CHAPTER 3
PRIORITY PROJECT IMPLEMENTATION

3.1 IMPLEMENTATION SCHEDULE

3.1.1 GENERAL

A Project implementation schedule is proposed assuming that the Project will require international funding for its implementation and will require an assignment of contractor(s) to be selected through an international competitive bidding.

3.1.2 IMPLEMENTATION SCHEDULE FOR PRIORITY PROJECT

(1) Project Component

The Priority Project will be composed of 1) the improvement of the Central sewerage system and 2) the development of the new sewerage system for the Luyanó-Martín Pérez Abajo sewer district. The sewerage system components are as shown in the section 2.1, 2.3 and 2.4.

(2) Implementation Schedule

The Priority Project will be implemented according to the following schedule:

The Project will be commenced by Financial Arrangement for securing financer(s). Upon authorization of financial arrangement, an engineering consultant will be selected and he will carry out Detailed Design for the Project.

The tender documents will also be prepared by the consultant. Through the tender of bidders, contractor(s) will be selected and the Construction Stage will be commenced.

Construction of sewerage system components are scheduled to be implemented from year 2008 to 2010. Implementation schedule is proposed as shown in Figure 3.1.

3.2 PROJECT COST ESTIMATES FOR PRIORITY PROJECT

3.2.1 BASIS OF CAPITAL COST ESTIMATE

Project cost is estimated in accordance with project components and implementation plan of the Priority Project.

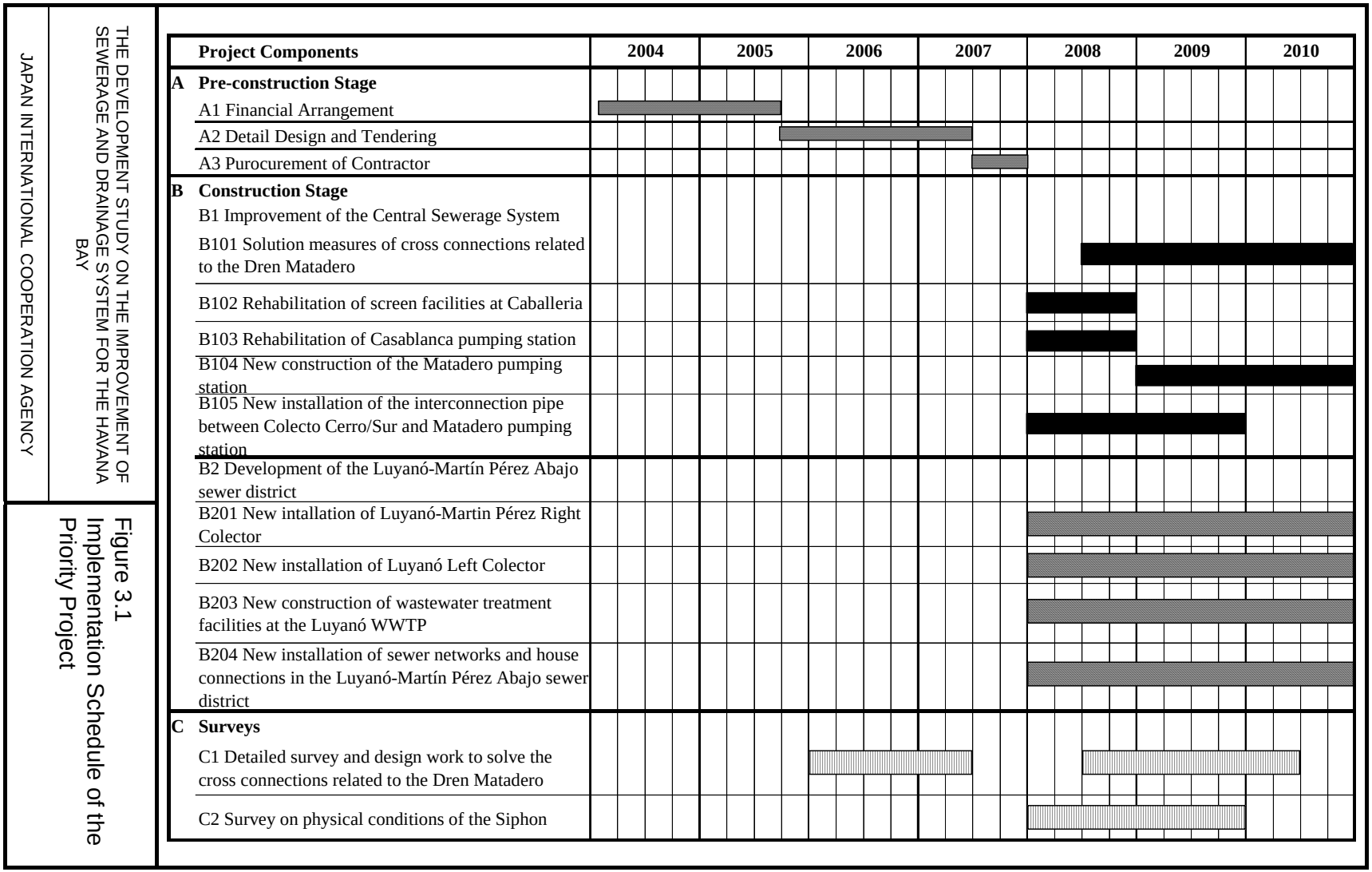
The Project cost comprises following compositions and each cost item is estimated.

1) Direct Construction Cost
2) Land Acquisition and Compensation
3) Administrative Expense
4) Engineering Services
5) Physical Contingency

The project cost is estimated based on the following condition.

(1) Price Level

The price level of the project cost is as of 2003.


JAPAN INTERNATIONAL COOPERATION AGENCY
THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY
Figure 3.1 Implementation Schedule of the Priority Project
Project Components
2004
2005
2006
2007
2008
2009
2010
A Pre-construction Stage
A1 Financial Arrangement
A2 Detail Design and Tendering
A3 Purocurement of Contractor
B Construction Stage
B1 Improvement of the Central Sewerage System
B101 Solution measures of cross connections related to the Dren Matadero
B102 Rehabilitation of screen facilities at Caballeria
B103 Rehabilitation of Casablanca pumping station
B104 New construction of the Matadero pumping station
B105 New installation of the interconnection pipe between Colecto Cerro/Sur and Matadero pumping station
B2 Development of the Luyanó-Martín Pérez Abajo sewer district
B201 New intallation of Luyanó-Martin Pérez Right Colector
B202 New installation of Luyanó Left Colector
B203 New construction of wastewater treatment facilities at the Luyanó WWTP
B204 New installation of sewer networks and house connections in the Luyanó-Martín Pérez Abajo sewer district
C Surveys
C1 Detailed survey and design work to solve the cross connections related to the Dren Matadero
C2 Survey on physical conditions of the Siphon

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(2) Foreign and Local Currency Portion

The project cost includes Foreign Currency (F.C.) portion and Local Currency (L.C.) portion. Foreign currency is estimated in terms of US Dollar and local currency is estimated in Pesos.

(3) Direct Construction cost

1) Sewers

The construction cost of sewers is estimated based on the capital cost estimate, multiplying the quantity by the unit price as described in the section 13.6 in the Sewerage System Master Plan Study. The detailed data and calculation on cost estimation is summarized in the Appendix-12 of the Supporting Report.

2) Pumping Station and Wastewater Treatment Plant

The cost is estimated separately of four kinds of work such as civil work, architectural work, mechanical work and electrical work as explained in the section 16.3 of the Supporting Report.

(4) INDIRECT CONSTRUCTION COST

1) Land Acquisition and Compensation

The cost for land acquisition and compensation will not be required for the construction of the proposed Luyanó WWTP and Matadero pumping station because the proposed sites are belong to the central government.

2) Administrative Expenses

The cost for administrative expenses required by Cuban executing agency, relative government bodies and related agencies for the implementation of the project, is estimated at 3 % of the local portion of direct construction cost.

3) Engineering Services

The cost of engineering services is estimated separately for the rehabilitation and improvement works of the existing facilities and for the new construction works. This service includes detailed surveys on cross connections and physical conditions of the siphon, and also includes brief training program for operators for new WWTP as well as basic design, detail design, preparation of tender documents and construction supervision.

The cost of engineering services for the rehabilitation and improvement works of the existing sewerage facilities is estimated at 12 % of the total direct construction cost and that for the new works is estimated at 10 % of the total direct construction cost.

4) Physical Contingency

The physical contingency is estimated at 10 % of the total direct construction cost.

3.2.2 PROJECT COST

The required project cost for the priority project is shown in Table 3.1. Table 3.2 and 3.3 show the detailed project cost for the improvement of the Central sewerage system and the development of the Luyanó-Martín Pérez Abajo sewer district, respectively.

Table 3.1 Project Cost for the Priority Project

Unit: FC(x1000US$), LC(x1000Pesos)

Item	Improvement of the Central Sewerage System		Development of the New Sewerage (Luyanó-Martín Pérez Abajo) System		Total	
	FC	LC	FC	LC	FC	LC
1. Sewers	6,619	4,411	23,964	15,976	30,583	20,387
2. Pumping System	5,669	2,935	0	0	5,669	2,935
3. WWTP	0	0	6,891	3,273	6,891	3,273
Total Direct Cost	12,288	7,346	30,855	19,249	43,143	26,595
1. Land Acquisition and Compensation	0	0	0	0	0	0
2. Administrative Expenses	0	220	0	577	0	797
3. Engineering Services	1,352	810	3,086	1,925	4,438	2,735
4. Physical Contingency	1,229	735	3,086	1,925	4,315	2,660
Total Indirect Cost	2,581	1,765	6,172	4,427	8,753	6,192
Total Capital Cost at 2003 Price	14,869	9,111	37,027	23,676	51,896	32,787

Table 3.2 Project Cost for the Central Sewerage Improvement under the Priority Project

Component	FC (x 1000 US$)	LC (x 1000 Pesos)
1.1 New Installation of Pumped Main, Colector Sur Nuevo, and Interconnection Pipe	3,139	2,091
1.2 Solution Measures of the Cross connections	3,480	2,320
1. Sub-total of the Sewers	6,619	4,411
2.1 Rehabilitation of the Screen Facilities	190	87
2.2 New Construction of Matadero Pumping Station	2,971	1,490
2.3 Rehabilitation of the Casablanca Pumping Station	2,508	1,358
2. Sub-total of the Pumping Station	5,669	2,935
Total Direct Cost	12,288	7,346
1. Land Acquisition and Compensation	0	0
2. Administrative Expenses	0	220
3. Engineering Services	1,352	810
4. Physical Contingency	1,229	735
Total Indirect Cost	2,581	1,765
Total Capital Cost at 2003 Price	14,869	9,111

Table 3.3 Project Cost for the New Sewerage Development under the Priority Project

Component	FC (x 1000 US$)	LC (x 1000 Pesos)
1.1 Luyanó-Martín Pérez Right Colector and sewer networks	19,234	12,822
1.2 Luyanó Left Colectors and sewer networks	4,730	3,154
1. **Sub-total of the Sewers**	23,964	15,976
2. **WWTP**	6,891	3,273
Total Direct Cost	30,855	19,249
1. Land Acquisition and Compensation	0	0
2. Administrative Expenses	0	577
3. Engineering Services	3,086	1,925
4. Physical Contingency	3,086	1,925
Total Indirect Cost	6,172	4,427
Total Capital Cost at 2003 Price	37,027	23,676

3.2.3 OPERATION AND MAINTENANCE COST

The O/M cost comprises following compositions and each cost item is estimated.

1) Personnel Cost
2) Power Cost
3) Chemical Cost

The O/M cost required to operate the proposed sewerage system components is summarized in Table 3.4.

(1) Personnel Cost

Personnel cost is estimated in terms of local currency of Cuban Pesos. The unit cost is based on the actual cost required for each classified personnel. The personnel cost is estimated for the proposed personnel necessary to construct and operate and maintain the proposed sewerage facilities. The number and classification of the proposed personnel were described in the section of 2.5.5. The calculation sheet is given in Appendix-12 of the Supporting Report.

(2) Power Cost

Power cost is estimated in terms of local currency of Cuban Pesos. Power cost is estimated for the existing Casablanca pumping station, the Matadero pumping station, and the Luyanó WWTPs. The required power cost depends on the wastewater volume pumped which is estimated based on the assumption of sewerage coverage. The detailed cost information is referred to Appendix-12 of the Supporting Report.

(3) Chemical Cost

Chemical cost is estimated based on volume of chemicals required for de-watering of sludge produced in the Luyanó WWTP by mechanical dewatering facilities. Since the chemicals will be imported the chemical cost is estimated in terms of foreign currency of US Dollars. The detailed cost estimation is given in Appendix-12 of the Supporting Report.

Table 3.4 Annual Operation and Maintenance Cost required under the Priority Project

Year	Annual Personnel Cost (x 1,000 Pesos)						Annual Power Cost (x 1,000 Pesos)					Chemical	O/M Cost Total	
	Head Quarter	Improvements of the Central system			Luyanó WWTP	Total	Improvements of the Central system			Luyanó WWTP	Total	Cost (x 1,000 USD) Luyanó WWTP	Posos x 1,000	USD x 1,000
		Matadero PS	Casablanca PS	Sub-total			Madero PS	Casablanca PS	Sub-total					
2011	540	73	107	180	145	865	53	180	233	44	277	17	1,142	17
2012	540	73	107	180	145	865	53	180	233	51	284	33	1,149	33
2013	540	73	107	180	145	865	53	180	233	56	289	46	1,154	46
2014	540	73	107	180	145	865	53	180	233	59	292	54	1,157	54
2015	540	73	107	180	145	865	53	180	233	63	296	62	1,161	62
2016	540	73	107	180	145	865	53	184	237	85	322	67	1,187	67
2017	540	73	107	180	145	865	53	184	237	87	324	71	1,189	71
2018	540	73	107	180	145	865	53	184	237	89	326	75	1,191	75
2019	540	73	107	180	145	865	53	184	237	91	328	79	1,193	79
2020	540	73	107	180	145	865	53	184	237	93	330	83	1,195	83
2021	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2022	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2023	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2024	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2025	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2026	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2027	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2028	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2029	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2030	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2031	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2032	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2033	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2034	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83
2035	540	73	107	180	145	865	53	187	240	104	344	83	1,209	83

Source:JICA Study Team

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3.3 ORGANIZATIONS AND INSTITUTIONS

3.3.1 GENERAL

For the implementation of projects in the water and sewerage sector it is important to understand the institutional arrangement at national and provincial level, and how the central government control mechanism coordinates with the provincial delegations and the water supply and sanitation companies themselves.

There is also the cross cutting issue of the strong connection with the environmental sector, also at national and provincial level, and again it is necessary to know the role and responsibilities of the many other ministries linked to the environment.

With regard to this particular study, it is also necessary to fully understand the fundamental institutional arrangement for issues of environmental concern in the Havana Bay basin.

This section of the report therefore sets out the present institutional arrangements and makes recommendations for strengthening, where thought necessary, to assist in improving future operations in both the Water Supply & Sewerage, and Environmental Sectors for Havana Bay.

3.3.2 WATER SUPPLY AND SEWERAGE SECTOR

Regarding the governmental agency responsible for the water supply and sewerage sector, Figure 3.2 shows how INRH operates in the City of Havana. Havana is itself a province and the Provincial Delegation (DPRH) of the City of Havana provides the link with the city's water supply and sewerage corporations.

INRH has been in existence for over forty years, and is able to provide engineering services to the water supply & sewerage corporations, as well as controlling the water rights which are essential for sustainability. In addition, through CENHICA and EAH, INRH is able to develop and issue standards for the protection of water sources in the bay basins, and monitor the water quality of all terrestrial waters.

By the time this priority project is implemented, Aguas de la Habana will have expanded its service area to cover all of the new works under this project. This mixed enterprise already manages, operates and maintains the Central Sewerage System which will be extensively rehabilitated under this project.

Since the 25 year concession agreement between Aguas de la Habana and INRH came into effect in April 2000, Aguas de la Habana has developed an appropriate organizational structure to manage, operate and maintain the system, and has made good progress in raising the levels of service for the water supply. The organization includes a Sewerage and Drainage Division capable of expanding to absorb the new works, as well as appropriate departments for Information Systems and Human Resources.

3.3.3 ENVIRONMENTAL SECTOR

In accordance with the Law of the Environment (Law No. 81 of 1997), the Ministry of Science, Technology and Environment (CITMA) is responsible for environmental policy, and these responsibilities are carried out at Provincial level by the Provincial Delegations. Hence, environmental matters for the City of Havana are handled by DCITMA.

Unlike INRH, CITMA has only been in existence for about 10 years, and operates in an increasingly important environmental sector which is now recognized globally as a problem area. Due to the diversity of environmental issues many other ministries are involved in sustainable protection of the environment.

The principle ministries and institutions involved are shown in Table 3.6**,** and as can be seen they number more than twenty.

Included in the duties of CITMA are the following two items that are particularly relevant to Havana Bay:

(1) Establishing mechanisms for coordination among the various agencies and bodies for efficient management.

In this regard it is necessary for CITMA to ensure that the National Environmental Program is followed by all stakeholders and that the National Environmental Strategy is controlled and improved.

This is an enormous task given the number of agencies who must incorporate and evaluate the requirements of environmental protection in their development plans. The May 2000 issue of the Environmental Strategy recognizes that these agencies have not paid systematic attention to, and exercised control over their environmental problems.

(2) Assure compliance with legislation, and modernize and complete national environmental legislation

CITMA is responsible for the modernization and completion of the national environmental legislation, and compliance with this legislation.

As regards modernization and completion of legislation, it must be noted that the Law of the Environment establishes the legal principles to govern environmental policy and the basic legal requirements to regulate environmental management. It does not define in detail all that must be complied with, and more laws and regulations are required.

Several agencies are responsible for developing Technical standards to compliment the basic laws of the environment. Among them are CITMA, INRH, MINSAP and MINAG. There has to be an ongoing commitment to develop environmental legislation.

Regarding enforcement of legislation it was recognized during the GEF study that the application and enforcement of environmental law is generally weak, and although Cuba has proved its commitment to the protection of the environment with its environmental laws, strategy and development program, the current laws are not always enforceable, and the ecosystem continues to be at risk.

Regarding coordination, Figure 3.3 shows the link between the Environmental Sector and the Water Supply and Sewerage Sector for the City of Havana. Only Aguas de la Habana is shown as the Water supply and sewerage corporation since this will be the enterprise responsible for operation and maintenance of the Priority Works.

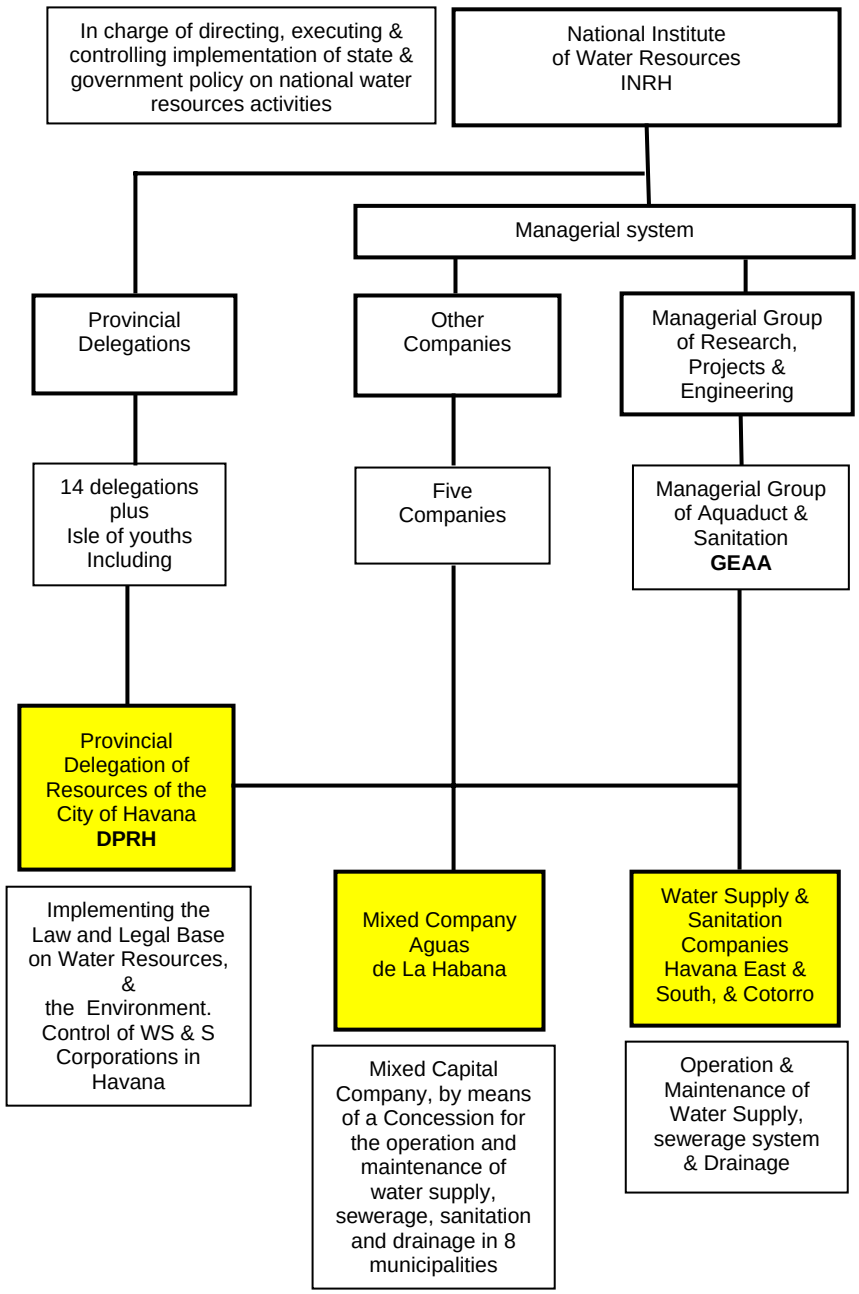
The water supply & sewerage sector and the environmental sector are linked through a National Council for Hydraulic Basins comprising representatives of INRH and CITMA. These councils operate at provincial level, and for the City of Havana, CITMA provide the president, and INRH the vice president.

At national level, the environmental sector is the responsibility of CITMA, and environmental matters are dealt with by delegations at provincial level (DCITMA). CITMA is also represented at municipal level.

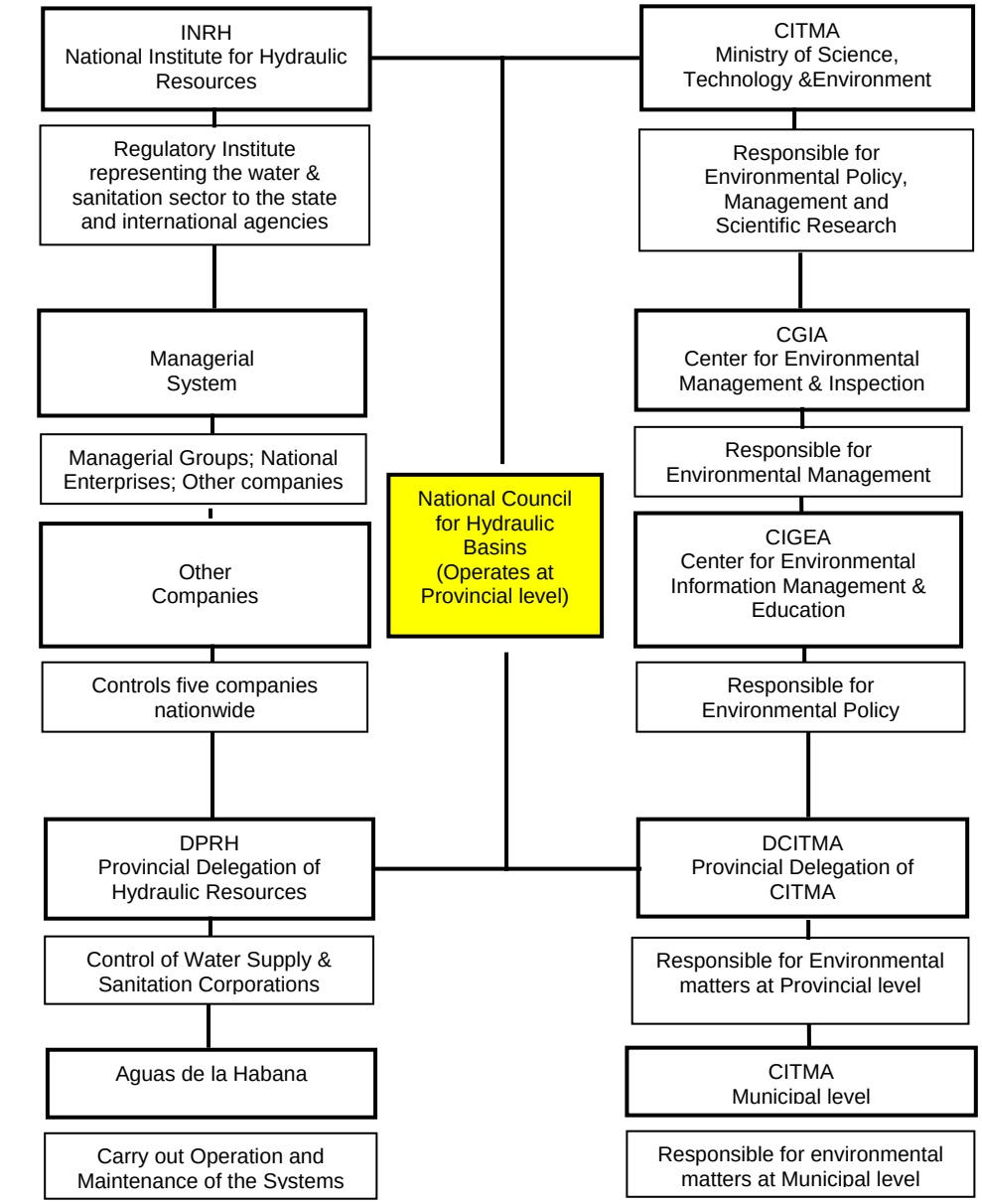
Table 3.5 Other State Agencies & Bodies in Environmental Management

Ministry or Agency	In Association with	Area of Responsibility
Central Administration of the State	Local Bodies of Popular Power	Coordinate and control of local environmental matters of concern.
INRH	CITMA Popular Power	Management of Terrestrial Waters. Coordinate water supply, sewerage & wastewater treatment.
Economy and Planning	CITMA Agencies of Popular Power	Coordinate zoning, and the National Environmental Information System. Essential public services.
Education	Higher Education, Culture and the Media	Coordinate Environmental Education
Finance and Prices	CITMA Economy and Planning	Determines tariffs & taxes for Environmental Protection. Operation of the National Fund for the Environment.
Foreign Trade	CITMA	Trade & the Environment
Agriculture	CITMA Basic Industry & Sugar Industry Sugar Industry.	Mangroves & other vegetation for bays, coastal zones etc. Terrestrial ecosystem. Sustainable agriculture.
Fishing Industry	CITMA INRH	Sustainable marine fishery resources. Aquatic, terrestrial & marine Ecosystems.
Transport	None	Regulations to protect marine, coastal resources & ports.
Public Health	CITMA None Labor & Social Security Agriculture	Atmosphere. Health & quality of life. Sounds, vibration etc. Toxic chemical pesticides.
Basic Industry	None Public Health	Mineral Resources. Mineral Waters.
Sugar	Agriculture & Basic Industry	Biomass for energy source, & reduction of environmental pollution.
Civil Defense	CITMA	Natural Disasters.
Tourism	CITMA, Economy & Planning	Sustainable development of tourism.
Labor & Social Security	CITMA, Public Health, Cuban Workers Confederation, National Association of Small Farmers	Environmental Protection during work activities.

Source: Law of the Environment No.81; 1997



THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 3.2 INRH-Organization Chart for the City of Havana
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 3.3 Environmental Sector and Water Supply & Sewerage Sector City of Havana
JAPAN INTERNATIONAL COOPERATION AGENCY	

3.3.4 INSTITUTIONAL ARRANGEMENT FOR HAVANA BAY

(1) General

At this point in time the institutional arrangements which affect Havana Bay are undergoing a change. Under the GEF project it was originally envisaged that GTE would be an interim organization pending the coming into being of a Port Authority. This concept has recently been modified and plans are underway to extend the mandate of GTE as a permanent organization by way of amendment to "Acuerdo" 3330, whilst at the same time creating a Port Authority.

(2) GTE

The State Working group for Cleaning up, Conservation and Development for the Havana Bay (GTE) is in charge of planning, organization, coordinating, executing and controlling the program for cleaning up and environmental management of Havana Bay at local level. Management of these activities is carried out in conjunction with other national and international institutions.

GTE will be the environmental authority for the whole of the Havana Bay Basin. GTE is an inter-ministerial, inter-sectoral organization principally coordinating sectoral ministries (e.g. MINTRANS), the environmental sector (CITMA) and territorial interests through the Provincial Assembly of the City of Havana (CAP).

GTE reports to the Executive Committee of the Council of Ministers (CECM) through the Integrated Management of Coastal Zones (MIZC). MIZC has a board representing all interested parties and all reports to CECM are first agreed by MINTRANS, CITMA and the president of the government of the City of Havana.

GTE has one Vice President representing CITMA and one representing the Popular Power, and works together with a Technical Committee currently comprised of twelve organizations of the central state administration. The following list shows the organizations involved:

- MINTRANS — CIMAB; SAMARP; and DSIM
- MININT — Captain of Havana Port
- MIP — Directorate for Fishing Regulations
- INRH — DPRH
- CAP — Provincial Directorates of Community Services; Public Health; and Physical Planning. Administrative Councils of Habana Vieja, Regla, and del Este

As can be seen, GTE is linked with INRH (through DPRH), and the Provincial Assembly of the City of Havana as well as the sectoral ministries concerned with the environment. This will be further strengthened by the addition of MINAG and the Administrative Councils of all of the 10 municipalities in the Havana Bay Basin.

GTE operates with revenue derived from charges levied on organizations in accordance with their bay frontage. These taxes are collected by ONAT and disbursed through the Ministry of Economy and Planning (MEP). Revenue amounts to about US$1 million/annum, and about half of this goes towards improving sewerage systems. Currently, GTE are committed to providing US$1 million to the Italian aided project for construction of a physic-chemical sedimentation wastewater treatment plant in the container yard near the river mouth of Rio Luyanó.

About 30-40% of revenue is used for various projects to clean up the bay and the remainder for environmental monitoring, environmental education and for special studies etc.

(3) Ministry of Transport

At national level, and in accordance with the Law of the Environment, MINTRANS has the responsibility to establish regulations assuring that transportation and civil navigation activities in marine waters and port activities occur without damaging marine and coastal resources, and port facilities.

In order to carry out the task of reducing pollution from shipping, MINTRANS works with the Directorate of Marine Security and Protection (DSIM) and its District Offices and through a National Company for Port Sanitation (SAMARP) (Empresa de Saniamiento Maritimo Portuario). Under Law No. 211-97 (MINTRANS) – Management &Disposal of Waste Generated by Ships (1997) Progress has been made on the management and control of solid and liquid waste from ships.

(4) Port Authority

A law (Judicial Norm) has been passed to establish National Port Authorities. Ports will be designated as national, provincial or local in accordance with the usage. Havana will be a national port, and it will have its own revenue to provide funds for the management of the port.

The area of control for the Havana Port Authority has been designated and this covers part of the immediate surround to the bay. The port authority will have some environmental responsibilities limited to the designated area.

Work on the organization chart and staff selection has already commenced for this new port authority.

3.3.5 INSTITUTIONAL STRENGTHENING

(1) General

Whilst examining the overall institutional situation as part of this study, it was noted that under the UNDP/GEF Project Document (CUB/99/G31) dated April 2002, proposals to restructure the institutions and legal framework were prepared. The GEF document identified that institutional strengthening in environmental management of the bay was needed.

The document states that one of the main reasons for the UNDP assistance to the GEF 5 year operational program (2002-2007) is the development and strengthening of national environmental institutions responsible for bay management. The document further states that the institutional framework will be strengthened by involving the different stakeholders in constructive discussions and through the establishment of appropriate incentive structures.

As regards this study, some difficulties were encountered in identifying which particular institutions or individuals were able to provide information, give official comments, and make timely final decisions on a variety of subjects. This has not only affected the technical part of the study, but also the financial and economic analysis, and the environmental education program, particularly as regards timing.

Future studies would benefit from a clear demarcation of responsibilities, the timely provision of information, permission to visit all necessary places and the collection of vital information consistent with the general procedures for international projects.

It may be generally concluded that with close coordination, the performance of the existing national, provincial, municipal, and local institutions involved in water supply & sewerage, and the environmental management of the bay will improve over time with inputs for institutional strengthening and training through the UNDP/GEF five year project from 2002 to 2007.

In order to continue this strengthening, the implementation arrangements for the Priority Project must have an institutional arrangement that will ensure coordination of all the concerned parties, but without committees being too extensive which would lead to inefficiencies.

There is little point in formulating another set of proposals for institutional strengthening in the environmental management of the bay, taking into consideration the recently changed institutional arrangements which are still being developed.

(2) INRH

Within the recent national economic constraints, INRH has been able to operate successfully in the City of Havana through its Provincial Delegation, DPRH. It has the institutional capacity to monitor the quality of terrestrial waters and carry out appropriate analysis through EAH and CENHICA respectively, although limited by available finance.

INRH also has the capacity to regulate and control the operation and maintenance activities of the City of Havana water supply & sewerage corporations. However, the Priority Works for the new sewerage area resulting from this study need to be augmented by the installation of primary sewers and household connections, and this will be the responsibility of GOC through INRH, and may also involve the operator, Aguas de la Habana., depending upon the terms and conditions of the concession agreement.

The human resources as well as the financial resources need to be carefully planned when this work is required. It is recommended that that the Concession Agreement with Aguas de la Habana be reviewed in the light of these requirements.

(3) Aguas de la Habana

When the service area of Aguas de la Habana is extended it will be the sole operator of the works envisaged by this project. Hence, management, operation and maintenance will fall under this one authority. As a mixed enterprise company under a concession agreement with INRH to 2025, the full expertise of Aguas de Barcelona will be available during the Priority Project, for the rehabilitated and expanded sewerage system.

(4) CITMA

There are two areas to be considered, these are the institutional capacity for coordination among the various agencies for efficient management, and compliance, modernization and completion of environmental legislation.

The Law of the Environment recognizes that environmental management is integral, crosses all social sectors, and requires the coordinated participation of state agencies and bodies, other entities and institutions, society, and citizens in general. Cuba is a socialist society and has a complex but highly developed system of integrated planning at national, regional and local levels.

There are shortcomings which have to be addressed by institutional capacity building to strengthen CITMA for the monitoring of the environmental protection plans which the agencies are required to draw up and implement. In the GEF Pilot Phase Project (95-98) it was concluded that integration between central and sectoral government institutions is insufficient. As previously stated, this problem is being addressed through the GEF project.

Regarding environmental legislation, lack of enforcement is mainly due to economic reasons and not a lack of institutional capacity. As the economy grows and/or external finance is made available the ability to enforce the laws will improve accordingly.

Modernization and completion of environmental laws is an ongoing commitment and one must

look at the progress made since the introduction of Law No. 33 in 1981, the subsequent change to the constitution (article 27, sustainable development), following the Earth Summit in Rio De Janeiro, the formation of CITMA in 1994, and the introduction of the Law of the Environment (No. 81 of 1997).

These major changes over a period of almost 20 years have been complimented by the issue of Decree Laws and Technical Standards (Normas Technicas), the latter being mainly the responsibility of CITMA, INRH, MINSAP and MINAG.

In this regard it must be noted that Cuba is not a member of the International Monetary Fund (IMF) and has very limited access to external sources of financing. Thus economic circumstances alone prevent Cuba from complying with its own laws of the environment.

Lengthy time periods have been required to develop subsidiary legislation, and it should only be necessary for GOC to ensure that major projects are not compromised through the timing of the issue of appropriate laws. As regards the Priority Project, it is important that legislation is completed for the control of both domestic and industrial wastewater discharged to terrestrial and coastal waters.

(5) GTE

With the ongoing changes to GTE it is not possible to comment on the overall institutional situation except that the human resources and financial capacity must increase to suit the growing responsibilities of this organization. The specific areas concerning the Priority Works are the environmental monitoring and environmental education.

As regards environmental monitoring, GTE have taken note of the recommendations in the Master Plan section of this report and will implement the full proposals over time. Financial constraints have so far limited sampling and analysis to 4 times a year (2 wet season and 2 dry season). In 2002 this was done with finance through GTE and JICA, and in 2003 financed solely by GTE.

A proposal has been developed for digital mapping, with an integrated system involving CITMA, CIMAB and MINSAP, at an estimated cost of US$1 million. This proposal is a huge leap forward and is unlikely to become a reality for several years to come. GTE would be well advised to solicit the necessary funding from GOC and/or external sources for a more modest scheme that will ensure that the recommended sampling and monitoring program can be put in place now.

The ability of GTE to expand its program of environmental education has been strengthened through this study by the production of a second video and two handbooks for community and schools programs, and the INRH program.

Once again GTE have plans for an extensive sophisticated Environmental Center, but funding and construction of this facility will take several years at least, and implementation of this environmental education program should commence immediately.

Program development and implementation is a challenging and demanding task, and GTE have limited resources. Only one person is available on a full time basis and it is recommended that a second specialist be employed to ensure rapid program development and concurrent implementation in the various sectors involved in the program. In addition, implementation will require appropriate financial resources for the necessary seminars and workshops, transport etc. to control the program. GTE may have between US$10-20,000/annum for an education program.

However, should the human and/or financial resources be found inadequate when the

implementation program is produced, then GTE may consider seeking the required resources from international donor agencies.

JICA has committed a large amount of finance to provide educational material and it is essential that this material be put to immediate good use with the rapid introduction and implementation of the program envisaged.

(6) MINTRANS

With the imminent formation of a port authority for the City of Havana, there is little to comment on until the authority has been formed and the interaction between the port authority, MINTRANS, GTE etc. can be observed.

It is important however that MINTRANS continues to coordinate the task of reducing pollution from ships with GTE, and that the new port authority olso coordinates with GTE on its environmental responsibilities.

3.3.6 INSTITUTIONAL ARRANGEMENTS FOR PROJECT IMPLEMENTATION

(1) General

Due to the relatively high capital cost of rehabilitation and construction works resulting from this Master Plan and Feasibility Study for the Priority Works, it is assumed that international financing will be required and that international consultants and contractors will be involved in detailed design and construction.

For control of the projects in Cuba, it will therefore be necessary to involve those ministries related to foreign investment, the institutions involved in the environmental sector, and the water supply and sewerage sector in the City of Havana.

(2) Project Institutional Framework

On commencement of the project it is recommended that a steering committee be formed representing all of the relevant agencies and bodies.

For coordination of the project at national level, MINVEC is the central government ministry for the coordination of international cooperation and therefore supervises the execution and implementation of all foreign projects in Cuba.

For the administration of the project, GTE is being developed as the environmental authority for the Havana Bay basin and therefore should play a leading role for coordination at provincial and local level when the project is being developed.

The structure of GTE is such that it has strong links will all of the agencies and bodies concerned with the environmental matters of the City of Havana, Havana Bay, and the bay basin in particular. There will be a need to continually update information on water quality, and the growth and movement of the population in the bay basin and such information can be provided either directly by GTE or through its Technical Committee.

Since this will be a design and construction project in the water supply & sewerage sector, a most important agency will be INRH who will represent the central government as the eventual owner of the new assets. For supervision of this project it is recommended that the provincial delegation DPRH for the City of Havana represents INRH.

The new and rehabilitated works will be operated and maintained by Aguas de la Habana, and this enterprise should be included in the planning stage of the project, particularly in view of the extensive rehabilitation of existing work.

The international Consultant will also be represented, when selected, and the structure of the recommended Steering Committee, and the roles and responsibilities are shown in Figure 3.4. The Steering Committee will therefore comprise:

- MINVEC
- GTE
- INRH (DPRH)
- International Consultant
- Aguas de la Habana

Figure 3.4 also shows the agencies and bodies of the GTE Technical Committee who can contribute to the project and be kept informed through GTE.

(3) Design and Construction Supervision

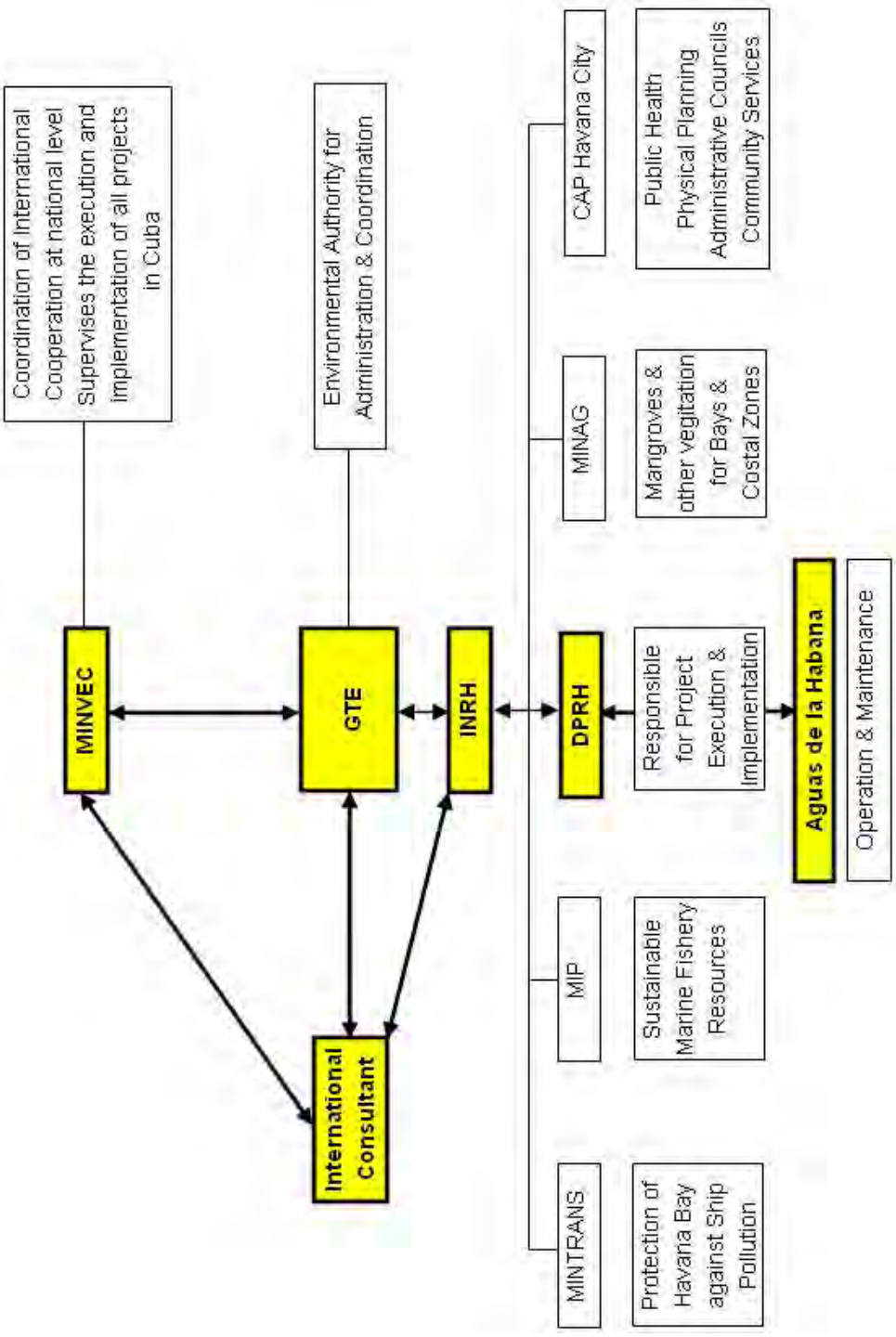
Loans and/or Grants from International Organizations will be channeled through MINVEC, and depending upon the donor country's project Loan/Grant system, the International Consultant will liaise directly or through MINVEC on financial and other related matters.

In view of the role of GTE as the environmental authority for the bay basin and its links with the many relevant agencies, GTE can again play an important coordinating role, however,since this is a construction project all technical matters which are the responsibility of the International Consultant should be dealt with by DPRH who will be responsible for the project as the client

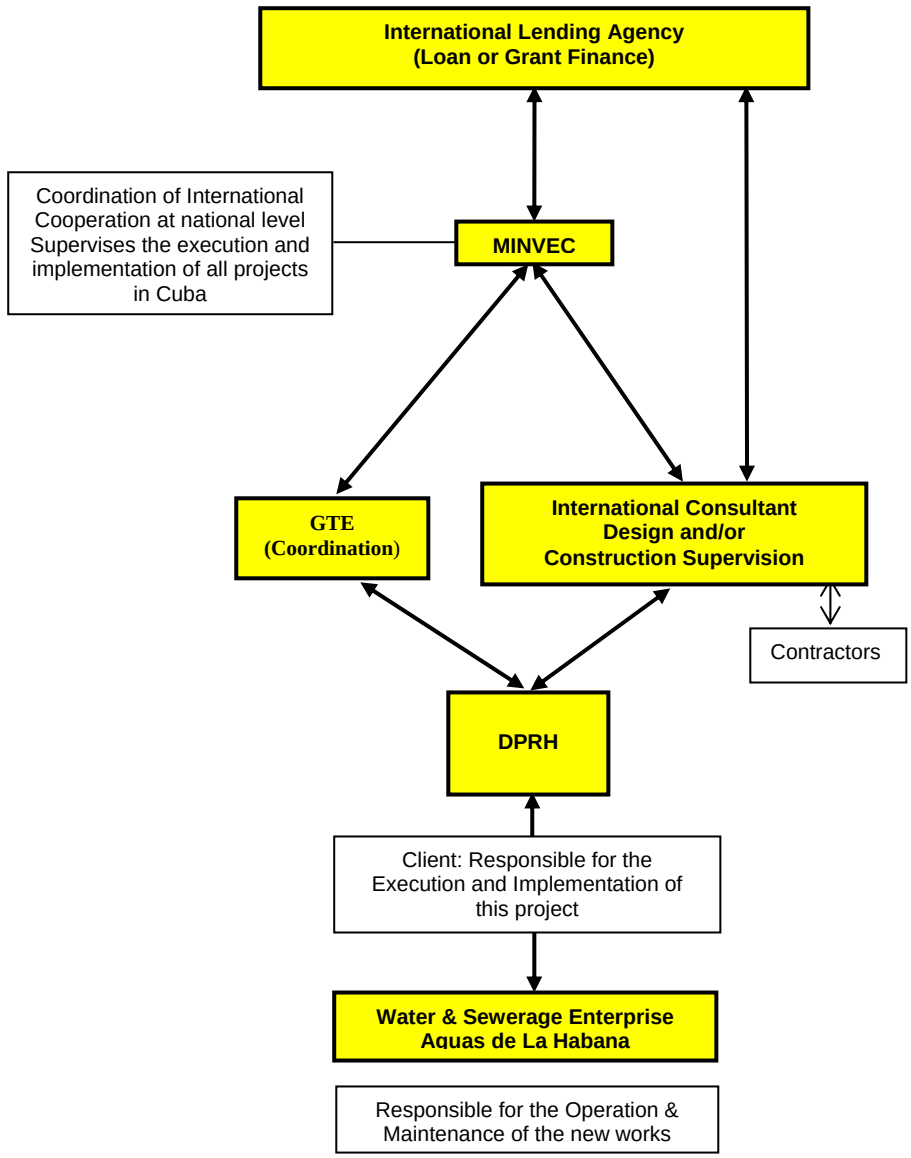
The role of Aguas de la Habana will vary depending upon the concession arrangement with INRH. As stated earlier in this report, the Concession Agreement should be reviewed before commencement of the Priority Works in view of the addition of assets to be operated and maintained, the financial consequences, and the disruption to services that may be caused by the construction works, particularly the extensive rehabilitation of the Central Sewerage System.

One system that may be adopted is to make the Operator responsible for some of the contracts, in place of IHRH, if such an arrangement would be beneficial to all parties to the contracts and allowed under the donor's rules. For example, in this particular case in may be better to have Aguas de la Habana responsible as the "Client" for all of the rehabilitation contracts in view of the close liaison required to minimize disruption to the sewerage system.

The recommended organizational structure for technical design and supervision of construction is shown in Figure 3.5**.**



THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 3.4 Project Institutional Framework Proposed Steering Committee



THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 3.5
Proposed Institutional Arrangement for Design and Construction Supervision

CHAPTER 4
FINANCIAL AND ECONOMIC ANALYSIS

4.1 FINANCIAL ANALYSIS

4.1.1 METHODOLOGY

The financial viability of a capital investment project was analyzed on the basis of discounted cash flow method, using three indicators namely net present value (NPV), benefit cost ratio (B/C), and financial internal rate of return (FIRR). The methodology is the same as what is described in Section 13.9.1 of Part I.

4.1.2 BASIC CONDITIONS

The conditions and assumptions applied to estimate financial costs and benefits of the master plan project are described in Section 13.9.1 of Part 1. Mostly the same conditions and assumptions were applied to estimate financial costs and benefits of the priority project. They are summarized as follows:

1) Implementation agency

The assumption is the same as that of master plan. The DPRH (Provincial Delegation of the National Institute of Water Resources in the City of Havana) will be the constructor and Aguas de La Habana (Havana Water) will be the operator. Aguas de La Habana will represent the other water companies that operate in the City of Havana in the financial analysis, which is based on a future merger possibility of the water companies in the city. In the financial analysis, DPRH and Aguas de La Habana will be imaginarily consolidated to form a singly entity that specializes in the proposed project only.

2) Project costs

The same framework as that of master plan was used for the assumption. The project costs consist of capital investments and O/M costs. The disbursement schedule of capital cost has been presented in Section 3.2.4. The O/M costs are determined as the difference between the with-project and the without-project situations. It is assumed that, without the project, the existing system will be maximally maintained and operated so that the present capacity can be maintained in the future. With the project, system will be rehabilitated and extended to cover existing as well as new customers.

3) Project benefits

The same framework as that of master plan was used for the assumption. The project benefits comprise revenues from sewerage users in served area and contributions from tourists who visit the City of Havana.

4) Exchange rate

The assumption is the same as that of master plan. In the financial analysis of the priority project, four types of currency mix were employed. The first was computation of Cuban peso portion only; the second was US$ portion only; the third was a combination of Cuban peso and US$ at the exchange rate of Ps1:US$1; and the forth was a combination at the Ps26:US$1.

5) Project life

The same framework as that of master plan was used for the assumption. Considering the approximate component mix of the project, the project life was determined as 30 years after completion of the construction works. Hence, it is considered that the project starts in 2008 (beginning of the construction) and ends in 2040 (30 years after the completion).

6) Discount rate

The assumption is the same as that of master plan. Considering the referential rates, the discount rate used in US$ portion and peso portion were determined at a six percent and an eight percent respectively.

7) Served population

The same framework as that of master plan was used for the assumption. The number of sewer users under the existing sewerage system is assumed at 860,000 in 2004. This number is assumed to be gradually increasing to 1,000,000 under both the with-project and the without-project situations.

8) Sewerage rate for domestic customers

The assumption is the same as that of master plan.

9) State entities and institutional customers

The same framework as that of master plan was used for the assumption. The number of institutional customers in 2004 who pay their sewerage bills in peso is assumed at 11,000. This number is set stable until the ending year of the project under the without-project situations.

10) Sewerage rate for state entities and institutional customers

The assumption is the same as that of master plan.

11) Hard currency earners

The same framework as that of master plan was used for the assumption. The number of hard currency earners in 2004 was assumed at 4,500. This number is expected to be moderately increasing until 2030 under both the with-project and the without-project situations.

12) Sewerage rate for hard currency earners

The assumption is the same as that of master plan.

13) Foreign tourists

The assumption is the same as that of master plan.

4.1.3 EVALUATION OF FINANCIAL VIABILITY

The project cash flows and results of financial indicators are shown in Table 4.1. Other tables that contain relevant computations are presented in Appendix 13. Based on the conditions previously explained, the FIRRs were computed at 5.2 percent in the US$ portion, and 51.0 percent in the peso portion. The FIRR resulted in 28.1 percent and 7.3 percent at the exchange

rate of Ps1:US$1 and Ps26:US$1 respectively. Consistent with the FIRRs, the NPVs and the B/Cs also resulted in high and positive values at the all portions and exchange rates. All those results indicate that the revenues from customers and the contribution from tourists are large enough to pay for the construction cost and the O/M cost of the project. Thus the project is regarded financially viable under the assumed conditions.

Table 4.1 Priority Project Cash Flow at Financial Cost

Yr. no.	Year	Cost				Benefit				Net Benefit			
		Capital expenditure ($000)	Capital expenditure (Ps000)	Operating expend. ($000)	Operating expend. (Ps000)	Foreign currency ($000)	Corpo-ration (Ps000)	Domestic user (Ps000)	Tourist contribut. ($000)	US$ ($000)	Peso (Ps000)	$ + Peso Ps1:$1 (Ps000)	$ + Peso Ps26:$1 (Ps000)
1	2004												
2	2005												
3	2006	1,553	684							-1,553	-684	-2,237	-41,070
4	2007	1,553	684							-1,553	-684	-2,237	-41,070
5	2008	14,610	9,612							-14,610	-9,612	-24,222	-389,467
6	2009	16,375	10,338							-16,375	-10,338	-26,713	-436,083
7	2010	17,804	11,469							-17,804	-11,469	-29,273	-474,368
8	2011			17	1,142	813	6,203	21,890	2,600	3,396	26,951	30,346	115,234
9	2012			33	1,149	845	6,466	22,420	2,600	3,412	27,737	31,149	116,449
10	2013			46	1,154	878	6,663	22,848	2,600	3,432	28,356	31,788	117,575
11	2014			54	1,157	910	6,794	23,172	2,600	3,456	28,809	32,265	118,665
12	2015			62	1,161	943	6,926	23,498	2,600	3,481	29,262	32,743	119,755
13	2016			67	1,304	975	6,991	23,720	2,600	3,508	29,407	32,915	120,615
14	2017			71	1,306	1,008	7,057	23,942	2,600	3,537	29,693	33,230	121,642
15	2018			75	1,308	1,040	7,123	24,165	2,600	3,565	29,980	33,545	122,670
16	2019			79	1,310	1,073	7,188	24,387	2,600	3,594	30,266	33,859	123,697
17	2020			83	1,312	1,105	7,254	24,610	2,600	3,622	30,552	34,174	124,724
18	2021			83	1,361	1,138	7,254	24,730	2,600	3,655	30,623	34,277	125,640
19	2022			83	1,361	1,170	7,254	24,850	2,600	3,687	30,743	34,430	126,605
20	2023			83	1,361	1,203	7,254	24,970	2,600	3,720	30,863	34,582	127,570
21	2024			83	1,361	1,235	7,254	25,090	2,600	3,752	30,983	34,735	128,535
22	2025			83	1,361	1,268	7,254	25,210	2,600	3,785	31,103	34,887	129,500
23	2026			83	1,361	1,300	7,254	25,330	2,600	3,817	31,223	35,040	130,465
24	2027			83	1,361	1,333	7,254	25,450	2,600	3,850	31,343	35,192	131,430
25	2028			83	1,361	1,365	7,254	25,570	2,600	3,882	31,463	35,345	132,395
26	2029			83	1,361	1,398	7,254	25,690	2,600	3,915	31,583	35,497	133,360
27	2030			83	1,361	1,430	7,254	25,810	2,600	3,947	31,703	35,650	134,325
28	2031			83	1,361	1,430	7,254	25,930	2,600	3,947	31,823	35,770	134,445
29	2032			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
30	2033			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
31	2034			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
32	2035			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
33	2036			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
34	2037			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
35	2038			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
36	2039			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
37	2040			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
	Total	51,895	32,787	2,247	39,523	36,725	213,744	747,729	78,000	60,583	889,162	949,745	2,464,320

Results:

Case I	US$ portion	FIRR: 5.2%	B/C: 0.9	NPV($): -3,393	(Discount rate: 6%)
Case II	Peso portion	FIRR: 51.0%	B/C: 7.0	NPV(P): 175,413	(Discount rate: 8%)
Case III	US$+peso (Ps1:$1)	FIRR: 28.1%	B/C: 3.6	NPV(P): 172,020	
Case IV	US$+peso (Ps26:$1)	FIRR: 7.3%	B/C: 1.1	NPV(P): 87,185	

4.1.4 SENSITIVITY ANALYSIS

In computing the financial indicators, some parameters may have a greater influence on the final result than others. It is useful to locate the parameters that have an important influence on the final results by sensitivity analysis so that they can be subjected to special attention of decision makers. Sensitivity analysis tests the robustness of the project when changes are effected to

the key project parameters. In evaluation of the priority project, the construction cost and the revenue are selected as key parameter. The results are shown in Table 4.2.

The benchmark FIRRs would be those computed for a sum of the US$ and the peso portions at the exchange rate of Ps1:US$1 and Ps26:US$1. The FIRRs are sensitive both to construction cost and revenue. A 20 percent increase in construction cost lowers the base FIRR by 1.5 percent. A 20 percent decrease in revenue lowers the base FIRR by 1.9 point. In these adverse cases, the FIRRs are still maintained over 5 percent, which is considered to be robust.

Table 4.2 Financial Sensitivity Analysis of Priority Project

	US$	Peso	US$+Peso (Ps1:US$1)	US$+Peso (Ps26:US$1)
Base case	5.2%	51.0%	28.1%	7.3%
Construction cost increases by 20%	3.8%	45.2%	24.4%	5.8%
Construction cost decreases by 20%	7.1%	58.9%	33.2%	9.4%
Revenue decreases by 20%	3.5%	43.6%	23.5%	5.4%
Revenue increases by 20%	6.7%	57.7%	32.4%	9.0%

4.1.5 LOAN REPAYMENT PROJECTION

The priority project will entail great expense upon the implementation agency. As can be seen in Table 4.1, the project will cost US$51.895 million and Ps32.787 million as the capital investment. As the recurrent cost or O/M cost it will need US$2.247 million and Ps39.523 million. The project cash flow shows that a heavy capital investment at the initial stage is required. After the rehabilitated or newly constructed facilities start the operation, cash flow turns to the black and keeps being positive throughout the project period.

The financial situation of the central government, local governments, and water companies are analyzed in Chapter 8 of Part I. The ability of those stakeholders to pay for the project is analyzed in Sections 13.8.1 and 13.8.2 of Part I.

The external finance possibility of Cuba is analyzed in Section 13.8.3 of Part I. The result of those analyses indicates that each stakeholder has to assume its requirement in a following manner:

- The Cuban government allocates its own available fund to the capital investment of the project or finds and external funding sources either by loan or grant.
- The DPRH uses the fund from the government to rehabilitate and construct the facilities planned in the project.
- Aguas de La Habana operates the facilities and pays the lease fee (equivalent to depreciation) to DPRH during the project period.
- Aguas de La Habana collects user charges from domestic users, institutional users, and foreign currency earning users. The collected charges are used to pay the O/M costs and the lease fee of the facilities related to the project.
- The government levies the contribution from tourists. The tourist's contribution can be collected at hotels or guesthouses together with their lodging expenses.
- The tourist's contribution collected by the government is earmarked for repayment of the fund obtained by the government.

In the year 2003 it is uncertain as to whether the central government can allocate the fund for the project. A possibility of Cuba's asking a loan to multilateral or bilateral financial institutions is also limited. Evidently it is not easy for Cuba to get a grant for that size of the project. Under these circumstances, an exemplary case of getting loans at currently available lending rates (Table 13.29 of Part I) and its repayment was examined. In Table 4.3, a trial computation is performed for repayment of a US dollar loan at a lending rate of 6 percent p.a., and a 30 year-loan period including a grace of 10 years. In Table 4.4 a repayment schedule of a peso loan at a lending rate of 8 percent and a 25 year-loan period including a grace of 5 years is simulated. The debt service coverage ratios are also computed and shown in Table 4.5. The debt service coverage ratios of over 1.0 throughout the loan repayment period suggest that the implementation agency can safely repay the loans under the assumed conditions.

Table 4.3 Foreign Loan Repayment Schedule

(US$ 000)

	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	Total
1st year	Beginning balance		1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,475	1,398	1,320	1,242	1,165	1,087	1,009	932	854	777	699	621	544	466	388	311	233	155	78					
disbursement	Borrowing *	1,553																																		1,553
	Repayment											78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78					1,553
	Interest payment	47	93	93	93	93	93	93	93	93	93	91	86	82	77	72	68	63	58	54	49	44	40	35	30	26	21	16	12	7	2					1,817
2nd year	Beginning balance			1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,553	1,475	1,398	1,320	1,242	1,165	1,087	1,009	932	854	777	699	621	544	466	388	311	233	155	78				
disbursement	Borrowing *		1,553																																	1,553
	Repayment												78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78					1,553
	Interest payment		47	93	93	93	93	93	93	93	93	93	91	86	82	77	72	68	63	58	54	49	44	40	35	30	26	21	16	12	7	2					1,817
3rd year	Beginning balance				14,610	14,610	14,610	14,610	14,610	14,610	14,610	14,610	14,610	14,610	13,880	13,149	12,419	11,688	10,958	10,227	9,497	8,766	8,036	7,305	6,575	5,844	5,114	4,383	3,653	2,922	2,192	1,461	731			
disbursement	Borrowing *			14,610																																14,610
	Repayment													731	731	731	731	731	731	731	731	731	731	731	731	731	731	731	731	731	731	731	731			14,610
	Interest payment			438	877	877	877	877	877	877	877	877	877	855	811	767	723	679	636	592	548	504	460	416	373	329	285	241	197	153	110	66	22			17,094
4th year	Beginning balance					16,375	16,375	16,375	16,375	16,375	16,375	16,375	16,375	16,375	16,375	15,556	14,738	13,919	13,100	12,281	11,463	10,644	9,825	9,006	8,188	7,369	6,550	5,731	4,913	4,094	3,275	2,456	1,638	819		
disbursement	Borrowing *				16,375																															16,375
	Repayment														819	819	819	819	819	819	819	819	819	819	819	819	819	819	819	819	819	819	819	819	819		16,375
	Interest payment				491	983	983	983	983	983	983	983	983	983	958	909	860	811	761	712	663	614	565	516	467	418	368	319	270	221	172	123	74	25			19,159
5ht year	Beginning balance						17,804	17,804	17,804	17,804	17,804	17,804	17,804	17,804	17,804	17,804	16,914	16,024	15,133	14,243	13,353	12,463	11,573	10,682	9,792	8,902	8,012	7,122	6,231	5,341	4,451	3,561	2,671	1,780	890	
disbursement	Borrowing *					17,804																														17,804
	Repayment															890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	17,804
	Interest payment					534	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,042	988	935	881	828	774	721	668	614	561	507	454	401	347	294	240	187	134	80	27	20,831
Total	Beginning balance		1,553	3,106	17,716	34,091	51,895	51,895	51,895	51,895	51,895	51,895	51,817	51,662	50,776	49,072	46,477	43,882	41,287	38,693	36,098	33,503	30,908	28,314	25,719	23,124	20,529	17,935	15,340	12,745	10,150	7,556	5,039	2,599	890	
	Borrowing	1,553	1,553	14,610	16,375	17,804																														51,895
	Repayment											78	155	886	1,705	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,595	2,517	2,439	1,709	890	51,895
	Interest payment	47	140	625	1,554	2,580	3,114	3,114	3,114	3,114	3,114	3,111	3,104	3,073	2,995	2,866	2,711	2,555	2,399	2,244	2,088	1,932	1,777	1,621	1,465	1,310	1,154	998	843	687	531	378	229	105	27	60,717

*30 years loan, including 10 years grace period, with interest rate of 6.0% p.a.

Table 4.4 Peso Loan Repayment Schedule

(Peso 000)

	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	Total
1st year	Beginning balance		684	684	684	684	684	650	616	581	547	513	479	445	410	376	342	308	274	239	205	171	137	103	68	34										
disbursement	Borrowing *	684																																		684
	Repayment						34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34										684
	Interest payment	27	55	55	55	55	53	51	48	45	42	40	37	34	31	29	26	23	21	18	15	12	10	7	4	1										793
2nd year	Beginning balance			684	684	684	684	684	650	616	581	547	513	479	445	410	376	342	308	274	239	205	171	137	103	68	34									
disbursement	Borrowing *		684																																	684
	Repayment							34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34									684
	Interest payment		27	55	55	55	55	53	51	48	45	42	40	37	34	31	29	26	23	21	18	15	12	10	7	4	1									793
3rd year	Beginning balance				9,612	9,612	9,612	9,612	9,612	9,131	8,651	8,170	7,690	7,209	6,728	6,248	5,767	5,287	4,806	4,325	3,845	3,364	2,884	2,403	1,922	1,442	961	481									
disbursement	Borrowing *			9,612																																9,612
	Repayment								481	481	481	481	481	481	481	481	481	481	481	481	481	481	481	481	481	481	481	481								9,612
	Interest payment			384	769	769	769	769	750	711	673	634	596	557	519	481	442	404	365	327	288	250	211	173	135	96	58	19								11,150
4th year	Beginning balance					10,338	10,338	10,338	10,338	10,338	9,821	9,304	8,787	8,270	7,754	7,237	6,720	6,203	5,686	5,169	4,652	4,135	3,618	3,101	2,585	2,068	1,551	1,034	517							
disbursement	Borrowing *				10,338																															10,338
	Repayment									517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517							10,338
	Interest payment				414	827	827	827	827	806	765	724	682	641	600	558	517	476	434	393	351	310	269	227	186	145	103	62	21								11,992
5ht year	Beginning balance						11,469	11,469	11,469	11,469	11,469	10,896	10,322	9,749	9,175	8,602	8,028	7,455	6,881	6,308	5,735	5,161	4,588	4,014	3,441	2,867	2,294	1,720	1,147	573						
disbursement	Borrowing *					11,469																														11,469
	Repayment										573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573						11,469
	Interest payment					459	918	918	918	918	895	849	803	757	711	665	619	573	528	482	436	390	344	298	252	206	161	115	69	23						13,304
Total	Beginning balance		684	1,368	10,980	21,318	32,787	32,753	32,684	32,135	31,070	29,430	27,791	26,151	24,512	22,873	21,233	19,594	17,955	16,315	14,676	13,037	11,397	9,758	8,119	6,479	4,840	3,235	1,664	573						
	Borrowing	684	684	9,612	10,338	11,469																														32,787
	Repayment						34	68	549	1,066	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,639	1,605	1,571	1,090	573				32,787
	Interest payment	27	82	494	1,292	2,164	2,622	2,617	2,593	2,528	2,420	2,289	2,158	2,027	1,895	1,764	1,633	1,502	1,371	1,240	1,109	977	846	715	584	453	323	196	89	23						38,033

*25 years loan, including 5 years grace period, with interest rate of 8.0% p.a.

Table 4.5 Changes in Debt Service Coverage Ratio under Priority Project

Year	Debt service coverage ratio			
	US$	Peso	US$+Peso (Ps1:US$1)	US$+Peso (Ps26:US$1)
2006	1.0	1.0	1.0	1.0
2007	1.1	1.1	1.1	1.1
2008	1.0	1.1	1.0	1.0
2009	1.1	1.1	1.1	1.1
2010	1.2	1.2	1.2	1.2
2011	1.6	10.6	5.7	1.9
2012	1.7	10.7	5.9	1.9
2013	1.7	9.4	5.5	1.9
2014	1.7	8.3	5.2	1.9
2015	1.7	7.5	5.0	2.0
2016	1.6	7.8	5.0	1.9
2017	1.6	8.1	5.1	1.9
2018	1.3	8.5	4.8	1.6
2019	1.1	8.9	4.5	1.4
2020	1.0	9.3	4.2	1.2
2021	1.0	9.7	4.3	1.2
2022	1.1	10.1	4.5	1.3
2023	1.1	10.6	4.7	1.3
2024	1.1	11.1	4.9	1.4
2025	1.2	11.7	5.1	1.4
2026	1.2	12.3	5.3	1.5
2027	1.3	13.0	5.5	1.5
2028	1.3	13.8	5.8	1.6
2029	1.4	14.7	6.1	1.7
2030	1.5	15.7	6.4	1.7
2031	1.5	17.1	6.8	1.8
2032	1.6	18.7	7.2	1.9
2033	1.7	28.0	8.4	2.0
2034	1.7	55.4	10.0	2.1
2035	1.8	n.a.	12.4	2.2
2036	2.0	n.a.	13.4	2.4
2037	2.1	n.a.	14.5	2.6
2038	3.1	n.a.	21.3	3.8
2039	6.2	n.a.	42.2	7.6

Note: Generally a debt service coverage ratio above 1.5 is adequate for a water company to be healthy.
"n.a." denotes that "not available" because there is no debt service.

4.2 ECONOMIC ANALYSIS

4.2.1 METHODOLOGY

The discounted cash flow method, the same methodology as used in the financial evaluation was applied. Three indicators were similarly computed, which were the net present value (NPV), benefit cost ratio (B/C), and economic internal rate of return (EIRR). They are described in Section 13.9.1 of Part I.

4.2.2 ECONOMIC COST/BENEFIT VALUATION

The conditions and assumptions applied to estimate economic costs and benefits of the master plan project are described in Section 13.9.2 of Part 1. Basically the same framework as what was used in the analysis of the master plan project was also applied here. However as the master plan project and the priority project differ in magnitude and effect, some conditions and assumptions are different from those of the master plan. They are summarized subsequently.

1) Material and equipment in foreign currency

The assumption is the same as that of master plan. Hence, financial prices of materials and equipment in foreign currency unit were converted into economic prices by a conversion factor of 0.9

2) Transactional cost in foreign currency

The assumption is the same as that of master plan. Therefore, financial prices of transactional costs denominated in foreign currency unit were converted into economic prices by 0.96.

3) Dealer margin

The assumption is the same as that of master plan. The dealer margin is regarded as a rent which distorts economic values. Thus, that was omitted when converting a financial value into its economic value.

4) Material and equipment in local currency

The assumption is the same as that of master plan. Therefore, financial prices of materials and equipment denominated in foreign currency unit were converted into economic prices by a conversion factor of 1.04.

5) Labor

The assumption is the same as that of master plan. Therefore, a standard wage rate factor of 0.8 was used to convert the financial price of labor into its economic price.

6) Transactional cost in local currency

The assumption is the same as that of master plan. Therefore, when transactional costs are quoted in local currency unit, no adjustment is necessary to remove the trade distortion effect.

7) Land

The same framework as that of master plan was used for the assumption. The priority project newly requires two plots of land which are for the Luyanó WWTP and the Matadero pumping station. The economic unit value of the lands is considered Ps210,528 as the land tenure lasts until 2040. Hence, the land values in 2008 are computed at Ps442,108 for Luyanó WWTP and Ps21,053 for Matadero pumping station.

8) Administrative expenses

The assumption is the same as that of master plan. Therefore, the financial value of administrative expenses was converted into its economic value by a conversion factor of 0.968.

9) Engineering services in foreign currency

The assumption is the same as that of master plan. Thus, no adjustment was necessary.

10) Engineering services in local currency

The assumption is the same as that of master plan. Thus, no adjustment was necessary.

11) Physical contingency in foreign currency

The assumption is the same as that of master plan. Hence the financial value was converted into its economic value by a conversion factor of 0.98.

12) Physical contingency in local currency

The assumption is the same as that of master plan. Hence the financial value was converted into its economic value by a conversion factor of 1.02.

13) Personnel cost in O/M

The assumption is the same as that of master plan. Hence the financial value was converted into its economic value by a conversion factor of 0.86.

14) Electricity cost in O/M

The assumption is the same as that of master plan. Hence the financial value was converted into its economic value by a conversion factor of 2.0.

15) Chemical cost in O/M

The assumption is the same as that of master plan. Hence the financial value was converted into its economic value by a conversion factor of 0.9.

16) Discount rate

Opportunity cost of capital represents the permissible economic rate of return, or discount rate for development projects. In general, 10 percent is applied as the opportunity cost of capital for assessing the economic viability.

17) Benefit of inhabitants

The same framework as that of master plan was used for the assumption. The aggregate benefit of inhabitants was computed by multiplying the number of households by a WTP. The WTP for an improved environment of the bay by materializing a sewerage project was estimated at Ps11 per household per month (Section 13.9.2 of Part I). The distinction between the master plan project and the priority project was not mentioned in the inhabitant survey. Hence the WTP of Ps11 is considered as a general WTP assuming that a wider improvement of the bay environment takes place as a result of the master plan project. In estimating the WTP for the priority project, this general WTP has been adjusted in proportion to the level of improvement realizable.

According to the planning base, the maximum pollution load reduction is 52 ton BOD per day in the master plan project and 46 in the priority project. Hence the WTP for the priority project (WTP_p) can be expressed as follows:

WTP_p = Ps11 × 46 ÷ 52 = Ps9.7

Aggregate benefits during the project period was therefore computed by applying the WTP_p of Ps9.7.

3) Benefit of industries

The same framework as that of master plan was used for the assumption. In the economic valuation of the master plan project, the WTP of industries who pay sewerage bills in US$ was estimated at 0.023 percent of the production. The WTP of industries who pay in peso was 0.046 percent. These percentages are considerably small in comparison with that of household WTP (1.4%). Considering those small percentages and possible indifference to the change of improvement magnitude, the proportional adjustment of the WTP like being attempted at the household WTP was not made.

4) Benefit of tourists

The same framework as that of master plan was used for the assumption. In the economic valuation of the master plan project, the WTP of tourists was estimated at US$2 or 0.2 percent of the tourist's average spending in Cuba. This is regarded as a relatively small percentage. Furthermore it is likely that tourists are rather indifferent to the magnitude of improvement, whether it is from the master plan project or the priority project. Therefore, the proportional adjustment of the WTP that was attempted at the household WTP was not made.

4.2.3 EVALUATION OF ECONOMIC VIABILITY

Based on the conditions previously explained, the EIRRs are computed at 8.9 percent in the US$ portion, 93.5 percent in the peso portion, 55.3 percent in the US$/peso combined portion at the 1:1 exchange rate, and 13.1 percent in the US$/peso combined portion at the 1:26 exchange rate. The project cash flows and the results of other financial indicators are shown in Table 4.6. Other tables that contain relevant computations are presented in Appendix 13.

The EIRR result of 13.4 percent for US$/peso combined portion at the exchange rate of 1:26 leads to the interpretation that the project is economically viable as it exceeds the hurdle rate of 10 percent.

Table 4.6 Priority Project Cash Flow at Economic Cost

Yr. no.	Year	Cost				Benefit				Net Benefit			
		Capital expenditure ($000)	Capital expenditure (Ps000)	Operating expend. ($000)	Operating expend. (Ps000)	Foreign currency ($000)	Corpo-ration (Ps000)	Domestic user (Ps000)	Tourist contribut. ($000)	US$ ($000)	Peso (Ps000)	$ + Peso Ps1:$1 (Ps000)	$ + Peso Ps26:$1 (Ps000)
1	2004												
2	2005												
3	2006	1,264	559							-1,264	-559	-1,823	-33,417
4	2007	1,264	559							-1,264	-559	-1,823	-33,417
5	2008	11,886	8,326							-11,886	-8,326	-20,212	-317,375
6	2009	13,322	8,457							-13,322	-8,457	-21,779	-354,841
7	2010	14,485	9,382							-14,485	-9,382	-23,867	-385,995
8	2011			15	1,298	1,600	3,200	62,518	2,600	4,185	64,421	68,605	173,223
9	2012			30	1,312	1,632	3,264	62,426	2,600	4,202	64,379	68,581	173,639
10	2013			41	1,322	1,665	3,329	62,334	2,600	4,223	64,342	68,565	174,147
11	2014			49	1,328	1,698	3,396	62,242	2,600	4,249	64,310	68,560	174,794
12	2015			56	1,336	1,732	3,464	62,150	2,600	4,276	64,278	68,554	175,457
13	2016			60	1,489	1,767	3,533	62,002	2,600	4,306	64,046	68,353	176,009
14	2017			64	1,493	1,802	3,604	61,854	2,600	4,338	63,965	68,303	176,752
15	2018			68	1,497	1,838	3,676	61,705	2,600	4,370	63,884	68,255	177,516
16	2019			71	1,501	1,875	3,749	61,557	2,600	4,404	63,806	68,209	178,299
17	2020			75	1,505	1,912	3,824	61,408	2,600	4,437	63,728	68,166	179,103
18	2021			75	1,563	1,950	3,901	61,408	2,600	4,476	63,747	68,222	180,115
19	2022			75	1,563	1,989	3,979	61,408	2,600	4,515	63,825	68,339	181,208
20	2023			75	1,563	2,029	4,058	61,408	2,600	4,555	63,904	68,459	182,322
21	2024			75	1,563	2,070	4,140	61,408	2,600	4,595	63,985	68,581	183,458
22	2025			75	1,563	2,111	4,222	61,408	2,600	4,637	64,068	68,705	184,617
23	2026			75	1,563	2,153	4,307	61,408	2,600	4,679	64,153	68,831	185,800
24	2027			75	1,563	2,196	4,393	61,408	2,600	4,722	64,239	68,961	187,005
25	2028			75	1,563	2,240	4,481	61,408	2,600	4,766	64,327	69,092	188,235
26	2029			75	1,563	2,285	4,570	61,408	2,600	4,811	64,416	69,227	189,490
27	2030			75	1,563	2,331	4,662	61,408	2,600	4,856	64,508	69,364	190,770
28	2031			75	1,563	2,378	4,755	61,408	2,600	4,903	64,601	69,504	192,075
29	2032			75	1,563	2,425	4,850	61,408	2,600	4,950	64,696	69,646	193,407
30	2033			75	1,563	2,474	4,947	61,408	2,600	4,999	64,793	69,792	194,765
31	2034			75	1,563	2,523	5,046	61,408	2,600	5,048	64,892	69,940	196,150
32	2035			75	1,563	2,574	5,147	61,408	2,600	5,099	64,993	70,092	197,563
33	2036			75	1,563	2,625	5,250	61,408	2,600	5,150	65,096	70,246	199,004
34	2037			75	1,563	2,678	5,355	61,408	2,600	5,203	65,201	70,404	200,474
35	2038			75	1,563	2,731	5,462	61,408	2,600	5,256	65,308	70,564	201,973
36	2039			75	1,563	2,786	5,571	61,408	2,600	5,311	65,417	70,728	203,503
37	2040			75	1,563	2,841	5,683	61,408	2,600	5,367	65,529	70,895	205,063
	Total	42,222	27,283	2,022	45,331	64,910	129,820	1,848,366	78,000	98,666	1,905,573	2,004,239	4,470,890

Results:

Case I	US$ portion	EIRR: 8.9%	B/C: 0.9	NPV($): -2,648	(Discount rate: 10%)
Case II	Peso portion	EIRR: 93.5%	B/C: 14.1	NPV(P): 295,126	(Discount rate: 10%)
Case III	US$+peso (Ps1:$1)	EIRR: 55.3%	B/C: 7.2	NPV(P): 292,477	
Case IV	US$+peso (Ps26:$1)	EIRR: 13.4%	B/C: 1.3	NPV(P): 226,272	

4.2.4 SENSITIVITY ANALYSIS

Sensitivity analysis was performed in the same way as what is done in financial evaluation. The results are shown in Table 4.7. The benchmark EIRRs would be those computed for a sum of the US$ and the peso portions at the exchange rate of Ps26:US$1. The EIRRs are sensitive both to construction cost and revenue. A 20 percent increase in construction cost and a 20 percent decrease in revenue lowers the EIRR by 2.1 point and 3.4 point respectively. A 20 percent decrease in construction cost and a 20 percent increase in revenue lifts the EIRR by 2.9 point and 3.5 point respectively. In all cases, the FIRRs are not below 10 percent, hence it can be said that the priority project has a strong resistibility against adverse situations.

Table 4.7 Economic Sensitivity Analysis of Priority Project

	US$	Peso	US$+Peso (Ps1:US$1)	US$+Peso (Ps26:US$1)
Base case	8.9%	93.5%	55.3%	13.4%
Construction cost increases by 20%	7.2%	84.6%	49.1%	11.3%
Construction cost decreases by 20%	11.1%	105.2%	63.6%	16.3%
Revenue decreases by 20%	5.8%	82.5%	47.4%	10.0%
Revenue increases by 20%	11.9%	103.2%	62.5%	16.9%

CHAPTER 5
ENVIRONMENTAL CONSIDERATIONS

5.1 GENERAL

In this Chapter results of the EIA Study on the Priority Projects is described and the full text of the EIA Study carried out by CIMAB is appended in Appendix-14 Environmental Impact Survey.

EIA Study for the following components of Priority Projects in the Existing Sewerage System (Central System) and New Sewerage System. They are:

Existing Sewerage System

1) Matadero Pumping Station
2) Colector Sur Nuevo, Pumped Main and By-Pass Pipe for Colector Cerro and Colector Sur
3) Casablanca Pumping Station
4) Screens at Caballeria

New Sewerage System

5) Luyanó Wasewater Treatment Plant
6) Luyanó Left Colector and Luyanó-Martín Pérez Right Colector

5.2 MATADERO PUMPING STATION

(1) Description

Matadero Pumping Station is designed to perform two main functions:

- To divert wastewater from Colector Cerro and Colector Sur (1,500 mm) prior to their confluence to Colector Sur Nuevo to facilitate rehabilitation of Colector Sur (1,950 mm & 2,100 mm)
- To transport wastewater from Colector Sur A to Colector Sur Nuevo

Its location is on the foothills of Atares Castle in a vacant land belonging to FAR (*Fuerzas Armadas Revolucionarias*) facing Avenida Fabrica prior to its intersection with Arroyo (Manglar).

(2) Evaluation of Facility Siting

The location was selected in consultation with DPPFA after considering another site in the island of the intersection of Avenida Fabrica and Arroyo which is favorable in terms of the layout of inlet and outlet pipes but was found to be not suitable in terms of soil conditions and due to the existence of a renovated park.

Area of the pumping station will be approximately 0.17 ha (46 m x 36 m) and the height of building above ground will be approximately 6 m. Around the pumping station site there are several workshops and garage buildings and the pumping station will not alter the landuse in that area significantly.

The selected location for pumping station is the most suitable and no seriously negative

environmental impacts due to its location is expected.

(3) Potential Impacts

Stage of Construction	Operation Stage
Increase of erosion	Changes in the erosion and sedimentation processes
Soil pollution	Contribution to improvement of water quality of Havana Bay.
Soil compaction	Introduction of new elements to the landscape
Changes in the drainage patterns	Generation of employments
Deposition of sediments in soils and waters	Barrier Effect
Overloading of the infrastructure in the area	Stimulation to the industrial development
Air pollution by dust and gas emissions	Generation of odor
Increase of the continuous and intermittent sound levels	Decrease of public and environmental health related problems
Visual obstruction	Operational problems
Landscape modification	Waste storage in the Matadero Pumping Station area
Health impacts caused by the emission of pollutants and noises	Improvement of the quality of life for both, workers and inhabitants of bay basin
Changes in the traffic flow	Waste management
Impacts to the tourist and institutional activity in the area	
Generation of employments and economic opportunities	
Migration of personnel from other areas	
Increase of the risk of work accidents	
Deposition of materials and polluting substances to the waters and soil	
Generation of excess material due to the excavation works	

(4) Prevention or Mitigation Measures

Following measures are necessary to be undertaken in the subsequent stages of the Project.

1) Land Acquisition

- Proposed land which currently belongs to FAR need to be acquired by GTE (/INRH)

2) Building

- Consideration to the architecture of the pump station building need to be given during the detailed design stage to blend with the surroundings

3) Measures during Power/Equipment Failure

- Pumping station is planned with stand-by pumps in case of equipment failure and with stand-by generator in case of power failure. However, extreme eventualities such as the failure of all pumps or the failure of power supply and the generators shall be considered in the detailed design whether to provide a by-pass to pumping station against flooding of wastewater.

4) Instruction to the Contractor to conform to good Construction Practices

- To provide tight containers for transport of materials and to provide covered containers to avoid loss of material during transportation
- To use safety devices in the concrete-mixer trucks to avoid the spill of material during the transport
- To avoid spilling of construction materials i.e. cement, concrete etc. to prevent blocking of drains and their ultimate discharge to bay
- To avoid cleaning of containers, machineries etc. on the street pavements to prevent spilling of fuel, lubricants etc. to the bay
- To control the speed of construction traffic and maintain awareness of safety

5) Prevention of odor and fly generation during operation stage

- Adherence to proper operation and maintenance procedures for storage and disposal of screenings and grit will be necessary to prevent excessive odor generation

5.3 COLECTOR SUR NUEVO, PUMPED MAIN AND BY-PASS PIPE FOR COLECTOR CERRO AND COLECTOR SUR

(1) Description

Colector Sur Nuevo is designed to convey wastewater inflow received through a pumped main from Matadero Pumping Station up to the Screens at Caballeria by gravity. It is an important Colector in the proposed Colector System to augment capacity of Colector Sur. Its route commences prior to the junction of Egido and Desemparados and is along Desemparados-San Pedro-Avenida Del Puerto upto the existing Screen facilities at Caballeria. Colector is to be laid underground anaverage depth of 6.5 m depth from ground level. Pipe diameter is 1,500 mm and the total length is 1,830 m. Manholes will be located at an interval not exceeding 100 m or at change in direction. Sur Nuevo will have two railway crossing near Desemparados and at near Customs Office which is no longer being used.

Pumped main is designed to convey wastewater pumped from Matadero Pumping Station to Colector Sur Nuevo. Pipe diameter is 1,350 mm and the pipe material is ductile iron. Its length is 1,020 m. Depth of pipe will be approximately 3.4 m and its route will also encounter two railway crossings.

By-Pass Pipe is designed to divert wastewater from Colector Cerro and Colector Sur prior to its confluence with Colector Cerro to Matadero Pumping Station by gravity. Concrete pipe of diameter 1,100 mm and 1,500 mm will be used. Length of pipe is 510 m. There will be one railway crossing.

(2) Evaluation of Facility Siting

The selected route for Sur Nuevo is the most appropriate being the most peripheral route along the coast of the bay where ground elevation is lower than inland. Its route avoids the narrow streets of Old Havana, its historic buildings and the existing Colector Sur where construction will be more difficult than that of the proposed route. Routes of Pumped Main and By-Pass pipe are the shortest routes between the facilities they connect and their routes are appropriate

As with construction of any other new underground facility in an urban area conflict with existing utilities such as water supply, power and communication cables etc. is unavoidable. In general Colector is deeper than the facilities of other utilities but need to be investigated prior to construction to take appropriate measures during construction.

3) Potential Impacts

Construction stage	Operation Stage
Change of land use	Changes of land use and the use of unproductive lands
Increase of the erosion processes	Soil compaction
Changes the dynamic local geomorphology	Changes in the erosion and sedimentation processes
Soil compaction	Introduction of unaware elements to the landscape
Changes of the drainage patterns	Generation of employments
Deposition of sediments in soils and waters	Stimulation to the industrial development
Soil pollution	Growth of the human settlements
Water pollution	Decrease of the problems of public and environmental health
Air pollution by dust and gas emission	Change in the population distribution
Increase of the continuous and intermittent sound levels	
Modification of the landscape	
Impact to the health due to emission of pollutants and noises	
Overload of the existing infrastructure in the area	
Impact to the tourist and institutional activity in the area	
Changes in the traffic flow	
Generation of employments and economic opportunities	
Migration of personal from other areas	
Increased risk of work accidents	
Deposition of materials and polluting substances to the water and soil	
Generation of excess material due to excavation	

(4) Prevention or Mitigation Measures

Following measures are necessary to be undertaken in the subsequent stages of the Project to prevent or mitigate negative impacts during construction stage

1) Coordination with Historians Office Master Plan and relevant authorities
   - On the layout of Colector and on any requirements necessary to be complied during construction
   - To execute actions during construction to protect known Cultural Heritage Sites (e.g. Paula de Almeda etc.) and actions required if any items of archeological value are found
2) Coordination with Utilities
   - INRH – water, sewer and storm water pipes
   - ETECSA – telephone lines

- Power Company – power supply lines
- Railway – railway tracks
- *"Red Tecnica"* – information on any other underground utilities related to port etc.

3) To investigate the feasibility of carrying out the work at night with relevant authorities and to the possibility of covering the trench with steel sheets to provide more room for traffic
4) To investigate the traffic flow pattern and origin-destination of the traffic during the detailed design stage to take necessary steps for traffic control and detour
5) Coordination with Traffic Division of Police (PNR) and other relevant institutions (i.e. public bus enterprise)
   - To inform the public and other relevant institutions in advance
   - To provide personnel to direct and control traffic flow
   - To relocate bus stops where necessary
6) To set-up a committee comprising of all relevant institutions to share information on the progress of construction and to facilitate coordination among institutions
7) Instruction to the Contractor to conform to good Construction Practices
   - To provide tight containers for transport of materials and to provide covered containers to avoid loss of material during transportation
   - To use safety devices in the concrete-mixer trucks to avoid the spill of material during the transport
   - To avoid spilling of construction materials i.e. cement, concrete etc. to prevent blocking of drains and their ultimate discharge to bay
   - To avoid cleaning of containers, machineries etc. on the street pavement to prevent spilling of fuel, lubricants etc. to the bay
   - To manage construction waste and excavated material to avoid piling-up along the street which can obstruct traffic, cause floods by blocking drains etc. and to dispose them at approved locations
   - To place barriers along the banks of the bay to prevent accidental spill of construction material to the bay
   - To control the speed of construction traffic and maintain awareness of safety
   - To take organizational measures to reduce construction noise

5.4 LUYANÓ WASTEWATER TREATMENT PLANT

(1) Description

Luyano WWTP is planned to be constructed adjacent to the WWTP site selected for the on-going GEF/UNDP Project. Total capacity of the wastewater treatment facility is 821 L/s (71,000 m^3/d) including the treatment facility being planned under the on-going GEF/UNDP Project. In the Priority Project, treatment capacity of 207 L/s is planned to be added to 200 L/s under GEF/UNDP Project to a capacity of 407 L/s.

(2) Evaluation of Facility Siting

This site was selected in consultation with DPPFA and other related Cuban organizations

following consideration of land availability, future plans of highway access to port facilities, other infrastructure development plans namely electricity distribution facilities etc. The selected site satisfy most of the environmental considerations. However, it will not be possible to layout all the treatment facilities at least 100 m away from the nearest households even though best effort is made to keep facilities which could be possible source of nuisance i. e. screen, grit chamber etc.

Total area of the site is 4.8 ha. In the proposed site, there are some buildings belonging to industries which are not utilized at present which need to be removed prior to implementation.

There are a few houses (11 houses) located within 100 m from the proposed facilities in the Second Stage which require the tenants are relocated with provision of similar housing. An awareness program with the concerned families shall be started as soon as possible for an amicable settlement.

There are no serious environmental problems due to the selected location of wastewater treatment plant and the site is considered appropriate.

3) Potential Impacts

Construction stage	Operation Stage
Change in land use	Changes in land use and the use of unproductive lands
Loss of vegetal cover layer	Soil compaction
Changes in dynamics of local geomorphology	Changes in the erosion and sedimentation processes
Soil compaction	Introduction of new elements to the landscape
Changes in the drainage patterns	Generation of employments
Deposition of sediments on soils and waters	Stimulation to the industrial development
Waters pollution	Better economic opportunities
Air pollution by dust and gas emissions	Decrease of the problems of public and environmental health
Increase of the continuous and intermittent sound levels	Generation of odor
Modification of the landscape	Increased risk of accidents
Impact to the health due to emission of pollutants and noises	
Overloading of the existing infrastructure	
Generation of employments and economic opportunities	
Migration of personal of other areas	
Increased risk of accidents	
Deposition of materials and polluting substances to the water and soils	
Relocation of families	

(4) Prevention or Mitigation Measures

Following measures are necessary to be undertaken in the subsequent stages of the Project.

1) On-going GEF/UNDP Project

- Detailed Design of the GEF/UNDP Project shall take into account the details of the proposed Master Plan especially for the design of common facilities of the treatment plant (e.g. inlet level of raw wastewater etc.)

2) Design Aspects

- To provide stand-by power supply to sustain biomass in the activated sludge process during power-failure
- To consider noise and vibration levels in the selection of equipment

3) Land Acquisition

- Proposed land need to be acquired by GTE (/INRH) and the buildings need to be removed

4) Resettlement

- An awareness program shall be started with the families whose residences are within the radius

5) Electric Power

- Power requirement of the WWTP shall be informed to the Electric Power Company for its inclusion in the energy plan for Havana City.

6) Baseline Environmental Data

- Existing wind direction, noise level and odor levels shall be observed around the proposed WWTP for comparison in the future with monitored data

7) Disposal of Sludge

- Sludge is planned to be disposed at land fill site with solid wastes. During the operation stage, it is necessary to investigate the composition of sludge and to evaluate its possible reuse such as soil conditioner, fertilizer, etc.
- Containers which are water-tight and covered shall be used for transportation to avoid spill

8) Prevention of odor and fly generation

- Adherence to proper operation and maintenance procedures for storage and disposal of screenings, grit and sludge will be necessary to prevent excessive odor and fly generation

9) Coordination with Traffic Division of Police (PNR)

- To inform the public and other relevant institutions in advance
- To provide personnel to direct and control construction traffic leaving and entering the site

10) Instruction to the Contractor to conform to good Construction Practices

- To provide tight containers for transport of materials and to provide covered containers to avoid loss of material during transportation
- To use safety devices in the concrete-mixer trucks to avoid the spill of material during the transport
- To avoid spilling of construction materials i.e. cement, concrete etc. to prevent blocking of drains and their ultimate discharge to Luyanó River and the bay
- To avoid cleaning of containers, machineries etc. on the street pavements to prevent spilling of fuel, lubricants etc. to the bay

- To control the speed of construction traffic and maintain awareness of safety

5.5 LUYANÓ-MARTÍN PÉREZ RIGHT COLECTOR AND LUYANÓ LEFT COLECTOR

(1) Description

Colectors being the means of collecting and conveying wastewater from their source of wastewater generation to WWTP are planned to be laid along public road to access all households and other buildings. HDPE pipes with external diameters ranging from 200 mm to 1200 mm will be laid at depths of 1.75 m or more. All of the Colectors are designed to convey wastewater by gravity. Colectors along the Via Blanca and along Anillo del Puerto which are important portion of the Colectors connecting to WWTP have river crossings at Martín Pérez River and at Luyanó River.

(2) Evaluation of Facility Siting

As expected in any developed urban area without sewerage system, conflict with existing utilities such as storm drains, water pipe, electricity cables, telephone lines etc. are expected and need to be resolved in the subsequent stages of the project without much problems as the Colectors are generally laid deeper. The proposed route of the Colectors are considered appropriate.

(3) Potential Impacts

Construction stage	Operation stage
Change in land use	Soil compaction
Increase in the erosive processes	Changes in the erosion and sedimentation processes
Changes in the dynamic local geomorphology	Stimulation to industrial development
Changes in the drainage patterns	Growth of human settlements
Deposition of sediments in soils and waters	Improvement of public and environmental health
Soil pollution	Changes in the population distribution
Water pollution	Changes in land use and the use of unproductive lands
Air pollution by dust and emission of gases	
Increase in noise levels (continuous and intermittent)	
Modification of landscape	
Health impact due to air pollutants and noise	
Overload to existing infrastructure	
Impact to institutional activity	
Impact to traffic flow	
Generation of employment and economic opportunities	
Migration of personnel from other areas	
Increase of the risk of work accidents	
Generation of excess material due to excavation	

(4) Prevention or Mitigation Measures

Following measures are necessary to be undertaken in the subsequent stages of the Project.

1) Coordination with Utilities
   - INRH – water, sewer and storm water pipes
   - ETECSA – telephone lines
   - Power Company – power supply lines
   - Railway – railway tracks
   - *"Red Tecnica"* – information on any other underground utilities
2) To investigate the feasibility of carrying out the work at night with relevant authorities and to the possibility of covering the trench with steel sheets to provide more room for traffic.
3) To investigate the traffic flow pattern and origin-destination of the traffic during the detailed design stage to take necessary steps for traffic control and detour
4) Coordination with Traffic Division of Police (PNR) and other relevant institutions (i.e. public bus enterprise)
   - To inform the public and other relevant institutions in advance

- To provide personnel to direct and control traffic flow
- To relocate bus stops where necessary

5) To set-up a committee comprising of all relevant institutions to share information on the progress of construction and to facilitate coordination among institutions

6) Instruction to the Contractor to conform to good Construction Practices

- To provide tight containers for transport of materials and to provide covered containers to avoid loss of material during transportation
- To use safety devices in the concrete-mixer trucks to avoid the spill of material during the transport
- To avoid spilling of construction materials i.e. cement, concrete etc. to prevent blocking of drains and their ultimate discharge to river and bay
- To avoid cleaning of containers, machineries etc. on the street pavement to prevent spilling of fuel, lubricants etc. to the river and bay
- To manage construction waste and excavated material to avoid piling-up along the street which can obstruct traffic, cause floods by blocking drains etc. and to dispose them at approved locations
- To control the speed of construction traffic and maintain awareness of safety
- To take organizational measures to reduce construction noise
- To take measures to protect excavations and ensure their stability and safety during construction

5.6 CASABLANCA PUMPING STATION

(1) Description

Rehabilitation of Casablanca Pumping Station is planned to replace existing pumps, generators and other related modifications within the existing site. Since this is an existing facility being in use to pump wastewater to Playa del Chivo it will become necessary to discharge wastewater to the bay during rehabilitation. Work is planned to be carried out to reduce the duration of raw wastewater discharge to the bay through stepwise decommissioning and installation of pumps.

(2) Evaluation of Facility Siting

Rehabilitation work will be carried out with minor modifications within the premises. Except for a construction of a cooling water tower outside building all other rehabilitation work will be within the building. The proposed rehabilitation will not modify the facility site.

(3) Potential Impacts

Construction stage	Exploitation stage
Overloads of the existent infrastructure in the area	Contribution to the improvement of environmental quality of Havana Bay
Increase of the continuous and intermittent sound levels	Improved pumping efficiency
Deterioration of the bay water quality	Stimulation to the industrial development
Increase of the particle levels in the air	Decrease of the noise levels
Generation of employments and economic opportunities	Decrease of the problems of environmental health
Movement of personal of other areas	Improvement of the work conditions and security
Increase of the risk of work accidents	Wastewater management
Increase of the production of garbage and residues	Energy consumption

(4) Prevention or Mitigation Measures

Following measures are necessary to be undertaken in the subsequent stages of the Project.

1) Planning of the Execution of the Tasks

- To minimize the discharge of raw wastewater to at the entrance to the bay during rehabilitation, execution of tasks and necessary stand-by shall be planned and prepared prior to commencing the rehabilitation work

2) Security and Safety

- Security and safety regulations shall be adhered to during transportation of equipment, materials, waste etc.
- Safety and health precautions shall be taken while working in the existing pumping station, with skilled personnel and with protection equipment for workers.
- To provide adequate ventilation and lighting.
- Security permission for the demolition work shall be obtained and shall include measures for workers protection

3) Sludge Remaining in the Siphon and other Demolition Waste

- Sludge remaining in the siphon shall be discharged to the landfill
- Disposal of any harmful waste generated during demolition shall be negotiated with Empresa Provincial de Materias Primas, EPRMP

5.7 SCREENS AT CABALLERIA

(1) Description

Rehabilitation of screens at Caballeria is to replace two gates which are not functioning and to install air pumps to facilitate grit removal.

(2) Evaluation of Facility Siting

Rehabilitation of screens at Caballeria is to replace two gates which are not functioning and to

install air pumps to facilitate grit removal. There will not be modifications to facility size and appearance.

(3) Potential Impacts

Construction Stage	Operation Stage
Overloads of the infrastructure in the area	Contribution to the improvement of water quality of Havana bay.
Increase of the continuous and intermittent sound levels	Increase of sound levels
Visual obstruction	Stimulation to the industrial development
Health impact caused by the emission of pollutants and noises	Bad odours
Generation of employments and economic opportunities	Reduction of health impacts
Migration of personal from other areas	Failures of system operation
Increased risk of workplace accidents	Improvement of workplace safety and working environment
Increase of waste production	Increased efficiency of screening and removal process
	Waste management

(4) Prevention or Mitigation Measures

Following measures are necessary to be undertaken in the subsequent stages of the Project.

1) Coordination

- To coordinate with Historians Office Master Plan on the modifications
- To coordinate with Traffic Division of Police (PNR) to provide personnel to control traffic during installation

2) Individual Protection Equipment

- To provide individual protection equipment to ensure health and safety of workers during rehabilitation and during operation

3) Disposal of Screenings and Grit

- To systematize the collection of screenings and grit and their disposal

5.8 EVALUATION OF MEASURES DURING EMERGENCY

Measures in the event of breakdown during the operation of key components of the Priority Projects are considered and their effects are evaluated. The key components are as follows.

1) Matadero Pumping Station
2) Casablanca Pumping Station
3) Luyanó WWTP

5.8.1 MATADERO PUMPING STATION

Matadero Pumping Station will become one of the key components of Existing Sewerage System and either power failure or pump failure can occur. In general, generators are planned in case of power failure to continue with pumping and stand-by pumps are planned in case of pump failure. In the extreme event of prolonged power failure or pump failure, it may become necessary to by-pass wastewater. In the detailed design stage, alternatives such as by-pass without diversion to bay and emergency by-pass to bay shall be considered. In the event of by-pass to the bay, untreated wastewater discharge to Atares will occur. Probability of this event should be reduced through detailed consideration of the number of generators and the pumps.

5.8.2 CASABLANCA PUMPING STATION

Rehabilitation of the Casablanca Pumping Station is in fact to address the non-functioning generators and the failure of pumps. As such, the existing situation in which discharge of raw wastewater at the entrance channel to the bay during either pump breakdown or power failure shall improve with increased number of pumps and generators.

5.8.3 LUYANÓ WWTP

Luyanó WWTP is the key component of New Sewerage System as the wastewater conveyance to the WWTP is planned under gravity. Power failure as well as equipment failure can cause disruption in the functioning of WWTP. In case of power failure, generators will be provided for inlet pump will ensure that wastewater goes through primary sedimentation tanks and power supply to sustain activated sludge biomass. In this case, provision of primary treatment can be still be considered beneficial compared to "without project" in which case raw wastewater will reach river and bay without treatment.

However, prolonged power failure or equipment failure will have serious consequences disrupting the process or damming wastewater within the Colectors which will result in raw wastewater discharge to river and bay. In the detailed design, consideration of whether to provide by-pass to river in the extreme event of prolonged power failure and the capacity of generators and their duration of operation shall be considered.

5.9 RECOMMENDATIONS

The EIA Study presented in this Chapter and in Appendix-14 will serve as a basis to obtain environmental license in the future prior to the operation of facilities. The Study need to be refined and strengthened in the subsequent stages of the Project prior to construction in order to be adequate to obtain environmental approval for construction and operation.

Several measures recommended in the prevention and mitigation measures need actions to be taken by GTE/INRH as early as possible to provide information to the relevant institutions and their participation in the prevention and mitigation measures. Their participation in the early stages will be valuable in the detailed design of the project components.

Consideration of Master Plan in the detailed design of on-going GEF/UNDP Project shall be taken as both are being carried out in parallel.

Recommendations related to surveys shall also be conducted as early as possible. They are,

- Observation of background environment levels (odor, noise and air pollutants) around Luyanó WWTP
- Origin-destination surveys for major Colector routes to plan for traffic control during construction of Colectors

- To collect information on the existing utilities along the Colector routes

CHAPTER 6
PROJECT EVALUATION

6.1 GENERAL

In this chapter, the Priority Project is evaluated from technical, economic, financial and environmental views.

6.2 TECHNICAL EVALUATION

6.2.1 GENERAL

The technical soundness of the sewerage system proposed in the Priority Project is examined with regard to the following viewpoints:

- Appropriate technology levels,
- Soundness of O/M level required to run the proposed sewerage system, and
- Project effects

6.2.2 PROPOSED FACILITIES

(1) Wastewater Collection System

The new sewer system is designed in principle to flow the wastewater by gravity, reducing to the maximum extent the energy need to pump up the wastewaters, consequently, the operation and maintenance of the system is easy and costs are low. All the sewers are designed to have flow allowances of 25 to 100 percent of the pipe capacity during the peak flow rates. This will allow interior of sewers to supply sufficient ventilation avoiding anaerobic conditions of the wastewaters in the sewers thereby preventing the possible sulfide buildup.

(2) Wastewater Treatment Plant (WWTP)

The limited availability of land area for Luyanó WWTP selected a conventional activated sludge process as an appropriate wastewater treatment process. This process requires high technology and cost to operate and maintain the facilities properly but is expected a high performance in pollution loads reduction. The whole excess sludge, after being stabilized by the anaerobic digester, will be dewatered by a mechanical equipment of belt filter press using chemical conditioning of a polymer and the dried sludge will be disposed off at the municipal landfill site. The mechanical dewatering equipment is needed within the limited land area availability and to prevent adverse environmental impacts of odor to the surrounding environment of residential areas. The belt filter press has some advantages of lower energy requirements, relatively low capital and operating costs, less complex mechanically and easier to maintain among other kinds of mechanical dewatering equipment.

6.2.3 LAND ACQUISITION AND RIGHTS

The new main sewers and pumping stations will be constructed within road reserves or on government-owned land. The site for construction of the wastewater treatment facilities under the Priority Project would be obtained together with the site for the GEF-UNDP Luyanó WWTP. The site has been selected at the vacant land so that no resettlement will be required, and any adverse environmental impacts could be minimized through implementation of prevention/mitigation measures. The land site totaling about 4 hectares (for the 7,100m^3/day treatment capacity by 2020) needs to be acquired

6.2.4 PROCUREMENT

Project contracts are envisaged to be awarded through international competitive biddings for the rehabilitation and construction of pumping stations and wastewater treatment plant facilities, while the installation of sewers a civil works required for the major sewerage facilities may be planned for Cuban contractors. The local contractors work would expect a contribute to the Havana province economy.

6.2.5 PROJECT EFFECTS ON THE IMPROVEMENT OF ENVIRONMENT

The Priority Project will contribute to the improvement in the water environment of Havana Bay. The improvement of the existing Central sewerage system will make better the most deteriorated water environment at Atares in the bay. The development of new sewerage system will collect and treat the wastewater generated at the most densely populated area of the Luyanó and Martín Pérez rivers and contribute to the improvement in the water environment of Guasabacoa.

The Priority Project is based on the maximum use of the existing and new sewerage system to reduce the pollution loads discharged to the Havana Bay efficiently and will contribute to the improvement of water environment of the Havana Bay and to the improvement in standards of sanitary life of inhabitants in the sewer service area. The improvement of the water environment will also contribute to the Cuban economy through providing the benefits to the tourism and other industries expected.

6.2.6 OVERALL TECHNICAL EVALUATION

The Priority Project will help alleviate existing adverse water quality conditions in Havana Bay and sanitary conditions in the bay basin.

The Project will provide the cost-effective wastewater collection and treatment facilities to service the most densely developed and severely degraded urban area in the Havana Bay basin and neighboring areas, which are compatible with a long-term strategy to serve the entire Area.

From the foregoing facts and discussions, it is evident that the proposed Priority Project is justified technically sound and will contribute to a large extent to the improvement of currently deteriorated environmental conditions of the Havana Bay and the bay basin area.

6.3 ECONOMIC AND FINANCIAL EVALUATION

6.3.1 FINANCIAL EVALUATION

The financial viability of the priority project is evaluated in Sections 4.1.3 through 4.1.5. The result is that the priority project is considerably attractive in the light of financial soundness. The FIRRs were computed at 5.2 percent for the US$ portion, 51.0 percent for the peso portion, 28.1 percent for the combination of the US$ and peso at the exchange rate of US$1:Ps1, and 7.3 percent for the same combination at a different exchange rate of US$1:Ps26. The 28.1 percent is extremely high figure and the 7.3 percent is the lowest acceptable figure as a self sustainable project. In fact, it would be too conservative to evaluate the priority project if the exchange rate of US$1:Ps26 is strictly applied. Therefore the FIRR of 7.3 percent would be financially satisfactory.

When the soundness of a project is evaluated by financial indicators, the premises and assumptions applied in computation of the financial indicators naturally matter. Although we tried to be conservative in employing those assumptions, some assumptions may still seem optimistic. Thus, justifications of key assumptions are examined subsequently.

1) Exchange rate

It is extremely difficult to forecast future exchange rates. The official exchange rate of US$1:Ps1 simply exists for convenience of accounting system. The unofficial but legal exchange rate of US$1:Ps26 is currently used for personal transactions only. If this US$1:Ps26 exchange rate is actually applied to foreign exchange computation of the priority project, the exchange market will be affected by its enormous amount of inflow of hard currencies, and the exchange rate will go toward peso's appreciation against US dollar. As a result, the exchange rate will be no longer the same. Under the uncertainties of the foreign exchange market, if the exchange rate of US$1:Ps1 is applied, the situation is regarded the most favorable to the implementation agency. In other words the situation becomes the most unfavorable if the exchange rate of US$1:Ps26 is applied. We expect that a real outcome falls somewhere in-between the two situations.

2) Sewerage rate for domestic customers

At the beginning of 2004, the average sewerage rate for domestic customers is assumed at Ps6 per person per year. This will be doubled in 2006 and raised to Ps36 in 2011. Although a six fold multiplication in seven years may seem unrealistic, it is justifiable. The current sewerage bill of Ps6 per person per year can be approximately converted to a Ps2 per household per month. Considering the Ps760 is the average monthly household income (Table 13.22 of Part I), the Ps2 accounts for merely 0.26 percent. Even after the six fold increase, the sewerage bill of Ps12 will account for 1.58 percent of household income, which still stays around empirical ceilings[1]. Incidentally a real increase of household income, that is likely to happen during the project period, is not considered.

3) Sewerage rate for state entities and institutional customers

At the beginning of 2004, the average sewerage rate of this category is assumed at Ps180 per customer per year. This will be doubled in 2006 and in 2011 raised to Ps900. This turns out to be a five hold multiplication in seven years. Compared with the tariff increase for domestic customers, which is six fold in seven years, this rise is still smaller.

4) Sewerage rate for hard currency earners

At the beginning of 2004, the average sewerage rate of this category is assumed at US$270 per customer per year. This will be US$365 in 2006 (35% increase) and in 2011 raised to US$495 (another 35% increase). This is an 83 percent increase in seven years. Compared with the tariff increase for domestic customers (500% increase) and that for state entities (400% increase), this rise is small by far.

5) Contribution from foreign tourists

The assumption is that the Cuban government has to levy US$2 per tourist per stay in the City of Havana, starting in 2011. The system of levying the tourist contribution and transferring it to the implementation agency has to be introduced by the Cuban government in the first place. The US$2 is a 0.2 percent of the average tourist spending in Cuba, which is regarded inexpensive compared with most of entertainment costs paid by tourists. The number of tourists visiting the City of Havana is assumed to increase from 0.959 million in 2002 to 1.3 million in 2011, which is a 36 percent increase in nine years. The City of Havana already experienced a 47 percent increase of tourist inflow in three years between the year 1997 (649,000 tourists) and 2000 (951,000 tourists).

[1] The Pan American Health Organization reportedly employs benchmarks of a household's affordable amount for water supply and sewerage. According to this, total of water and sewerage bill should be below 5 percent of household income (3.5 percent for water and 1.5 percent for sewerage).

6) Loan Repayment Projection

The simulation of borrowing and repaying loans and the changes in debt service coverage ratios indicate that the project can be funded through tariffs and tourist contributions except during the initial construction period. Under the year 2003 situations, the possibility of the government's asking a loan to multilateral or bilateral financial institutions is opaque. Getting a grant for this size of the project is not easy. It is essential that the central government should allocate the fund for the project during the initial construction period.

6.3.2 ECONOMIC EVALUATION

The economic viability of the priority project is evaluated in Sections 4.2.3 and 4.2.4. The EIRRs of combinations of US$ and peso all exceeds 10 percent. The B/Cs and the NPVs are also considerably high in all combinations. This means that the project is economically sound and its implementation is justifiable.

In the light of economic cost valuation, the appropriateness of conversion factors has to be ensured. In converting the financial cost of the priority project into its economic cost, various conversion factors were applied, which are explained in Section 13.9.2 of Part I. On average, those conversion factors are around 0.8, which is an ordinary level in economic cost valuations.

The economic benefit of the priority project is composed of the benefits perceived by all the industries and inhabitants within the boundary of the city of Havana, and tourists who visit the city of Havana. Not all of them are direct beneficiaries or new sewerage users as the priority project covers only a part of the area of the city of Havana. However all of them are considered as beneficiaries in a sense that they can enjoy the improved environment of the bay area.

Reduction of morbidity of water-borne diseases related to the development of water supply and sewerage system is an understandable benefit. This benefit is not included in computing economic indicators however, the quantification of the benefit is attempted in Section 13.9.2 of Part I. Assuming that a 10 percent of the acute diarrhea is attributable to poor excreta disposal and this can be eliminated by the priority project, the reduction of the incidence would be 25,000 per year. The economic benefit will be in Ps0.5 million per year at local price or US$3 million at foreign price.

Furthermore, the priority project, in combination with environmental education programs, will have a strong public appeal that the Cuban government commits itself to assume a responsible position for environmental improvement of the wider Caribbean region.

6.4 ENVIRONMENTAL EVALUATION

6.4.1 POLLUTION LOAD REDUCTION

Comparison of the pollution load reduction due to implementation of the Priority Projects in the Luyanó-Martín Pérez Sewer District with that of the M/P is shown in Table 6.1.

Implementation of Priority Projects will result in BOD_5 load reduction of 32% of that of reduction in M/P and 22% in terms of generation in the M/P Area. Corresponding values for T-N and T-P are 32% and 4%. In terms of the total load generated in all the Sewer Districts, % reduction due to Priority Projects is 11% (BOD_5) and 2% (T-N or T-P). Priority Projects will contribute very much to the reduction of organic pollution to the bay.

Table 6.1 Estimated Pollution Load Reduction in New Sewerage System-Priority Projects

Item	Load			
	BOD_5	T-N	T-P	SS
New Sewerage System-All Sewer Districts				
Load generation (T), kg/d	22,794	3,481	892	22,794
Potential load reduction (A), kg/d	20,515	522	134	20,515
New Sewerage System (Luyanó-Martín Pérez Sewer District) – M/P Area				
Load generation in M/P area, kg/d	11,723	1,779	460	11,723
Load reduction by GEF/UNDP (B), kg/d	2,546	64	17	2,546
Load reduction by M/P (C), kg/d	8,005	203	52	8,005
Total load reduction by GEF/UNDP and M/P, kg/d	10,551	267	69	10,551
Load reduction by F/S or Priority Projects (D), kg/d	2,584	65	17	2,584
Ratio of reduction in F/S to reduction in M/P, D/C	32%	32%	32%	32%
Ratio of reduction in F/S to total generation in M/P area, D/A	22%	4%	4%	22%
Ratio of reduction in F/S to total generation in all Sewer Districts, D/T	11%	2%	2%	11%

In the Central System, implementation of the Priority Project will result in the elimination of all cross-connections related to Dren Arroyo Matadero and San Nicholas. At the end of Stage 1, pollution load flowing through Dren Agua Dulce due to cross-connections will be pumped and treated at WWTP (on-going project with the aid of Italy and Belgium) and discharged to Guasabacoa. Table 6.4-2 shows the estimated load reduction based on measured load which is 60% in terms of BOD_5. Respective values for T-N, T-P and SS are 59%, 49% and 55%.

Table 6.2 Estimated Pollution Load Reduction in Central System-Priority Projects

Item	Load			
	BOD_5	T-N	T-P	SS
Central Sewerage System				
Estimated load generation, kg/d	31,733	4,721	1,225	31,733
Total measured load through drains*, kg/d	17,032	1,284	2,303	7,244
Load reduction due to implementation of Priority Projects, kg/d	10,262	755	1,132	4,002
Estimated load reduction based on measured load, kg/d	60%	59%	49%	55%

* - Total of that discharged through drains Matadero and San Nicholas and it should be noted that the existing Central System covers areas outside the bay basin. Wastewater generated in the areas outside bay basin will also be discontinued.

6.4.2 WATER QUALITY IMPROVEMENT

Tables 6.4-3 shows the results of estimate for wastewater discharge to the Bay with the implementation of Priority Projects based on the assumption described in Section 11.6, Part I of Main Report, Volume II.

Table 6.3 Case F/S

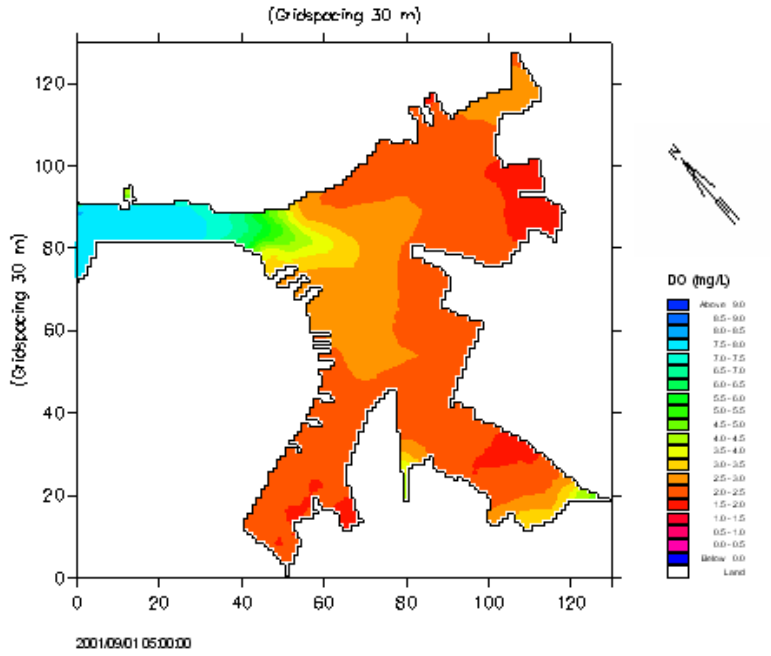
Sewer District	Source (River System)	Flow	BOD_5	T-N	T-P	SS
		m^3/d	kg/d	kg/d	kg/d	kg/d
Luyanó-abajo	Luyanó	210,323	16,302	2,641	1,336	13,808
Luyanó-arriba						
Martin Pérez-abajo	Martin Pérez	70,842	5,143	942	204	7,892
Martin Pérez-arriba						
Tadeo	Tadeo	10,635	1,934	307	76	1,945
Existing (Central)						
San Nicholas	San Nicholas					
Matadero	Matadero					
Agua Dulce	Agua Dulce					
Refinery		*6,406*	*21,723*	*54*	*1*	
Total		298,205	45,102	3,943	1,617	23,645

Figures 6.1 through 6.5 shows the results of water quality simulation with the implementation of Priority Projects (Case F/S) and its comparison with that of M/P. With the Priority Project, DO will be in the range of 1.5 to 2.0 mg/L in Atares and in Guasabacoa compared to 2.0 to 2.5 mg/L with the implementation of M/P (Figure 6.1).

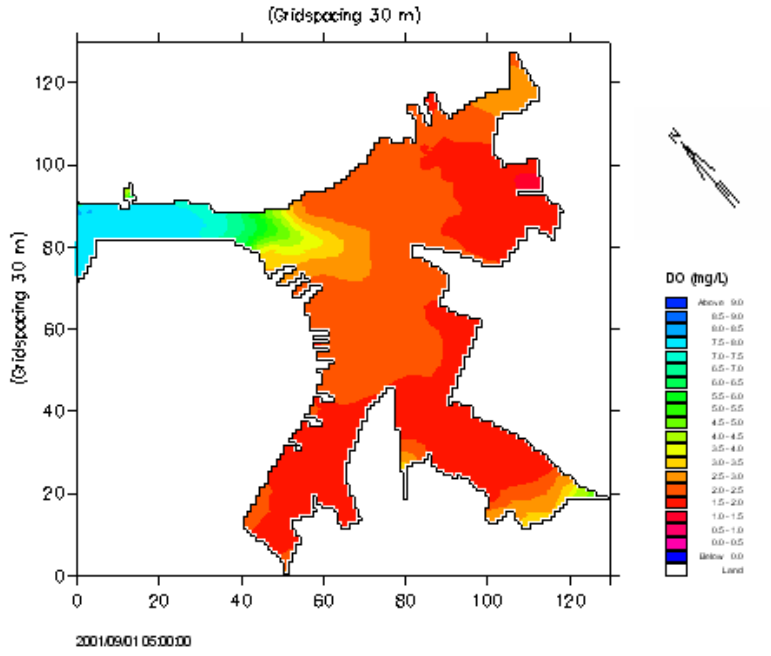
In terms of BODd, NH_4-N, PO_4-P and Chl-a (Figures 6.2 through 6.4), the concentration levels are similar in Atares with the implementation of Priority Projects (Case F/S) compared with that of M/P. The difference between F/S and M/P in DO levels in Atares arise due to the location of Atares. Atares is the most inland cove of the bay and the oxygen supply through underwater ocean current will be limited compared to other areas resulting in lower DO levels in Atares. With the implementation of Priority Projects, pollution load input to Atares through drains will be eliminated through elimination of cross-connections related to Dren Arroyo Matadero and as a result of the on-going Belgium/Italian aided project in which Dren Agua Dulce will be diverted for treatment and discharge to Guasabacoa. Further improvement of DO levels in Atares in the subsequent stages will be possible due to overall improvement of water quality in the other parts of the bay.

Compared to the existing levels of DO in Atares which is below 1.0 mg/L, the improvement in the range of 1.5 to 2.0 mg/L due to implementation of Priority Projects will be significant considering the long-term water quality goal of 3.0 mg/L and by elimination of pollution load input to Atares.

Priority Projects contribute significantly to the water quality improvement to improvement in the most polluted area of the bay which is Atares and also improve water quality in Guasabacoa.

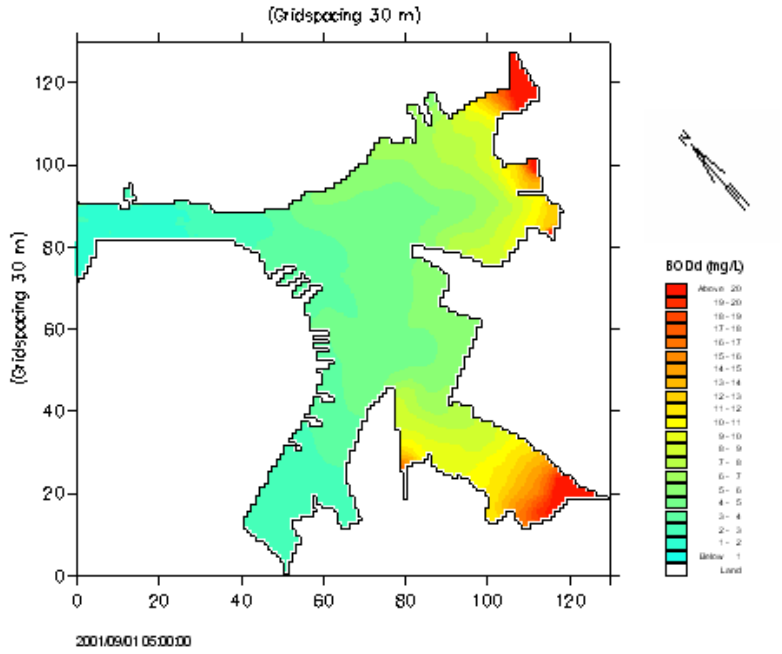


Case M/P

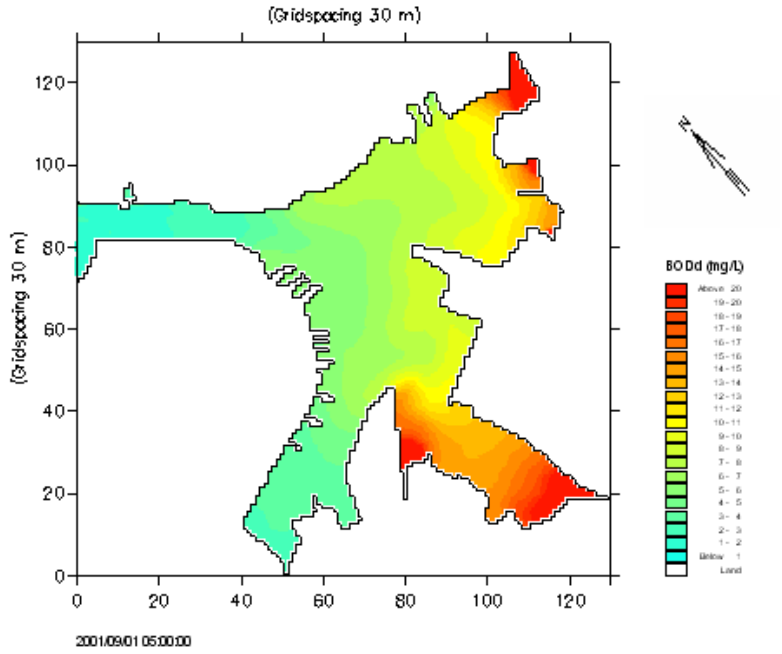


Case F/S

THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 6.1 Results of DO Levels for M/P and F/S
JAPAN INTERNATIONAL COOPERATION AGENCY	

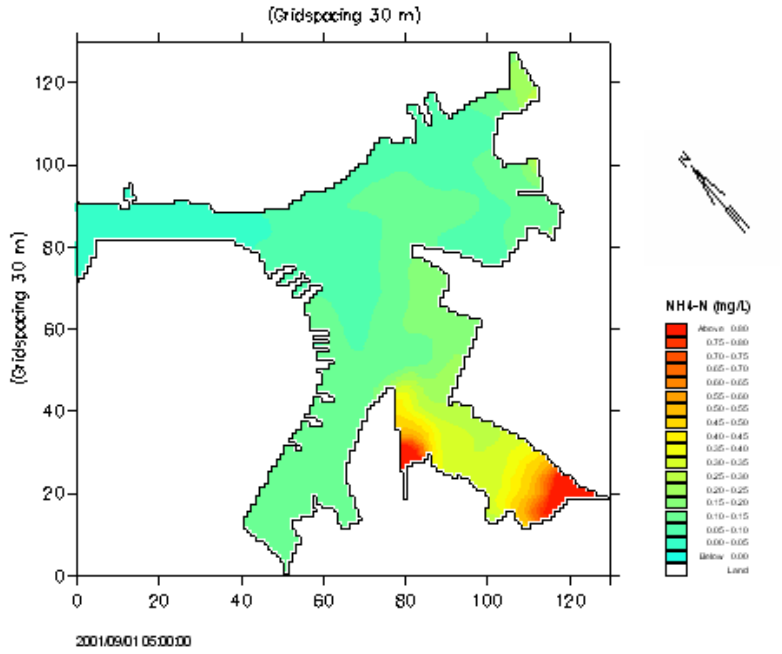


Case M/P

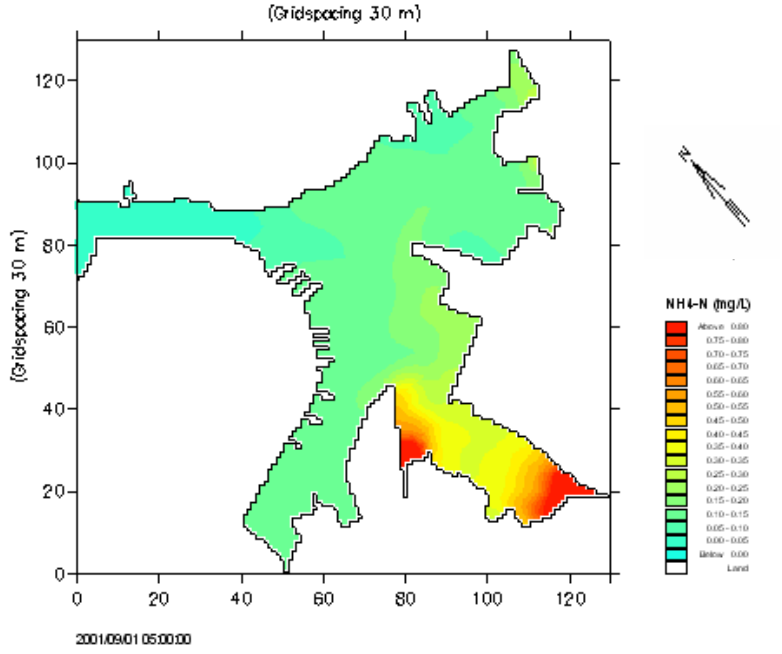


Case F/S

THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 6.2 Results of BOD Levels for M/P and F/S
JAPAN INTERNATIONAL COOPERATION AGENCY	

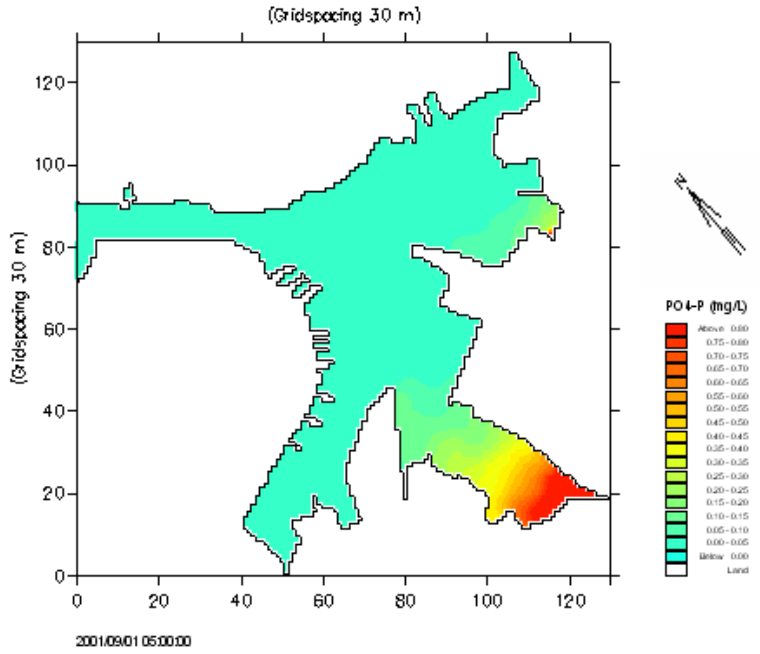


Case M/P

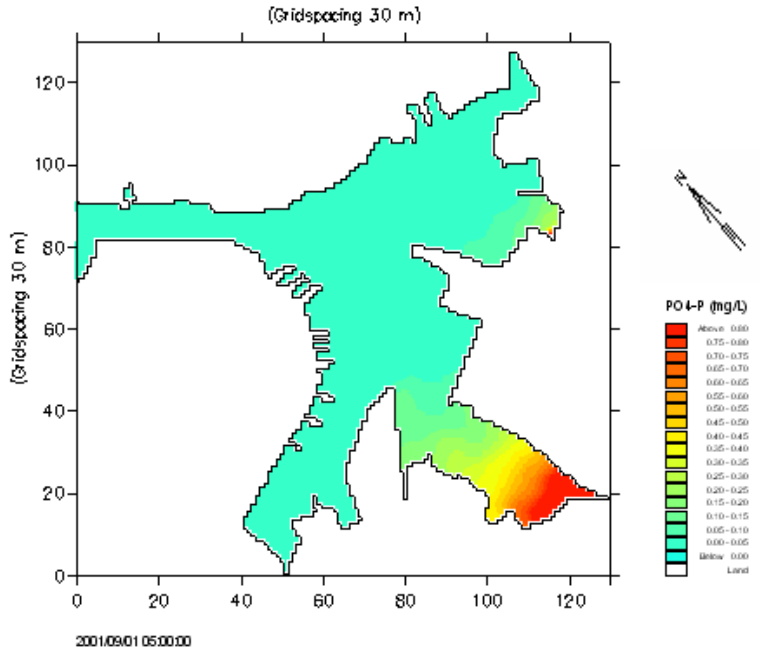


Case F/S

THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 6.3 Results of NH_4-N Levels for M/P and F/S
JAPAN INTERNATIONAL COOPERATION AGENCY	

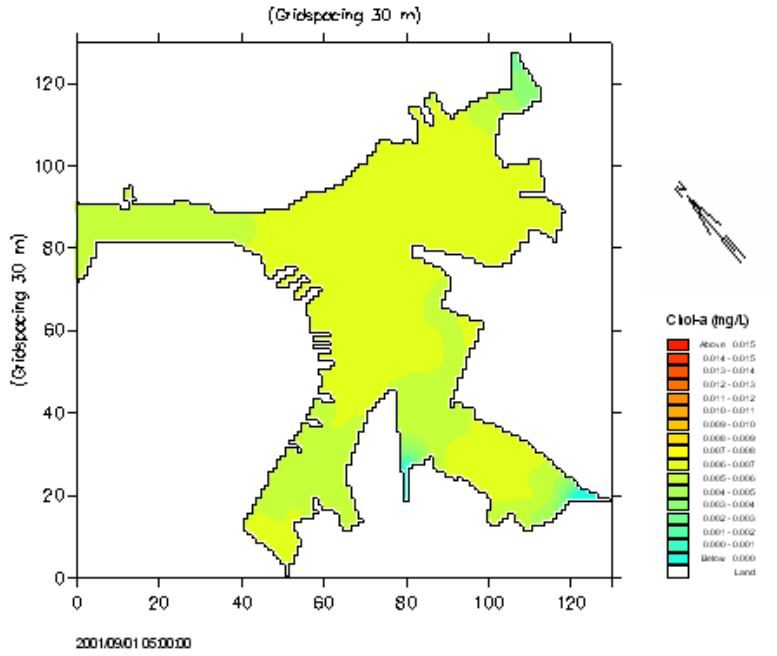


Case M/P

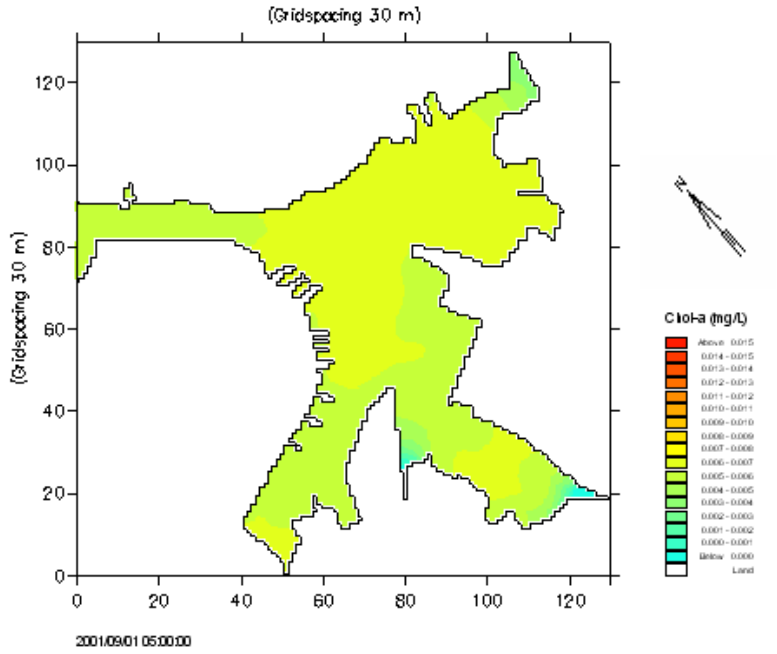


Case F/S

THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 6.4 Results of PO_4-P Levels for M/P and F/S
JAPAN INTERNATIONAL COOPERATION AGENCY	



Case M/P



Case F/S

THE DEVELOPMENT STUDY ON THE IMPROVEMENT OF SEWERAGE AND DRAINAGE SYSTEM FOR THE HAVANA BAY	Figure 6.5 Results of Chl-a Levels for M/P and F/S
JAPAN INTERNATIONAL COOPERATION AGENCY	

6.4.3 SUMMARY OF EVALUATION AND WAY FORWARD

EIA Study showed that, localized impacts due to generation of odor and generation of sludge at the sewerage facilities is envisaged unless appropriate maintenance procedures are followed. Further, during construction stage, negative impacts are also expected. Several measures for prevention/mitigation are made through the results of EIA Study for necessary action in the subsequent stages of the Priority Project.

Priority Projects will contribute immensely to the improvement of the water quality environment of Havana Bay and will protect the bay from deterioration due to untreated wastewater discharge through sewerage and drainage which would occur if the Project is not implemented. Improvement in the Existing Sewerage System will improve significantly the water environment of Atares which is the most polluted part in terms of DO level in Havana Bay. Development of New Sewerage System will contribute to the improvement in Guasabacoa and to the overall improvement of bay water environment.

In summary, Proposed Projects are environmentally sound and the negative impacts could be alleviated through recommended measures for prevention/mitigation.

6.5 OVERALL PROJECT EVALUATION

(1) The Priority Project is based on the maximum use of the existing and new sewerage system to reduce the pollution loads discharged to the Havana Bay efficiently and will contribute to the improvement of water environment of the Havana Bay and to the improvement in standards of sanitary life of inhabitants in the sewer service area. The improvement of the water environment will also contribute to the Cuban economy through providing the benefits to the tourism and other industries expected.

(2) The Priority Project will provide the sewerage service at the most built-up urban area. The present sewer service population of 433,200 (year 2001) will increase to 512,900 (year 2010) within Havana Bay basin together with GEF/UNDP on-going project.

(3) The Luyanó WWTP constructed under the Priority Project would have a capacity 17,900m^3/d or 207 L/s, and the total treatment capacity would become 35,200m^3/d or 407 L/s from 17,300m^3/d or 200 L/s which will be developed by the GEF/UNDP project. Therefore, an additional BOD_5 reduction expected by the WWTP under the Priority Project is about 2,584kg/day and the total reduction will be increased to about 5,130kg/day BOD_5 by both the GEF/UNDP project and the Priority Project which would otherwise be discharged to the Havana Bay.

(4) Without the implementation of the Priority Project, further environmental degradation and deterioration in public health will be inevitable, and the economic development of the area will be slowed.

The Project will provide an affordable and technically sound solution to the current pollution problems resulting in substantially improved wastewater services for the communities and a noticeably cleaner environment. The Project represents a major step toward improving the environment in the Project Area, resulting in significantly improved water environment and sanitation conditions.

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The Feasibility Study has verified the technical, economic, institutional and environmental feasibility of the proposed Priority Projects.

The proposed Priority Projects are expected to reduce the pollution loads to the most deteriorated area of the Havana Bay effectively and efficiently. The Priority Projects have proposed the improvement of existing Central sewerage system and the development of a new sewerage system for Luyanó-Martín Pérez Abajo sewer district which is most populated but no-sewered area. The improvement of the existing Central sewerage system will make better the most deteriorated water environment at Atares in the bay. The development of new sewerage system will collect and treat the wastewater generated at the most densely populated area of the Luyanó and Martín Pérez rivers and contribute to the improvement in the water environment of Guasabacoa.

7.2 RECOMMENDATIONS

The study concluded that the implementation of the Priority Project is feasible. It is matter of fact that the Project could hardly be implemented without the external financial supports and the Cuban government subsidy or self-fund. Because at the beginning of the Project, the investment costs for the construction and rehabilitation works of such magnitude would be financially serious burden to the Cuban implementing agency such as INRH and GTE.

Under the year 2003 situations, the possibility of the government's asking a loan to multilateral or bilateral financial institutions is opaque. Getting a grant for this size of the project is not easy. It is recommended that the Cuban government should seek and establish a fund to allocate it for the following important and urgently required components of the proposed Priority Project but needed lower cost: 1) Detailed survey and design work to solve the cross connection problems in the area related to the Dren Matadero, 2) Survey on physical conditions of the siphon, and 3) Execution of necessary measures to solve the cross connections in the area related to the Dren Arroyo Matadero. These components are essential for the success of the improvement plan of existing sewerage system and to eliminate the wastewater discharge to Atares through the Dren Arroyo Matadero.

Some important institutional arrangements are proposed to strengthen and ensure the coordination of all the concerned parties. GTE will be continuously the environmental authority for the whole of the Havana Bay Basin, in particular it is advised to secure the necessary funding for conducting the proposed environmental monitoring and environmental education. INRH and DPRH will play important roles for execution and implementation of the projects. The management, operation and maintenance of the sewerage facilities rehabilitated and constructed under the project will fall under the Aguas de la Habana, thus it is recommended that the Concession Agreement with Aguas de la Habana would be reviewed and revised.

To facilitate smooth implementation of the project, the institutional arrangements for project implementation are proposed. It is recommended that a steering committee be formed representing all of the relevant agencies and bodies, such as MINVEC, GTE, INRH (DPRH), Aguas de la Habana, and International Consultants as a Project Institutional Framework. It is also proposed to establish an organization for technical design and construction supervision.

It should be reminded that the sewerage system can reduce pollution loads to the Havana Bay only when the system operates properly. To operate properly, the followings are indispensable:

enough budget for the O/M of equipment and personal cost, receive stable power supply and periodical trainings for operator and staff to lift their moral as well as the technology required. The central government's support in term of financial and institutional assistance is also essential for the operation of the sewerage system.