496,000	56,000	24,000	80,000
8	2008	0	0	62,000	62,000	172,000	68,000	240,000	290,000	210,000	500,000	320,000	186,000	506,000	38,000	28,000	66,000
9	2009	0	0	62,000	62,000	227,000	79,000	306,000	314,000	229,000	543,000	458,000	226,000	684,000	40,000	31,000	71,000
10	2010	0	0	62,000	62,000	224,000	97,000	321,000	290,000	247,000	537,000	364,000	278,000	646,000	40,000	40,000	80,000
11	2011			62,000	62,000		97,000	97,000		247,000	247,000		278,000	278,000		40,000	40,000
12	2012			62,000	62,000		97,000	97,000		247,000	247,000		278,000	278,000		40,000	40,000
13	2013			62,000	62,000		97,000	97,000		247,000	247,000		278,000	278,000		40,000	40,000
14	2014			62,000	62,000		97,000	97,000		247,000	247,000		278,000	278,000		40,000	40,000
15	2015			62,000	62,000		97,000	97,000		247,000	247,000		278,000	278,000		40,000	40,000
16	2016			59,520	59,520		93,120	93,120		237,120	237,120		266,880	266,880		38,400	38,400
17	2017			57,040	57,040		89,240	89,240		227,240	227,240		255,760	255,760		36,800	36,800
18	2018			54,560	54,560		85,360	85,360		217,360	217,360		244,640	244,640		35,200	35,200
19	2019			52,080	52,080		81,480	81,480		207,480	207,480		233,520	233,520		33,600	33,600
20	2020			49,600	49,600		77,600	77,600		197,600	197,600		222,400	222,400		32,000	32,000
21	2021			47,120	47,120		73,720	73,720		187,720	187,720		211,280	211,280		30,400	30,400
22	2022			44,640	44,640		69,840	69,840		177,840	177,840		200,160	200,160		28,800	28,800
23	2023			42,160	42,160		65,960	65,960		167,960	167,960		189,040	189,040		27,200	27,200
24	2024			39,680	39,680		62,080	62,080		158,080	158,080		177,920	177,920		25,600	25,600
25	2025			37,200	37,200		58,200	58,200		148,200	148,200		166,800	166,800		24,000	24,000
26	2026			34,720	34,720		54,320	54,320		138,320	138,320		155,680	155,680		22,400	22,400
27	2027			32,240	32,240		50,440	50,440		128,440	128,440		144,560	144,560		20,800	20,800
28	2028			29,760	29,760		46,560	46,560		118,560	118,560		133,440	133,440		19,200	19,200
29	2029			27,280	27,280		42,680	42,680		108,680	108,680		122,320	122,320		17,600	17,600
30	2030			24,800	24,800		38,800	38,800		98,800	98,800		111,200	111,200		16,000	16,000
31	2031			22,320	22,320		34,920	34,920		88,920	88,920		100,080	100,080		14,400	14,400
32	2032			19,840	19,840		31,040	31,040		79,040	79,040		88,960	88,960		12,800	12,800
33	2033			17,360	17,360		27,160	27,160		69,160	69,160		77,840	77,840		11,200	11,200
34	2034			14,880	14,880		23,280	23,280		59,280	59,280		66,720	66,720		9,600	9,600
35	2035			12,400	12,400		19,400	19,400		49,400	49,400		55,600	55,600		8,000	8,000
36	2036			9,920	9,920		15,520	15,520		39,520	39,520		44,480	44,480		6,400	6,400
37	2037			7,440	7,440		11,640	11,640		29,640	29,640		33,360	33,360		4,800	4,800
38	2038			4,960	4,960		7,760	7,760		19,760	19,760		22,240	22,240		3,200	3,200
39	2039			2,480	2,480		3,880	3,880		9,880	9,880		11,120	11,120		1,600	1,600
40	2040			0	0		0	0		0	0		0	0		0	0
41	2041			0	0		0	0		0	0		0	0		0	0
42	2042			0	0		0	0		0	0		0	0		0	0
43	2043			0	0		0	0		0	0		0	0		0	0
44	2044			0	0		0	0		0	0		0	0		0	0
45	2045			0	0		0	0		0	0		0	0		0	0
46	2046			0	0		0	0		0	0		0	0		0	0
47	2047			0	0		0	0		0	0		0	0		0	0
48	2048			0	0		0	0		0	0		0	0		0	0
49	2049			0	0		0	0		0	0		0	0		0	0
50	2050			0	0		0	0		0	0		0	0		0	0
Total		921,000	2,880,000	1,550,000	4,430,000	1,428,000	2,041,000	3,469,000	2,969,000	5,622,000	8,591,000	2,993,000	5,872,000	8,865,000	377,000	833,000	1,210,000

Incremental Cost of Environmental Rehabilitation Projects for Coal Mining Industry (US$)

Cam Pha West Basin Rehabilitation			Cua Ong Basin Rehabilitation			Dredging			Environmental Measures for Processing Plants			Environmental Measures for Mine Wastewater			Pilot Project			Total Cost
Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total	
0	0	0	0	0	0	1,315,000	0	1,315,000	0	0	0	0	0	0	675,000	0	675,000	2,192,000
0	0	0	0	0	0	1,315,000	0	1,315,000	58,000	0	58,000	0	0	0	727,000	0	727,000	2,791,000
0	0	0	0	0	0	1,315,000	0	1,315,000	58,000	0	58,000	0	0	0	261,000	0	261,000	4,802,000
0	0	0	28,000	0	28,000	1,315,000	0	1,315,000	53,000	0	53,000	58,000	0	58,000	0	38,000	38,000	2,656,000
0	0	0	28,000	0	28,000	1,315,000	0	1,315,000	55,000	0	55,000	360,000	0	360,000	0	40,000	40,000	3,037,000
0	0	0	66,000	12,000	78,000	1,315,000	0	1,315,000	0	226,000	226,000	720,000	0	720,000	0	44,000	44,000	3,706,000
0	0	0	57,000	18,000	75,000	1,075,000	0	1,075,000	0	238,000	238,000	720,000	0	720,000	0	44,000	44,000	3,564,000
10,000	0	10,000	49,000	20,000	69,000	1,075,000	0	1,075,000	0	250,000	250,000	0	90,000	90,000	0	0	0	2,787,000
30,000	11,000	41,000	48,000	25,000	73,000	1,075,000	0	1,075,000	0	250,000	250,000	0	90,000	90,000	0	0	0	2,903,000
42,000	13,000	55,000	49,000	30,000	79,000	1,075,000	0	1,075,000	0	250,000	250,000	0	90,000	90,000	0	0	0	3,215,000
25,000	14,000	39,000	29,000	35,000	64,000	1,075,000	0	1,075,000	0	250,000	250,000	0	90,000	90,000	0	0	0	3,164,000
	14,000	14,000		35,000	35,000		0	0		250,000	250,000		90,000	90,000			0	1,113,000
	14,000	14,000		35,000	35,000		0	0		250,000	250,000		90,000	90,000			0	1,113,000
	14,000	14,000		35,000	35,000		0	0		250,000	250,000		90,000	90,000			0	1,113,000
	14,000	14,000		35,000	35,000		0	0		250,000	250,000		90,000	90,000			0	1,113,000
	14,000	14,000		35,000	35,000		0	0		250,000	250,000		90,000	90,000			0	1,113,000
	13,440	13,440		33,600	33,600		0	0		240,000	240,000		86,400	86,400			0	1,068,480
	12,880	12,880		32,200	32,200		0	0		230,000	230,000		82,800	82,800			0	1,023,960
	12,320	12,320		30,800	30,800		0	0		220,000	220,000		79,200	79,200			0	979,440
	11,760	11,760		29,400	29,400		0	0		210,000	210,000		75,600	75,600			0	934,920
	11,200	11,200		28,000	28,000		0	0		200,000	200,000		72,000	72,000			0	890,400
	10,640	10,640		26,600	26,600		0	0		190,000	190,000		68,400	68,400			0	845,880
	10,080	10,080		25,200	25,200		0	0		180,000	180,000		64,800	64,800			0	801,360
	9,520	9,520		23,800	23,800		0	0		170,000	170,000		61,200	61,200			0	756,840
	8,960	8,960		22,400	22,400		0	0		160,000	160,000		57,600	57,600			0	712,320
	8,400	8,400		21,000	21,000		0	0		150,000	150,000		54,000	54,000			0	667,800
	7,840	7,840		19,600	19,600		0	0		140,000	140,000		50,400	50,400			0	623,280
	7,280	7,280		18,200	18,200		0	0		130,000	130,000		46,800	46,800			0	578,760
	6,720	6,720		16,800	16,800		0	0		120,000	120,000		43,200	43,200			0	534,240
	6,160	6,160		15,400	15,400		0	0		110,000	110,000		39,600	39,600			0	489,720
	5,600	5,600		14,000	14,000		0	0		100,000	100,000		36,000	36,000			0	445,200
	5,040	5,040		12,600	12,600		0	0		90,000	90,000		32,400	32,400			0	400,680
	4,480	4,480		11,200	11,200		0	0		80,000	80,000		28,800	28,800			0	356,160
	3,920	3,920		9,800	9,800		0	0		70,000	70,000		25,200	25,200			0	311,640
	3,360	3,360		8,400	8,400		0	0		60,000	60,000		21,600	21,600			0	267,120
	2,800	2,800		7,000	7,000		0	0		50,000	50,000		18,000	18,000			0	222,600
	2,240	2,240		5,600	5,600		0	0		40,000	40,000		14,400	14,400			0	178,080
	1,680	1,680		4,200	4,200		0	0		30,000	30,000		10,800	10,800			0	133,560
	1,120	1,120		2,800	2,800		0	0		20,000	20,000		7,200	7,200			0	89,040
	560	560		1,400	1,400		0	0		10,000	10,000		3,600	3,600			0	44,520
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
	0	0		0	0		0	0		0	0		0	0			0	0
107,000	276,000	383,000	354,000	735,000	1,089,000	13,265,000	0	13,265,000	224,000	5,714,000	5,938,000	1,858,000	1,890,000	3,748,000	1,663,000	166,000	1,829,000	53,738,000

Table 23.3.4 (2) Cost Recovery Schedule for Environmental Rehabilitation of Coal Mining

No.	Year	Total Construction and O & M Cost of EMP Activities for Coal Mining (US$)			Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)	Grant for Pilot Project Construction	Grant for Environmental Planning
		Construction Cost	O & M Cost	Total							
0	2000	1,315,000	0	1,315,000	1,315,000			0	0	675,000	202,000
1	2001	1,690,000	0	1,690,000	3,005,000	13,150		0	13,150	727,000	374,000
2	2002	4,282,000	0	4,282,000	7,287,000	30,050		0	30,050	261,000	259,000
3	2003	2,423,000	233,000	2,656,000	9,710,000	72,870		233,000	305,870	0	0
4	2004	2,764,000	273,000	3,037,000	12,474,000	97,100		273,000	370,100	0	0
5	2005	3,063,000	643,000	3,706,000	15,537,000	124,740		643,000	767,740	0	0
6	2006	2,753,000	725,000	3,478,000	18,290,000	155,370		725,000	880,370	0	0
7	2007	1,936,000	851,000	2,787,000	20,226,000	182,900		851,000	1,033,900	0	0
8	2008	1,973,000	930,000	2,903,000	22,199,000	202,260		930,000	1,132,260	0	0
9	2009	2,205,000	1,010,000	3,215,000	24,404,000	221,990		1,010,000	1,231,990	0	0
10	2010	2,051,000	1,113,000	3,164,000	26,455,000	244,040		1,113,000	1,357,040	0	0
11	2011	0	1,113,000	1,113,000	26,455,000	264,550		1,113,000	1,377,550	0	0
12	2012	0	1,113,000	1,113,000	26,455,000	264,550		1,113,000	1,377,550	0	0
13	2013	0	1,113,000	1,113,000	26,455,000	264,550		1,113,000	1,377,550	0	0
14	2014	0	1,113,000	1,113,000	26,455,000	264,550		1,113,000	1,377,550	0	0
15	2015	0	1,113,000	1,113,000	26,455,000	264,550		1,113,000	1,377,550	0	0
16	2016	0	1,068,480	1,068,480	26,455,000	264,550		1,068,480	1,333,030	0	0
17	2017	0	1,023,960	1,023,960	26,455,000	264,550		1,023,960	1,288,510	0	0
18	2018	0	979,440	979,440	26,455,000	264,550		979,440	1,243,990	0	0
19	2019	0	934,920	934,920	26,455,000	264,550		934,920	1,199,470	0	0
20	2020	0	890,400	890,400	26,455,000	264,550		890,400	1,154,950	0	0
21	2021	0	845,880	845,880	25,573,167	264,550	881,833	845,880	1,992,263	0	0
22	2022	0	801,360	801,360	24,691,333	255,732	881,833	801,360	1,938,925	0	0
23	2023	0	756,840	756,840	23,809,500	246,913	881,833	756,840	1,885,587	0	0
24	2024	0	712,320	712,320	22,927,667	238,095	881,833	712,320	1,832,248	0	0
25	2025	0	667,800	667,800	22,045,833	229,277	881,833	667,800	1,778,910	0	0
26	2026	0	623,280	623,280	21,164,000	220,458	881,833	623,280	1,725,572	0	0
27	2027	0	578,760	578,760	20,282,167	211,640	881,833	578,760	1,672,233	0	0
28	2028	0	534,240	534,240	19,400,333	202,822	881,833	534,240	1,618,895	0	0
29	2029	0	489,720	489,720	18,518,500	194,003	881,833	489,720	1,565,557	0	0
30	2030	0	445,200	445,200	17,636,667	185,185	881,833	445,200	1,512,218	0	0
31	2031	0	400,680	400,680	16,754,833	176,367	881,833	400,680	1,458,880	0	0
32	2032	0	356,160	356,160	15,873,000	167,548	881,833	356,160	1,405,542	0	0
33	2033	0	311,640	311,640	14,991,167	158,730	881,833	311,640	1,352,203	0	0
34	2034	0	267,120	267,120	14,109,333	149,912	881,833	267,120	1,298,865	0	0
35	2035	0	222,600	222,600	13,227,500	141,093	881,833	222,600	1,245,527	0	0
36	2036	0	178,080	178,080	12,345,667	132,275	881,833	178,080	1,192,188	0	0
37	2037	0	133,560	133,560	11,463,833	123,457	881,833	133,560	1,138,850	0	0
38	2038	0	89,040	89,040	10,582,000	114,638	881,833	89,040	1,085,512	0	0
39	2039	0	44,520	44,520	9,700,167	105,820	881,833	44,520	1,032,173	0	0
40	2040	0	0	0	8,818,333	97,002	881,833	0	978,835	0	0
41	2041	0	0	0	7,936,500	88,183	881,833	0	970,017	0	0
42	2042	0	0	0	7,054,667	79,365	881,833	0	961,198	0	0
43	2043	0	0	0	6,172,833	70,547	881,833	0	952,380	0	0
44	2044	0	0	0	5,291,000	61,728	881,833	0	943,562	0	0
45	2045	0	0	0	4,409,167	52,910	881,833	0	934,743	0	0
46	2046	0	0	0	3,527,333	44,092	881,833	0	925,925	0	0
47	2047	0	0	0	2,645,500	35,273	881,833	0	917,107	0	0
48	2048	0	0	0	1,763,667	26,455	881,833	0	908,288	0	0
49	2049	0	0	0	881,833	17,637	881,833	0	899,470	0	0
50	2050	0	0	0	0	8,818	881,833	0	890,652	0	0
	Total	26,455,000	24,699,000	51,154,000	Total	8,090,495	26,455,000	24,699,000	59,244,495	1,663,000	835,000

Notes : 1. Assumed interest rate for donors' soft loan = flat rate of 1 % 0.01

2. Maximum repayment (depreciation) period for the donors' soft loan = 40 years (10 years of which are grace period)

Table 23.3.5 Cost Recovery Schedule for Environmental Management of Tourism

No.	Year	Incremental Cost of EMP Activities for Tourism (US$)										Total	Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)	Grant for Construction Cost	Grant for Management Planning
		Management Planning	Sanitation Management (Phase 1)			Sanitation Management (Phase 2)			Patrolling Capacity Reinforcement										
			Construction Cost	O & M Cost	Sub-Total	Construction Cost	O & M Cost	Sub-Total	Construction Cost	O & M Cost	Sub-Total								
0	2000	50,000	29,000	0	29,000	0	0	0	0	0	0	79,000	0			0	0	29,000	50,000
1	2001	0	241,000	0	241,000	0	0	0	0	0	0	241,000	0	0		0	0	241,000	0
2	2002	0	241,000	0	241,000	0	0	0	67,000	0	67,000	308,000	0	0		0	0	308,000	0
3	2003	0	0	125,000	125,000	14,000	0	14,000	0	60,000	60,000	199,000	0	0		185,000	185,000	14,000	0
4	2004	0	0	125,000	125,000	176,000	0	176,000	32,000	73,000	105,000	406,000	0	0		198,000	198,000	208,000	0
5	2005	0	0	125,000	125,000	224,000	0	224,000	0	85,000	85,000	434,000	0	0		210,000	210,000	224,000	0
6	2006	25,000	0	125,000	125,000	257,000	0	257,000	32,000	98,000	130,000	537,000	0	0		223,000	223,000	289,000	25,000
7	2007	0	0	125,000	125,000	0	108,000	108,000	0	110,000	110,000	343,000	0	0		343,000	343,000	0	0
8	2008	0	0	125,000	125,000	0	108,000	108,000	32,000	124,000	156,000	389,000	0	0		357,000	357,000	32,000	0
9	2009	0	0	125,000	125,000	0	108,000	108,000	0	136,000	136,000	369,000	0	0		369,000	369,000	0	0
10	2010	0	0	125,000	125,000	0	108,000	108,000	32,000	149,000	181,000	414,000	0	0		382,000	382,000	32,000	0
11	2011			112,500	112,500		108,000	108,000		149,000	149,000	369,500	0	0		369,500	369,500	0	0
12	2012			100,000	100,000		108,000	108,000		149,000	149,000	357,000	0	0		357,000	357,000	0	0
13	2013			87,500	87,500		108,000	108,000		149,000	149,000	344,500	0	0		344,500	344,500	0	0
14	2014			75,000	75,000		108,000	108,000		149,000	149,000	332,000	0	0		332,000	332,000	0	0
15	2015			62,500	62,500		108,000	108,000		149,000	149,000	319,500	0	0		319,500	319,500	0	0
16	2016			50,000	50,000		97,200	97,200		134,100	134,100	281,300	0	0		281,300	281,300	0	0
17	2017			37,500	37,500		86,400	86,400		119,200	119,200	243,100	0	0		243,100	243,100	0	0
18	2018			25,000	25,000		75,600	75,600		104,300	104,300	204,900	0	0		204,900	204,900	0	0
19	2019			12,500	12,500		64,800	64,800		89,400	89,400	166,700	0	0		166,700	166,700	0	0
20	2020			0	0		54,000	54,000		74,500	74,500	128,500	0	0		128,500	128,500	0	0
21	2021			0	0		43,200	43,200		59,600	59,600	102,800	0	0	0	102,800	102,800	0	0
22	2022			0	0		32,400	32,400		44,700	44,700	77,100	0	0	0	77,100	77,100	0	0
23	2023			0	0		21,600	21,600		29,800	29,800	51,400	0	0	0	51,400	51,400	0	0
24	2024			0	0		10,800	10,800		14,900	14,900	25,700	0	0	0	25,700	25,700	0	0
25	2025			0	0		0	0		0	0	0	0	0	0	0	0	0	0
26	2026			0	0		0	0		0	0	0	0	0	0	0	0	0	0
27	2027			0	0		0	0		0	0	0	0	0	0	0	0	0	0
28	2028			0	0		0	0		0	0	0	0	0	0	0	0	0	0
29	2029			0	0		0	0		0	0	0	0	0	0	0	0	0	0
30	2030			0	0		0	0		0	0	0	0	0	0	0	0	0	0
31	2031			0	0		0	0		0	0	0	0	0	0	0	0	0	0
32	2032			0	0		0	0		0	0	0	0	0	0	0	0	0	0
33	2033			0	0		0	0		0	0	0	0	0	0	0	0	0	0
34	2034			0	0		0	0		0	0	0	0	0	0	0	0	0	0
35	2035			0	0		0	0		0	0	0	0	0	0	0	0	0	0
36	2036			0	0		0	0		0	0	0	0	0	0	0	0	0	0
37	2037			0	0		0	0		0	0	0	0	0	0	0	0	0	0
38	2038			0	0		0	0		0	0	0	0	0	0	0	0	0	0
39	2039			0	0		0	0		0	0	0	0	0	0	0	0	0	0
40	2040			0	0		0	0		0	0	0	0	0	0	0	0	0	0
41	2041			0	0		0	0		0	0	0	0	0	0	0	0	0	0
42	2042			0	0		0	0		0	0	0	0	0	0	0	0	0	0
43	2043			0	0		0	0		0	0	0	0	0	0	0	0	0	0
44	2044			0	0		0	0		0	0	0	0	0	0	0	0	0	0
45	2045			0	0		0	0		0	0	0	0	0	0	0	0	0	0
46	2046			0	0		0	0		0	0	0	0	0	0	0	0	0	0
47	2047			0	0		0	0		0	0	0	0	0	0	0	0	0	0
48	2048			0	0		0	0		0	0	0	0	0	0	0	0	0	0
49	2049			0	0		0	0		0	0	0	0	0	0	0	0	0	0
50	2050			0	0		0	0		0	0	0	0	0	0	0	0	0	0
Total		75,000	511,000	1,562,500	2,073,500	671,000	1,458,000	2,129,000	195,000	2,250,500	2,445,500	6,723,000	Total	0	0	5,271,000	5,271,000	1,477,000	75,000

Table 23.3.6 Cost Recovery Schedule for Natural Resources Management

No.	Year	Incremental Cost of EMP Activities for Natural Resources (US$)													Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)	Grant for Facilities & Construction
		Fishing Inspection			Landscape	Shipping Patrol			Reforestation in Bare Area			Rehabilitation of Mangrove Swamp			Total					
		Facility (Boat)	O & M	Sub-Total	Construction	Facility (Boat)	O & M	Sub-Total	Construction	O & M	Sub-Total	Construction	O & M	Sub-Total						
												92,000	0	92,000	92,000	0		0	0	92,000
0	2000	0	0	0	0	0	0	0	0	0	0	81,000	0	81,000	291,000	0		6,000	6,000	285,000
1	2001	32,000	6,000	38,000	50,000	0	0	0	122,000	0	122,000	81,000	0	81,000	211,000	0	0	6,000	6,000	205,000
2	2002	0	6,000	6,000	0	0	0	0	124,000	0	124,000	81,000	0	81,000	268,000	0	0	23,000	23,000	245,000
3	2003	0	6,000	6,000	0	32,000	4,000	36,000	125,000	5,000	130,000	88,000	8,000	96,000	268,000	0	0	26,000	26,000	206,000
4	2004	0	6,000	6,000	0	0	4,000	4,000	125,000	6,000	131,000	81,000	10,000	91,000	232,000	0	0	33,000	33,000	206,000
5	2005	0	7,000	7,000	0	0	5,000	5,000	125,000	10,000	135,000	81,000	11,000	92,000	239,000	0	0	34,000	34,000	236,000
6	2006	0	7,000	7,000	0	0	5,000	5,000	155,000	10,000	165,000	81,000	12,000	93,000	270,000	0	0	37,000	37,000	268,000
7	2007	0	7,000	7,000	25,000	0	5,000	5,000	155,000	12,000	167,000	88,000	13,000	101,000	305,000	0	0	41,000	41,000	231,000
8	2008	0	7,000	7,000	0	0	5,000	5,000	150,000	13,000	163,000	81,000	16,000	97,000	272,000	0	0	43,000	43,000	231,000
9	2009	0	7,000	7,000	0	0	5,000	5,000	150,000	14,000	164,000	81,000	17,000	98,000	274,000	0	0	46,000	46,000	231,000
10	2010	0	7,000	7,000	0	0	5,000	5,000	150,000	16,000	166,000	81,000	18,000	99,000	277,000	0	0	46,000	46,000	231,000
11	2011		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
12	2012		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
13	2013		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
14	2014		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
15	2015		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
16	2016		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
17	2017		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
18	2018		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
19	2019		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
20	2020		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
21	2021		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
22	2022		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
23	2023		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
24	2024		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
25	2025		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
26	2026		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
27	2027		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
28	2028		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
29	2029		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
30	2030		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
31	2031		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
32	2032		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
33	2033		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
34	2034		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
35	2035		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
36	2036		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
37	2037		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
38	2038		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
39	2039		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
40	2040		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
41	2041		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
42	2042		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
43	2043		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
44	2044		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
45	2045		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
46	2046		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
47	2047		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
48	2048		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
49	2049		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
50	2050		7,000	7,000			5,000	5,000		16,000	16,000		18,000	18,000	46,000	0	0	46,000	46,000	0
Total		32,000	346,000	378,000	75,000	32,000	238,000	270,000	1,381,000	726,000	2,107,000	916,000	825,000	1,741,000	4,571,000	Total	0	2,135,000	2,135,000	2,436,000

Notes
1. Assumed interest rate for donors' soft loans = Bar rate of US$ + 6.01
2. Maximum repayment (depreciation) period for the donors' soft loan = 40 years (10 years of which are grace period)

Table 23.3.7 Cost Recovery Schedule for Environmental Monitoring

No.	Year	Incremental Cost of EMP Activities for Environmental Monitoring						Total	Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)	Grant for Equipments
		Environmental Monitoring			Environmental Inspection									
		Equipment	Monitoring (O & M)	Sub-Total	Equipment	Inspection (O & M)	Sub-Total							
0	2000	30,000	72,000	102,000	30,000	4,000	34,000	136,000	0			76,000	76,000	60,000
1	2001	0	11,000	11,000	0	4,000	4,000	15,000	0	0		15,000	15,000	0
2	2002	0	32,000	32,000	0	4,000	4,000	36,000	0	0		36,000	36,000	0
3	2003	79,000	24,000	103,000	0	4,000	4,000	107,000	0	0		28,000	28,000	79,000
4	2004	24,000	37,000	61,000	0	4,000	4,000	65,000	0	0		41,000	41,000	24,000
5	2005	108,000	64,000	172,000	0	4,000	4,000	176,000	0	0		68,000	68,000	108,000
6	2006	90,000	40,000	130,000	0	4,000	4,000	134,000	0	0		44,000	44,000	90,000
7	2007	0	23,000	23,000	30,000	7,000	37,000	60,000	0	0		30,000	30,000	30,000
8	2008	0	42,000	42,000	0	7,000	7,000	49,000	0	0		49,000	49,000	0
9	2009	0	25,000	25,000	0	7,000	7,000	32,000	0	0		32,000	32,000	0
10	2010	0	87,000	87,000	0	7,000	7,000	94,000	0	0		94,000	94,000	0
11	2011		87,000	87,000		7,000	7,000	94,000	0	0		94,000	94,000	0
12	2012		87,000	87,000		7,000	7,000	94,000	0	0		94,000	94,000	0
13	2013		87,000	87,000		7,000	7,000	94,000	0	0		94,000	94,000	0
14	2014		87,000	87,000		7,000	7,000	94,000	0	0		94,000	94,000	0
15	2015		87,000	87,000		7,000	7,000	94,000	0	0		94,000	94,000	0
16	2016		87,000	87,000		7,000	7,000	94,000	0	0		94,000	94,000	0
17	2017		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
18	2018		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
19	2019		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
20	2020		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
21	2021		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
22	2022		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
23	2023		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
24	2024		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
25	2025		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
26	2026		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
27	2027		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
28	2028		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
29	2029		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
30	2030		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
31	2031		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
32	2032		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
33	2033		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
34	2034		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
35	2035		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
36	2036		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
37	2037		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
38	2038		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
39	2039		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
40	2040		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
41	2041		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
42	2042		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
43	2043		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
44	2044		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
45	2045		87,000	87,000		7,000	7,000	94,000	0	0	0	94,000	94,000	0
46	2046		87,000	87,000		7,000	7,000	94,000				94,000	94,000	0
47	2047		87,000	87,000		7,000	7,000	94,000				94,000	94,000	0
48	2048		87,000	87,000		7,000	7,000	94,000				94,000	94,000	0
49	2049		87,000	87,000		7,000	7,000	94,000				94,000	94,000	0
50	2050		87,000	87,000		7,000	7,000	94,000				94,000	94,000	0
Total		331,000	3,937,000	4,268,000	60,000	336,000	396,000	4,664,000	Total	0	0	4,273,000	4,273,000	391,000

Notes : 1. Assumed interest rate for donors' soft loan = flat rate of 1 % = 0.01

2. Maximum repayment (depreciation) period for the donors' soft loan = 40 years (10 years of which are grace period)

Table 23.3.8 Cost Recovery Schedule for Institutional Management

No.	Year	Total T/A & Training and Equipment Cost for Institutional Management (INS)							Cumulated Borrowed Funds	Interest Payment (1)	Repayment (2)	O & M Cost (3)	Total Cash Outflow (1+2+3)	Grant for Construction, Training and Facility
		Environmental Management Capacity			Visitor Center			Total						
		Equipment	Training and O & M	Sub-total	Construction	O & M	Sub-total							
0	2000	134,000	350,000	484,000	200,000	0	200,000	684,000	0			0	0	684,000
1	2001	0	572,000	572,000	235,000	0	235,000	807,000	0	0		0	0	807,000
2	2002	0	452,000	452,000	2,236,000	40,000	2,276,000	2,728,000	0	0		40,000	40,000	2,688,000
3	2003	0	22,000	22,000	0	40,000	40,000	62,000	0	0		40,000	40,000	22,000
4	2004	0	391,000	391,000	0	40,000	40,000	431,000	0	0		40,000	40,000	391,000
5	2005	74,000	11,000	85,000	0	40,000	40,000	125,000	0	0		40,000	40,000	85,000
6	2006	0	412,000	412,000	0	40,000	40,000	452,000	0	0		40,000	40,000	412,000
7	2007	0	10,000	10,000	0	40,000	40,000	50,000	0	0		50,000	50,000	0
8	2008	0	10,000	10,000	0	40,000	40,000	50,000	0	0		50,000	50,000	0
9	2009	0	10,000	10,000	0	40,000	40,000	50,000	0	0		50,000	50,000	0
10	2010	74,000	10,000	84,000	0	40,000	40,000	124,000	0	0		50,000	50,000	74,000
11	2011		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
12	2012		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
13	2013		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
14	2014		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
15	2015		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
16	2016		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
17	2017		10,000	10,000		40,000	40,000	50,000	0	0		50,000	50,000	0
18	2018		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
19	2019		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
20	2020		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
21	2021		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
22	2022		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
23	2023		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
24	2024		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
25	2025		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
26	2026		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
27	2027		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
28	2028		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
29	2029		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
30	2030		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
31	2031		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
32	2032		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
33	2033		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
34	2034		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
35	2035		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
36	2036		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
37	2037		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
38	2038		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
39	2039		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
40	2040		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
41	2041		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
42	2042		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
43	2043		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
44	2044		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
45	2045		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
46	2046		10,000	10,000		40,000	40,000	50,000	0	0	0	50,000	50,000	0
47	2047		10,000	10,000		40,000	40,000	50,000				50,000	50,000	0
48	2048		10,000	10,000		40,000	40,000	50,000				50,000	50,000	0
49	2049		10,000	10,000		40,000	40,000	50,000				50,000	50,000	0
50	2050		10,000	10,000		40,000	40,000	50,000				50,000	50,000	0
Total		282,000	2,650,000	2,932,000	2,671,000	1,960,000	4,631,000	7,563,000	Total	0	0	2,400,000	2,400,000	5,163,000

Notes : 1. Assumed interest rate for donors' soft loan = Usl rate of 1 % = 0.01

2. Maximum repayment (depreciation) period for the donors' soft loan = 40 years (10 years of which are grace period)