

6.8 ORGANIZATIONAL PLAN

The present organization of ViK is formed by four functional departments, which are Water Supply Department, Sewerage System Department, Technology & Development Department, and Economic & Legal Department. Currently a few over 10 persons are engaged in the WWTP, doing preparatory works for possible resumption of the wastewater treatment operation.

In fact, there is no accepted standard as to the ideal number of staff for operating a WWTP of particular served area and population. It is however obvious that the wastewater treatment requires a sufficient number of engineers, technicians and other types of staff. It goes without saying that those persons should be better experienced as well as qualified.

The proposed organizational structure for the Project is depicted in **Figure 6.10**. The functions considered necessary in the organization are summarized in **Table 6.31**. Those functions can be either (i) performed by the WWTP's own staff, (ii) entrusted to ViK's existing units or (iii) contracted out to external contractors/suppliers. The number of staff to perform the required functions, either of WWTP's own or of external contractors totals to 40. The deployment of those staff is shown in **Figure 6.10**. Those functions and the number of staff are merely the guidelines based on which the practical organizational arrangement can be made.

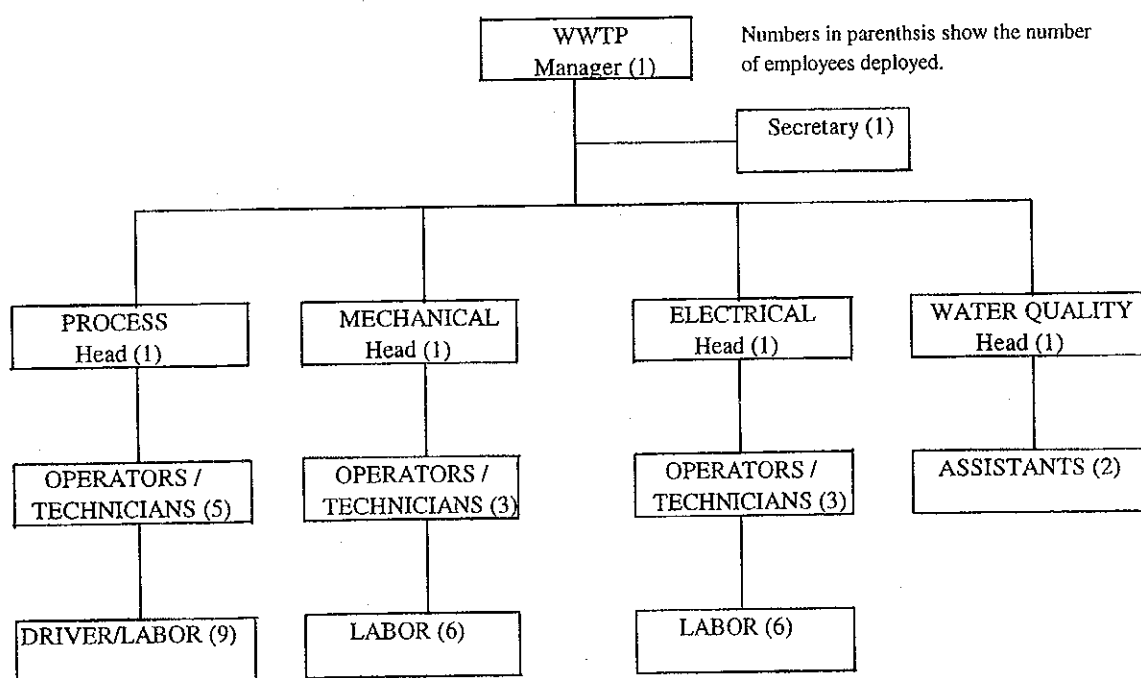


Figure 6.10 PROPOSED WWTP ORGANIZATIONAL STRUCTURE

Table 6.31 NECESSARY FUNCTIONS IN WWTP

WWTP Manager	
<ul style="list-style-type: none"> Organize, manage, check and evaluate the overall technical and administrative work of WWTP Coordinate administrative and O&M activities and give proper orders to section heads Report the development and progress of activities to the senior management 	
Administrative Section	
(Possible to be partly or entirely entrusted to ViK's homologous sections)	
<ul style="list-style-type: none"> Finance and accounting --- Make financial and accounting reports of WWTP operation Procurement --- Take charge of procurement, supply and inventory control of materials used for O&M of WWTP operation Coordination and public relation --- Coordinate with external organizations in terms of public relation about WWTP operation Miscellaneous works --- Perform secretarial works, clerical works, and guard facilities 	
Process Section	
Section Head	<ul style="list-style-type: none"> Take charge of O&M and monitoring of treatment process of facilities
Operator/ Technician	<ul style="list-style-type: none"> Assist the section head Take charge of direct control and supervision of routine O&M in treatment process of facilities
Driver/Labor	<ul style="list-style-type: none"> Drive vehicles and transport people and sludge Clean treatment facilities and perform miscellaneous tasks
Mechanical Section	
Section Head	<ul style="list-style-type: none"> Take charge of O&M and monitoring of mechanical facilities
Operator/ Technician	<ul style="list-style-type: none"> Assist the section head Take charge of direct control and supervision of routine O&M of mechanical facilities
Labor	<ul style="list-style-type: none"> Clean mechanical facilities and perform miscellaneous tasks
Electrical Section	
Section Head	<ul style="list-style-type: none"> Take charge of O&M and monitoring of electrical facilities and controls
Operator/ Technician	<ul style="list-style-type: none"> Assist the section head Take charge of direct control and supervision of routine O&M of electrical facilities
Labor	<ul style="list-style-type: none"> Clean electrical facilities and perform miscellaneous tasks
Water Quality Section	
Section Head	<ul style="list-style-type: none"> Take charge of water quality analysis and operation of the laboratory
Assistant	<ul style="list-style-type: none"> Assist the section head Take charge of direct control and supervision of routine O&M of laboratory facilities Carry out on site wastewater quality tests and sampling for laboratory tests

Securing the qualified engineers and experts either by recruitment or outsourcing, is an important aspect of the organizational arrangement especially at the initial stage of the Project. However, it is anticipated that difficulties may arise in the recruitment or the outsourcing process since

qualified professionals in the field of wastewater treatment are neither sufficiently available within the existing ViK's organization nor in the local labor market.

Under those circumstances where such experienced and qualified staff is not readily available, it is vital for the ViK staff, especially key personnel to go through proper training and acquire necessary skills and knowledge. The basic knowledge about O&M primarily comprises (i) role required for plant operator, (ii) processes involved in wastewater treatment (iii) equipment used in wastewater treatment, (iv) routine operation procedures, (v) preventive maintenance procedures and (vi) safety.

That knowledge can be transferred to the ViK staff by foreign experts through training courses provided normally by bilateral technical assistance programs. It is therefore recommended that key WWTP operators be sent for training, for the agreed period of time in foreign countries.

The actual operation skills can be also provided in situ, through direct contact with personnel sufficiently experienced in the operation of WWTP. Use of external contractors/suppliers who can dispatch such capable engineers or technicians to the Project for a certain period is considered realistic for such objective.

In areas of administration, billing and collection, and customer relations of wastewater treatment operation, it is practical that ViK's other homologous sections support WWTP. By this way, the administrative expenses will be expectedly reduced and the anticipated difficulty to recruit the qualified and experienced staff in those areas will be minimized.

6.9 PRELIMINARY COST ESTIMATE

6.9.1 General

As a result of first field survey (data collection and research on the construction situation of Sarajevo), the following three points were discovered. The first point concerns locally available construction materials, the second point concerns labour force conditions in general, and the third point deals with natural conditions of Sarajevo. These are summarised below.

Due to Sarajevo's geographical location, its economic situation and relationships with European countries, most construction materials are locally available. In this project, it was decided to import the electrical and mechanical equipment. It is assumed that International Competitive Bidding (ICB) shall be applied in tendering of the project.

6.9.2 Project Cost

The cost of this scale of construction works may vary significantly depending on the source of finance, bidding procedure and contract methods used in general. Therefore, the following conditions are assumed:

- (1) Japan's ODA project will be introduced.
- (2) Physical contingency is assumed as 10% of the cost (direct and indirect cost) in terms of the depth of the preliminary engineering design.
- (3) The following countries are taken into account for the origin of imported materials or equipment:

1) Ductile Cast Iron Pipe:	Croatia
2) Mild Steel Pipe:	Croatia
3) Mechanical & Electrical Equipment:	European Countries
- (4) Exchange Rate are

KM 1.00	=	DEM 1.00
DEM 1.00	=	JPY 71.20

* Status: End of May 1999

The total project cost for the URW is approximately 76.06 Million DEM of which foreign and local currency portions are shown in **Table 6.32** (local currency is used mostly to cover local labour cost and local materials). **Table 6.33** shows the break up of construction costs per facility.

Table 6.32 TOTAL PROJECT COST

Unit : Million DEM

NAME OF THE WORKS	F/C	L/C	COST
1. TOTAL CONSTRUCTION COST			
1) Civil Works	1.99	7.99	9.98
2) Architectural Works	1.55	3.19	4.74
3) Mechanical Works	26.71	6.69	33.40
4) Electrical Works	12.83	3.20	16.03
Total	43.08	21.07	64.15
2. ENGINEERING SERVICE COST			
5) Consulting Fees for Engineering Services	0.50	0.50	1.00
6) Consulting Fees for Supervising	2.50	1.50	4.00
Total	3.00	2.00	5.00
3. CONTINGENCY			
7) Contingency (10%)			6.91
TOTAL PROJECT COST			76.06
4. DIRECT WORKS BY DIRECT MANAGEMENT OF BiH SIDE			
8) High-tension Voltage Wire			0.20
9) Local Tax / Value Tax			0.10
10) Miscellaneous Works			0.40
11) Others			0.30
TOTAL DIRECT COST			1.00

Table 6.33 FACILITY WISE BREAKUP OF THE CONSTRUCTION COST

Unit : Thousand DEM

No.of Facility	Civil		Architectural		Mechanical		Electrical		Total
	FC	LC	FC	LC	FC	LC	FC	LC	
0	682	2,728	104	416	3,064	766	474	119	8,353
1	4	15	22	88	808	202	760	190	2,089
2	7	30	0	0	1013	254	(included in 1)		1,304
3	19	78	0	0	1,053	264	(included in 19)		1,414
4	150	600	0	0	405	102	(included in 9)		1,257
5	447	1,789	0	0	1,540	385	2,309	578	7,048
6	19	75	0	0	1,060	266	(included in 8)		1,420
7	0	0	0	0	(included in 6)		(included in 24)		0
8	4	18	4	16	464	116	474	119	1,215
9	4	18	4	16	237	60	190	48	577
10	41	163	0	0	944	237	(included in 11)		1,385
11	2	9	2	10	(included in 10)		190	48	261
12	331	1,326	0	0	754	189	(included in 13)		2,600
13	0	0	200	800	10,147	2,537	1,856	464	16,004
14	0	0	9	40	1,137	285	(included in 13)		1,471
15	221	884	0	0	379	95	(included in 13)		1,579
16	21	83	0	0	464	117	(included in 8)		685
17	3	11	(included in 18)		104	27	(included in 18)		145
18	0	0	96	384	2,921	731	768	182	5,082
19	0	0	5	20	(included in 23)		190	48	263
20	0	0	56	224	0	0	1,430	358	2,068
21	0	0	7	30	0	0	1,126	282	1,445
22	0	0	3	13	0	0	(included in 23)		16
23	0	0	228	912	0	0	2,322	581	4,043
24	0	0	5	24	222	56	285	72	664
25	0	0	800	200	0	0	(included in 23)		1,000
Supple- mental Work	40	158	0	0	0	0	459	115	772
Total	1,995	7,985	1,545	3,193	26,716	6,689	12,833	3,204	64,160
Grand Total	9,980		4,738		33,405		16,037		64,160
	C&A=14,718				M&E=49,442				

6.9.3 Operation & Maintenance Cost

Operation & Maintenance Cost for the URW are estimated based on the following condition and assumptions. **Table 6.34** shows estimated operation and maintenance cost.

Table 6.34 OPERATION & MAINTENANCE COST

1. Spare Part Cost			
(Construction Cost × 5%) / (12 month/year/(15-30 year))			= 12,100/ DEM/month
2. Chemical Consumption Cost			
Chlorine	30.00 ton/month × 2,500 DEM/ton × 80%		= 60,000/DEM/month
Polymer	5.70 ton/month × 10,000 DEM/ton × 80%		= 45,600/DEM/month
3. Power Consumption Cost			
(1) Electricity			
Obracunska	2,000 kW × 18.36 DEM/kW/Month		= 36,720/DEM/month
Activna	850 kW-hrs. × (av. 0.053 DEM/kW-hrs.) × 720 hrs/month		= 32,436/DEM/month
(2) Diesel			
	500 l/time × 2.5 times/month × 1.00 DEM/l		= 1,250/DEM/month
4. Personnel Expenses			
40 × 1,285 DEM/month			= 51,400/DEM/month
5. Depreciation Cost			
(Construction Cost)/(15-30 years)/12 month/year			= 242,000/DEM/month
6. Final Disposal Cost for RAD			
12 m ³ × 30 days × 90 DEM/m ³			= 242,000/DEM/month
TOTAL			= 513,906/DEM/month
			say = 514,000 or
			= 6.16 million DEM/year

6.10 FINANCIAL PLAN

In this section, the financial plan of the Project is formulated on the basis of the financial evaluation performed in the **Chapter 7**. Explained below are the assumptions used in the financial planning.

(1) Foreign loan

It is assumed that a yen-denominated loan is available in order to finance the 85 percent of capital investment cost of the Project. The loan interest rate is expected to be 1 percent per annum. The lending period is 40 years including grace period of 10 years.

(2) Foreign exchange rate

In 1999, KM is the dominant currency of payment in BiH, and KM and DM have same value in the BiH domestic market. It is expected that DM and other foreign currencies circulated in BiH will decrease with KM's gaining the confidence as a national currency. In the financial planning, the exchange rates of relevant currencies are set to be at $DM\ 1.00 = KM\ 1.00 = Yen\ 70.20$

(3) Foreign exchange loss or gain

The Project may incur foreign exchange loss or gain if the exchange rate of KM / Yen is different between in year 2000 and in years when interest payment and principal repayment occur. In other words, if KM depreciates against yen in the future, there will be foreign exchange loss. If KM appreciates against yen, there will be gain. However, forecast of the foreign exchange rate in future is out of our scope. Therefore, in our base case of financial planning, it is assumed that the exchange rates of the currencies used in the Project keep unchanged during the Project period and the repayment period. Consequently no foreign exchange loss or gain will be expected.

(4) Domestic financing source

ViK has been relying on Sarajevo Canton for the source of capital investments. For this Project, however, the principal financing source is supposed to be a yen loan. More precisely, the yen loan is expected to cover the 85 percent of the capital investment amount. The remaining 15 percent could be provided through grants if the Project would be of public character. However, by applying the principle of conservatism here, a domestic KM loan should be expected rather than a grant. In fact, there exists no long-term commercial KM loan in the present BiH capital market. The short-term commercial KM loans exist, however, dominant interest rates are more than 20 percent per annum, reflecting the unforeseeable financial situation. Considering those situations, we assume that the 15 percent of the capital investment amount are financed by a 10-year KM loan with the interest rate of 10 percent per annum.

(5) Corporate income tax

ViK has been operating at a loss for the past years, therefore no corporate income tax has been levied during that period. In the financial planning, however, if the WWTP operation is isolated from the rest of operations, profits will be expected. And for those profits, income tax may be levied. We assume the tax rate of 30 percent.

As a result of applying the aforementioned assumptions in the financial planning, the following outputs are produced:

- 1) Sources and uses of cash which show actual cash flows of the Project (**Table 6.35**)
- 2) Foreign loan repayment schedule (**Table 6.36**)
- 3) Domestic loan repayment schedule (**Table 6.37**)

It should be noted that in years 2000 and 2001, the Project has a negative cash balance (Line 15 of **Table 6.35**). The total amount of the negative balances is roughly KM 2 million. This means that additional short-term loans or grants of this amount will be required to cover the finance gap. Even if grants are not given and instead, even if a loan is only the financing source available, it seems not difficult to pay the interest and repay the loan. Because the positive cash balances in the subsequent years sufficiently exceed KM 2 million by year 2005.

For referential information, another financial plan is drawn up (**Tables 6.38 and 6.39**). The only difference from the base case, is that the 15 percent of the capital investment is financed by grants, not a loan. In this case, a negative cash balance still appears in years 2000 and 2001. However, the total cash deficit of KM 0.6 million will be relatively small amount and could be financed smoothly.

Assumption :

- 85% by Foreign Yen Loan with Interest Rate of 1%**
- 15% by Domestic KM Loan with Interest Rate of 10%**
- Future KM / Yen Exchange Rate : 71.2 Yen = 1 KM**
- Tax Rate : 30%**

Table 6.35 SOURCES AND USES OF CASH (Unit: 000 KM)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total		
1 Cash received from:																														
2 WWTP rate revenue from all users			6,955	7,586	7,924	8,340	8,577	8,775	9,026	9,283	9,546	9,814	10,087	10,368	10,656	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	247,321	
3 Foreign loan:Capital invest x 85%	29,393	29,393																											58,786	
4 Domestic loan or subsidy	5,187	5,187																											10,374	
5 Working capital injection	406	1,219																												
6 Cash used for:																														
7 Capital investment	34,580	34,580																											69,160	
8 WWTP direct O&M cost			3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	81,572	
9 WWTP overhead cost			487	531	555	584	600	614	632	650	668	687	706	726	746	761	761	761	761	761	761	761	761	761	761	761	761	761	761	17,312
10 Tax payment Tax rate = 30%			270	292	306	324	336	348	360	372	384	396	408	420	432	444	456	468	480	492	504	516	528	540	552	564	576	588	43,494	
11 Repayment of foreign loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33,312	
12 Foreign loan interest	147	441	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	12,453	
13 Foreign exchange loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
14 Repayment of domestic loan	0	0	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	10,374	
15 Domestic loan interest	259	778	986	882	778	674	571	467	363	259	156	52																	6,224	
16 Working capital repayment			324	493	471	336																								
17 Cash balance	0	0	0	0	0	509	1,104	1,336	1,603	1,875	201	498	1,784	1,987	2,194	2,350	2,369	2,389	2,408	2,428	2,448	2,467	2,487	2,506	2,526	2,546	2,565	42,580		
18 Accumulated Cash	0	0	0	0	0	509	1,613	2,950	4,553	6,428	6,629	7,127	8,911	10,898	13,091	15,441	17,810	20,193	22,637	25,035	27,483	29,950	32,437	34,943	37,469	40,015	42,580			

Table 6.36 FOREIGN LOAN REPAYMENT SCHEDULE (Unit: JP Yen Million)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	Total	
1st year		2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,023	1,953	1,884	1,814	1,744	1,674	1,604	1,535	1,465	1,395	1,325	1,256	1,186	1,116	1,046	977	907	837	767	698	628	558	488	419	349	279	209	140	70	2,093	
2nd year												70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	2,093
3rd year																																										
4th year																																										
5th year																																										
6th year																																										
7th year																																										
8th year																																										
9th year																																										
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Foreign exchange rate JP Yen / KM	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	

*40 years loan, including 10 years grace period, with interest rate 1.00% p.a.

Table 6.37 DOMESTIC LOAN REPAYMENT SCHEDULE (Unit: 000 KM)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
1st year		5,187	5,187	4,668	4,150	3,631	3,112	2,594	2,075	1,556	1,037	519	5,187
2nd year													
3rd year													
4th year													
5th year													
6th year													
7th year													
8th year													
9th year													
10th year													
11th year													
12th year													
Foreign exchange rate JP Yen / KM	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2

*12 years loan, including 2 years grace period, with interest rate 10% p.a.

Assumption :

85% by Foreign Yen Loan with Interest Rate of 1%

15% by Domestic Grants

Future KM / Yen Exchange Rate :71.2 Yen = 1 KM

Tax Rate : 30%

Table 6.38 SOURCES AND USES OF CASH (Unit: 000 KM)

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	
1	Cash received from:																													
2	WWTP rate revenue from all users			6,955	7,586	7,924	8,340	8,577	8,775	9,026	9,283	9,548	9,814	10,087	10,368	10,656	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	247,321	
3	Foreign loan:Capital invest x 85%	29,393	29,393																										58,786	
4	Domestic loan or subsidy	5,187	5,187																										10,374	
5	Working capital injection	147	441																											
6	Cash used for:																													
7	Capital investment	34,580	34,580																										69,160	
8	WWTP direct O&M cost			3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	81,572	
9	WWTP overhead cost			487	531	555	584	600	614	632	650	668	687	706	726	746	761	761	761	761	761	761	761	761	761	761	761	761	17,312	
10	Tax payment Tax rate = 30%			270	292	302	314	326	338	350	362	374	386	398	410	422	434	446	458	470	482	494	506	518	530	542	554	566	43,494	
11	Repayment of foreign loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12	Foreign loan interest	147	441	588	588	588	588	588	588	588	588	578	558	539	519	500	480	460	441	421	402	382	363	343	323	304	284	265	12,453	
13	Foreign exchange loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
14	Repayment of domestic loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15	Domestic loan interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
16	Working capital repayment			588																									0	
17	Cash balance	0	0	1,760	2,412	2,287	2,557	2,712	2,841	3,004	3,172	3,394	3,587	3,784	3,987	4,194	4,406	4,623	4,845	5,072	5,304	5,541	5,783	6,030	6,282	6,539	6,801	7,068	7,340	59,176
18	Accumulated cash	0	0	1,760	4,172	6,459	9,016	11,728	14,569	17,572	20,744	22,138	23,725	25,509	27,496	29,690	32,039	34,409	36,797	39,206	41,634	44,081	46,548	49,035	51,541	54,067	56,613	59,178		

Table 6.39 FOREIGN LOAN REPAYMENT SCHEDULE (Unit: JP Yen Million)

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	Total	
1	1st year																																										
2	Beginning outstanding		2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,023	1,953	1,884	1,814	1,744	1,674	1,604	1,535	1,465	1,395	1,325	1,256	1,186	1,116	1,046	977	907	837	767	698	628	558	488	419	349	279	209	140	70	2,093	
3	Borrowing *	2,093																																									
4	Repayment											70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	2,093
5	Interest payment	10	21	21	21	21	21	21	21	21	21	21	20	19	18	18	17	16	16	15	14	14	13	12	12	11	10	9	9	8	7	7	6	5	5	4	3	2	2	1	0	513	
6	2nd year																																										
7	Beginning outstanding		2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,093	2,023	1,953	1,884	1,814	1,744	1,674	1,604	1,535	1,465	1,395	1,325	1,256	1,186	1,116	1,046	977	907	837	767	698	628	558	488	419	349	279	209	140	70	2,093	
8	Borrowing *		2,093																																								
9	Repayment											70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	2,093
10	Interest payment	10	21	21	21	21	21	21	21	21	21	21	20	19	18	18	17	16	16	15	14	14	13	12	12	11	10	9	9	8	7	7	6	5	5	4	3	2	2	1	0	-492	
11	Total		2,093	4,186	4,186	4,186	4,186	4,186	4,186	4,186	4,186	4,046	3,907	3,767	3,627	3,488	3,348	3,209	3,069	2,930	2,790	2,651	2,511	2,372	2,232	2,093	1,953	1,814	1,674	1,535	1,395	1,256	1,116	977	837	698	558	419	279	140	0	4,186	
12	Borrowing	2,093	2,093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,186			
13	Repayment	0	0	0	0	0	0	0	0	0	0	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	4,186	
14	Interest payment	10	31	42	42	42	42	42	42	42	42	41	40	38	37	36	34	33	31	30	29	27	26	24	23	22	20	19	17	16	15	13	12	10	9	8	6	5	3	2	1	1,005	
15	Foreign exchange rate JP Yen / KM	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2		

*40 years loan, including 10 years grace period, with interest rate 1.00% p.a.

Assumption :

100% by Foreign Yen Loan with Interest Rate of 1%

Future KM / Yen Exchange Rate : 71.2 Yen = 1 KM

Tax Rate : 30%

Table 6.40 SOURCES AND USES OF CASH (Unit: 000 KM)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	
1 Cash received from:																													
2 WWTP rate revenue from all users			6,955	7,586	7,924	8,340	8,577	8,775	9,026	9,283	9,548	9,814	10,087	10,368	10,656	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	247,321
3 Foreign loan:Capital invest x 100%	34,580	34,580																											69,160
4 Domestic loan or subsidy	0	0																											0
5 Working capital injection	173	519																											0
6 Cash used for:																													
7 Capital investment	34,580	34,580																											69,160
8 WWTP direct O&M cost			3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	81,572
9 WWTP overhead cost			487	531	555	584	600	614	632	650	668	687	706	726	746	761	761	761	761	761	761	761	761	761	761	761	761	761	17,312
10 Tax payment Tax rate = 30%			270	292	302	318	328	338	348	358	368	378	388	398	408	418	428	438	448	458	468	478	488	498	508	518	528	538	43,494
11 Repayment of foreign loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Foreign loan interest	173	519	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	692	14,650
13 Foreign exchange loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14 Repayment of domestic loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Domestic loan interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Working capital repayment			692																										0
17 Cash balance	0	0	1,552	2,308	2,183	2,454	2,608	2,737	2,900	3,068	947	1,143	1,343	1,549	1,760	1,919	1,942	1,965	1,988	2,011	2,034	2,057	2,080	2,103	2,127	2,150	2,173	51,102	
18 Accumulated cash	0	0	1,552	3,860	6,044	8,497	11,106	13,842	16,742	19,810	20,757	21,899	23,243	24,792	26,552	28,471	30,413	32,378	34,366	36,378	38,412	40,469	42,550	44,653	46,780	48,929	51,102		

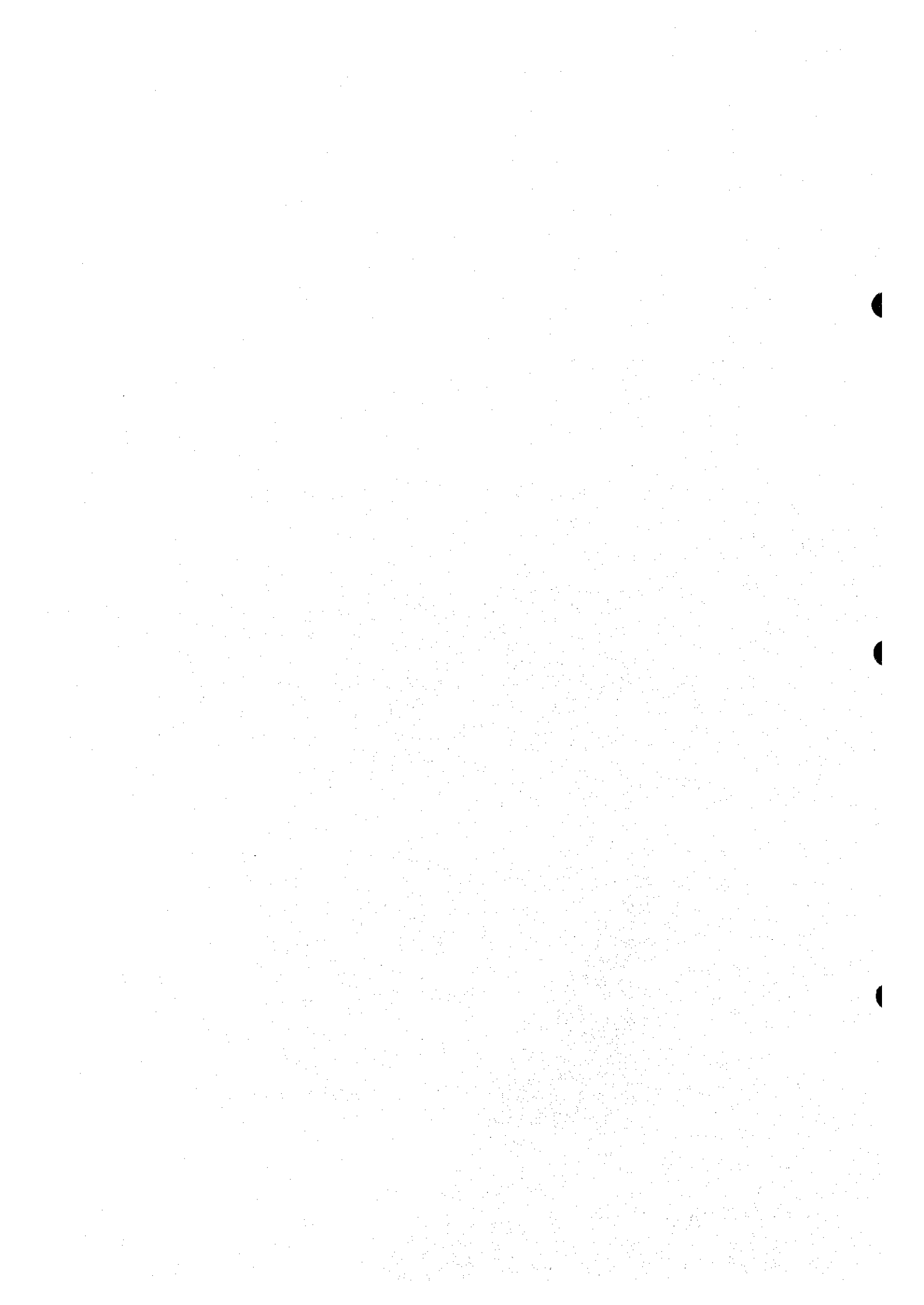
Table 6.41 FOREIGN LOAN REPAYMENT SCHEDULE (Unit: JP Yen Million)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	Total	
1st year																																										
2 Borrowing *	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	
3 Repayment																																										
4 Interest payment	12	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
5 2nd year																																										
6 Borrowing *		2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	2,462	
7 Repayment																																										
8 Interest payment		12	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	
9 Total																																										
10 Borrowing	2,462	2,462	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924		
11 Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
12 Interest payment	12	37	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49		
13 Foreign exchange rate JP Yen / KM	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2		

*40 years loan, including 10 years grace period, with interest rate 1.00% p.a.

**CHAPTER 7. FINANCIAL AND ECONOMIC
EVALUATION**





CHAPTER 7. FINANCIAL AND ECONOMIC EVALUATION

7.1 FINANCIAL EVALUATION

The financial viability of a capital investment project is analyzed on the basis of discounted cash flow method which is essentially aiming to clarify whether or not the anticipated net cash flows (cash inflows less cash outflows) from the project are reasonably attractive for the investor to risk his funds. In the discounted cash flow method, the financial internal rate of return (FIRR) of the Project has been computed. The FIRR can be compared with interest rates of available loans or target profit rates of the Project.

7.1.1 Assumption for Financial Evaluation

In the financial evaluation various assumptions have to be made. The major assumptions are described in the subsequent paragraphs. **Table 7.1** presents those assumptions and the resultant parameters used for the financial evaluation:

(1) Construction period

The rehabilitation of WWTP starts in year 2000 and ends in 2001.

(2) Initial investment cost

The initial investment cost used in the financial evaluation comprises the construction cost and the engineering service cost. The contingency cost is not included. The initial investment cost is supposed to be spent by equal amount in each year of the construction period. As the result, the initial investment cost will be incurred as follows:

Year 2000	Year 2001	Total
KM 34.58 million	KM 34.58 million	KM 69.16 million

(3) Operation period

The weighted average of service lives of facilities and equipment rehabilitated or replaced by the Project is computed at 25 years. Thus, the operation period is considered same, being from 2002 through 2026.

(4) O&M cost

The annual O&M cost is estimated at KM 3.263 million. That is based on the appropriate number of workers and expenses in order to properly operate the facilities and equipment used in the Project. The O&M cost used in the financial evaluation is a cash basis, accordingly the KM 3.263 million does not include depreciation costs of the facilities. Neither included are replacement costs and substantial repair costs of those facilities and equipment whose service lives are less than the Project operation period, or 25 years. Because the replacement costs and the repair costs can be considered to be offset by residual values at the end of the Project operation period.

(5) Overhead cost

In addition to direct operation and maintenance expenses of WWTP, the Project entails selling, general, and administrative expenses, which are estimated to be 7 percent of WWT rate revenue.

(6) Design population and sewage flow

Design population and sewage flows of 2001, 2010 and 2015 are borrowed from the data in the

Table 7.1 ASSUMPTION IN FINANCIAL EVALUATION

#	Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015-2026
1	Population	342,423	355,997	371,570	379,405	387,405	395,574	403,915	412,432	421,129	430,009	438,076	446,334	454,788	463,434	472,271	481,292	490,497	500,000	506,250
2	Number of households	92,547	96,486	100,424	102,542	104,704	106,912	109,168	111,468	113,819	116,219	118,669	121,171	123,726	126,336	128,992	131,694	134,442	137,234	136,824
3	Domestic sewage flow (l/cd)	171	176	180	183	187	190	194	198	200	201	203	205	207	209	210	212	214	216	216
4	Commercial sewage flow (l/cd)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
5	Industrial sewage flow (l/cd)	27	28	29	30	30	30	31	31	32	32	33	33	33	33	34	34	34	34	34
6	Institutional sewage flow (l/cd)	27	28	29	30	30	30	31	31	32	32	33	33	33	33	34	34	34	34	34
7	Other sewage flow (l/cd)	5	4	2	3	4	5	6	6	6	8	7	7	7	7	7	7	7	7	6
8	Total sewage flow (l/cd)	240	245	250	256	261	267	273	280	282	283	286	288	290	292	295	297	299	300	300
9	Domestic water consumption (m ³ /day/all household)	65,060	69,614	74,314	77,323	80,453	83,711	87,100	90,735	93,454	96,255	99,140	102,111	105,171	108,323	111,464	114,658	118,006	121,500	121,500
10	Commercial water consumption (m ³ /day/all commercial)	3,805	3,967	4,129	4,216	4,305	4,395	4,488	4,583	4,679	4,778	4,879	4,981	5,087	5,195	5,305	5,417	5,531	5,646	5,625
11	Industrial water consumption (m ³ /day/all industrial)	10,273	11,107	11,973	12,458	12,962	13,487	14,033	14,604	15,204	15,834	16,494	17,185	17,907	18,661	19,447	20,265	21,116	22,000	21,925
12	Institutional water consumption (m ³ /day/all institutional)	1,902	1,988	2,078	2,165	2,254	2,344	2,436	2,530	2,626	2,724	2,824	2,926	3,030	3,136	3,244	3,354	3,466	3,580	3,575
13	Other water consumption (m ³ /day/all others)	91,313	97,182	103,214	107,719	112,403	117,277	122,346	128,312	132,031	135,595	139,317	143,363	147,738	151,701	155,953	160,407	164,947	169,550	168,750
14	Total water consumption (m ³ /day)	190	195	200	204	208	212	216	220	222	224	226	228	229	232	234	236	238	240	240
15	Domestic water consumption (l/cd)	21.4	21.9	22.5	22.9	23.4	23.8	24.3	24.8	25.0	25.2	25.4	25.6	25.9	26.1	26.3	26.5	26.8	27.0	27.0
16	Domestic water consumption (m ³ /month/household)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
17	Total domestic rate (K/M/m ³)	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
18	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
19	Water (K/M/m ³)	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
20	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
21	Sewage (K/M/m ³)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
22	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
23	WWTP (K/M/m ³)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
24	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
25	Total industry and commercial rate (K/M/m ³)	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	
26	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
27	Water (K/M/m ³)	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	
28	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
29	Sewage (K/M/m ³)	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	
30	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
31	WWTP (K/M/m ³)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
32	Change from previous year (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
33	Average net wage (K/M/month)	266	329	300	437	459	482	501	521	536	553	564	575	581	586	586	586	586	586	586
34	Change from previous year (%)	24%	18%	12%	29%	5%	5%	4%	4%	3%	3%	2%	2%	1%	1%	0%	0%	0%	0%	
35	Average number of household members	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	
36	Average net household income (K/M/month)	658	760	874	917	963	1,002	1,042	1,073	1,105	1,127	1,150	1,161	1,173	1,173	1,173	1,173	1,173	1,173	
37	Sum of domestic water, sewage, & WWTP bill (K/M/month)	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
38	Water/Sewage/WWTP rate against household income	3.2%	2.8%	3.3%	4.4%	5.8%	5.7%	5.5%	5.5%	5.4%	5.4%	5.4%	5.3%	5.3%	5.3%	5.3%	5.4%	5.4%	5.5%	
39	Billing to domestic users (000K/M/year)	23,747	25,409	27,071	28,733	30,395	32,057	33,719	35,381	37,043	38,705	40,367	42,029	43,691	45,353	47,015	48,677	50,339	52,001	
40	Water (000K/M/year)	16,823	17,766	18,709	19,652	20,595	21,538	22,481	23,424	24,367	25,310	26,253	27,196	28,139	29,082	29,925	30,868	31,811	32,754	
41	Sewage (000K/M/year)	7,124	7,623	8,122	8,621	9,120	9,619	10,118	10,617	11,116	11,615	12,114	12,613	13,112	13,611	14,110	14,609	15,108	15,607	
42	WWTP (000K/M/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
43	Collection efficiency (%)	11.87%	13.72%	15.57%	17.42%	19.27%	21.12%	22.97%	24.82%	26.67%	28.52%	30.37%	32.22%	34.07%	35.92%	37.77%	39.62%	41.47%	43.32%	
44	Revenue from domestic users (000K/M/year)	24,914	26,162	27,410	28,658	29,906	31,154	32,402	33,650	34,898	36,146	37,394	38,642	39,890	41,138	42,386	43,634	44,882	46,130	
45	Billing to non-domestic users (000K/M/year)	17,439	18,313	19,187	20,061	20,935	21,809	22,683	23,557	24,431	25,305	26,179	27,053	27,927	28,801	29,675	30,549	31,423	32,297	
46	Water (000K/M/year)	7,474	7,849	8,224	8,599	8,974	9,349	9,724	10,100	10,475	10,850	11,225	11,600	11,975	12,350	12,725	13,100	13,475	13,850	
47	Sewage (000K/M/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
48	WWTP (000K/M/year)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
49	Collection efficiency (%)	80%	82%	84%	86%	88%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	
50	Revenue from non-domestic users (000K/M/year)	19,931	21,453	22,975	24,497	26,019	27,541	29,063	30,585	32,107	33,629	35,151	36,673	38,195	39,717	41,239	42,761	44,283	45,805	
51	Revenue from all users (000K/M/year)	31,864	35,174	46,148	61,630	87,564	95,437	99,723	105,015	107,989	110,441	113,585	116,820	120,147	123,474	126,801	130,128	133,455	136,782	

Interim Report. For years 2001 through 2009, and 2011 through 2014, the numbers are interpolated by almost equal growth rates. For years 2016 through 2026, same numbers as year 2015 are employed in order to isolate the targets covered by the Project.

(7) Water consumption

WWT rate will be charged on the basis of consumption of ViK water users. If non ViK water users use only ViK's sewerage, their discharge volumes will become the bases for WWT rate computation. In financial evaluation WWT rate revenues will be calculated on the basis of water consumption. The water consumption is calculated on the basis used in the Interim Report that defines sewage volume as the 90 percent of water consumption.

(8) Water loss

Since the water consumption is calculated from sewage volume, water loss in the network is an irrelevant factor in financial evaluation.

(9) Collection efficiency

The collection efficiencies of 1998 were about 50 percent for domestic users and about 80 percent for non-domestic users. The main reason of the low collection efficiency for domestic users is the fact that considerable number of users are exempted to pay certain amount of water charge and that the Sarajevo Canton Government does not fully reimburse this exempted amount to ViK. These collection efficiencies are assumed to improve as follows:

Year	1998	1999	2000	2001	2002	2003-2026
Domestic user	50%	54%	58%	62%	66%	70%
Non domestic user	80%	82%	84%	86%	88%	90%

(10) Tariff

The current tariff consists of water rate and sewage rate. This sewage rate only covers the use of sewerage system and does not include the final treatment of wastewater. In our financial evaluation, it is assumed that in 2002 when the WWTP restarts, the new wastewater treatment (WWT) rate is introduced. This WWT rate will become the financial source to operate and maintain the WWTP, and repay loans for the Project. In this sense, the water rate and the sewage rate do not seem relevant parameters in the financial evaluation, however, the relevancy exists because those three type of rates are supposed to be collected by ViK in a single bill. Accordingly, the WWT rate should be at a reasonable level in comparison with the water rate and the sewage rate.

Presently, ViK is not even able to recover the operating cost by the rate revenue. Therefore, it is considered inevitable to raise the water rate and the sewage rate. Several reports by the International Community also point out that the tariff should be raised to more than double.¹ The price increase will be affected obviously by governments' fiscal and social policies that are presently uncertain. In the meantime, our financial evaluation assumes that the water rate and the sewage rate for domestic users will be able to increase by 2002 when WWTP will resume the operation. It is also assumed that 2002 onward those rates will increase at the same pace as other prices.

¹ The level of 2.5KM/m³ is suggested in "Water Sector Restructuring and Privatization" - USAID Privatization Project, July 1998. The levels of 2.32KM in 2005 and 3.35KM in 2010 are recommended in "Water Sector Institution Strengthening" - Phare, April 1999.

In terms of the tariff for non-domestic users, currently the same rates are applied to industry, commercial, and institutional users. It is assumed that this rule keeps unchanged. However, the present tariff level for non-domestic users is 2.6 times as large as the domestic users, which represents substantial cross-subsidization from non-domestic users to domestic users. Thus, the increase rate of non-domestic tariff is assumed to be lower than that of domestic tariff.

To sum up, the evolution of future tariff on the basis of year 2000 real price, is shown as follows:

Year	1999	2000	2001	2002-2026
Domestic user				
Water	0.70	0.90	1.20	1.50
Sewage	0.30	0.40	0.55	0.70
Wastewater treatment				0.20
Total	1.00	1.30	1.75	2.40
Non domestic user				
Water	1.82	2.00	2.20	2.50
Sewage	0.78	0.90	1.05	1.20
Wastewater treatment				0.30
Total	2.60	2.90	3.25	4.00

(KM/m³)

(11) Special water fees

The special water fees for water abstraction and water pollution have been introduced in 1999. PCWAs are supposed to collect the fees from some water users. It is still uncertain however, as to whether PCWAs can actually perform the collection and how much the fee will be. It is scheduled that ViK may shortly start paying to PCWA Sava Watershed, 0.09KM/m³ as the special water fees on behalf of the customers concerned. When the payment starts, ViK is likely to be obliged to collect the additional 0.09KM/m³ from the customers concerned, which signifies, from the customers' viewpoints, a rate increase. In our financial evaluation, this possible rate increase is taken into consideration in year 2000.

(12) Inflation

The base year is set to be the year 2000 when the construction starts. In the past few years, the increase rates of net wage have exceeded that of other prices. For example, the average net wage in 1998 increased by 24 percent from the previous year, while the increase rate of retail prices was 5 percent. It is assumed that this increase gap between net wage and other prices will diminish, however, the increase of net wage in real term will continue until 2010.

(13) Average household size

According to the BiH censuses, the household size of BiH was 3.62 in 1991. The estimated household size of FBiH in 1996 was 3.37. Based on the findings of our questionnaire survey in 1999, average household size of samples is 4.07. Interpreting that information, it is assumed that the household size during the Project period remains to be 3.70.

The number of employed person per household is assumed to be 1.5. And we assume that the average household income is the double of net wage because it is not unusual that unemployed or retired person receives pension or other miscellaneous income. In terms of level of combined billing amount of water and sewage for domestic users, roughly 6 percent of household income is generally recognized as a maximum.

(14) Privatization

Privatization of ViK or other modalities of private sector participation to ViK's operation is likely in a few years. It is uncertain, however, as to how WWTP operation will be treated in the future. In our financial evaluation, WWTP operation is isolated from other ViK's operation, thus the privatization is an irrelevant factor. Possible changes in revenue and expenses caused by privatization and other factors are analyzed later in sensitivity analysis.

7.1.2 Result of Financial Evaluation

The FIRR of the Project was computed, using the assumptions previously explained. The result was 5.9 percent. The cash flow stream to compute the Project's FIRR is shown in **Table 7.2**. The cash flow used in FIRR computation does not include the interest payments for loans. This is because if the interest payment is included in FIRR computation, the resultant FIRR cannot be compared with interest rates of available loans.

The implication of FIRR of 5.9 percent is that the Project will be financially viable if the cost of capital does not exceed that percentage. The cost of capital for the Project is considered the interest cost of the foreign loan, plus the foreign exchange loss, plus the interest cost of the domestic loan. If the Project could be fully financed by grants, there would be no interest or foreign exchange loss, thus the cost of capital would be zero. But if the Project is financed by a foreign loan and a domestic loan, and incurs foreign exchange loss through repayment of principal and interest payment for the foreign loan, the cost of capital will comprise the loan interests and the foreign exchange loss.

For example, the cost of capital would be computed at 2.35 percent, when assuming that (1) the 85 percent of the capital investment cost is financed by a foreign soft loan with interest rate of 1 percent; (2) the remaining 15 percent is financed by a domestic loan with interest rate of 10 percent; and (3) there will be no foreign exchange loss incurred. Under this case, the Project will be considered financially sound because there is an enough margin of 3.55 percent between the FIRR of 5.9 percent and the cost of capital of 2.35 percent.

Table 7.2 COMPUTATION OF FIRR

Item	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015-2026
1) WWTP rate revenue from domestic users (000KM/year)		0	0	3,876	4,278	4,451	4,637	4,776	4,919	5,066	5,218	5,374	5,531	5,693	5,859	6,030	6,209
2) WWTP rate revenue from non-domestic users (000KM/year)		0	0	3,079	3,308	3,474	3,703	3,802	3,856	3,959	4,065	4,174	4,283	4,394	4,509	4,626	4,656
3) Capital investment (000KM/year)		34,580	34,580														
4) WWTP direct O&M cost (000KM/year) *				3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263
5) WWTP overhead cost (000KM/year) WWTP rate revenue x 7%				487	531	555	584	600	614	632	650	668	687	706	726	746	761
6) Net cash flow (000KM/year)		-34,580	-34,580	3,205	3,792	4,107	4,493	4,714	4,898	5,131	5,371	5,617	5,864	6,118	6,379	6,647	6,842
7) FIRR =	5.9%	**															

* Depreciation cost is excluded ** FIRR on total project cost, before tax

7.1.3 Financial Sensitivity Analysis

The FIRR may vary when the parameters used in the computation change their values. Therefore, it is worthwhile understanding beforehand, how those parameters affect on the FIRR. In the first stage of sensitivity analysis, the parameters are grouped into two broad categories, namely the benefit and the cost. The benefit includes all cash inflows such as revenue from domestic users and revenue from non domestic users. The cost includes all cash outflows such as capital investment, direct O&M cost, and overhead cost. The sensitivity analysis is performed for combined cases of the cost change and the benefit change. Considering the safety side, the benefit was varied by -20% and -10% . In the same way, the cost was varied by $+20\%$ and $+10\%$. The resultant FIRRs are shown in **Table 7.3**.

Table 7.3 RESULT OF FIRST STAGE OF FINANCIAL SENSITIVITY ANALYSIS

		Benefit		
		0%	-10%	-20%
Cost	0%	5.9%	4.3%	2.5%
	+10%	4.4%	2.9%	1.1%
	+20%	3.1%	1.5%	-0.3%

▨ Viable, if the cost of capital is 2.35%

The situation of the increased cost by 20 percent and the decreased benefit by 20 percent is an extremely conservative case where the FIRR comes out to be the minus 0.3 percent. This case obviously means that the Project is financially unsound. There are two other extremely conservative cases whose financial viability is low if the cost of capital is 2.35 percent as assumed in the previous subchapter. The one is the case when the benefit is decreased by 10 percent and the cost is increased by 20 percent. The FIRR is computed at 1.5 percent. And the other is when the benefit is decreased by 20 percent and the cost is increased by 10 percent. The resultant FIRR is 1.1 percent. Except under those three conservative cases, the Project is regarded as reasonably sound.

As the second stage of the sensitivity analysis, an attempt was made to locate the parameters within the broad category that have an important influence in computation of the FIRR. Because, by doing so, those located parameters can be subjected to special attention. In this analysis, three parameters were highlighted to see their impacts on the project cash flow, namely (1) capital investment cost, (2) operating cost (direct O&M plus overhead costs), and (3) rate revenue. Each of the parameters was varied by given percentages (-30% , -20% , -10% , $+10\%$, $+20\%$, and $+30\%$). If the effect of variation is large, the FIRR or the project viability can be considered sensitive to that parameter. The result is summarized in **Figure 7.1**.

The steepness of each line appeared in **Figure 7.1** indicates the sensitivity of FIRR to each parameter. The rate revenue line is the steepest, meaning that the financial viability of the Project is most sensitive to changes of the rate revenue. If the rate revenue increases by 30 percent, the FIRR will increase by 4.0 percentage points ($= 9.9\% - 5.9\%$). The capital investment cost and the operating cost are almost same in terms of sensitivity to FIRR, however, each of them does not affect the Project's FIRR as much as the rate revenue.

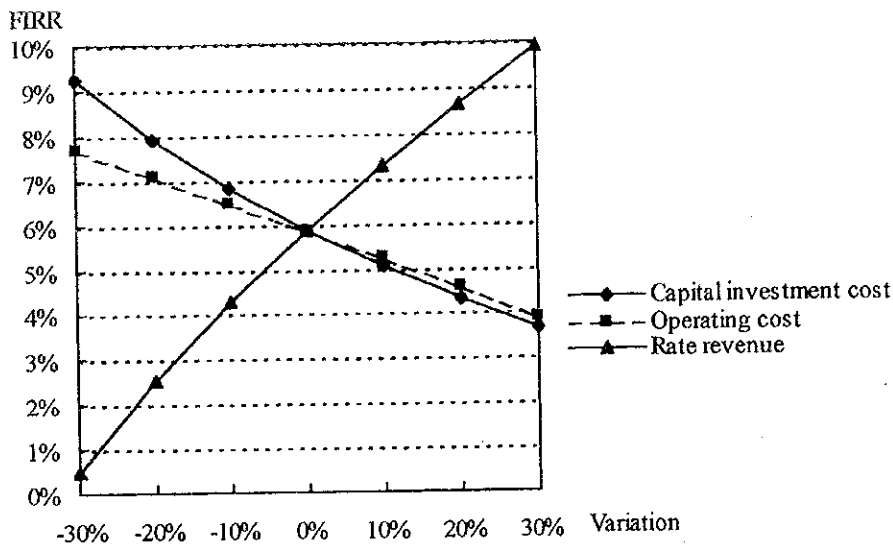


Figure 7.1 RESULT OF SECOND STAGE OF FINANCIAL SENSITIVITY ANALYSIS

Variation	Capital investment	Operating cost	Rate revenue
-30%	9.2 %	7.7 %	0.5 %
-20%	7.9 %	7.1 %	2.5 %
-10%	6.8 %	6.5 %	4.3 %
0%	5.9 %	5.9 %	5.9 %
10%	5.0 %	5.2 %	7.3 %
20%	4.3 %	4.6 %	8.7 %
30%	3.7 %	3.9 %	9.9 %

7.2 ECONOMIC EVALUATION

7.2.1 Economic Benefit

The economic benefit is usually difficult to be quantified. Because benefits like a sense of relaxation or security is intangible and uncountable. However, in our economic evaluation, an attempts to quantify the economic benefit is made, assuming that the benefit is represented by "consumer's surplus", or the aggregated amount which domestic users and non-domestic users are willing to pay for WWTP.

The consumer's surplus of domestic users is estimated at 3.0 KM /month/household. Because according to the findings of the Door-to-Door Survey, the average price that a user is willing to pay for wastewater treatment or environmental protection, was 3.0 KM /month/household. While in the street survey, the price was 4.1 KM /month/household.

The consumer's surplus of non-domestic users is calculated based on the findings of the Non-Domestic User Survey. According to the survey, the industry is willing to pay for WWTP, 42 percentage points on top of existing sewage bill percentage against water bill, which is currently 43 percent. This can be interpreted that the industry is willing to pay for wastewater treatment, up to 85 percent of water bill. Thus, it is estimated that the consumer's surplus is the difference between the 85 percent of the water bill and the wastewater bill during the Project operation

period.

7.2.2 Economic Cost

A primordial difference between the financial evaluation and the economic evaluation of a project is that whether the profitability is judged from the micro-economic viewpoints or macro-economic viewpoints. In the financial evaluation, all the costs incurred for the Project are considered as project costs at actual market values. In the economic evaluation, however, the project cost does not include those simply transferred from one to another party within the same national economy. For example, tax, interest, and subsidy are not regarded as project costs. Furthermore, costs that are distorted from the real economic values, are corrected in the economic evaluation. For example, market prices of unskilled labors when unemployment rate is high or minimum wage requirement exist, are often overvalued from the real economic prices.

In order to correct the distortion, each distorted financial cost is multiplied by a conversion coefficient whose value is usually less than 1. This coefficient varies depending on cost item, however, due to insufficiency of economic data in FBiH, it is difficult to estimate those coefficients. Thus, applying the principle of conservatism, economic costs in our economic evaluation is not corrected downward. As the result, the value of economic cost is regarded same as that of financial cost.

7.2.3 Result of Economic Evaluation

The EIRR of the Project was computed, using the assumptions previously explained. The result is 17.4 percent. The cash flow stream to compute the Project's EIRR is shown in **Table 7.4**.

The EIRR of 17.4 percent is much higher than the FIRR of 5.9 percent, which can justify the realization of the Project. And generally speaking, the EIRR of 17.4 percent can be considered a satisfactory level. Because the economic cost of capital or the economic opportunity cost is rarely exceeds that percentage. However, the Project cannot be really economically prioritized among other projects, until the EIRR of the Project is compared with EIRRs of other projects of similar types or in same areas.

Table 7.4 COMPUTATION OF EIRR

Item	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015-2026
1) WTP of domestic users	3.0 KM/month/household			3,769	3,849	3,930	4,013	4,097	4,184	4,272	4,362	4,454	4,545	4,637	4,731	4,828	4,926
2) WTP of non-domestic users	85% of water rate - sewage rate			10,787	11,333	11,900	12,687	13,025	13,211	13,565	13,928	14,301	14,673	15,054	15,446	15,848	15,953
3) Capital investment (000KM/year)		34,580	34,580														
4) WWTP direct O&M cost (000KM/year) *				3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263
5) WWTP overhead cost (000KM/year)				487	531	555	584	600	614	632	650	668	687	706	726	746	761
6) Net cash flow (000KM/year)		-34,580	-34,580	10,807	11,388	12,012	12,853	13,259	13,518	13,942	14,377	14,823	15,267	15,722	16,189	16,667	16,855
7) EIRR = 17.4%	**																

* Depreciation cost is excluded ** EIRR on total project cost, before tax

7.2.4 Economic Sensitivity Analysis

A sensitive analysis for EIRR is performed by the same reason explained in the sensitivity analysis for FIRR. The combined cases of the cost change and the benefit change are same as in the sensitivity analysis for FIRR. The resultant EIRRs are shown in Table 7.5.

Table 7.5 RESULT OF ECONOMIC SENSITIVITY ANALYSIS

		Benefit		
		0%	-10%	-20%
Cost	0%	17.4 %	15.4 %	13.2 %
	+10%	15.6 %	13.6 %	11.6 %
	+20%	13.9 %	12.1 %	10.1 %

Viablr, if the economic cost of capital is 10%

Since the base case has an already high EIRR of 17.4 percent, under all the combined cases, the resultant EIRR does not drop sharply. If we reasonably assume the economic cost of capital or the economic opportunity cost to be 10 percent, all the cases exceed the hurdle rate. Thus, from the economic point of view, the downside risk of the Project is low.

7.3 TARIFF AND COLLECTION RATE

With the consideration of the financial evaluation that takes into consideration the estimated cost of operation and maintenance, it is recommended that the tariff rate be gradually raised as follows:

Year	1999	2000	2001	2002-2026
Domestic user				
Water	0.70	0.90	1.20	1.50
Sewage	0.30	0.40	0.55	0.70
Wastewater treatment	—	—	—	0.20
Total	1.00	1.30	1.75	2.40
Non domestic user				
Water	1.82	2.00	2.20	2.50
Sewage	0.78	0.90	1.05	1.20
Wastewater treatment	—	—	—	0.30
Total	2.60	2.90	3.25	4.00

(KM/m³)

The collection rate also needs improvement as the socio-economic situation is to be rehabilitated. The recommended schedule is as follows:

Year	1998 actual	1999	2000	2001	2002	2003 - 2026
Domestic user	50%	54%	58%	62%	66%	70%
Non domestic user	80%	82%	84%	86%	88%	90%

Assumption :

85% by Foreign Yen Loan with Interest Rate of 1%
 15% by Domestic KM Loan with Interest Rate of 10%
 Future KM / Yen Exchange Rate : 70 Yen = 1 KM
 Tax Rate : 30%

Table 7.4 SOURCES AND USES OF CASH

(Unit: 000 KM)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	
1 Cash received from:																													
2 Foreign loan	29,333	29,333																										58,786	
3 Domestic loan or subsidy	5,187	5,187																										10,374	
4 WWTP rate revenue from all users			6,955	7,586	7,924	8,340	8,577	8,775	9,026	9,283	9,548	9,814	10,087	10,368	10,650	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	247,321
5 Cash used for:																												69,160	
6 Capital investment	34,580	34,580																										81,572	
7 WWTP direct O&M cost			3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	17,312	
8 WWTP overhead cost			487	531	555	584	600	614	632	650	668	687	706	726	746	761	761	761	761	761	761	761	761	761	761	761	761	761	43,494
9 Tax payment			270	292	302	314	326	338	350	362	374	386	398	410	422	434	446	458	470	482	494	506	518	530	542	554	566	578	32,332
10 Repayment of foreign loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11 Foreign loan interest	147	441	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	12,614	
12 Foreign exchange loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13 Repayment of domestic loan	0	519	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	1,037	10,374	
14 Domestic loan interest	259	752	934	830	726	622	519	415	311	207	104	26																5,706	
15 Cash balance	-406	-1,712	376	545	529	897	1,156	1,386	1,555	1,927	1,228	1,032	1,774	1,977	2,184	2,340	2,358	2,379	2,399	2,418	2,438	2,457	2,477	2,497	2,516	2,536	2,555	43,916	

Table 7.5 FOREIGN LOAN REPAYMENT SCHEDULE

(Unit: JP Yen Million)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	Total	
1st year																																											
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12th year																																											
13 Foreign exchange rate JP Yen / KM	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	

*40 years loan, including 10 years' grace with interest rate of 1% p.a.

Table 7.6 DOMESTIC LOAN REPAYMENT SCHEDULE

(Unit: 000 KM)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
1st year													
2 year													
3rd year													
4th year													
5th year													
6th year													
7th year													
8th year													
9th year													
10th year													
11th year													
12th year													

*10 years loan with interest rate of 10% p.a.

Assumption :

85% by Foreign Yen Loan with Interest Rate of 1%
 15% by Domestic KM Loan with Interest Rate of 0% (=Grant)
 Future KM / Yen Exchange Rate : 70 Yen = 1 KM
 Tax Rate : 30%

Table 7.7 SOURCES AND USES OF CASH

(Unit: 000 KM)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	
1 Cash received from:																													
2 Foreign loan - Capital invest x 85%	29,393	29,393																										58,786	
3 Domestic loan or subsidy	5,187	5,187																										10,374	
4 WWTP rate revenue from all users			6,955	7,586	7,924	8,340	8,577	8,775	9,026	9,283	9,548	9,814	10,067	10,368	10,656	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	10,865	247,321
5 Cash used for:																													
6 Capital investment	34,580	34,580																										69,160	
7 WWTP direct O&M cost			3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	3,263	81,572
8 WWTP overhead cost			487	531	555	564	600	614	632	650	668	687	706	726	748	761	751	761	761	761	761	761	761	761	761	761	761	761	17,312
9 Tax payment Tax rate = 30%			270	292	302	314	326	338	350	362	374	386	398	410	422	434	446	458	470	482	494	506	518	530	542	554	566	578	43,494
10 Repayment of foreign loan																													
11 Foreign loan interest	147	441	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	588	12,614
12 Foreign exchange loss																													
13 Repayment of domestic loan																													
14 Domestic loan interest																													
15 Cash balance	-147	-441	2,347	2,412	2,287	2,557	2,712	2,841	3,004	3,172	2,369	1,577	1,774	1,977	2,184	2,340	2,559	2,379	2,399	2,418	2,438	2,457	2,477	2,497	2,516	2,536	2,555	59,998	

Table 7.8 FOREIGN LOAN REPAYMENT SCHEDULE

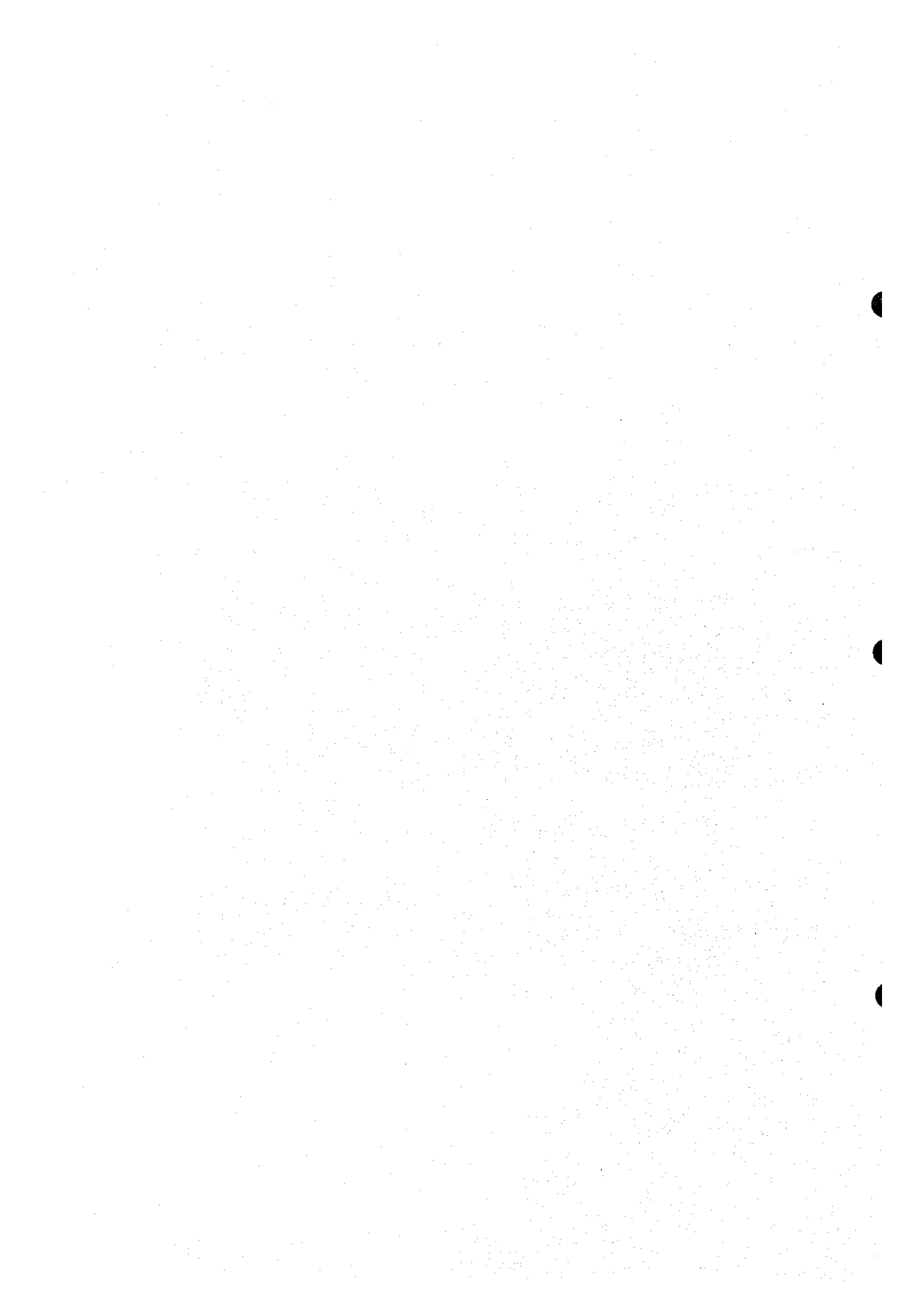
(Unit: JP Yen Million)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	Total				
1st year																																														
2 year																																														
3 borrowing																																														
4 Repayment																																														
5 interest payment																																														
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10 Total																																														
11 Borrowing																																														
12 Repayment																																														
13 interest payment																																														
14 Foreign exchange rate JP Yen / KM																																														

*40 years loan, including 10 year's grace with interest rate of 1% p.a.

**CHAPTER 8. ENVIRONMENTAL IMPACT
ASSESSMENT (EIA)**





CHAPTER 8 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

8.1 GENERAL

In this chapter, environmental impacts and countermeasures are described for the proposed Proper Plan for rehabilitation. Brief description of the relevant laws and regulations as well as their future direction is also provided. Relevant data are shown in **Appendix N**.

8.2 LEGISLATIVE FRAMEWORK AND FUTURE DIRECTION

8.2.1 Existing Laws and Regulations

Currently there are no laws or regulations on environment which deals specifically with environmental impact assessment. Following is a brief description of the laws related to environment with respect to this Project.

(1) Water Law

Water Law of federation was enacted in 1998 and entrusted licensing of water abstraction and wastewater discharges to PCWA (Public Company for Watershed Area). Two PCWA's, one for Sava Basin and the other one for Adriatic Sea was established but have not commenced functioning fully with all the responsibilities entrusted by the law. Approval obtained during pre-war period for treated wastewater discharge to Bosna river at BOD₅ and SS concentrations of 20 mg/L and 30 mg/L which was the original design criteria still holds.

(2) Classification of Water Courses

Decree on Classification of Waters (Official Gazette of SRBH, No. 2/67, 1980) enacted during pre-war era, use four categories for water courses based on their use. According to this classification, Miljacka River and Bosna River downstream of WWTP are classified as Category III while upstream of both rivers are classified as Category II.

(3) Industrial Effluent Standard for Discharge to Public Sewerage System

This law for Sarajevo City was enacted following the construction of Sarajevo WWTP prior to winter Olympics. **Appendix N** shows the standards.

(4) Air Pollution and Noise

Canton Sarajevo has enacted a law on air pollution in 28 May 1999. Air quality standards and emission standards for stationary sources such as generators/boilers are specified. Standard for hydrogen sulphide is $7 \mu\text{g}/\text{m}^3$. Regards to gas engines where methane gas from the digester will be used and CO₂, SO₂ and NO₂ will be released to the atmosphere. **Appendix N** shows the air quality standards.

Regarding the noise, next to the WWTP Rajlovac military base and airfield is located north-east of WWTP and the land use around is agricultural. Therefore, special consideration to noise is not made as the noise levels within WWTP will be designed considering the health of workers.

8.2.2 Proposed Laws and Their Direction

Following are the excerpts from the Final Report of the Water Sector Institution Strengthening Project which sets out the basis of future direction of water sector.

(1) Environmental Protection Law (proposed)

Water Sector Institution Strengthening Project (1999) proposed that the Water Law is repealed and replaced by a new law on Environmental Protection by 2002. It will set guidelines for the drafting of environmental sector laws. Laws regard to water and solid waste management are considered to be urgently needed. International assistance is to be provided through the EU Environment Programme. It calls for establishment of River Basin Bodies which shall be responsible for all regulatory and enforcement functions in the water and environment sector.

It also proposed establishment of the Ministry of Environment and Water Management integrating the responsibilities held by Ministry of Agriculture, Water Management and Forestry and Ministry of Physical Planning and Environment.

(2) Law on Solid Wastes Management (proposed)

An EU Project on Solid Waste Management Plan has been initiated. This Project will deal with the necessary legislation required.

(3) Other Aspects

Basic policy adopted in the preparation of laws and regulations is towards achieving EC standards. Therefore, EC directives and trends are considered in this study especially for standards on sludge disposal, industrial effluent discharge etc.

8.2.3 Environmental Administration

Ministry of Physical Planning and Environment is responsible for environmental administration at the federation level and Ministry of Reconstruction, Development and Environmental Protection at the Sarajevo Canton. Meetings were held to brief the project details and for preliminary preparations for project approval. It was indicated that approval will be required only for additional facilities and not for the reconstruction of existing facilities.

8.3 MAJOR IMPACTS AND COUNTERMEASURES

The screening and scoping were carried out according to JICA Guidelines for sewerage projects, with the following identified as major impacts. It should be noted that the project involves rehabilitation and re-commissioning of WWTP without any increase in capacity as in the previous operation before war. The major impacts are:

- Pollutant load reduction (positive impact)
- Sewage sludge generation and disposal
- Industrial wastewater discharge to sewerage system
- Odour generation

Only minor impacts are expected during construction, as demolition and excavation work is very

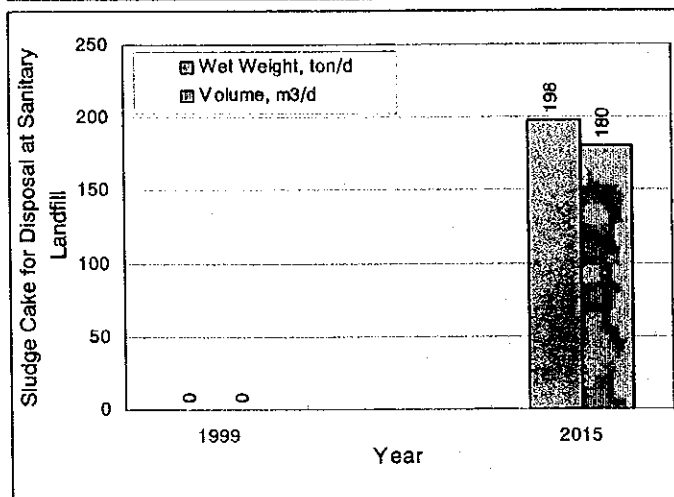
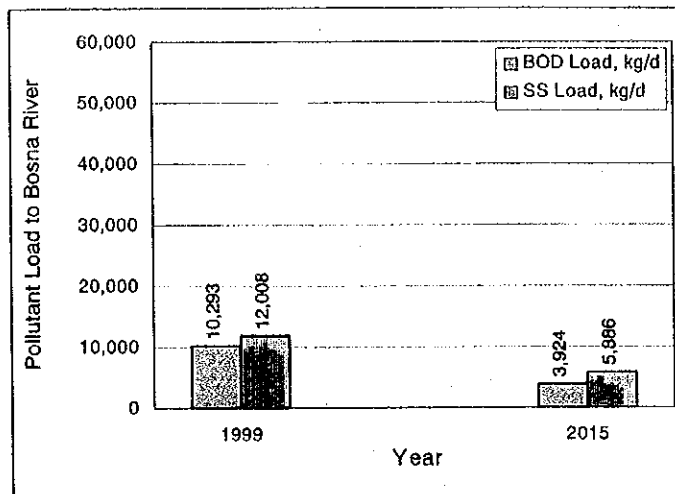
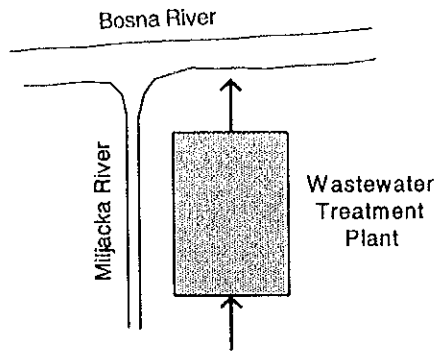
minimal. Most of the civil work involves repair of cracks and improvement of the surface of concrete walls.

8.3.1 Pollutant Load Reduction

Major positive impact of the project is the reduction of pollutant load discharged into Miljacka River/Bosna River. **Figure 8.1** shows the estimated reduction of pollutant load discharged into Miljacka River/Bosna River in the year 2015 with the implementation of the project. This will benefit greatly in the improvement of water quality to Bosna River downstream of WWTP.

It should be noted that the effluent quality criteria adopted at 20 mg/L BOD₅ and 30 mg/L SS, which is the same as the original design criteria is appropriate for rehabilitation. Any further improvement on effluent quality of WWTP need to be weighed against improvements required in the sewer network to prevent direct discharges and overflows into Miljacka River within Sarajevo City (Discussion in Supporting Report : **Appendix N**).

With Project



Without Project

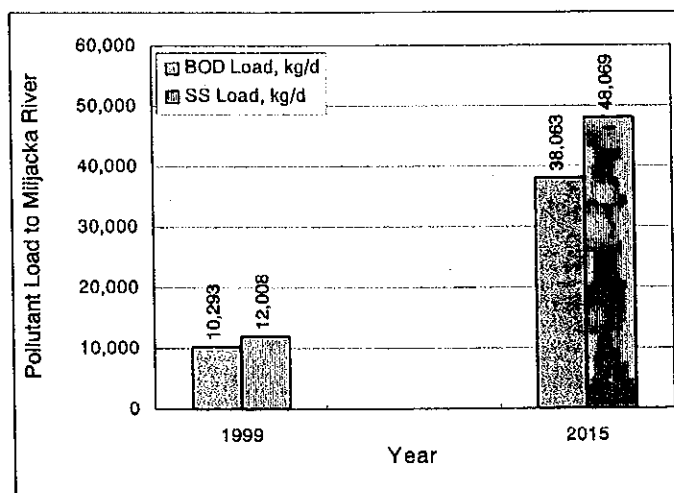
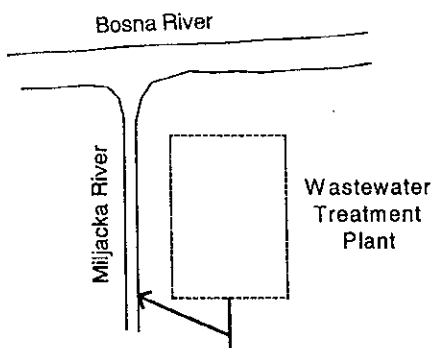


Figure 8.1 POLLUTANT LOAD REDUCTION AND SLUDGE CAKE GENERATION WITH THE PROPOSED PROJECT

8.3.2 Sewage Sludge Generation and Disposal

(1) Quantity and Quality of Sludge Cake

Sludge cake for disposal is expected to have 25% of solids with a specific gravity of 1.1. **Table 8.1** shows the estimated amount of sludge cake for final disposal.

Table 8.1 ESTIMATED SLUDGE CAKE GENERATION

Year	Volume, m ³ /day	Wet Weight, ton/day
2000	107	118
2015	180	198

(2) Disposal Site

The disposal site at Buca Potok is located approximately 10 km by road from the WWTP (**Figure 8.2**). The Landfill which was an open dump for the last 30 years is currently being transformed into a sanitary landfill. Its area is 65 hectares and is planned for expansion. Soil layer beneath the landfill is clay eliminating concerns of groundwater pollution. Under the transformation project, stormwater and leachate collection drains have been constructed following holding tanks for each. The collected stormwater and leachate are discharged into Lepenica stream, which flows into Bosna River. Boreholes for collection and burning of methane gas have also been provided. Phase I of the project is funded by EU and is nearing completion. According to Cantonal Public Municipal Enterprise (RAD) landfill site has sufficient capacity until year 2010 and steps are being taken to expand the landfill area.

In 1999, average quantity of solid waste disposal was 500 metric tonnes per day. Due to large amount of demolitions in Sarajevo, an additional amount of 700 metric tonnes of construction debris also being dumped during summer months. These demolition material serves as daily cover.

(3) Assessment of Impact

Major impact of sludge cake disposal is the quantity of sludge cake. With respect to quality of sludge cake for disposal, design values are 24% of solids and this was achieved when the WWTP was operating which is satisfactory although there are no limits on water content of cakes at present. Toxic materials such as heavy metals can be expected to be within limits with control of industrial wastewater discharges. For example, **Table 8.2** compares the content of sludge cake in

1988 which is favorable for agricultural reuse by EC directives, which can also be considered favorable for landfill disposal which has clay strata underneath.

Table 8.2 COMPARISON OF HEAVY METALS CONTENT OF SLUDGE CAKE WITH EC STANDARDS

Parameter	Sludge Cake (1987) ¹	EC Directive ² 86/278/EEC Appendix 1B
Zinc (Zn), mg/kg	2,956	2,500 – 4,000
Manganese (Mn), mg/kg	436	
Lead (Pb), mg/kg	98	75 - 1200
Copper (Cu), mg/kg	248	1,000 – 1,750
Cadmium (Cd), mg/kg	5.5	20 - 40
Nickel (Ni), mg/kg	94	300 - 400
Chromium (Cr), mg/kg	56	1,000 – 1,500
Cobalt (Co), mg/kg	12	
Mercury (Hg), mg/kg		16 - 25

*1 – Distribucija teških metala između čvrste i tečne faze muljeva postojenja za otpadne vode u sarajevu – Dr. Esma Velagic Habul & Zlatko Hofman, (average value of three determinations).

*2 - Sludge boundary values for agricultural reuse.

To control toxic materials, such as heavy metals, stringent industrial effluent standards for discharge into public sewerage system is expected to be implemented. When the WWTP is re-commissioned, WWTP sludge cake can be monitored for controlling toxic materials as discussed in the next section.

To reduce the sludge cake quantity for disposal, agricultural reuse, composting with municipal refuse or incineration can be used. Implementation of these options will require further investigation following the re-commissioning of WWTP. Disposal alternatives together with that of municipal solidwastes will need to be considered in the management of solidwastes. The study named “Nation-wide Solid Wastes Management Strategy for Bosnia and Herzegovina” has been initiated and will deal with this issue. ViK need to coordinate with the Cantonal Public Municipal Enterprise (RAD) in this issue for further action.

8.3.3 Odour Generation and Control

When the WWTP was in operation there was no complaints of odour as WWTP is located in the plain of Butila around which the landuse is mainly agricultural and industrial warehouse. Spreading of fresh cow-dung is practised in the agricultural land next to WWTP. Under these conditions odour generation at WWTP is unlikely to cause nuisance in the short-term. Therefore, covering of existing facilities and odour treatment of foul air will not be provided under this Project. Odour control will be through good housekeeping and by providing green-belt around the WWTP which exists partially.

In the operation and maintenance, good housekeeping should be provided especially at screens, grit removal/storage, and at sludge dewatering / sludge storage facility through strict adherence to operational procedures.

However, pretreatment facility and sludge dewatering facility which are the main sources of odour will be re-built under this project. Odour-control facilities for these are planned and can be built when stricter controls become necessary in the future.

8.3.4 Industrial Wastewater Monitoring and Control

Industrial wastewater monitoring and control is necessary for protecting biological processes of WWTP as well as for reuse of sludge cake such as in agriculture. During pre-war period, monitoring of industrial wastewater was done at the Main Laboratory (building No. 25) by Zavod za Vodoprivredu which is now a private company. At this time of transition, institution to carry out this task has not yet been established. Implementation of this task need to be carried out by ViK. Sampling and analysis can be entrusted to Vodoprivreda or other certified institutions.

With regards to industrial effluent standard for discharge in to sewerage system, review of the existing standards with respect to heavy metals and toxic materials as proposed in the Long-term Solutions for Water Supply, Drainage and Sewerage Study is necessary. With respect to organic matter, treatment level to the quality of raw sewage is acceptable.

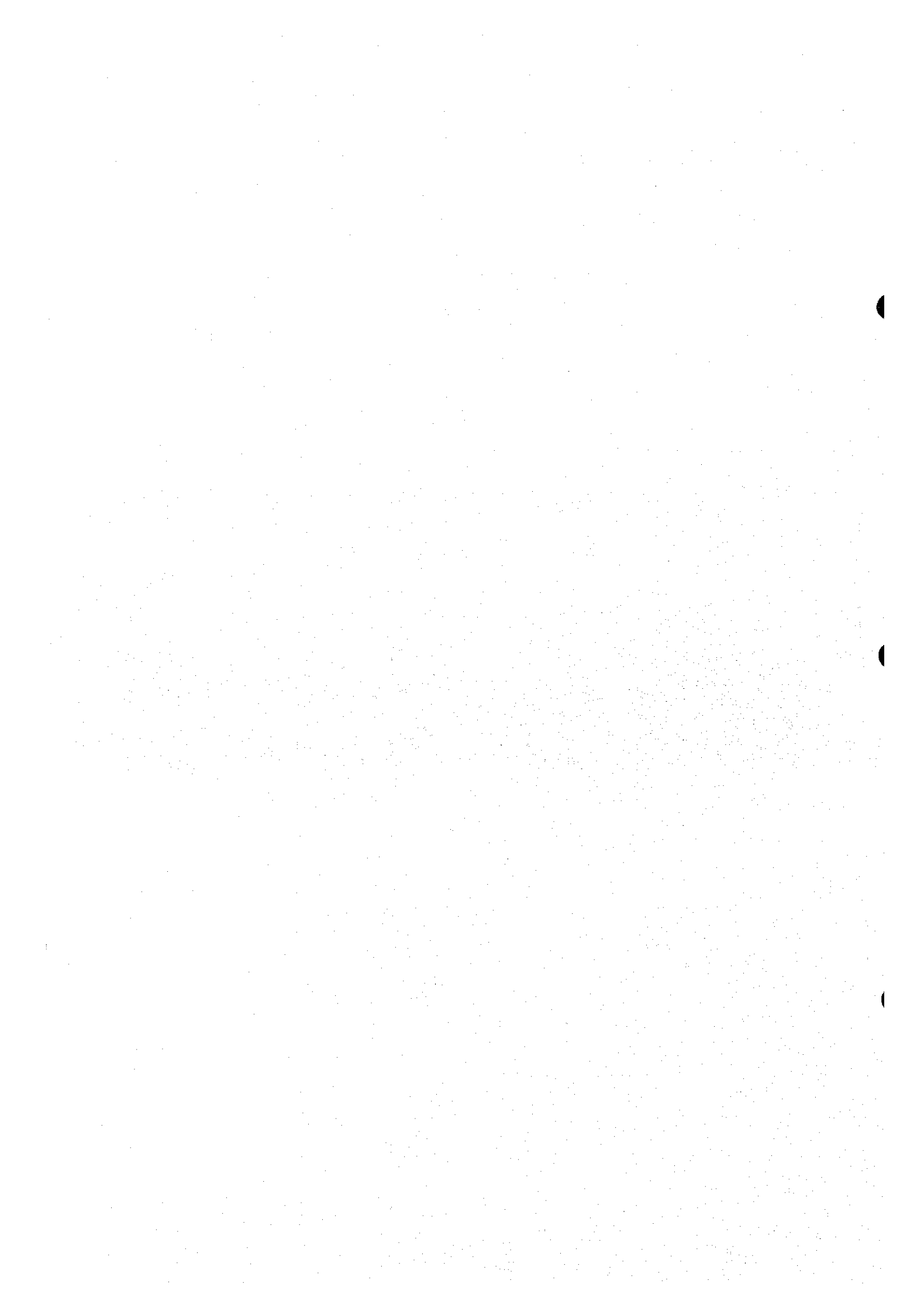
8.4 RECOMMENDATIONS

Rehabilitation and re-commissioning of WWTP will greatly reduce the pollutant loads discharged into Miljacka River and Bosna River. As discussed in the previous sections, there are impacts which need to be minimised by taking countermeasures. Following is a summary of countermeasures :

- (1) Monitoring of sludge for toxic materials
- (2) Monitoring and control of industrial wastewater
- (3) Establishing a continuous green belt around the perimeter of the WWTP
- (4) Training and practising of good house-keeping procedures in grit and sludge handling
- (5) Improvement of sewer network to prevent direct discharges and overflows into rivers

CHAPTER 9. CONCLUSION AND RECOMMENDATION





CHAPTER 9. CONCLUSION AND RECOMMENDATION

9.1 CONCLUSION

(1) Basic Concept of the Project

Primarily, this Feasibility Study was conducted on the concept of rehabilitating the WWTP by bringing it back to the pre-war condition. Therefore, each facility including mechanical and electrical equipment was assessed in order to bring back these to the pre-war capacity or condition. Based on the results of assessment, preliminary designs have been done.

(2) Assessment Works

The First and Second field assessment of the WWTP has identified the following matters:

- 1) If the Project is implemented, the treatment capacity of the WWTP may return to the condition before the War and can correspond to the planned sewage volume in 2015.
- 2) It became clear that after the calculation model the civil and architectural structure of the wastewater treatment facilities has sufficient capacity. Repairs of construction joints, expansion joints, reinforced concrete protection, partial structural reinforcement are required. It is also concluded that most of the existing mechanical equipment can be used provided that cleaning, overhauling, and replacement of damaged and missing parts are done. Moreover, it is impossible to use electric facilities at all.
- 3) From the point of view of structural aspects, the sludge treatment facilities can be utilized provided that appropriate repair measures are applied in the same manner as the wastewater treatment facilities. Except for a total replacement of the sludge dehydration and boiler facilities, most of the existing mechanical equipment can be used provided that cleaning, overhauling and replacement of damaged and missing parts are done. However, total replacement of the electrical equipment is required.

(3) Alternative Rehabilitation Plan

Based on the assessment work, alternative rehabilitation plans are discussed and the most appropriate method was selected as follows:

1) Aeration Method Alternative

In order to determine the most appropriate aeration method of an activated sludge

treatment process, aeration system using surface aerators and diffused air system were compared. The great difference in both the methods is the electric power consumption. Although the higher power consumption of the surface aerators could be offset by the biogas available for power generation, the cost of retrofitting the existing aeration tank to accommodate the diffused air system is prohibitive. Therefore, the use of the existing surface aerator is the most suitable option for the Project.

2) Comparison of Sludge Treatment Process Alternatives

A comparison between the existing anaerobic digestion and the direct sludge-dewatering process is carried out. In terms of the volume of the generated sludge cake for disposal in consideration with the existing condition of the landfill and future regulations, the existing method is preferable. Besides, anaerobic digestion generates electricity, which is utilized in the operation of the WWTP.

(4) The WWTP Rehabilitation Project and Costs

Based on the assessment work, the fundamentals for WWTP rehabilitation were formulated as follows:

- 1) Installation of new pre-treatment and pre-screening facilities that will remove heavier grit particles before they are lifted by the screw pumps.
- 2) Existing facilities would be basically rehabilitated and improved to bring them back to the pre-war condition.
- 3) All mechanical equipment and electric facilities, except some parts of the clarifiers would be newly replaced.
- 4) As an architectural work, a new boiler room and generator building will be constructed, and the others will be rehabilitated.

Based on these improvement fundamentals, the preliminary design of the Project is formulated with the estimated cost as follows:

- a) The Total Project Cost is estimated at DEM 76 million, consisting of the construction cost, and engineering plus contingency cost at DEM 64 million and DEM 12 million, respectively.
- b) Annual O&M cost is estimated at about DEM 6.1 million.

(5) Economic and Financial Evaluation

Economic and financial evaluation is done with some assumptions in consideration with preliminary design and estimation, and O&M cost. The calculation shows Financial Internal Rate of Return (FIRR) of 5.9 %. The result indicates that the Project is feasible as a loan project, provided that revenue collection will be improved by raising tariff rates. The economic benefit of the Project is justified by the calculation of the Economic Internal Rate of Return (EIRR), which is 17.6 %. According to the result of questionnaire survey done on the domestic and non-domestic water uses in Sarajevo, recognition on the improvement of the environment and the water quality of Bosna and Miljacka Rivers was considerably high. The survey resulted to a relatively high amount of Willingness To Pay (WTP) at KM 3.0 to 4.1 per household per month.

(6) Environmental Impact Assessment (EIA)

The start up of the rehabilitated WWTP may give some environmental impact, with the following countermeasure will be effective.

- 1) It is important to reduce the quantity and weight of precipitated sand and dewatered sludge cake for disposal. The compost treatment is a good option.
- 2) To discharge the industrial wastewater into the sewerage system would require the establishment of discharging standards and necessity pre-treatment facilities before disposal into the system.
- 3) Disinfection by chlorination is designed to satisfy future environmental regulation on fecal coliform.

9.2 JUSTIFICATION

(1) Co-ordination with the Bosnian Development Plan

As mentioned in **Chapter 3**, the role of Japan's Official Development Assistance (ODA) is clear in "Priority Reconstruction Projects". Based on the framework of the plans, it is also clear that the WWTP rehabilitation plan is an effective project in cooperation with related projects implemented by other donor countries. Since other international organizations and donor countries have also indicated the same recognition, the implementation of the WWTP Rehabilitation is highly desired.

(2) Effect of Sewage Treatment on Environment Improvement

After completion of the Project, treated effluent will generate about 20 mg/l of BOD₅ and about 30 mg/l of SS, which are the discharging standards into the Bosna River. This condition will contribute towards the environmental of the Danube River.

The implementation of the project will likewise improve the water quality of the Milijaka River and the sanitary and environmental conditions of Srajevo. It would be possible that more houses and industries will be connected to the system as the sewerage area expands.

(3) Environmental Regulation

The population is expected to increase up to 40% and the economic situation to recover back to the pre-war level by year 2000. In such a situation, it is possible for BiH to be obligated to follow the strict European Standards on wastewater discharge into receiving waters. Hence, the long-term project plan toward 2015 is proposed in this report.

9.3 RECOMMENDATION

(1) Recommendation for Total Plan

In order to meet the environmental requirement and wastewater quality and volume for 2015 upgrading of the treatment plant facilities will be necessary. The followings are recommended for the Long - Term Plan.

1) Expansion of the Final Sedimentation Tank

By the year 2015, two additional Final Sedimentation Tank will be necessary to follow the German Standard for surface loading rate, which attains its peak during rainy season. The capacity and other technical data on the two proposed tanks will be the same as the existing one. These will be constructed north of the existing facility as shown on **Drawing G-1**, of the Preliminary Design Drawings.

2) Chlorination System

The fecal coliform count on the effluent will be possibly regulated by year 2015. Therefore, disinfection by chlorination is proposed as a countermeasure. This future standard (FC = 200/100 ml) can be attained by a chlorine dosage of 8 mg/l.

3) Odour Control Measure

Considering a safe, sanitary and environmentally friendly working condition, odour treatment will be necessary in the existing and proposed preliminary treatment facilities.

(2) Human Resources Development

It is strongly recommended to assign process engineers, maintenance engineers and water quality specialist in the operation of the WWTP. A consistent program for human resources

development and training is indispensable based on the Mid-Term Plan.

(3) Outsourcing of Operation and Maintenance

The contract with constructors of the Project should include the training program of local staffs for operation and maintenance during the first year of the WWTP operation. Thereafter, it is recommended to have partial outsourcing on manpower contract for the operation and maintenance.

Since the WWTP operate as a system, following strongly the daily routine work and schedule, operation and maintenance manual are especially important for improvement of the treatment efficiency.

(4) Increase in Tariff and Collection Rate

With the consideration of financial and economic evaluation, and the cost of estimated operation and maintenance, it is recommended to raise the wastewater tariff rate gradually by the year 2002 to the following level.

Domestic Users : 0.7 + 0.2 (for WWTP) KM/m³

Non-Domestic Users : 1.2 + 0.3 (for WWTP) KM/m³

The collection rate is currently about 50% for domestic users and 70% for non-domestic users. As the socio-economic situation is to be rehabilitated, the collection rate should be improved up to 70% and 90% respectively by the year 2003.

(5) Promotion for the Implementation of the Project

This study project is a part of the Japan ODA pledged in 1996 to support the reconstruction of BiH. The realization of this WWTP rehabilitation project is highly desired for supporting and promoting the effort of reconstruction.

It is indispensable for the responsible institutions to take necessary actions for the realization of the projects.







JICA