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Japan International Cooperation Agency (JICA)

Ministry of Environment and Waters
Republic of Bulgaria

THE STUDY ON INTEGRATED ENVIRONMENTAL MANAGEMENT FOR THE MARITZA RIVER BASIN IN THE REPUBLIC OF BULGARIA

Final Report

Summary

March 1999

Pacific Consultants International, Tokyo

The cost estimate was made based on prevailing market price in late 1997 and expresses in US$ according to the following exchange rate.

US$ 1.00 = Leva 1730 =Yen 114

(As of late 1997)

PREFACE

In response to a request from the Government of the Republic of Bulgaria, the Government of Japan decided to conduct the Study on the Integrated Environmental Management for the Maritza River Basin in the Republic of Bulgaria and entrusted the Study to the Japan International Cooperation Agency.

JICA selected and dispatched a study team headed by Mr. Hajime Tanaka of Pacific Consultants International Co., Ltd. to Bulgaria, four times between March 1997 and March 1999. In addition, JICA set up an advisory committee headed by Mr. Senro Imai, Development Specialist of Japan International Cooperation Agency, between March 1997 and February 1999, which examined the Study from specialist and technical points of view.

The team held discussion with the officials concerned of the Government of Bulgaria, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Bulgaria for their close cooperation extended to the study.

March, 1999

Kimio Fujita
President
Japan International Cooperation Agency

THE STUDY
ON
INTEGRATED ENVIRONMENTAL MANAGEMENT FOR
THE MARITZA RIVER BASIN IN THE REPUBLIC OF BULGARIA

March 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit the final report entitled the" The Study on Integrated Environmental Management for the Maritza River Basin in the Republic of Bulgaria". This report has been prepared by the Study Team in accordance with the contract signed on March 1997, October 1997, May 1998 and September 1998 between the Japan International Cooperation Agency and Pacific Consultants International.

In the Study, the Study Team based on the analysis of the existing environmental problems in the Maritza River Basin, presents the Master Plan of Integrated Environmental Management for the Maritza River Basin and the Feasibility Study on the priority projects identified in the Master Plan. The report consists of the Summary, Main Report, Supporting Report and Data Book.

All members of the Study Team wish to express sincere appreciation to the personnel of your Agency, Advisory Committee, and the Embassy of Japan in Bulgaria, and also to the officials concerned of the Government of the Republic of Bulgaria for their cooperation extended to the Study Team. The Study Team sincerely hopes that the results of the Study will contribute to the environmental management for the Maritza River Basin and also to the sustainable development of the area.

Yours Faithfully

Hajime Tanaka

Hajime TANAKA
Team Leader of the Study Team

OUTLINE OF THE STUDY

THE STUDY ON INTEGRATED ENVIRONMENTAL MANAGEMENT FOR THE MARITZA RIVER BASIN IN THE REPUBLIC OF BULGARIA

OUTLINE OF THE STUDY

1. The Study

The Study area is located in the southern part of Bulgaria and covers about 21,000 sq. km of the Maritza River Basin. The Maritza River runs 321.6 km eastward within the territory of Bulgaria, flows along the boundary between Turkey and Greece with joining the Tundza River and Arda river, and finally discharges into the Aegean Sea.

The water resources of the basin are extensively used by agriculture, hydropower, domestic and industrial water supply sectors, suffering from a lot of water stresses such as lack of water resources and deterioration of water quality.

The basin has been affected for many years by many pollution sources, i.e., wastes and refuse from urban areas, factories, mines, agricultural land and livestock farms, of which the hazardous substances could have been affecting the health of people, the water users and the environment in the basin.

The Government of Bulgaria (GOB) has started to take an action for restoration and protection of the environmental situation by formulating environmental laws and regulations, and strengthening related organizations. According to a draft of the new Water Act, the GOB aims to be in line with European Commission (EC) water policy, and especially the proposal for an EC Water Framework Directive which sets out a timetable within which the member states must set up River Basin District Authorities whose immediate task will be the preparation of River Basin Management Plans.

In accordance with the aims of the GOB, the Study is considered as a pilot study on the river

basin management plan and would provide the GOB with a basic frame and information that enable the GOB to review sub-sectors' water resources management and to formulate sustainable development policies for integrated water resources and environmental management of the Maritza river basin.

The Study consists of the Master Plan Study for integrated environmental management for the Maritza River Basin and the Feasibility Study on the priority projects that are sewerage treatment works for the three towns, i.e., Pazardjik, Dimitrovgrad and Stara Zagora.

2. Master Plan

(1) The Study has set a target to improve and maintain the water quality in sufficient good (class - I or class - II) along the Maritza River main stream and her major tributaries by the target year 2015. In order to improve and sustain the water resources and the environmental situations, the master plan proposed structural and nonstructural measures, i.e., three phased expansion of municipal wastewater treatment capacities, reduction of untreated wastewater discharges from industry and livestock strengthening of the implementation organization, strengthening of the monitoring systems, required development studies and investigations.

(2) From technical transfer aspects the Study has developed a GIS database and river water quality simulation model that would be utilized by the Government of Bulgaria as management tools for the Maritza River Basin after the Study.

2.1 Proposed Master Plan

The proposed Master Plan consists of the followings:

1) Structural measures for improvement of the water quality and the environment of the basin,

2) Non-structural measures for improvement and maintenance of the water resources and the environmental conditions of the basin,
3) Required management organizations for implementation of the proposed Master Plan,
4) Required development studies and investigations to support for management of water resources and environment of the basin,
5) Priority projects for improvement of the water quality and environmental conditions of the basin.

2.2 Socio-Economic Framework for the Target Year 2015

Socio-economic frameworks for the Master Plan worked out for the target year 2015 are:

- The GRDP of the Maritza river basin will grow at 6.8 % per annum on an average through 2015 supported by the annual average growth of agriculture at 3.0 %, industry at 7.5 % and service at 7.0 %.
- The total population in the basin will become 1,921,000 (urban population: 1,357,000, rural population: 564,000) in 2015, representing a 10 % increase from the population of 1,758,000 in 1995.

2.3 Zoning of Land Use and Environmental Sensitive Areas

Direction of desirable land use and management practices are studied for the basin and the Study area is classified into the five categories, i.e., forest area, agriculture area, urban area, conservation area, national parks and protection areas.

2.4 Water Quality Management Plan

According to the pollution loads and pollution sources estimated, the BOD loads are mostly discharged from domestic, industry and livestock sectors, and TN loads are mainly

from industry and livestock sectors. For improvement of the water quality and environmental situation the proposed structural and nonstructural measures are as follows:

(1) Reduction of Pollution Loads from Major Urban Centers, Industries and Livestock Farms

1) Reduction of pollution loads from 36 urban centers

Of the 772 settlements in the basin some 38 urban centers are reported to have sewer systems, of which only six (6) urban centers have sewerage treatment plants. However, only a few of them are active. In the Master Plan it is proposed to improve the wastewater treatment works for 36 urban centers as structure measures by phased expansion as follows:

- 1st Priority: 7 cities (primary and secondary treatment)
- 2nd Priority: 10 cities (primary treatment)
- 3rd Priority: 19 cities (primary treatment)

2) Reduction of pollution loads from major industries and livestock farms

The pollution loads from the major industries and livestock farms are to be reduced by regulation. It is proposed to start strict monitoring for the top 1-20 industries and major livestock farms and then others.

(2) Strengthening of Monitoring Systems for Management of Water Quality

In order to conduct an optimum water quality management for the basin it is necessary to conduct regular monitoring activities at the major hot spots along the Maritza main stream and tributaries, and also to conduct periodical monitoring at the heavy polluter, industries and mines in addition to their formal report. Based on the monitoring system for the

water quality management established by MoEW, the following stations including new stations have been planned:

Principal Station	–	6 stations in Maritza River (One new station proposed)
		6 stations in the tributaries
Auxiliary Station	–	7 stations in Maritza River
		24 stations in the tributaries (Four new stations proposed)

(3) Investigations for getting supporting data and information for management of water quality and related development study are planned as follows:

- Sewer systems of major urban centers for rehabilitation and improvement,
- Industrial effluent for management,
- Mining sites for preparation of measures against accidental pollution,
- Solid waste dumping sites for improvement,
- Biological monitoring and investigation as a supporting measure for management of the basin.
- Study on groundwater management for controlling quantity and quality of groundwater

2.5 River Basin Management Plan

The water resources of the Maritza river basin is extensively used by agriculture, hydropower, domestic and industrial water supply sectors. The surface water is distributed by numerous structures including dams and intakes as well as inner-basin and inter-basin transfer facilities for irrigation and hydropower. The groundwater is extracted by numerous wells for domestic and industrial water supply. The water resources of the basin are not used in efficient way and require an optimum management from the basin management aspect. For management of water resources and environment of the basin, the proposed components and measures are as follows:

(1) Zoning for water resources management

For conservation of water resources and for controlling water usage, the basin has been classified into the following areas:

1) Zone of Category – 1: Special basins for controlling water resource potential and demand

The sub-basins of the Category-1 are important basins for surface water potential, which have rich forest area of water resources and major reservoirs. The sub-basins in the Category-1 require measures for conservation and enhancement of water resources potential by protection and expansion of forest areas, including agro-forest and fruit trees.

2) Zone of Category – 2: Basins for controlling water resources potential and water demand

The sub-basins of the Category-2 have moderate surface water potential as well as moderate surface water demand. The sub-basins require proper control of water usage as well as conservation of water resources.

3) Zone of Category – 3: Special basins for controlling water demand

The sub-basins in the Category-3 are water-consuming basins. The sub-basins in the category require measures for efficient usage of water for irrigation, hydropower, domestic and industrial water supply, by proper management and rehabilitation of the water use systems as well as updating of the water demand and supply.

(2) Countermeasures for Water Resources Management

Based on the zoning, countermeasures for water resources management are formulated considering following scenarios.

- Scenario 1: Conservation and enhancement of water resources potential by conservation of forest area
- Scenario 2: Efficient usage of water for irrigation, hydropower, domestic water supply and industrial water supply.
- Scenario 3: Effective control of water resource potential by optimum operation of the existing hydraulic facilities.

The proposed countermeasures are as follows:

1) Strengthening of Monitoring Systems for Management of Water Resources in the Basin

Strengthening of the monitoring systems including installation of new gauges for meteorology, hydrology, and water use facilities such as irrigation and hydropower, domestic water supply and industrial water supply are proposed.

2) Conservation and increase forest area for water resources

In order to conserve and enhance water resources, conservation and increase of forest area is proposed especially for the sub-basins of Category-1.

3) For management of water resources and environment the following development studies and investigations are planned:

- Water resources management study in Bulgaria,
- Agricultural development study in the Maritza river basin,
- Water balance study on hydropower systems,

- Investigation of municipal water supply systems for rehabilitation and improvement,
- Post evaluation of the existing major hydraulic facilities such as dams and reservoirs from environmental aspects.

2.6 Project Cost

The project costs of this study are summarized as follows:

		Costs (US$ 1000)
1)	Construction of municipal wastewater treatment plants:	
-	1st Stage towns	122,021
-	2nd Stage towns	36,437
-	3rd Stage towns	55,272
	Total cost for WWTP	213,730
2)	Rehabilitation of water supply systems:	
-	1st Stage water supply systems	64,104
-	2nd Stage water supply systems	20,141
-	3rd Stage water supply systems	35,570
	Total cost for WS systems	119,815
3)	Strengthening of meteo-hydrological monitoring networks -	360
	Grand total	333,905

2.7 Financial Evaluation

The evaluation from the national economy point of view assesses the total investment for the Master Plan projects over the planning period up to the year 2015 in the light of public investments that are likely to be devoted to water and wastewater works and environmental sectors.

The total investment cost for water and wastewater works estimated by the Master Plan at US$ 333.9 million is smaller than the projected total public fixed capital expenditure of water/wastewater sector (US$ 366.0 million) up to the year 2015. However, the investment requirement for Stage I (US$ 186.1 million) is much larger than the projected public fund allocation during the stage (US$ 81.5 million).

Considering the combined public capital expenditure of water/wastewater sector with environment sector of US$ 217.3 million for Stage I and US$ 975.9 million up to Year 2015, financial viability for the M/P will become higher. Given the expected recovery and the renewed growth of the Bulgarian economy, the estimated investments on water and wastewater works in the Maritza river basin may be tolerable over the medium to the long term.

2.8 Institutional Structure Plan

Based on the concept of the New Water Act under preparation, a River Basin Management Organization shall be established for management of the Maritza River Basin under the MoEW and also a Project Implementation Unit (PIU) shall be established in order to support the new management organization.

For establishment of a New River basin management organization, a training program of a short-term and a long-term for the required staff will be necessary.

2.9 Initial Environmental Examination (IEE) for Priority Projects

The proposed WWTPs will benefit the community as a whole. It is nevertheless important to look rigorously at each of its component parts to ensure that environmental benefits are fully realized. In order to confirm the environmental effects at the proposed sites, EIA for the priority projects will be required.

2.10 Priority Projects for F/S

In order to improve the water quality of the Maritza River, it is proposed to improve or construct wastewater treatment works at 36 cities by phased expansion. The 1st Priority seven cities and the three priority cities for F/S are identified from technical and environmental aspects. The three priority cities for F/S are Pazardjik, Dimitrovgrad and Stara Zagora.

2.11 Action Plan

The phased program is planned as follows:

1. Preparation period: 2 years (1999 – 2000)
2. Phase-1: 5 years (2001 – 2005)
3. Phase-2: 5 years (2006 – 2010)
4. Phase-3: 5 years (2011 – 2015)

3. Feasibility Study

3.1 Environmental Management Plan

For environmental management, the environmental sensitive areas and spots located in the vicinities of the three priority urban centers, require close monitoring and further investigation

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3.2 Preliminary Design of Treatment Plants

(1) Basic Conditions

It is planned to satisfy the Standards of the EC Urban Wastewater Directive and also the current Bulgarian River standard that will be applied. The EC requirement is:

- BOD5 25 mg/l
- SS 35 mg/l

(2) Preliminary Design

The preliminary designs on treatment facilities sized only sufficient for Municipal populations within the areas to be served at the 3 towns. The proposed treatment works' designs developed and design criteria for the Study are summarized as follows:

1) Pazardjik

- Design PE: 97,000
- Total daily average flow: 29,400 m3/day
- BOD Loads (kg/day): 5,240 kg/day
- Process: Conventional activated sludge process

2) Dimitrovgrad

- Design PE: 61,000
- Total daily average flow: 18,800 m3/day
- BOD Loads : 3,300 kg/day
- Process: Extended aeration process

3) Stara Zagora

- Design PE: 165,000
- Total daily average flow: 49,400 m3/day
- BOD Loads : 8,890 kg/day
- Process: Conventional activated sludge process

(3) Sludge Disposal

The fats and oils & heavier grits collected in the Initial Mechanical Stages of the treatment works are generally satisfactory disposed to landfill or by burying at approved sites.
The settled sludge and biological sludge from the Mainstream Process Units are to be dried and digested to be suitable for disposal to agricultural lands.

(4) Reduction of Pollution Loads by WWTPs

The water quality simulation with and without WWTPs assesses the effects on the water quality by reduction of domestic BOD loads with the proposed WWTPs. The WWTPs of the three cities have a high effect for improvement of the water quality of the Maritza River by reducing the BOD loads of the river right after the downstream of the towns and also the water quality of the Maritza river as a whole, reducing a large part of the BOD loads from the basins.

Town	Priority Region*[1]	without WWTP	with WWTP	Domestic Load in year 2015*[2] (kg BOD/d)	% of Domestic Load reduction by WWTP*[3]
		mg BOD/L			
Pazardjik	Upstream, Maritza	12	6	17,900	29
Dimitrovgrad	Mid-stream, Maritza	3	2	9,400	32
Stara Zagora	Sazliyka	61	40	13,100	61

Note: *1: see Fig. S.2.4

*2: pollution load in priority region

*3: reduction rate per priority region based on the load in year 2015

3.3 Cost Estimation

(1) Project Cost

The project costs of the proposed wastewater treatment plants are shown as follows:

1) Pazardjik

	FC	LC	Total	(Unit: US$1,000)
(Direct cost)				
Preparatory works	1,764	810	2,574	
WWTP	10,950	4,590	15,540	
Collector	813	813	1,626	
Sub total	13,527	6,313	19,740	
(Indirect cost)				
Administration	-	987	987	
Engineering service	1,579	395	1,974	
Physical contingency	2,029	932	2,961	
Total	17,135	8,527	25,662	

2) Dimitrovgrad

	FC	LC	Total	(Unit: US$1,000)
(Direct cost)				
Preparatory works	1,057	485	1,542	
WWTP	7,046	3,235	10,281	
Sub total	8,103	3,720	11,823	
(Indirect cost)				
Administration	-	591	591	
Engineering service	946	236	1,182	
Physical contingency	1,215	558	1,773	
Total	10,264	5,105	15,369	

3) Stara Zagora

	FC	LC	Total	(Unit: US$1,000)
(Direct cost)				
Preparatory works	1,472	609	2,081	
Construction (WWTP)	14,717	6,094	20,811	
Sub total	16,189	6,703	22,892	
(Indirect cost)				
Administration	-	1,145	1,145	
Engineering service	1,831	458	2,289	
Physical contingency	2,428	1,005	3,433	
Total	20,448	9,311	29,759	

(2) Operation and Maintenance (O&M) Cost

The O&M cost is estimated at 15 % of the direct construction cost for Pazardjik WWTP and Stara Zagora WWTP, and at 7 % of that for Dimitrovgrad.

3.4 O&M

The VIKs seem over-staffed and inefficient, particularly below the managerial level. It is clear that the future sustainable operation and maintenance of the WWTPs is dependent upon improving the operational efficiency of the proposed works and the VIK itself.

There are a number of deficiencies in the current cost recovery mechanism. It is clear that full cost recovery is essential if the WWTPs are to be successfully and sustainable operated and maintained.

3.5 EIA

The construction and operation of the WWTPs at the three urban centers will have no significant adverse effects on the social or natural environment. There will be positive benefits to the communities and their immediate environments.

The construction and operation of these plants will not have any adverse effects on the local flora and fauna and that there are no protected species of plants in the Red Data Book of Bulgaria to be found in their vicinities. There are no archeological, historical or architectural monuments that would be affected by the construction or operation of the three plants.

3.6 Investment and Financial Aspect

The financial analysis on the WWTPs for the three Municipalities of Pazardjik, Dimitrovgrad and Stara Zagora is conducted on the assumption that these facilities will be owned and operated by the respective municipalities. There are a few possible financing sources for the implementation of the WWTPs. They are:

1) National and Municipal Environmental Protection Funds;
2) User charges to be newly introduced:
3) Regular budget of the Municipality and
4) Grants or soft loans from external sources.

User charges and combining different sources of funds will be required for the implementation of WWTPs.

3.7 Financial and Economic Evaluation

(1) Condition of Economic Evaluation

Simple methods are used here to convert the financial costs to economic costs. 90 % of the initial investment costs are taken to be the economic costs of the initial investments used. The economic costs for O&M are taken to be 85 % of the O&M costs used for the financial evaluation.

On the benefit side, the same value of the user charge used for the financial evaluation is used in the economic evaluation without adjustment. Considering the minimum amount of user charge and the necessary amount for repayment of the concessional loan, the user charge is assumed to be increased with 6 % in line with the national and domestic economic growth by 15th year and further increase with 2 % annually after 16th year.
Terms of the concessional loan are assumed as follows:

- Interest rate: 1.7% per annum,
- Repayment period: 40 years, and
- Grace period: 7 years.

The economic efficiency is evaluated mainly by the Economic Internal Rate of Return (EIRR) for which values higher than 8 % is considered feasible in consideration to the opportunity cost of capital, assumed to be about 8 %.

(2) Economic and Financial Evaluation

The financial evaluation and economic evaluation are indicated by the Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR). The minimum requirement of the user charges is only to cover the O&M cost for WWTPs. The ranges of the initial user charge are:

- Pazardjik WWTP: Lv. 450/m3 (FIRR: 3.35%, EIRR 5.19 %) - Lv. 550/m3 (FIRR: 5.99 %, EIRR: 7.80 %)
- Dimitrovgrad WWTP: Lv. 300/m3 (FIRR: 3.87 %. EIRR: 5.26 %) - Lv. 400/m3 (FIRR: 7.02 %, EIRR: 8.42 %)
- Stara Zagora WWTP: Lv. 300/m3 (FIRR: 2.99 %, EIRR: 4.91 %) - Lv. 400/m3 (FIRR: 6.93 %, EIRR: 8.81 %)

(3) Conclusion of Economic and Financial Evaluation

If the initial user charges are high, the annual balance and the cumulative balance turn positive during early stage of WWTP operation. If the initial user charges are low, the annual balance and the cumulative balance turn to positive after about 10 to 20 years after the operation of the WWTPs. In these cases, FIRR and EIRR are in the acceptable range. In order to make financial balance in the initial operating stage of the three WWTPs more sound, it is desirable to apply MEPF to cover the O&M costs in this stage.

However, applicable rates are necessary to be studied more precisely in the detailed design stage. The study shall include progressive rates of user charges on the monthly discharged amount of wastewater and also graduated rates of user charges on the pollution levels of discharged wastewater.

(4) Intangible Benefit

The intangible benefits include improvement of living condition and environmental condition in and around the priority towns as well as increasing usable water resources potential with better quality and its users. Considering these intangible benefits of the projects, there is a high financial and economic viability for implementing these three WWTP projects.

3.8 Project Evaluation

The WWTPs of the three cities will improve the water quality and enhance the living conditions and feasible in technical, economic, social and environmental terms as follows:

(1) The technical efficiency of the proposed WWTPs for Pazardjik, Dimitrovgrad and Stara Zagora are evaluated by the reduction of BOD loads, the difference between the BOD loads with and without the WWTPs.

According to the results of the water quality simulation, the BOD loads right after the down streams at the three WWTPs are to be reduced to 50% to 65% of the loads without the WWTPs and supposed to have a good improving effect of the water quality of the Maritza main stream.

(2) The economic efficiency is evaluated by EIRR for which a value higher than about 8% is considered to be feasible due to the assumed opportunity cost of capital in the country.

The value of FIRR is compared with the interest rate of the concession loan of 1.7%. The value of EIRR and FIRR are in the acceptable range.

(3) As for social and environmental effects, the construction and operation of the WWTPs will have no significant adverse effects on the social and natural environment. They will provide positive effects to the communities and their immediate environment.

3.9 Implementation Program

(1) The overall coordination for implementation of the proposed wastewater treatment works shall be provided by the MoEW. For implementation of the proposed sewerage treatment works the responsible organizations of the Central Government shall be the MoRDPW and Municipalities of Pazardjik, Dimitrovgrad and Stara Zagora as the local responsible organizations.

(2) According to the Action Plan the implementation period shall consist of two phases as follows:

1) Preparation Period (1999 – 2000)
2) Phase-1 (2001 –2005)

4 Conclusion and Recommendation

(1) The proposed Master Plan for Integrated Environmental Management for the Maritza River Basin is feasible in technical, financial, social and environmental terms. It is recommended for the Government of Bulgaria to take immediate actions for implementation of the proposed structural and non-structural measures, because the Maritza River Basin is extremely vulnerable to water resources and environmental problems.

(2) Effective use of the results of the Study, including the database and mathematical models for management of the Maritza River basin is recommended.

(3) As for the priority projects identified in the Master Plan, the feasibility study on wastewater treatment works for the three urban centers, i.e., Pazardjik, Dimitrovgrad and Stara Zagora, has been conducted. They are feasible in technical, financial, social and environmental terms. It is also recommended to take immediate actions for early implementation of the projects because of their high effect for improvement of the water quality and environmental conditions of the Maritza main stream and the Sazliyka River.

(4) As for O&M of the proposed wastewater treatment works, the cost recovery will be marginal, but full cost recovery shall be essential for the WWTPs to be operated sustainable and successfully. It is recommended to review the current cost recovery mechanism and to improve the operational efficiency of the proposed works and the VIKs themselves.

SUMMARY

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SUMMARY

This is a summary of the Final Report for 'The Study on Integrated Environmental Management for the Maritza River Basin in the Republic of Bulgaria' (hereinafter referred to as 'the Study'), which, according to the request from the Government of Bulgaria, the Government of Japan decided to conduct through the technical cooperation program. The Scope of Work was agreed upon between the Government of Bulgaria and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on October 3, 1996 and December 30, 1996.

The Study aims to formulate a Master Plan for integrated environmental management of the Maritza river basin, to conduct a Feasibility Study on the priority projects identified in the Master Plan and to pursue technology transfer to the counterpart personnel in the course of the Study.

The Study area is located in the southern part of Bulgaria and covers about 21,000 sq. km of the Maritza River Basin. The Maritza River runs 321.6 km eastward within the territory of Bulgaria, flows along the boundary between Turkey and Greece with joining the Tundza River and Arda river, and finally discharges into the Aegean Sea. The Study Area and the Maritza River Basin are shown in Fig. S.1.1 and her sub basins are shown in Table S.1.1 and Fig. S.1.2.

The water resources of the basin are extensively used by agriculture, hydropower, domestic and industrial water supply sectors, suffering from a lot of water stresses such as lack of water resources and deterioration of water quality.

The basin has been affected for many years by many pollution sources, i.e., wastes and refuse from urban areas, factories, mines, agricultural land and livestock farms, of which the hazardous substances could have been affecting the health of people, the water users and the environment in the basin.

The Government of Bulgaria (GOB) has started to take an action for restoration and protection of the environmental situation by formulating environmental laws and regulations, and strengthening related organizations. According to a draft of the new Water Act, the GOB aims to be in line with European Commission (EC) water policy and especially the proposal for an EC Water Framework Directive which sets out a timetable within which the member states must set up River Basin District Authorities whose immediate task will be the preparation of River Basin Management Plans.

In accordance with the aims of the GOB, the Study is considered as a pilot study on the river basin management plan and would provide the GOB with a basic frame and information that enable the GOB to review sub-sectors' water resources management and to formulate sustainable development policies for integrated water resources and environmental management of the Maritza river basin.

The Study was commenced in April 1997 and proposed Master Plan and priority projects for F/S in August 1998. The F/S on the priority projects has been conducted since the end of September 1998.

The Final Report presents the proposed Master Plan and the results of the Feasibility Study on the priority projects that are sewerage treatment works for the three urban centers, i.e., Pazardjik, Dimitrovgrad and Stara Zagora. The subjects of this summary report consists of the followings:

1) Basic Concept
2) Proposed Master Plan
3) Feasibility Study on the Priority Projects
4) Conclusion and Recommendation

1. Basic Concept

(1) The Maritza river basin has been suffered from a lot of water stresses, lack of water resources and deterioration of water environment, and requires an optimum plan for

improvement and management of the water resources and environment. The Study would support the Government of Bulgaria to establish a River Basin Management Organization for the Maritza River Basin due to the new Water Act that is under preparation in line with the European Commission (EC) water policy.

(2) The Study set a target to improve and maintain the water quality in sufficient good conditions (class - I or class - II) along the Maritza River main stream and her major tributaries by the target year 2015. In order to improve and sustain the water resources and the environmental situations, the master plan proposed structural and nonstructural measures, i.e., three phased expansion of municipal wastewater treatment capacities, reduction of untreated wastewater discharges from industry and livestock strengthening of the implementation organization, strengthening of the monitoring systems, required development studies and investigations.

(3) The Study has developed a GIS database and river water quality simulation model that would be utilized by the Government of Bulgaria as management tools for the Maritza River Basin after the Study.

2. Proposed Master Plan

The proposed Master Plan consists of the followings (refer to Table S.2.1):

1) Structure measures for improvement of the water quality and the environment of the basin,
2) Non-structural measures for improvement and maintenance of the water resources and the environmental conditions of the basin,
3) Required management organizations for implementation of the proposed Master Plan,
4) Required development studies and investigations to support for management of water resources and environment of the basin,

5) Priority projects for improvement of the water quality and environmental conditions of the basin.

2.1 Socio-Economic Framework for the Target Year 2015

Socio-economic frameworks for the Master Plan have worked out for the target year 2015. According to the macro framework, the GRDP and population are assumed as follows:

- The GRDP of the Maritza river basin will grow at 6.8 % per annum on an average through 2015, supported by the annual average growth of agriculture at 3.0 %, industry at 7.5 % and service at 7.0 %.
- The total population in the basin will become 1,921,000 (urban population: 1,357,000, rural population: 564,000) in 2015, representing a 10 % increase from the population of 1,758,000 in 1995. The rural population will decrease slightly, and the urbanization ratio will increase to 71 % in 2015.

2.2 Zoning of Land Use and Environmental Sensitive Areas

Direction of desirable land uses and management practices are studied for the basin by overlaying the developed base maps i.e., Distribution of Elevation, Existing Land Use, Distribution of Slope, Erosion Potential and Environmental Sensitive Area maps. The Study area is classified into the five categories, i.e., forest area, agriculture area, urban area, conservation area, national parks and protection areas that are shown in Figs. S.2.1 and S.2.2.

2.3 Water Quality Management Plan

According to the pollution loads and pollution sources estimated, the large part of BOD loads are discharged from domestic, industry and livestock sectors, and TN loads are from industry and livestock sectors as follows:

	BOD	TN
Domestic:	45 %	19 %
Industry:	35 %	33 %
Livestock:	20 %	28 %
Others:	0 %	20 %

For improvement of the water quality and environmental situation the proposed measures are as follows:

- Reduction of the pollution loads from urban centers, industries and livestock farms,
- Strengthening of the monitoring systems for management of water quality,
- Investigation for getting supporting data and information for management of water quality and related development study.

(1) Reduction of Pollution Loads from Major Urban Centers, Industries and Livestock Farms

1) Urban centers

Of the 772 settlements in the basin, some 38 urban centers are reported to have sewer systems, of which only six (6) urban centers have sewerage treatment plants i.e., Plovdiv, Nova Zagora, Radnevo, Hissarya, Ihtiman and Pamporovo. However, only three of the existing treatment plants (Plovdiv, Ihtiman and Pamporovo) are active. The locations of urban centers with sewer system are shown in Fig. S.2.3.

The pollution loads and their impacts to the Maritza main stream have been assessed. The sub-basins in the Maritza River Basin and the most polluted sub-basins identified are shown in Fig. S.2.4. The most polluted sub-basins identified and their percentages to the total pollution loads are as follows:

	Total	Domestic	Industry	Livestock
Maritza Up-stream (MU2/MM1)	24 %	26 %	21 %	28 %
Maritza Mid-Stream (MM2)	22 %	15 %	34 %	18 %
Maritza Down Stream (HAR)	7 %	12 %	3 %	3 %
Sazliyka (SAZ)	27 %	21 %	35 %	24 %
Other	20 %	26 %	7 %	27 %

In order to improve the water quality and environmental situation of the basin, improvement of the sewerage treatment facilities have been planned. The priority orders of wastewater treatment works for the 36 urban centers are studied based on the assessment of their pollution loads and impacts to the Maritza main stream. The proposed priority order and treatment levels of the 36 urban centers are assessed based on the estimated pollution loads in 1992 and in 2015 and grouped as follows:

- 1st Priority: 7 cities (primary and secondary treatment)
- 2nd Priority: 10 cities (primary treatment)
- 3rd Priority: 19 cities (primary treatment)

The 1st priority towns are Pazardjik, Plovdiv, Assenovgrad, Dimitrovgrad, Haskovo, Stara Zagora and Velingrad that are assessed as the heaviest polluters and have identified lands for their treatment works.

The 2nd priority towns are also heavy polluters, but their estimated loads are lower and their lands for treatment facilities are not identified. The 3rd priority towns include ones located in the tributary basins.

2) Major industries and livestock farmings

The pollution loads from the top 20 industries and major livestock farms, are to be reduced by regulation. It is proposed to start from the top 1-20 industries and then

others. As for livestock farmings, currently most animals are raised and kept in low number in small farms, and they are regarded as non-point source. For reduction of pollution loads, it is recommended to change from wet cleaning to dry cleaning.

(2) Strengthening of the Monitoring Systems for Management of Water Quality

In order to conduct an optimum water quality management for the basin, it is necessary to conduct regular monitoring activities at the major hot spots along the Maritza main stream and tributaries and also to conduct periodical monitoring at the heavy polluter industries, including mines in addition to their formal report.

The existing monitoring system for the water quality management established by the MoEW has been reviewed and the following principal and auxiliary stations are selected and five new stations are proposed as shown in Fig. S.2.5:

Principal Station	–	6 stations in Maritza River
		6 stations in the tributaries
Auxiliary Station	–	7 stations in Maritza River
		24 stations in the tributaries

- One new principal station is planned along the Maritza River after the confluence of the Luda Yana, at where Pazardjik is discharging the urban wastewater and also the proposed WWTP is to discharge the effluent.
- Four new auxiliary stations are planned on a tributary of Topolnitza and Blatnitza at where the effluent from the existing WWTPs flows out, at the mid-stream of Luda Yana for tracing the heavy metal pollution and at Batak reservoir, the largest reservoir in the study area.

The frequency of sampling is planned:

Principal station – strictly once in a month

Auxiliary station – strictly once in two months (monthly sampling is recommendable)

For industrial effluent, each industry should have obligation to report the effluent quality correctly. In addition to the reports, it is required for REIs to conduct the effluent quality survey of industries occasionally. The strict monitoring of the top 20 industries, that are shown in Fig. S.2.6, is recommended to start, then of the others. Based on the observation, the effluent regulation should be reviewed. It is recommended that the effluent quality be the same as the effluent quality level of WWTP.

(3) Investigations for getting supporting data and information for management of water quality and related development study are as follows:

- Sewer systems of major urban centers for rehabilitation and improvement,
- Industrial effluent for management,
- Mining sites for preparation of measures against accidental pollution,
- Solid waste dumping sites for improvement,
- Biological monitoring and investigation as a supporting measure for management of the basin.
- Study on groundwater management for controlling quantity and quality of groundwater

2.4 River Basin Management Plan

The water resources of the Maritza river basin is extensively used by agriculture, hydropower, domestic and industrial water supply sectors. The surface water is distributed by numerous structures including dams and intakes as well as inner-basin and inter-basin transfer facilities for irrigation and hydropower (Refer Fig. S.2.7). The groundwater is extracted by numerous wells for domestic and industrial water supply. The

water resources of the basin are not used in efficient way and require an optimum management from the basin management aspect (Refer Figs. S.2.8 and S.2.9).

For management of water resources and environment of the basin, the proposed components are as follows:

- Conservation of the river basin for water resources,
- Strengthening of monitoring systems for water resources and water usage,
- Conservation of forest area in the river basin,
- Development studies and investigations

(1) Zoning for Water Resources Management

For conservation of water resources and for controlling water usage, each sub-basin was assessed and classified in the following three zones as shown in Fig. S. 2.10:

1) Zone of Category – 1: Special basins for controlling water resources potential and demand

The sub-basins of the Category - 1 are important basins for surface water potential, which have rich forest area of water resources and major reservoirs. The sub-basins that are assessed for conservation and enhancement of water resources potential by conservation of forest areas including reforestation as well as agro-forest and fruit trees are as follows:

- Vacha River Basin (VAC)
- Chepinska River Basin (CPI)
- Stara River Basin (STA)
- Chepelarska River Basin (CPE)
- Topolnitza River Basin (TOP)

- Upper sub-basin of Maritza Main Upstream (MU1)
- Downstream Basin of Maritza Main Stream (MD)

2) Zone of Category – 2: Basins for controlling water resources potential and water demand

The sub-basins of the Category - 2 have moderate surface water potential as well as moderate surface water demand. The sub-basins require proper control of water usage as well as conservation of water resources. The sub-basins are as follows:

- Middle sub-basin of Maritza Main Mid-stream (MM2)
- Lower sub-basin of Maritza Main Mid-stream (MM3)

3) Zone of Category – 3: Special basins for controlling water demand

The sub-basins in the Category - 3 are water consuming basins.

The sub-basin that require efficient usage of water for irrigation, hydropower, domestic and industrial water supply, by proper management and rehabilitation of the water use systems as well as updating of the water demand and supply, are the following sub-basins:

- Lower sub-basin of Maritza Main Upstream (MU2)
- Upper sub-basin of Maritza Main Mid-stream (MM1)
- Luda Yana River Basin (LUD)
- Pyassachnik River Basin (PYA)
- Stryama River Basin (STR)
- Sazliyka River Basin (SAZ)
- Harmanliyska River Basin (HAR)

(2) Countermeasures for Water Resources Management

Based on the zoning, countermeasures for water resources management are formulated by considering following scenarios.

- Scenario1: Conservation and enhancement of water resources potential by conservation of forest area
- Scenario2: Efficient usage of water for irrigation, hydropower, domestic water supply and industrial water supply.
- Scenario3: Effective control of water resources potential by optimum operation of the existing hydraulic facilities.

The proposed countermeasures are as follows:

1) Strengthening of Monitoring systems for Management of Water Resources in the Basin

Strengthening of monitoring systems including installation of new-water gauges for meteorology, hydrology, and water use facilities such as irrigation and hydropower, domestic water supply and industrial water supply are planned as shown in Figs. S.2.11, S.2.12 and s.2.13.

2) Conservation of Forest Area for Water Resources

In order to conserve and enhance water resources, conservation and increase of forest area is proposed especially for the sub-basins of Category - 1.

3) Development Studies and Investigations for Management of Water Resources and Environment

- Water resources management study in Bulgaria,
- Agricultural development study in the Maritza river basin,
- Water balance study on hydropower systems,
- Investigation of municipal water supply systems for rehabilitation and improvement,
- Post evaluation of the existing major river facilities such as dams and reservoirs from environmental aspects.

2.5 Project Cost

The recent transition in the economy has been so deep and dramatic that there is insufficient historical cost data in respect of major infrastructure projects completed to 'international standard'. Accordingly cost models are prepared based on similar works elsewhere in Eastern Europe (East Germany, Poland and Hungary).

The project costs of this study are summarized as follows:

		Costs (US$ 1000)
1)	Construction of municipal wastewater treatment plants:	
	- 1st Stage towns	122,021
	- 2nd Stage towns	36,437
	- 3rd Stage towns	55,272
	Total cost for WWTP	213,730
2)	Rehabilitation of water supply systems:	
	- 1st Stage water supply systems	64,104
	- 2nd Stage water supply systems	20,141
	- 3rd Stage water supply systems	35,570
	Total cost for WS systems	119,815
3)	Strengthening of meteo-hydrological monitoring networks -	360
	Grand total	333,905

2.6 Financial Evaluation

The evaluation from the national economy point of view assesses the total investment for the Master Plan projects over the planning period up to the year 2015 in the light of public investments that are expected and likely to be devoted to water and wastewater works.

The total investment cost for water and wastewater works estimated by the Master Plan at US$ 333.9 million is smaller than the projected total public fixed capital expenditure of US$ 366.0 million up to the year 2015. However, the investment requirement for Stage I (US$ 186.1 million) is much larger than the projected public fund allocation during the stage (US$ 81.5 million).

However, there is some flexibility between the expenditure of environment and that of water/wastewater fields. The combined total amount to US$ 217.3 million for Stage I and US$ 975.9 million up to Year 2015. Therefore, considering the combined public capital expenditure for environment with water/wastewater works, financial viability for the M/P will become higher.

Given the expected recovery and the renewed growth of the Bulgarian economy, the estimated investments on water and wastewater works in the Maritza river basin may be tolerable over the medium to the long term.

2.7 Institutional Structure Plan

(1) The New Water Act under preparation describes the proposed river basin management structure. This approach is in line with European Commission (EC) water policy and especially the proposal for an EC Water Framework Directive which sets out a timetable within which the member states must set up River Basin District Authorities whose immediate task will be the preparation of River Basin Management Plans. This concept

shall be followed and a river basin management organization shall be established for management of the Maritza River Basin under the MoEW.

(2) In order to support the River Basin Management Organization, it would be required to establish a Project Implementation Unit (PIU). For implementation of large-scale projects in the environmental field, the basic functions of the proposed PIU should be:

1) To act as a focal point for implementation of the project for management of the basin.
2) To act liaison with the Ministry of Environment and Water, the Ministry of Public Works and Regional Development, other government agencies, local authorities, and the Maritza River Basin Councils during the project implementation phases.
3) To act liaison between the Basin Management Organization and international funding agencies, which will fund the identified structural and non-structural measures.
4) To assist and carry out the procurement of necessary goods and services.

(3) For establishment of a new river basin management organization, the Government should have a training program of a short-term and a long-term for the required staff.

2.8 Initial Environmental Examination (IEE) for Priority Project

(1) IEE, which is carried out at the outset of the development project at planning stage, includes SCREENING and SCOPING of the environmental impacts. It is based on accessible existing information and data, and incorporates comments and judgements of specialists who are familiar with the environmental impacts of similar projects. The objectives of IEE are:

- To evaluate by screening whether EIA is necessary for the project and, if so, by scooping, to define its contents,

- To examine, from an environmental standpoint, the measures for alleviating the adverse environmental effects of the project that require consideration without a full scale Environmental Impact Assessment.

It is undoubtedly that a complete sewerage and treatment system will benefit the community as a whole. It is nevertheless important to look rigorously at each of its component parts to ensure that environmental benefits are fully realized or, at least that any potentially harmful effects by these schemes are recognized at the outset and minimized. In order to confirm the environmental impacts at the proposed sites, EIA for the priority projects will be required.

(2) Under the Bulgarian Environment Protection Act (EPA) 1997, it is required that all significant new developments shall be subjected to Assessment of the Impact Factor on the Environment (AIFE). The proposed schemes for the Study will require a full AIFE (=EIA) under this Act before any construction takes place.

2.9 Priority Projects for F/S

(1) From environmental management aspects it has the highest priority to improve the water quality in the basin.

(2) In order to improve the water quality of the Maritza River, it is decided to improve or construct wastewater treatment works at 36 cities by phased expansion.

(3) The 1st Priority cities identified from technical aspects are the following seven cities:

1. Pazardjik
2. Plovdiv
3. Assenovgrad
4. Haskovo
5. Dimitrovgrad
6. Stara Zagora

7. Velingrad

(4) Priority cities for F/S selected are the following three cities:

- Pazardjik
- Dimitrovgrad
- Stara Zagora

2.10 Action Plan

(1) Phased Program

The phased program is planned to be divided into four phases:

1.	Preparation period:	2 years (1999 – 2000)
2.	Phase-1:	5 years (2001 – 2005)
3.	Phase-2:	5 years (2006 – 2010)
4.	Phase-3:	5 years (2011 – 2015)

(2) Action Plan

1) Preparation period (1999 – 2000)

The activities to be carried out during this period are to build a firm foundation for the implementation of the short, medium and long-term targets successfully. The targets are:

- to establish a Management Organization for the Maritza river basin,
- to prepare the training program for strengthening the Basin Management Organization,
- to establish an information system,

- to establish effective monitoring, inspection and laboratory operation systems,
- to prepare for implementation of the 1st priority projects,
- to prepare for implementation of the proposed development studies

2) Phase-1 (2001 – 2005):

- to conduct routine operational activities under the management Organization,
- to commence and complete the 1st priority projects,
- to commence the preparation works for the 2nd priority projects,
- to complete the development studies,
- to promote sustainable development and management of surface water,

3) Phase-2 (2006 – 2010):

- to conduct routine operational activities under the Organization,
- to complete the 2nd priority projects,
- to commence the preparation works for the 3rd priority projects,
- to review the activities proposed for the next stage,
- to conduct necessary development studies.

4) Phase-3 (2011 – 2015):

- to conduct routine operational activities under the Organization,
- to complete the 3rd priority projects,
- to complete municipal and industrial wastewater treatment plants.
- to establish sustainable use of land and water resources,
- to restoration of the natural purification capacity of the river,
- to review the activities proposed for the next stage

3. Feasibility Study

3.1 Environmental Management Plan

For environmental management, environmental sensitive areas and spots in the vicinities of the three priority urban centers, i.e., Pazardjik, Dimitrovgrad and Stara Zagora, are designated. They will require close investigation and monitoring, together with the proposed monitoring systems in the master plan. They are listed as follows:

(1) Pazardjik (Refer Fig. S. 3.1)

- Proposed future protection areas in the right bank of the Maritza river and in the Yadenitza river basin,
- Three important wet lands along the Maritza river,
- Proposed conservation area for water resources (Category-1); MU1, CPI and STA basins,
- Assarel mine in the Luda Yana,
- Soil contamination areas of the downstream of Topolnitza and Luda Yana, and in the north of Panagyurishte,
- Two industries among the top 20 (Maritza KK and Trakia paper)
- Intake weirs.

(2) Dimitrovgrad (Refer Fig. S. 3.2)

- Five important wetlands,
- Proposed conservation area for water resources (Category-1); MD basin,
- Proposed area for efficient use of water resources (Category-3.); MM3, HAR and SAZ basins,
- Several mines; boundary between the Harmanliyska and Banska river basins,
- Closed uranium mine in the west of Haskovo,
- One industry among the top 20; SC Neohim,
- Intake

(3) Stara Zagora (Refer Fig. S. 3.3)

- Proposed area for efficient use of water resources (Category-3)
- Several mines
- Uranium mines and deposits
- Five industries of the top 20; three in the industrial estate two outside the town area,
- Intake

3.2 Preliminary Design of Treatment Plants

(1) Planning Criteria

The planning criteria for preliminary design of treatment works at the three urban centers are summarized and shown in Table S.3.1.

It is essential to satisfy the Standards of the EC Urban Wastewater Directive. Also the current Bulgarian River standard is also applied.
The EC requirement is:

- BOD5 25 mg/l
- SS 35 mg/l

(2) Preliminary Designs

The preliminary designs on treatment facilities are sized only sufficient for Municipal populations within the served areas at the 3 towns as follows:

- Treatment provided for the urban areas at present connected to the main town sewer systems,
- Exclusion of all industrial effluents (diversion and/or complete treatment separated from the Municipal Works) in principle,

- Assuming "space" for the expansion needed when the town is able to fund its full system expansion plans.

The proposed treatment works' designs developed and design criteria for the Study are summarized as follows:

1) Pazardjik

- Design PE: 97,000
- Total daily average flow: 29,400 m3/day
- BOD Loads (kg/day): 5,240 kg/day
- Process: Conventional activated sludge process

2) Dimitrovgrad

- Design PE: 61,000
- Total daily average flow: 18,800 m3/day
- BOD Loads : 3,300 kg/day
- Process: Extended aeration process

3) Stara Zagora

- Design PE: 165,000
- Total daily average flow: 49,400 m3/day
- BOD Loads : 8,890 kg/day
- Process: Conventional activated sludge process

The locations and general layout plans of the WWTPs are shown in Figs. S.3.4 - S.3.9.

Practically speaking, there is a possibility that the industrial wastewater with similar quality of domestic wastewater from medium and small size industries in the service area of the proposed municipal WWTPs might be discharged into sewerage network. In this case, the design wastewater volume with medium and small size industries will be about 1

to 4 % larger than the design wastewater volume without industries. This difference can be judged at very small and will not affect the size of the proposed three WWTPs.

However, in the case of inclusion of the industrial wastewater from medium and small size industries, it is essential that the wastewater quality is similar to the quality of domestic wastewater and that at least pre-treatment should be conducted before discharging into sewers. Furthermore, large industries as well as industries with different wastewater quality from domestic wastewater should treat their wastewater by themselves to meet the requirement of effluent standard.

(3) Sludge Disposal

Screenings fats and oils & the heavier grits collected in the Initial Mechanical Stages of the treatment works that are generally collected in skips at the site, are generally satisfactory disposed to landfill or by burying at approved sites.

The settled sludge and biological sludge from the Mainstream Process Units are to be dried and digested to be suitable for disposal to agricultural lands.

(4) Reduction of Pollution Loads by WWTPs

The effects of the proposed WWTPs for Pazardjik, Dimitrovgrad, and Stara Zagora are assessed by the water quality simulation and by the reduction of BOD loads with and without the WWTPs. The BOD loads right after the down streams of the three WWTPs are summarized as follows:

- Pazardjik WWTP is assumed to reduce 29 % of the domestic BOD loads from the Maritza Upstream basin and to improve the water quality of the Maritza main stream significantly, by reducing the BOD load from 12 mg/L to 6 mg/L levels.

- Dimitrovgrad WWTP is assumed to reduce 32% of the domestic pollution load from the Maritza mid-stream basin and to improve the water quality of the Maritza main stream, by reducing the BOD load from 3 to 2 mg/L levels.
- Stara Zagora WWTP is assumed to reduce 61% of the domestic pollution load from the Sazliyka River Basin and to improve the water quality of the Sazliyka River, by reducing the BOD load from 61 mg/L to 40 mg/L levels.
- It is assumed that with the three WWTPs will have a high improvement effect for the Maritza main stream not only at right after the downstream of WWTPs, but also at the downstream as a whole.

Town	Priority Region*1	without WWTP	with WWTP	Domestic Load in year 2015*2 (kgBOD/d)	% of Domestic Load reduction by WWTP*3
		mgBOD/L			
Pazardjik	Upstream, Maritza	12	6	17,900	29
Dimitrovgrad	Mid-stream, Maritza	3	2	9,400	32
Stara Zagora	Sazliyka	61	40	13,100	61

note: *1: see Fig. S.2.4

*2: pollution load in priority region

*3: reduction rate per priority region based on the load in year 2015

3.3 Cost Estimation

(1) The costs are estimated only in respect of the project of collecting and treating and discharging the existing wastewater. The cost estimates exclude all land costs, service costs, support services, power supply costs, and Bulgarian taxes and import customs duties, stamp duties and like charges.

(2) The cost estimate include following items:

1) Direct construction cost

- Preparation works, including demolition of the existing structures,
- Main works composed of construction of collectors and wastewater treatment plans, including civil, mechanical, and electrical works.

2) Administration cost: 5 % of the direct cost

3) Engineering cost: 10 % of the direct cost

4) Physical contingency: 15 % of the direct cost

(3) The project costs of the proposed wastewater treatment plants for Pazardjik, Dimitrovgrad, and Stara Zagora, are shown as follows:

1) Pazardjik

	FC	LC	Total (Unit: US$1,000)
(Direct cost)			
Preparatory works	1,764	810	2,574
WWTP	10,950	4,590	15,540
Collector	813	813	1,626
Sub total	13,527	6,313	19,740
(Indirect cost)			
Administration	-	987	987
Engineering service	1,579	395	1,974
Physical contingency	2,029	932	2,961
Total	17,135	8,527	25,662

2) Dimitrovgrad

	FC	LC	Total (Unit: US$1,000)
(Direct cost)			
Preparatory works	1,057	485	1,542
WWTP	7,046	3,235	10,281
Sub total	8,103	3,720	11,823
(Indirect cost)			
Administration	-	591	591
Engineering service	946	236	1,182
Physical contingency	1,215	558	1,773
Total	10,264	5,105	15,369

3) Stara Zagora

	FC	LC	Total (Unit: US$1,000)
(Direct cost)			
Preparatory works	1,472	609	2,081
Construction (WWTP)	14,717	6,094	20,811
Sub total	16,189	6,703	22,892
(Indirect cost)			
Administration	-	1,145	1,145
Engineering service	1,831	458	2,289
Physical contingency	2,428	1,005	3,433
Total	20,448	9,311	29,759

(4) Operation & Maintenance Cost (O&M)

For estimation of the O&M cost, the cost model issued by the World Bank for Central and Eastern Europe based on flow rate and treatment process is refereed. Operational & maintenance costs are estimated as:

Item	Pazardjik WWTP	Dimitrovgrad WWTP	Stara Zagora WWTP
Percentage to the direct construction cost	15 %	7 %	15 %
O&M Cost (US$ 1000/year)	2,961	828	3,434

3.4 O&M

(1) The general organizational approach does not vary from one VIK to another, either in terms of overall structure or, more specifically, in terms of the operation of WWTPs.

(2) The VIKs are over-staffed and inefficient, particularly below the managerial level. It is clearly demonstrated in the ratio of VIK employees per 1000 heads of population served where the current ratios are approximately 1.5 for Pazardjik, 1.8 for Dimitrovgrad and 1.8 for Stara Zagora.

These staff ratios are high, when compared to the average ratio of approximately 0.63 employees per 1000 head of population served in the UK for a privatized utility providing *both* water supply and sewerage (collection, treatment and disposal) services, or the conservative estimate of less than 1.0 employee per 1000 people served observed in a well run public or private utility company around the world.

(3) It is clear that the future sustainable operation and maintenance of the WWTPs is dependent upon improving the operational efficiency of the proposed works and the VIK itself.

(4) For the new WWTPs', successful and sustainable operation can only be achieved if planned preventative maintenance is practiced. This can only be achieved in practice through the proper structured training of all employees.

(5) There are a number of deficiencies in the current cost recovery mechanism. It is clear that full cost recovery is essential if the WWTPs are to be successfully and sustainably operated and maintained. The user through charges pays "Full cost recovery" as meaning that the following cost elements of any services provided in relation to water use:

- Operation and maintenance costs,
- Capital maintenance costs,
- Capital costs (capital element (principal) and interest payments),
- Reserves for future improvements and extensions.

Although it is noted that exemptions may be granted for the following reasons:

- in order to allow the basic level of water use for domestic purposes at an affordable price,
- in order to allow the capital cost subsidies for infrastructure projects which are designed to assist in the achievement of specific environmental objectives,
- In order to take account of a specific geographical or climatic situation of a region.

There is a range of measures to be considered. In respect of future changes in the water supply revenue system and cost recovery, some of these considerations are fundamental and require changes to the laws and/or regulations currently in force in Bulgaria. Others require action from the VIKs.

3.5 EIA

(1) The construction and operation of the WWTPs at Pazardjik, Dimitrovgrad and Stara Zagora will have no significant adverse effects on the social or natural environment. There will be positive benefits to the communities and their immediate environments. There will be improved water quality in the rivers which presently receive discharges of

raw sewage, though full recovery from pollution will depend on measures required to be taken by the industries and livestock farming activities which also cause severe water pollution.

In view of the proposed exclusion of major industries from the sewerage system, it is most unlikely that any heavy metals or other toxic substances such as pesticides or micro organic compounds will be present in the sludge and, therefore, the dried digested sludge should be suitable for use on agricultural land, though examination for infectious organisms will be desirable.

(2) The construction and operation of these plants will not have any adverse effects on the local flora and fauna and that there are no protected species of plants in the Red Data Book of Bulgaria to be found in their vicinities. There are no archeological, historical or architectural monuments that would be affected by the construction or operation of the three plants.

(3) It is noted that in each WWTP the design specification includes the provision of facilities for terminal chlorinating of the effluent *as required under present Bulgarian Law*. We understand that this is only required for use "in emergencies", though these are not specified. Such practice should not be permitted in most western countries on several grounds. Chlorine is an extremely toxic substance, especially to fish and aquatic life.

3.6 Investment and Financial Aspect

The financial analysis on the WWTPs for the three Municipalities of Pazardjik, Dimitrovgrad and Stara Zagora is conducted on the assumption that these facilities will be owned and operated by the respective municipalities.

There are a few possible financing sources for the implementation of the WWTPs. They are:

1) National and Municipal Environmental Protection Funds,
2) User charges to be newly introduced,
3) Regular budget of the Municipality and
4) Grants or soft loans from external sources.

(1) Environmental Protection Funds

The Environmental Protection Funds are available at the national and the municipal levels. Sources of funds are fees for the use of environment and natural resources, fines for pollution exceeding admissible levels, subsidies from the national budget, portion of liquidated property of privatized State enterprises, grants and others. Respective Boards of Directors set project selection criteria. The total investments of the National Environmental Protection Fund (NEPF) to the water sector in 1996, 1997 and 1998 were Lv. 1,241 million, Lv. 4,820 million and Lv. 21,804 million respectively.

(2) User Charges

VIKs are required by law to collect water charges to cover their operation costs, including a 12% profit. As WWTPs are established, additional water charges will be imposed. Specifics of such charges are not known due to the transitional period, except some general principles applicable. The government is expected to fix charges for different substances discharged under the Water Act to be newly enacted.

According to the sample survey on water use, conducted by the JICA Study Team, the monthly average water charge is Lv. 3,838 during summer (3 months a year) and Lv. 1,824 during winter (9 months) per family. The total annual water charge is calculated ate Lv. 27,930 per family. The same survey shows that the affordability to pay the water charge is about Lv. 2,400/month or Lv. 29,000/year per family on an average. It has been

estimated that the willingness-to-pay by family for improved water quality is in the range of Lv. 19,000- 49,000/year.

Therefore, it is desirable that the initial user charge for sewerage to be set by considering the minimum requirement of user charge, which can at least cover operation and maintenance of the facilities within the limit of willingness-to-pay. If this is not possible, the user charge is better to be set as low as possible.

It is reasonable that the user charge will be increased in line with the national and domestic growth of economy to cover the O&M, repayment of the loan within the future limit of the willingness to pay.

(3) Municipal Budget

Revenues and expenditure of the Pazardjik, Dimitrovgrad and Stara Zagora in recent three years, including subsidies, are studied. The total revenue as well as subsidy of each Municipality increased abruptly in 1997, but the expenditures of the Municipalities for infrastructure, including road, environment, water supply, sewerage, electricity and others are still at low levels, i.e.: Pazardjik: 0.7 %, Dimitrovgrad: 2.6 % and Stara Zagora: 2.0 %.

(4) External Sources

Grants or soft loans are available from various external sources, including multi-lateral aid organizations, such as the World Bank, EBRD and EC facilities and by-lateral aid organizations, such as OECF of Japan, GTZ of Germany and Swiss Aid.

The World Bank offered in 1991 loan funds to support water and wastewater projects, but the implementation has been delayed. Also, the grant offered by EC through the Cross-border Program has not been much utilized so far. EBRD can lend directly to VIKs with

a municipal or a commercial bank guarantee with typical terms of 15 year repayment and interest rates at 7.5- 8% per annum.

OECF provides concessional loans for a wide range of projects. In particular, OECF applies more favorable terms for environmental projects. For "special environmental projects" for preventing industrial pollution and addressing global environmental problems, the interest rate is 0.75%, and for "general environmental projects", such as flood control and sewerage systems, excluding the special environmental projects, the interest rate has been reduced from 2.5% to 1.7% for lower middle to middle income countries. Repayment periods and grace periods of OECF for lower middle to middle income countries are as follows:

1) 40 year repayment period including 10 year grace period for special environmental projects in developing countries excluding upper-middle-income countries.

2) 30 year repayment period including 10 year grace period for other projects in LLDC, low-income countries and lower-middle-income countries.

3) 25 year repayment period including 7 years grace period for other projects in middle-income countries and all projects in upper-middle-income countries.

Note: Upper-middle-income countries (more than US$ 3,036)
Middle-income countries (US$ 1,466 – US$ 3,035),
Lower-middle-income countries (US$ 766 – US$ 1,465).

Various financial schemes may be formulated for the implementation of WWTPs by combining different sources of funds. The following conditions seem reasonable for a desirable financing scheme to satisfy.

1) External sources of soft loans with concessional terms should be utilized as much as possible, preferably those having a reasonable grace period covering construction and initial operation periods.

2) The respective municipalities through either their regular budgets or the MEPFs should cover interest payments during the grace period.

3) User charges should be introduced after the completion of each WWTP initially to cover O&M costs and increased in steps subsequently to cover larger portions of the loan repayments.

4) With all these conditions to be spelled out in advance, a strong case should be made for the utilization of the NEPF to cover part of the initial investments.

3.7 Financial and Economic Evaluation

(1) Basic concept for formulating the financial scheme is as follows:

1) The foreign currency portion of the initial investment shall be covered by the External sources,

2) The local currency portion of the initial investment cost shall be covered by the NEPF grant,

3) Replacement cost for mechanical and electrical equipment with every 15 years is assumed to be covered by the NEPF grant,

4) Considering the minimum amount of user charge and the necessary amount for repayment of the concessional loan, the user charge is assumed to be increased with

6 % in line with the national and domestic economic growth by 15th year and further increase with 2 % annually after 16th year.

5) The economic efficiency is evaluated mainly by the Economic Internal Rate of Return (EIRR) for which values higher than 8 % is considered feasible in consideration to the opportunity cost of capital, assumed to be about 8 %.

(2) Condition of Economic Evaluation

Economic evaluation of projects is the assessment of economic viability of projects from the national economy point of view. Revenues and costs estimated and used for the financing evaluation would have to be adjusted for the purpose of economic evaluation usually by applying various national parameters. Derivation of the national parameters is difficult due to the transitional state of the Bulgarian economy.

Simple methods are used here to convert the financial costs to economic costs. Trial calculation is made for the economic internal rate of return of each WWTP project.

Capital equipment and associated works to be imported for the WWTP project will be exempted from import duties. However, import duties are imposed on some commodities consumed or used domestically. This causes some variance between general price levels in the domestic and the international markets. To reflect this variance in economic evaluation, 90 % of the initial investment costs are taken to be the economic costs of the initial investments used.

The economic costs for O&M are taken to be 85 percent of the O&M costs used for the financial evaluation.

On the benefit side, the same value of the user charge used for the financial evaluation is used in the economic evaluation without adjustment.

(3) Economic and Financial Evaluation

The financial evaluation and economic evaluation are indicated by the Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR). The minimum requirement of the user charges is only to cover the O&M cost for WWTPs. The ranges of the initial user charge are as follows.

- Pazardjik WWTP: Lv. 450/m3 (FIRR: 3.35%, EIRR: 5.19 %) - Lv. 550/m3 (FIRR: 5.99 %, EIRR: 7.80 %)
- Dimitrovgrad WWTP: Lv. 300/m3 (FIRR: 3.87 %. EIRR: 5.26 %) - Lv. 400/m3 (FIRR: 7.02 %, EIRR: 8.42 %)
- Stara Zagora WWTP: Lv. 300/m3 (FIRR: 2.99 %, EIRR: 4.91 %) - Lv. 400/m3 (FIRR: 6.93 %, EIRR: 8.81 %)

The cases that are conducted the financial and economic analysis is shown in Table S. 3.2.

(4) Conclusion

If the initial user charges are high, the annual balance and the cumulative balance turn positive during early stage of WWTP operation. In this case FIRR and EIRR are in the preferable range. If the initial user charges are low, the annual balance and the cumulative balance turn to positive after about 10 to 20 years after the operation of the WWTPs. In these cases, FIRR and EIRR are in the acceptable range.

In order to make financial balance in the initial operating stage of the three WWTPs more sound, it is desirable to apply MEPF to cover the O&M costs in this stage.

Applicable user charges are necessary to be studied more precisely in the detail design stage. The study shall include the progressive rates of user charge, which applies higher unit user charge for bigger wastewater discharger and lower unit user charge for small wastewater discharger, depending on the quantity of domestic wastewater. Also it shall be necessary to apply graduated rates of user charge on the quality of wastewater, considering many types of users.

The intangible benefits such as improvement of living condition and environmental condition in and around the priority towns as well as increasing usable water resources potential with better quality and its users. Considering these intangible benefits of the projects, there is a high financial and economic viability for implementing these three WWTP projects.

3.8 Project Evaluation

The WWTPs of the three cities will improve the water quality and enhance the living conditions and feasible in technical, economic, social and environmental terms as follows:

(1) The technical efficiency of the proposed WWTPs for Pazardjik, Dimitrovgrad and Stara Zagora are evaluated by the reduction of BOD loads, the difference between the BOD loads with and without the WWTPs.
According to the results of the water quality simulation, the BOD loads right after the down streams at the three WWTPs are to be reduced to 50% - 65% of the loads without the WWTPs and supposed to have a good improving effect of the water quality of the Maritza main stream.

(2) The economic efficiency is evaluated by EIRR for which a value higher than about 8% is considered to be feasible due to the assumed opportunity cost of capital in the country.
The value of FIRR is compared with the interest rate of the concession loan of 1.7%. The value of EIRR and FIRR are in the acceptable range.

(3) As for social and environmental effects, the construction and operation of the WWTPs will have no significant adverse effects on the social and natural environment. They will provide positive effects to the communities and their immediate environment.

The effects with the projects are summarized in Table S.3.3.

3.9 Implementation Program

(1) The overall coordination for implementation of the proposed wastewater treatment works shall be provided by the MoEW. For implementation of the proposed sewerage treatment works, the responsible organizations of the Central Government shall be the MoRDPW and Municipalities of Pazardjik, Dimitrovgrad and Stara Zagora as the local responsible organizations.

If the River Basin Agency for the Maritza River Basin established timely based on the new Water Act now under preparation, it would take the overall responsibilities for the implementation of the projects from river basin management aspects.

(2) In order to implement the proposed projects successfully, it is recommendable to utilize an international consultant. Construction works should be conducted by the contractors selected by international bidding.

(3) According to the Action Plan the implementation period shall consist of two phases as follows:

1) Preparation Period (1999 – 2000)

The major tasks required for this stage will be as follows:

- To follow up the project for implementation,

- To reinforce necessary staff to the implementation organizations,
- To arrange financial and other requirement for implementation of the project.

2) Phase-1 (2001 –2005)

The major tasks in this stage will be as follows:

- To execute the proposed wastewater treatment works (about 3 years),
- To prepare detailed design, PQ and tender documents and tendering (12-13 months),
- To supervise the construction works (about 2 years),
- To prepare for O&M activities.
- To commence O&M activities.

The implementation schedule and disbursement schedule for the projects are shown in Tables S.3.4 and S.3.5.

4 Conclusion and Recommendation

(1) The proposed Master Plan for Integrated Environmental Management for the Maritza River Basin is feasible in technical, financial, social and environmental terms. It is recommended for the Government of Bulgaria to take immediate actions for implementation of the proposed structural and non-structural measures, because the Maritza River Basin is extremely vulnerable to water resources and environmental problems.

The proposed measures in the Master Plan are as follows:

1) Implementation of waste water treatment works of the major cities as structure measures for improvement of the water quality and the environment of the Maritza River Basin.
2) Implementation of non-structural measures for improvement and maintenance of the water resources and the environmental conditions of the basin.
3) Establishment of required management organizations for implementation of the proposed master plan.
4) Execution of required development studies and investigations to support for management of water resources and environment of the Maritza River Basin.
5) Early implementation of the priority projects for improvement of the water quality and environmental conditions of the basin.

(2) Effective use of the results of the Study, including the database and mathematical models for management of the Maritza River basin is recommended.

(3) As for the priority projects identified in the Master Plan, the feasibility study on wastewater treatment works for the three urban centers, i.e., Pazardjik, Dimitrovgrad and Stara Zagora, has been conducted. They are feasible in technical, financial, social and environmental terms. It is also recommended to take immediate actions for early implementation of the projects because of their high effect for improvement of the water quality and environmental conditions of the Maritza main stream and the Sazliyka River.

(4) As for O&M of the proposed wastewater treatment works, the cost recovery will be marginal, but full cost recovery shall be essential for the WWTPs to be operated sustainable and successfully. It is recommended to review the current cost recovery mechanism and to improve the operational efficiency of the proposed works and the VIKs themselves.

TABLES

TABLE S.1.1 CATCHMENT AREA AND RIVER LENGTH OF THE BASINS

Number	River	Catchment area (km^2)	River length (km)
1.	**MARITZA MAIN STREAM**	**8323**	**305**
MU	Upstream Basin of the Main Stream	1602	103
MU1	Upper sub-basin	1173	30
MU2	Lower sub-basin	429	73
MM	Mid-stream Basin of the Main Stream	5087	136
MM1	Upper Sub-basin	1518	40
MM2	Middle sub-basin	1993	47
MM3	Lower sub-basin	1576	49
MD	Downstream Basin of the Main Stream	1634	66
2.	**MAJOR TRIBUTARIES**	**12991**	**873**
TOP	Topolnitza River (left tributary)	1857	129
LUD	Luda Yana River (left tributary)	739	73
PYA	Pyassachnik River (left tributary)	419	65
STR	Stryama River (left tributary)	1694	101
CPI	Chepinska River (right tributary)	919	75
STA	Stara River (right tributary)	366	54
VAC	Vacha River (right tributary)	1689	101
CPE	Chepelarska River (right tributary)	979	75
HAR	Harmanliyska River (right tributary)	986	81
SAZ	Sazliyka River (left tributary)	3343	119
	Total	**21314**	**1178**

TABLE S.2.1 PROPOSED MASTER PLAN FOR RIVER BASIN MANAGEMENT (1/2)

Management Plan		Zoning	Countermeasures	Project Cost (US$ 1000)	
				Structural Measures	Non-structural Measures
1.	**Water Quality Management**	**Priority region including priority towns for pollution control** Priority region: 1) Maritza Upstream 2) Maritza Mid-stream 3) Maritza Downstream Priority towns: 1) 1st priority towns: 7 towns 2) 2nd priority towns: 10 towns 3) 3rd priority towns: 19 towns	**(1) Construction of Domestic Wastewater Treatment Plants (WWTPs)** 1) 1st Stage Towns: 7 towns 2) 2nd Stage Towns: 10 towns 3) 3rd Stage Towns: 19 towns **(2) Regulation for Reduction of Pollution Load** 1) Industry (specially for top 20) 2) Animal breeding farms **(3) Strengthening of Monitoring System for Surface Water Quality**	**213,730** 122,021 36,437 55,272 -	 -
2.	**Water Resources Management**	**Water resources potential conservation and water demand control** 1) Zone I: For controlling water resources potential 2) Zone II: Medium of Zone I and Zone III 3) Zone III: For controlling water demand	**(1) Strengthening of Monitoring Systems** 1) Meteorology and hydrology 2) Water use facilities **(2) Rehabilitation of Water Supply Systems** 1) 1st stage system 2) 2nd stage system 3) 3rd stage system	 **119,815** 64,104 20,141 35,570	**360**
3.	**Land Use and Environmental Management**	**Land use categories and environmental sensitive areas** 1) Forest area 2) Agricultural area 3) Urban area 4) Conservation area 5) National parks and protection areas	**(1) Monitoring of Land Use and Natural Environment** 1) Land use 2) Natural environment		-
			Sub-total	**333,905**	**360**
			Grand total	**333,905**	

TABLE S.2.1 PROPOSED MASTER PLAN FOR RIVER BASIN MANAGEMENT (2/2)

Management Plan		Proposed Items
4.	**Further Development Studies and Investigations**	**(1) Development Studies** 1) Water resources management study in Bulgaria 2) Agricultural development study in the Maritza River Basin 3) Water balance study on hydropower systems 4) Study on groundwater management 5) Post-evaluation of the existing major river facilities **(2) Investigations** 1) Municipal water supply systems 2) Sewer systems of major urban centers 3) Industrial effluent 4) Mining sites for accidental pollution 5) Solid waste dumping sites 6) Biological monitoring
5.	**Institutional Structure Plan**	1) Establishment of River Basin Management Organization 2) Establishment of Project Implementation Unit (PIU) for supporting the River Basin Management Organization to implement large-scale project(s)
6.	**Phasing of the Master Plan**	Preparation Period : Year 1999 – Year 2000 Phase 1 : Year 2001 – 2005 Phase 2 : Year 2006 – 2010 Phase 3 : Year 2011 - 2015

Remarks:

1st stage towns for domestic wastewater treatment plants:

Pazardjik, Plovdiv, Assenovgrad, Haskovo, Dimitrovgrad, Stara Zagora and Velingrad

TABLE S.3.1 DESIGN CRITERIA FOR WWTP AND RELATED FACILITIES

Town	Pazardjik	Dimitirovgrad	StaraZagora	Notes
Design Population	97,000	61,000	165,000	
Design PE	97,000	61,000	165,000	
Total daily average flow	29,400 m3/day	18,800 m3/day	49,400 m3/day	250 l/person·day
Peak dry weather flow: Qdwf	45,600 m3/day	30,200 m3/day	73,800 m3/day	
Peak wet weather flow: Qwwf(2*Qdwf)	91,200 m3/day	60,400 m3/day	147,600 m3/day	
BOD load	5,240 kg/day	3,300 kg/day	8,890 kg/day	54 g/person·day
SS load	6,310 kg/day	3,980 kg/day	10,700 kg/day	65 g/person·day
Related facilities				
main collector	new φ1.3 L= 2,640	existing φ1.0	existing 2.0*2.0	
over flow chamber	new biginning point of new main collector	existing end of existing main collector	new inside WWTP	
WWTP				
site area	10.8 ha	6.4 ha	11.4 ha	
process	conventional activated sludge process	extended aeration process	conventional activated sludge process	
WWTP main facilities				
screening , grit removal	○	○	○	coarse&fine
oil removal	○	○	○	
primary sedimentation tanks	○		○	hydraulic surface load 50 m3/m2·day
aeration tanks	○	○	○	HRT 9hrs (CAS) HRT 24hrs (ExA)
final sedimentation tanks	○	○	○	hydraulic surface load 20 m3/m2·day (CAS) 8 m3/m2·day (ExA)
disinfection (emergency)	○	○	○	HRT 30 min
sludge gravity thickening	○	○	○	surface loading rate 60 kg-ds/m2·day
sludge digestion	○		○	retention period 30 days
gas tanks	○		○	storage for 12 hrs
dewatering equipment (belt press)	○	○	○	sludge loading rate 100 kg-ds/m·hr
sludge drying bed(stand-by)	○	○	○	
control building	○	○	○	
sludge dewatering building	○	○	○	
other buildings	○	○	○	

TABLE S.3.2 SUMMARY OF FINANCIAL AND ECONOMIC ANALYSIS

1. PAZARDJIK WWTP PROJECT

1-1 FINANCIAL AND ECONOMIC ANALYSIS OF CASES

Case No.	Initial User charge (Lv./m3)	Positive financial balance		FIRR	EIRR	Remarks
		Annual	Cumulative			
Case 1	350	From 15th year	From 33th year	#DIV/0!	#NUM!	Annual increase of user charge
Case 2	400	From 14th year	From 24th year	#NUM!	3.67%	ditto
Case 3	450	From 12th year	From 19th year	3.35%	5.19%	ditto
Case 4	500	From 10th year	From 15th year	4.74%	6.55%	ditto
Case 5	550	From 9th year	From 13th year	5.99%	7.80%	ditto
Case 6	600	From 6th year	From 10th year	7.14%	8.96%	ditto
Case 7	650	From 5th year	From 7th year	8.21%	10.06%	ditto
Case 8	700	From 4th year	From 5th year	9.23%	11.11%	ditto

1-2 SENSITIVITY ANALYSIS

Case No.	Initial User charge (Lv./m3)	Positive financial balance		FIRR	EIRR	Remarks
		Annual	Cumulative			
Case 5-1	550	From 10th year	From 14th year	5.38%	7.09%	Capital cost x 1.1
Case 5-2	550	From 11th year	From 18th year	4.36%	6.29%	O&M cost x 1.2

2. DIMITROVGRAD WWTP PROJECT

2-1 FINANCIAL AND ECONOMIC ANALYSIS OF CASES

Case No.	Initial User charge (Lv./m3)	Positive financial balance		FIRR	EIRR	Remarks
		Annual	Cumulative			
Case 1	250	From 11th year	From 16th year	1.85%	3.31%	Annual increase of user charge
Case 2	300	From 9th year	From 9th year	3.87%	5.26%	ditto
Case 3	350	From 3rd year	From 4th year	5.55%	6.93%	ditto
Case 4	400	From 3rd year	From 3rd year	7.02%	8.42%	ditto
Case 5	450	From 3rd year	From 3rd year	8.35%	9.79%	ditto
Case 6	500	From 3rd year	From 3rd year	9.58%	11.07%	ditto
Case 7	550	From 3rd year	From 3rd year	10.74%	12.28%	ditto
Case 8	600	From 3rd year	From 3rd year	11.84%	13.44%	ditto

2-2 SENSITIVITY ANALYSIS

Case No.	Initial User charge (Lv./m3)	Positive financial balance		FIRR	EIRR	Remarks
		Annual	Cumulative			
Case 4-1	400	From 3rd year	From 3rd year	6.35%	7.70%	Capital cost x 1.1
Case 4-2	400	From 3rd year	From 4th year	6.20%	7.68%	O&M cost x 1.2

3. STARA ZAGORA WWTP PROJECT

3-1 FINANCIAL AND ECONOMIC ANALYSIS OF CASES

Case No.	Initial User charge (Lv./m3)	Positive financial balance		FIRR	EIRR	Remarks
		Annual	Cumulative			
Case 1	250	From 15th year	From 29th year	#NUM!	2.44%	Annual increase of user charge
Case 2	300	From 12th year	From 19th year	2.99%	4.91%	ditto
Case 3	350	From 10th year	From 14th year	5.11%	6.97%	ditto
Case 4	400	From 6th year	From 9th year	6.93%	8.81%	ditto
Case 5	450	From 4th year	From 4th year	8.57%	10.49%	ditto
Case 6	500	From 3rd year	From 3rd year	10.09%	12.08%	ditto
Case 7	550	From 3rd year	From 3rd year	11.52%	13.59%	ditto
Case 8	600	From 3rd year	From 3rd year	12.90%	15.04%	ditto

3-2 SENSITIVITY ANALYSIS

Case No.	Initial User charge (Lv./m3)	Positive financial balance		FIRR	EIRR	Remarks
		Annual	Cumulative			
Case 4-1	400	From 6th year	From 9th year	6.35%	8.15%	Capital cost x 1.1
Case 4-2	400	From 10th year	From 14th year	5.40%	7.41%	O&M cost x 1.2

TABLE S.3.3 PROJECT EVALUATION FOR THE PRIORITY PROJECTS

Item	Pazardjik WWTP Project	Dimitrovgrad WWTP Project	Stara Zagora WWTP Project
1. Project Features			
1) Treatment for	Domestic wastewater	Domestic wastewater	Domestic wastewater
2) Design population (Year 2015)	97,000 person	61,000 person	165,000 person
3) Total daily average flow	29,400 m3/day	18,800 m3/day	49,400 m3/day
4) BOD load	5,240 kg/day	3,300 kg/day	8,890 kg/day
5) SS load	6,310 kg/day	3,980 kg/day	10,700 kg/day
6) Treatment process	Conventional activated sludge	Extended aeration process	Conventional activated sludge
7) Space for future treatment	TN and TP	TN and TP	TN and TP
2. Project Cost	US$ 25,662,000	US$ 15,370,000	US$ 29,760,000
3. Technical Evaluation			High technical viability
1) Reduction of domestic load (BOD)	Priority Town: 90 % Priority Region: 29 %	Priority Town: 90 % Priority Region: 32 %	Priority Town: 90 % Priority Region: 61 %
2) Water quality improvement (BOD)	Very high improvement effect in the Upstream Maritza. (Class III to Class I)	High improvement effect in the Downstream Maritza. (Middle level to higher level of Class I)	High improvement effect from Stara Zagora Town to middle stream of Sazliyka River. Very high improvement effect in the Downstream Maritza. (Beyond Class III to Class III)
3) Technical viability	Very high	Very High	Very high
4. Financial and Economic Evaluation			
1) Marginal condition			
- Initial user charge	Lv. 450/m3	Lv. 300/m3	Lv. 300/m3
- Positive financial balance	Annual from 12th year Cumulative from 19th year	Annual from 9th year Cumulative from 9th year	Annual from 12th year Cumulative from 19th year
- FIRR	3.35 %	3.87 %	2.99 %
- EIRR	5.19 %	5.26 %	4.91 %
2) Appropriate condition			
- Initial user charge	Lv. 550/m3	Lv. 400/m3	Lv. 400/m3
- Positive annual financial balance	Annual from 9th year Cumulative from 13th year	Annual from 3rd year Cumulative from 3rd year	Annual from 6th year Cumulative from 9th year
- FIRR	5.99 %	7.02 %	6.93 %
- EIRR	7.80 %	8.42 %	8.81 %
3) Evaluation	Acceptable to preferable range	Acceptable to preferable range	Acceptable to preferable range
5. Social Impact	1) Very high impact for improving living environment 2) Very high impact for realizing municipal responsibility to the people and river basin 3) Increasing employment opportunity	1) Very high impact for improving living environment 2) Very high impact for realizing municipal responsibility to the people and river basin 3) Increasing employment opportunity	1) Very high impact for improving living environment 2) Very high impact for realizing municipal responsibility to the people and river basin 3) Increasing employment opportunity
6. Environmental Impact	1) Very high impact for improving river water quality in the basin 2) No adverse impacts to natural environment	1) Very high impact for improving river water quality in the basin 2) No adverse impacts to natural environment	1) Very high impact for improving river water quality in the basin 2) No adverse impacts to natural environment
7. Summary of Project Viability	Very high viability	Very high viability	Very high viability

TABLE S.3.4 IMPLEMENTATION PROGRAM

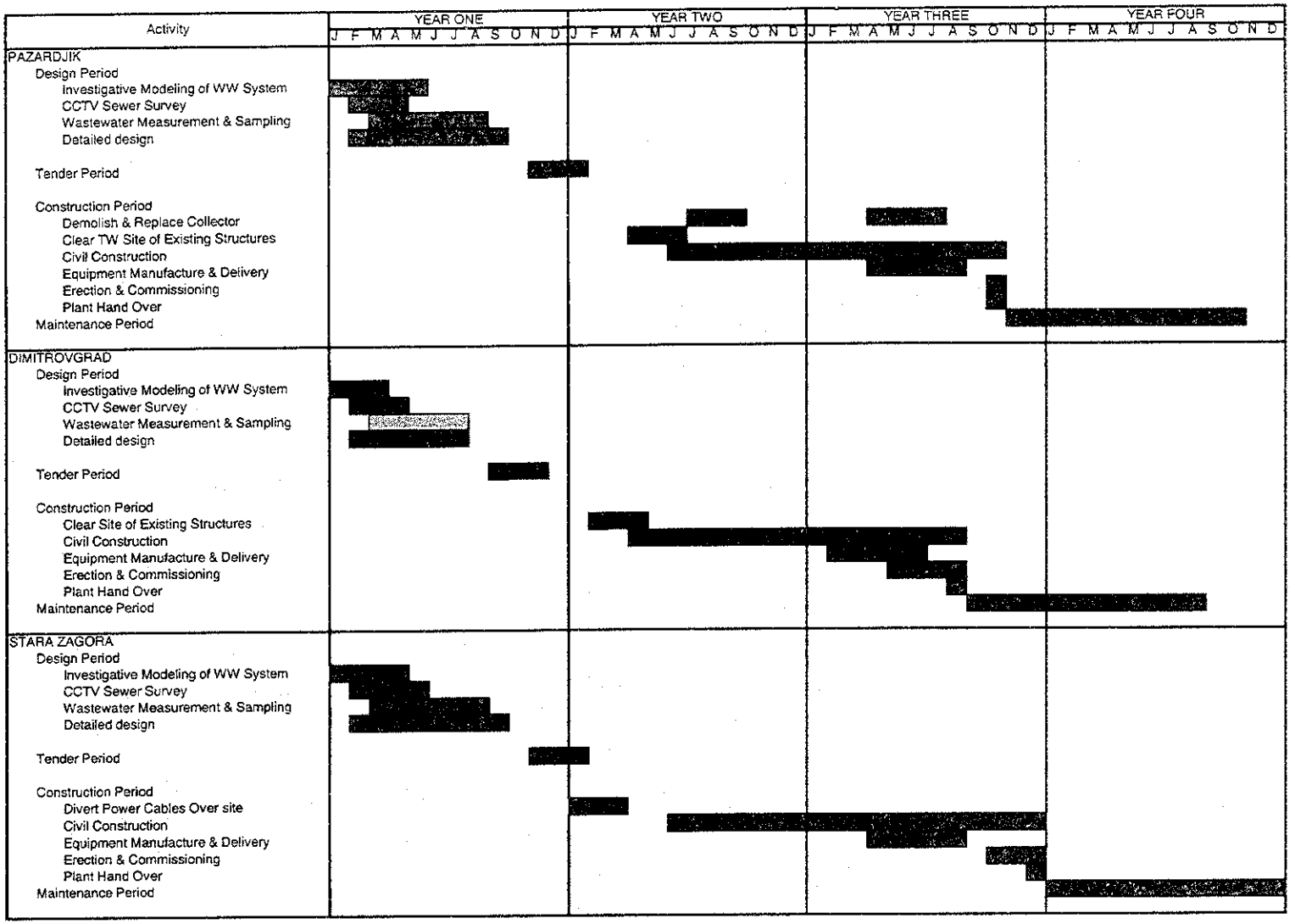

TABLE S.3.5 DISBURSEMENT SCHEDULE OF WWTPs (1/2)

1. Disbursement Schedule of Pazardjik WWTP Project

No.	Item	Unit		Cost			
				Year 2001	Year 2002	after Y 2003	Total
1.	Construction Cost						
1-1	Direct Cost	US$ 1000	Sub-total	9,870	9,870		19,740
		US$ 1000	FC	6,764	6,764		13,527
		US$ 1000	LC	3,107	3,107		6,213
1-2	Engineering	US$ 1000	Sub-total	987	987		1,974
		US$ 1000	FC	790	790		1,579
		US$ 1000	LC	197	197		395
1-3	Administration	US$ 1000	Sub-total	494	494		987
		US$ 1000	FC	0	0		0
		US$ 1000	LC	494	494		987
1-4	Physical Contingency	US$ 1000	Sub-total	1,481	1,481		2,961
		US$ 1000	FC	1,015	1,015		2,029
		US$ 1000	LC	466	466		932
1-5	Grand Total	US$ 1000	Total	12,831	12,831		25,662
		US$ 1000	FC	8,568	8,568		17,135
		US$ 1000	LC	4,263	4,263		8,527
2.	O&M	US$ 1000/year	Total	0	0	2,961	
	(15 % of 1-1)	US$ 1000/year	FC	0	0	0	
		US$ 1000/year	LC	0	0	2,961	

2. Disbursement Schedule of Dimitrovgrad WWTP Project

No.	Item	Unit		Cost			
				Year 2001	Year 2002	after Y 2003	Total
1.	Construction Cost						
1-1	Direct Cost	US$ 1000	Sub-total	5,912	5,912		11,823
		US$ 1000	FC	4,052	4,052		8,103
		US$ 1000	LC	1,860	1,860		3,720
1-2	Engineering	US$ 1000	Sub-total	591	591		1,182
		US$ 1000	FC	473	473		946
		US$ 1000	LC	118	118		236
1-3	Administration	US$ 1000	Sub-total	296	296		591
		US$ 1000	FC	0	0		0
		US$ 1000	LC	296	296		591
1-4	Physical Contingency	US$ 1000	Sub-total	887	887		1,773
		US$ 1000	FC	608	608		1,215
		US$ 1000	LC	279	279		558
1-5	Grand Total	US$ 1000	Total	7,685	7,685		15,370
		US$ 1000	FC	5,132	5,132		10,264
		US$ 1000	LC	2,553	2,553		5,106
2.	O&M	US$ 1000/year	Total	0	0	828	
	(7 % of 1-1)	US$ 1000/year	FC	0	0	0	
		US$ 1000/year	LC	0	0	828	

TABLE S.3.5 DISBURSEMENT SCHEDULE OF WWTPs (2/2)

3. Disbursement Schedule of Stara Zagora WWTP Project

No.	Item	Unit		Cost			
				Year 2001	Year 2002	after Y 2003	Total
1.	Construction Cost						
1-1	Direct Cost	US$ 1000	Sub-total	11,446	11,446		22,892
		US$ 1000	FC	8,095	8,095		16,189
		US$ 1000	LC	3,352	3,352		6,703
1-2	Engineering	US$ 1000	Sub-total	1,145	1,145		2,289
		US$ 1000	FC	916	916		1,831
		US$ 1000	LC	229	229		458
1-3	Administration	US$ 1000	Sub-total	572	572		1,145
		US$ 1000	FC	0	0		0
		US$ 1000	LC	572	572		1,145
1-4	Physical Contingency	US$ 1000	Sub-total	1,717	1,717		3,434
		US$ 1000	FC	1,214	1,214		2,428
		US$ 1000	LC	503	503		1,005
1-5	Grand Total	US$ 1000	Total	14,880	14,880		29,760
		US$ 1000	FC	10,224	10,224		20,449
		US$ 1000	LC	4,655	4,655		9,311
2.	O&M	US$ 1000/year	Total	0	0	3,434	
	(15 % of 1-1)	US$ 1000/year	FC	0	0	0	
		US$ 1000/year	LC	0	0	3,434	

Note:

1. Replacement of machine and electrical equipments shall be conducted in every 15 years after commencement of operation (Year 2017, Year 2032)
   Replacement cost is as follows:

1)	Pazardjik WWTP	FC	7,155	(US$ 1000/time)
		LC	795	(US$ 1000/time)
		Total	7,950	(US$ 1000/time)
2)	Dimitrovgrad WWTP	FC	5,262	(US$ 1000/time)
		LC	585	(US$ 1000/time)
		Total	5,847	(US$ 1000/time)
3)	Stara Zagora WWTP	FC	9,701	(US$ 1000/time)
		LC	1,078	(US$ 1000/time)
		Total	10,779	(US$ 1000/time)