

**FILE COPY**

Report No. 1167-YU

# Appraisal of Sarajevo Water Supply and Sewerage Project Yugoslavia

May 7, 1976

Regional Projects Department  
Europe, Middle East and North Africa Regional Office

**FOR OFFICIAL USE ONLY**



**Document of the World Bank**

---

This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not otherwise be disclosed without World Bank authorization.

### CURRENCY EQUIVALENTS

Currency Unit = Dinar (Din)  
US\$ 1.0 = Din 18.0  
Din 1.0 = US\$0.055

### WEIGHTS AND MEASURES

Kilometer (km)	0.62 mile
Square Kilometer (km <sup>2</sup> )	0.386 square mile
Hectare (ha)	2.47 acres
Millimeter (mm)	0.03937 inch
Centimeter (cm)	0.3937 inch
Meter (m)	39.37 inches
Cubic Meter (m <sup>3</sup> )	264 US gallons
Cubic Meters per second (m <sup>3</sup> /sec)	22.8 million US gallons/day
Liter (l)	0.264 US gallon
Liters per second (l/sec)	22,800 US gallons/day
Liters per capita per day (l/cd)	0.264 US gallon/capita/day
Milligram per liter (mg/l)	1.0 parts per million

### GLOSSARY OF ABBREVIATIONS

BIH	=	Bosna i Hercegovina (Republic of Bosnia and Herzegovina)
VODOVOD	=	Preduzece Vodovod i Kanalizacija Sarajevo
SFRY	=	Socialist Federal Republic of Yugoslavia
SAS	=	Social Accounting Service

### VODOVOD'S Fiscal Year

January 1 to December 31

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
TABLE OF CONTENTS

	<u>Page No.</u>
SUMMARY .....	i-iii
I. INTRODUCTION .....	1
II. THE SECTOR .....	2
III. THE PROJECT AREA .....	3
A. Background .....	3
B. Water Supply .....	4
C. Sewerage .....	4
IV. THE PROJECT .....	6
A. Objectives .....	6
B. Description .....	6
1. Water Supply .....	6
2. Sewerage .....	7
C. Status of Engineering .....	8
D. Cost Estimates .....	8
E. Financing Plan .....	11
F. Implementation .....	12
G. Disbursements .....	13
H. Environmental and Health Impacts .....	14
V. THE PROJECT ENTITY .....	14
A. Background .....	14
B. Organization and Management .....	14
C. Operation .....	15
D. Accounts .....	16
E. Audit .....	16
F. Insurance .....	17

This report was prepared by Messrs. W. Hayden, A. Al-Khafaji, R. Saunders and J. Lowther.

This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not otherwise be disclosed without World Bank authorization.

TABLE OF CONTENTS (Continued)

Page No.

VI.	FINANCE .....	17
	A. Background .....	17
	B. Past Performance and Present Position .....	17
	C. Tariffs .....	17
	D. Future Performance .....	18
VII.	BENEFITS AND JUSTIFICATION .....	19
	A. Water Supply .....	19
	B. Sewerage .....	20
	C. Water Supply and Sewerage Tariffs .....	20
XIII.	AGREEMENTS REACHED AND RECOMMENDATION .....	21

ANNEXES

1. The City and Its Organization
2. Existing Water Supply and Sewerage Facilities
3. Projections of Population, Water Production, Water Sales and Water Losses
4. Description of the Project
5. Forecast Cost Estimates
6. Construction Schedule
7. Estimated Schedule of Disbursements
8. Organization Chart of **Preduzece Vodovod i Kanalizacija Sarajevo**
9. Income Statements - Water Supply
10. Income Statements - Sewerage
11. Consolidated Income Statements
12. Cash Flow Statements
13. Balance Sheets
14. Assumptions for Financial Forecasts
15. Water Supply and Sewerage Tariffs
16. Justification
17. Indicators

MAPS

- IBRD 11458R - Water Supply System
- IBRD 11459R - Sewerage System

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT

YUGOSLAVIA

SUMMARY

i. Sarajevo is the Capital and economic center of the Republic of Bosna i Hercegovina, one of the less developed Republics in Yugoslavia. The city is located in the narrow valley of the Miljacka River at an altitude ranging from about 500 to 700 meters above sea level. The climate is continental characterized by hot summer, severe winter and large diurnal temperature differences.

ii. Large scale migration from the surrounding areas took place in the post-war period and the city's population increased threefold to over 300,000 during the last thirty years. However, investment in infrastructure did not keep pace with the city's growth and Sarajevo is presently faced with overstrained public utility services, water shortages and high levels of water pollution.

iii. Most of the water distribution pipes are small and in the old part of the city they are badly corroded. Over one third of the water produced is unaccounted-for. This is attributed to the age of a considerable part of the distribution system and high system pressure in parts of the city resulting from incomplete separation of pressure zones.

iv. Domestic sewage, hospital and industrial wastes are discharged directly into the Miljacka River without treatment or disinfection. During the summer, the Miljacka has the characteristics of an open sewage canal as the sewage flow is about three times the river's minimum flow. A more serious problem, however, is the infiltration of sewage into the corroded water supply pipes. This has resulted in several epidemics of diarrhea and hepatitis in recent years.

v. The proposed project aims at improving the water supply facilities and abating the water pollution in Sarajevo. The project comprises rehabilitation and expansion of the water supply and sewer systems and construction of a sewage treatment plant. The project is estimated to cost US\$95.7 million of which US\$38.5 million (40%) is foreign exchange. The project components are the least cost solution chosen from various alternatives to meet the project objectives.

vi. The proposed Bank loan of US\$45.0 million would be lent to Preduzece Vodovod i Kanalizacija Sarajevo (Vodovod) for a period of 25 years including 5 years grace. The loan would provide about 47% of the project costs or 98% of the foreign exchange cost including interest during construction on the Bank loan. The balance of the financial requirements would be met by internal cash generation, local loans and capital contributions.

vii. Expenditure by the City Assembly of Sarajevo and Vodovod for preparation of feasibility studies, final designs and tender documents amounting to about US\$1.5 million is expected to be incurred prior to loan signature. Retro-active Bank financing of not more than US\$750,000 is proposed.

viii. Material and equipment estimated to cost more than US\$200,000 will be procured after international competitive bidding in accordance with the Bank Group guidelines. For purpose of bid comparison, it is proposed that qualified domestic manufacturers of these goods will be given a margin of preference of 15% or customs duties, whichever is lower. Civil works contracts estimated to cost more than US\$500,000 will be awarded after international competitive bidding in accordance with Bank Group guidelines. The other equipment supply and civil works contracts would be awarded on the basis of competitive bidding advertised locally and in accordance with procedures of the Socialist Federal Republic of Yugoslavia which are satisfactory. Most major equipment supply and civil works contracts are expected to be won by Yugoslav firms; contracts for specialized equipment for the sewage treatment plant are expected to be awarded to foreign contractors.

ix. Project construction is expected to begin in late 1976 and to be completed in 1980. Vodovod will be responsible for carrying out the project. However, the Institute for Construction of the City has been designated to coordinate construction of the project works and the natural gas system, being installed simultaneously and partially financed by IBRD, to ensure a minimum disruption of the normal commercial life of the city. Consultants have been appointed to assist in final design, procurement and construction supervision.

x. Vodovod is a financially autonomous enterprise and has been profitable since its establishment. In 1973, Vodovod earned an overall rate of return on net fixed assets of 9.2% which increased to 13.1% in 1974. Its main financial problem has been its inability to generate or borrow sufficient funds to expand the system to meet the rapidly growing demand.

xi. The City Assembly has approved in principle tariff increases of 200% and 400% for water supply and sewerage respectively between 1973 and 1980. Vodovod will earn a rate of return on net fixed assets during the project construction period averaging about 13% and will provide about 30% of the financing requirements from internal cash generation.

xii. The benefits associated with the provision of a reliable supply of safe water and adequate sewage collection and disposal are partially revealed by the savings in medical costs, increased productivity, general improvement in individual well being, greater recreational possibilities and other associated economic and health benefits. Using incremental revenues at 1976 tariffs as a measure of benefits, the internal economic rate of return for the water supply investment is about 15.6%. The proposed average water supply and sewerage tariff during the project construction period of Din 6.8 per m<sup>3</sup> in real terms compares favorably with the long term incremental costs of providing these services at a discount rate of 8%.

xiii. Agreement having been reached on the principal issues, the project is suitable for a Bank loan of US\$45.0 million to Preduzece Vodovod i Kanalizacija Sarajevo with the guarantee of the Socialist Federal Republic of Yugoslavia. In view of the five-year construction period an appropriate term for the loan is twenty five years including five years grace.



APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA

I. INTRODUCTION

1.01 The Government of the Socialist Federal Republic of Yugoslavia (SFRY) has requested a Bank loan to help finance a project to abate the water pollution and to improve the supply of safe water in Sarajevo, capital of the Republic of Bosna i Hercegovina (BIH). The project comprises expansion of the water supply and sewer systems and construction of a sewage treatment plant. The project is estimated to cost US\$95.7 million equivalent with a foreign exchange component of US\$38.5 million. A Bank loan of US\$45.0 million is proposed, equivalent to about 47% of the project cost, for a period of 25 years including 5 years grace. Preduzece Vodovod i Kanalizacija Sarajevo (Sarajevo Water Supply and Sewerage Enterprise), will be the borrower of the Bank loan.

1.02 The proposed water supply facilities are part of a Master Plan to rehabilitate and expand the water supply system. Feasibility studies were prepared in 1970 to provide adequate sewage collection and treatment facilities. The studies were revised in 1974 in consultation with Bank missions and the proposed sewerage works are part of a program to meet the city's requirements to 1985 with provision for expansion.

1.03 In parallel with this project the Bank is also considering financing the Sarajevo Air Pollution Control Project to abate the dangerously severe air pollution levels in the city, caused primarily by the burning of lignite coal, wood and fuel oil for heating, by providing a natural gas supply.

1.04 A Bank reconnaissance mission to Sarajevo was undertaken in January 1973 to provide guidance on preparation of feasibility studies for project works. Several Bank missions subsequently visited Sarajevo to review progress and assist in project preparation. An appraisal mission comprising Messrs. W. Hayden, J. Lee, A. Al-Khafaji, R. Saunders and J. Lowther visited Sarajevo in December 1974. A mission to update this report was undertaken in February 1976. This report is based on information obtained by the missions and provided by the City Assembly of Sarajevo, Preduzece Vodovod i Kanalizacija Sarajevo, and their consultants. 1/

---

1/ Stanford Research Institute, California; Professor Van der Emde, Vienna Technical Institute; Energoinvest of Sarajevo; Sarajevo Institute of Urban Planning and members of the Faculty of Civil Engineering, University of Sarajevo.

## II. THE SECTOR

2.01 The Federal Commission for Water Management is responsible for establishing the basic framework for the maintenance of water quality within the country. Commissions for Water Management in each Republic coordinate the water quality actions and report to the Federal Commission. Water quality standards and streams classification are established by the Republic's Commission and local communes are responsible for complying with the standards. The Republic of BiH issued regulations in 1967, 1968 and 1969 concerning the "Protection of Waters, Classification of Waters, and Categorization of Streams". The regulations define measures to limit the release of harmful materials into the Republic's waterways and provide for construction of plants and equipment to process wastewater and reduce pollution. Four classes of waterways were established according to the purpose for which the water is intended. Class I designation represents clean, unpolluted water while Class IV is a highly polluted stream. Furthermore, a Republic Water Fund provides financial assistance to the communes to achieve water quality objectives within their jurisdiction. The Fund is providing a capital contribution of Din 100 million (US\$5.6 million) towards the cost of the proposed sewage treatment plant.

2.02 Increasing attention is being paid in Yugoslavia to the problems of water pollution and to the integrated development of water resources. The authorities wish to preserve and enhance the quality of their inland and coastal waters by construction of flow regulating structures and waste treatment facilities. Examples of other projects in the sector with which the Bank is involved are:

- (a) Ibar Multipurpose Water Project in Kosovo for which the Bank lent US\$45.0 million in 1971 (Loan 777-YU) and
- (b) Dubrovnik Water Supply and Wastewater Project in Croatia, for which the Bank lent US\$6.0 million in 1975 (Loan 1066-YU).

2.03 In Yugoslavia, water supply and sewerage services are not provided or regulated at the Federal or Republic level. Individual communes are generally responsible for their own facilities and in the large urban centers the services are provided by local enterprises. In Sarajevo, Preduzece Vodovod i Kanalizacija Sarajevo (Vodovod) provides water supply and sewerage services for the four communes comprising the city (para. 3.04).

### III. THE PROJECT AREA

#### A. Background

3.01 Sarajevo is the Capital of the Republic of Bosna i Hercegovina (BIH), one of the constituent Republics of the Socialist Federal Republic of Yugoslavia. The city is located in the valley of the Miljacka River, a tributary of the Bosna River. The altitude of the urban area varies between 480 and 720 meters above sea level (m.a.s.l.). The densely populated part of the city lies in a narrow valley with the slopes rising steeply at about 200 meters per kilometer. The city is surrounded by mountainous terrain, the highest point being 1,630 m.a.s.l. The climate is continental characterized by hot summers, severe winters and large diurnal temperature differences.

3.02 The earliest traces of organized settlement in the Sarajevo region reach back to the Neolithic period. The city developed as a military and administrative center within the Ottoman Empire and its physiognomy was strongly influenced by its Turkish rulers. In 1878, Turkish power was replaced by the Austro-Hungarian Monarchy. During the Hapsburgs' forty years rule, the present commercial center of the city was constructed. On June 28, 1914 Sarajevo's name became a milestone in history when the Crown Prince, Archduke Francis Ferdinand, was assassinated in the city. The economic development of the city was dormant in the inter war years. But in the post-war period a dramatic expansion of the city took place and an extensive area of high-rise apartment buildings was constructed in the western suburbs.

3.03 Sarajevo is the economic center of BIH, one of the less developed Republics of Yugoslavia. The city accounts for the largest segment of the Republic's economy but lags behind other Yugoslav urban centers in development. Large scale migration from the underdeveloped surrounding areas took place in the post-war period and the city's population increased threefold to over 300,000 during the last thirty years. Despite substantial investment, infrastructure of the city did not keep pace with growth and Sarajevo, in common with other rapidly developing urban centers, is faced with a severe housing shortage, overstrained public utility services, traffic congestion and water and air pollution.

3.04 In Yugoslavia, the basic unit of local government is the Commune but communes in large urban centers may combine to form political units to which they entrust specific rights and duties. The City of Sarajevo consists of four communes and has been empowered to govern the Sarajevo urban area, to raise revenue through taxes, duties and fees and to maintain and develop public services (Annex 1). The main governing body of the city is the Skupstina Grada or City Assembly which is composed of delegates elected by work organizations, citizens and political bodies. The City Assembly undertakes the normal local government functions and has specific authority over local public utilities enterprises.

## B. Water Supply

3.05 Sarajevo water sources consist of mountain springs and groundwater from a well field in the Sarajevsko Polje (Sarajevo Plain) of the Zeljeznica River. Raw water quality is generally good, less than 10 mg/1 of silicate turbidity and a coliform bacilli count of less than 10 per 100 ml of water. All water supplies are chlorinated and tested daily to determine the bacteriological, physical and chemical quality. The system was operating at design capacity in 1969 and it has been standard practice during the five-year period of 1969-1974 to have the water supply to many areas of the city turned off for several hours a day. Because of shortage of funds, the expansion planned for 1969 did not commence until 1973 and the new facilities were put into operation in December 1974. The expanded facilities alleviated the water shortages but will only be adequate to meet water demand through 1978. IBRD Map 11458R and Annex 2 provide details of the existing system.

3.06 At present over one third of the water produced is unaccounted-for. The high water losses are attributed to the advanced age of a large part of the distribution system and high system pressure in parts of the city, resulting from incomplete separation of pressure zones. There are about 22,600 connections serving about 90% of the population (Annex 3). The number of connections are low as a significant percentage of the population reside in high-rise apartment buildings which are served by one or two connections per building. Consumption per capita in 1974 was 307 l/cd, down from 323 l/cd in 1969.

3.07 Water from the mountain spring flows by gravity into the city reservoirs. Groundwater from the Sarajevsko Polje is distributed through three main pumping stations and several booster stations. The distribution system consists of some 330 km of pipes. In addition, there are some 50 km of galvanized steel pipes, mostly 1/2 inch, which are regarded as service-connections. Most of the distribution pipes are small - only 125 km are larger than 100 mm diameter. The distribution pipes in the old part of the city were installed more than sixty years ago and are badly corroded and broken.

## C. Sewerage

3.08 The present sewer system comprises about 250 km of collector, main sewers and laterals and about 100 km of house connections. The two main collectors on the right bank of the Miljacka River were constructed between 1902 and 1914 and were sized for a city population of 60,000. The network includes separate sewers and storm water drainage serving an area of 530 hectares (ha) and combined sewers serving an area of about 770 ha mostly along the banks of the Miljacka River. IBRD Map 11459R and Annex 2 provide details of the existing system.

3.09 At the end of 1974, about 70% of the population, mostly in the densely populated center of Sarajevo, were connected to the sewer system. The capacity of the system is inadequate and flooding of low areas occurs after heavy rainfall. Many sewers have deteriorated badly and infiltration into the system is excessive. Some 20,000 non-connected households discharge

their sewage into nearby streams or dispose of it to the ground using septic tanks. In several sections of the town, the soil is relatively impermeable and the septic tanks have to be emptied frequently.

3.10 The main collectors in Sarajevo discharge directly into the Miljacka River. Storm water from the areas served by the separate system is discharged either directly into the Miljacka or into tributaries or creeks. Sewage from settlements in the Sarajevsko Polje is discharged into the Zeljeznica River through a principal sewer which passes through the groundwater protection area. This sewer line must be relocated to reduce the seepage of sewage into the water supply source. Sewage from the small Vogosca settlement is discharged directly to the Vogoscar River.

3.11 The storm water and sewage from the city flows into the Miljacka River without treatment or disinfection. During the summer, the sewage flow is about three times the minimum flow of the River. At this time, the Miljacka has the characteristics of an open sewage canal and is the source of an unbearable stench and a serious health hazard. Furthermore, the city hospitals, i.e., the surgical clinics, the infectious disease pavillion, the tuberculosis pavillion and leprosarium discharge their extremely dangerous pathological wastes into the sewage network. The discharge of untreated sewage to the Miljacka River is a health hazard not only to Sarajevo but also to the communities along the Bosna River of which the Miljacka is a tributary.

3.12 A more serious problem, however, is the infiltration of sewage from leaking sewers into corroded water supply pipes through back siphonage. In spite of the regular chlorination of the city's water supplies, bacteriological pollution of the distributed water is detected frequently, particularly in the old part of the city where water pipes are badly corroded and very often in close proximity to the sewers. Waterborne diseases are an ever-present threat to the citizens of Sarajevo. Some typical waterborne bacterial diseases which could be transmitted by this route are typhoid, cholera, paratyphoid and bacillary dysentery. Waterborne viral diseases include poliomyelitis and infectious hepatitis.

3.13 An epidemic of diarrhea was reported in the city in 1955, when 5,600 persons were reported ill and two died. The epidemic was caused by infiltration of sewage from a hospital into the water supply system. A recent diarrhea epidemic caused by sewage infiltration also was reported in 1973 when 2,477 persons were infected but none died. In 1970, an epidemic of infectious hepatitis struck the city and in certain areas which lack adequate water supply and sanitation such outbreaks recur frequently. Because of water shortages and frequent pipe failures in recent years, there have been several epidemics of hepatitis among school children. Records of the Department of Hygiene and Epidemiology of the Sarajevo Health Institute show the following reported cases of waterborne diseases for the period 1967-1973:

<u>Disease</u>	<u>Number of Patients</u>	<u>Treated in Hospital</u>		<u>Number of Deaths</u>
		<u>Number</u>	<u>Days</u>	
Hepatitis Virosa	4,155	1,850	30	4
Typhus Abdominalis	165	131	30	1
Paratyphus A & B	38	34	30	-
Disenteria	4,033	739	14	1
Salmonellosis	252	90	14	-

With Sarajevo receiving tourists from all parts of the world, the threat of a waterborne cholera outbreak is not remote if the present unsanitary conditions prevail.

#### IV. THE PROJECT

##### A. Objectives

4.01 The proposed project aims at improving the water supply facilities and abating the water pollution in the Sarajevo area. The project comprises rehabilitation and expansion of the water supply and sewer systems and construction of a sewage treatment plant. Improvement of the water supply facilities is needed in order to provide safe and adequate supply of water. Rehabilitation and extension of the existing inadequate sewer system and construction of a new sewage treatment plant is essential to safeguard public health and abate pollution in the Miljacka and Bosna Rivers.

##### B. Description

4.02 The project elements are described in detail in Annex 4 and shown on IBRD Maps 11458R and 11459R. Project components were selected from among several alternatives as the least cost solution to meet the projected requirements. The following is a summary of the proposed project works:

#### 1. WATER SUPPLY

4.03 The proposed water supply facilities are part of a master plan to expand the production facilities at the Sarajevsko Polje and to rehabilitate and extend the distribution network. They are designed to provide Sarajevo with an adequate supply of water through 1985 and to serve an area approximately twice that served by the present system. The proposed water supply facilities comprise the following:

- (a) construction of an infiltration gallery;

- (b) construction of six new reservoirs and expansion of three existing reservoirs to provide an additional storage capacity of 24,500 m<sup>3</sup>;
- (c) construction of a booster pumping station and expansion of four existing pumping stations;
- (d) installation of some 31 km of water mains to improve services in existing areas and to provide water for new developments;
- (e) replacement of about 51 km of corroded distribution pipes and about 5,000 house connections, mostly in the old quarter of the city;
- (f) installation of a telemetry control system and master meters to facilitate operation of the system;
- (g) undertaking of hydrogeological studies to prepare a water resources master plan;
- (h) construction of a headquarter for Vodovod and supply of office equipment; and
- (i) provision for engineering services including designs, supervision, project administration and training.

## 2. SEWERAGE

4.04 The present sewer system, mostly old and worn-out, includes sanitary sewers to remove sewage and combined sewers to remove sewage and storm water. Several alternatives for collection of sewage and storm water were investigated including separate sanitary sewers, combined sewers and various possible combinations of the two systems. A city-wide sanitary sewer system and a sewage treatment plant were the least cost solution. The existing combined sewers will be gradually converted to stormwater sewers. The proposed main sewers are designed for the projected sewage flows of the year 2000, while the principal units of the treatment plant are designed for the 1985 flows with provisions for expansion. The proposed sewerage facilities comprise the following:

- (a) construction of about 33 km of collectors and main sewers;
- (b) replacement of 4.5 km of worn-out sewer laterals and about 2000 service connections;
- (c) construction of sewage treatment facilities;
- (d) installation of sludge filters and renovation of the existing dump to provide for proper disposal of the dried sludge;

- (e) provision for engineering services including designs, supervision, project administration and training, and
- (f) installation of an activated sludge pilot plant for experimentation in sewage treatment process to attain optimal utilization of the main treatment facilities.

4.05 Several investigations were undertaken by Vodovod and their consultants to determine the organic and hydraulic loadings of the present sewage and to assess the probable effects of various sewage treatment processes on the water quality of the Bosna and Miljacka Rivers. To meet the Republic's water quality standards for these rivers and because of their relatively low assimilative capacity during period of minimum flow, a high degree of sewage treatment is necessary. A sewage treatment plant employing the activated sludge process, located near the confluence of the Bosna and Miljacka Rivers, is recommended. The sewage effluent will be discharged to the Bosna River where more dilution water is available. Primary treatment will be provided for sewage from the nearby settlement of Vogosca prior to discharge to the Bosna River.

4.06 The sewage treatment will be performed by means of a biological process, the activated sludge process, in which most of the organic matter is assimilated by a bacterial mass and taken out from the sewage. Primary and excess sludge will be digested and pumped to the proposed sanitary landfill at the site of the existing dump. Dewatering will be undertaken on belt filters and the dried sludge disposed at the landfill.

#### C. Status of Engineering

4.07 Feasibility studies and preliminary engineering for the water supply and sewerage components were prepared by Vodovod with the assistance of local and foreign consultants. Energoinvest and the Institute for Urban Planning, experienced local consultants, in joint venture with Professor Van der Emde of the Vienna Technical Institute and other foreign consultants were appointed to prepare final designs, tender documents and assist in bid evaluation and supervision of construction. The project provides for about 100 man years of engineering services, training and operational assistance. About 20% of these services will be provided by foreign consultants. Retroactive financing of about US\$750,000 is proposed (para 4.14).

#### D. Cost Estimates

4.08 Project cost estimates, including duties and taxes, but excluding interest during construction, are shown in Annex 5. The total project cost is estimated at about US\$95.7 million of which about US\$38.5 million (40%) is the estimated foreign exchange. Summary of cost estimates is as follows:

<u>Project Elements</u>	<u>Project Costs</u>						<u>% of Total Project Costs</u>
	<u>Million Dinars</u>			<u>Million Dollars</u>			
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	
<u>WATER SUPPLY SYSTEM</u>							
Infiltration Gallery and River Regulation	6.7	4.4	11.1	.4	.2	.6	.6
Pumping Stations	10.0	7.9	17.9	.6	.4	1.0	1.0
Distribution Network Extension	53.4	34.5	87.9	3.0	1.9	4.9	5.1
Distribution Pipes Replacement	82.4	46.3	128.7	4.5	2.6	7.1	7.4
Reservoirs	46.5	19.9	66.4	2.6	1.1	3.7	3.9
Telemetry System, Power & Cathodic Protection	7.8	19.2	27.0	.4	1.1	1.5	1.6
Enterprise Headquarter	22.3	9.6	31.9	1.2	.6	1.8	1.9
Office Equipment	.9	3.5	4.4	.1	.1	.2	.2
Water Resource Investigation	10.4	3.5	13.9	.6	.2	.8	.8
Engineering Services & Training	26.7	13.1	39.8	1.5	.7	2.2	2.3
Physical Contingencies	40.0	24.3	64.3	2.2	1.4	3.6	3.8
Price Increases	102.8	62.3	165.1	5.7	3.5	9.2	9.6
Total Water Supply	<u>409.9</u>	<u>248.5</u>	<u>658.4</u>	<u>22.8</u>	<u>13.8</u>	<u>36.6</u>	<u>38.2</u>
<u>SEWERAGE SYSTEM</u>							
Collectors & Sewers Reconstruction	117.5	61.3	178.8	6.5	3.4	9.9	10.3
Sewers & Service Connections	17.1	7.3	24.4	1.0	.4	1.4	1.5
Treatment Facilities	215.7	187.1	402.8	12.0	10.4	22.4	23.4
Sludge Disposal Site	17.9	10.2	28.1	1.0	.6	1.6	1.7
Engineering Services & Training	25.8	17.2	43.0	1.4	1.0	2.4	2.5
Physical Contingencies	59.1	42.5	101.6	3.3	2.3	5.6	5.9
Price Increases	166.1	119.4	285.5	9.2	6.6	15.8	16.5
Total Sewerage	<u>619.2</u>	<u>445.0</u>	<u>1064.2</u>	<u>34.4</u>	<u>24.7</u>	<u>59.1</u>	<u>61.8</u>
Total Project Costs	<u>1,029.1</u>	<u>693.5</u>	<u>1722.6</u>	<u>57.2</u>	<u>38.5</u>	<u>95.7</u>	<u>100.0</u>

4.09 The cost estimates were prepared by Vodovod and consultants on the basis of preliminary designs. Unit prices were derived from recent civil works contracts and suppliers' quotations for pipes and equipment. The cost of engineering services was estimated using prevailing rates for consultant services in Yugoslavia and Western Europe. The cost estimates reflect price conditions expected to prevail in January 1976 and are reasonable. Physical contingencies of 15% were added to cover unforeseen conditions which may arise during detailed designs and construction of the project. Price increases during the project construction period were calculated using the following annual rates:

	<u>1976</u>	<u>1977-79</u>	<u>1980</u>
Equipment	10	8	7
Civil Works	14	12	10

4.10 During the project construction period, Vodovod would undertake, in addition to the proposed project works, land purchases and relocation of houses within the groundwater sources protection zone and routine expansion and renovation of the water supply and sewerage systems. The capital expenditure required to cover these activities was estimated at about Din 140.0 (US\$7.8) million.

E. Financing Plan

4.11 The following table sets out the estimated total fund requirements for the project construction period and the sources from which those requirements are forecasted to be met:

	<u>FY 1976-1980</u>		
	<u>VODOVOD</u>		
	<u>Din</u>	<u>US\$</u>	<u>%</u>
	<u>-----Millions-----</u>		
<u>Requirements</u>			
Project Expenditures	1,722.6	95.7	85
Interest During Construction			
IBRD	136.3	7.6	7
Local Banks	22.1	1.2	1
Other Capital Expenditure	140.0	7.8	7
<u>Total Requirements</u>	<u>2,021.0</u>	<u>112.3</u>	<u>100</u>
<u>Sources</u>			
Internal Cash Generation	757.6	42.1	37
Less: Contributions, Reserve Fund, Debt Service & Increased Working Capital	133.7	7.4	7
Net Internal Cash Generation	623.9	34.7	30
<u>Borrowings</u>			
Proposed IBRD Loan	810.0	45.0	40
Local Banks Loans	152.1	8.5	8
<u>Total Borrowings</u>	<u>962.1</u>	<u>53.5</u>	<u>48</u>
<u>Capital Contributions</u>			
Republic Water Fund	100.0	5.6	5
City Assembly	50.0	2.7	3
Housing Fund	150.0	8.3	7
Site Preparation Fund	135.6	7.5	7
<u>Total Capital Contributions</u>	<u>435.0</u>	<u>24.1</u>	<u>22</u>
<u>Total Sources:</u>	<u>2,021.0</u>	<u>112.3</u>	<u>100</u>

4.12 The proposed Bank loan of US\$45.0 million would provide about 40% of the total financing requirements or about 98% of the foreign exchange cost including interest during construction on the Bank loan. The loan is equivalent to about 47% of the project costs and is consistent with Bank lending to the less developed Republics in Yugoslavia. The period of the loan would be 25 years, including 5 years grace.

4.13 The balance of Vodovod's financing will be provided from domestic sources in BIH as follows: 30% from internal cash generation, 8% from local loans and 22% by way of capital contributions. The internal cash generation was calculated using proposed water supply and sewerage tariffs (Annex 15) and operating costs were escalated for price increases at 16% for 1976, 13% for 1977, 10% for 1978 and 7% per annum thereafter. The local banks loans are for a period of 20 years including a grace period of five years, at an interest

rate of 7.5% per annum. The City Assembly has agreed to guarantee the local financing and provide the additional funds to meet cost overruns, if any. A condition of effectiveness of the Bank loan is that the financing plan is ratified by the appropriate authorities.

4.14 Expenditure by the City Assembly and Vodovod for preparation of feasibility studies, final designs, and tender documents amounting to about US\$1.5 million is expected to be incurred prior to loan signature. Retroactive Bank financing of not more than US\$750,000 is proposed.

#### F. Implementation

##### Construction Schedule

4.15 Construction of the project works is scheduled to commence in late 1976 and to be completed by the end of 1980. Details of the construction schedule are given in Annex 6. Vodovod will be responsible for construction and operation of the proposed facilities.

##### Construction Coordination

4.16 The City Assembly has recently established the Institute for Construction of the City (Institute) to be responsible for the physical development of the urban area. The Institute has been designated to coordinate implementation of this project and a natural gas system, being installed simultaneously and financed under the Sarajevo Air Pollution Control Project, to ensure a minimum disruption of the normal commercial life of the city. This is particularly necessary in Sarajevo where the streets are narrow and traffic congestion is a serious problem even in normal times. The City Assembly and Vodovod have agreed that the Institute will have an overall responsibility for coordinating the construction of the project but that supervision of construction of the project works will be the responsibility of Vodovod.

##### Land Acquisition

4.17 Water pipes and sewers will generally be laid in the streets, but Vodovod must acquire land for the pumping stations, sewage treatment plant and the administration building. It is understood that the necessary land will be purchased from the communes. Vodovod has agreed that all necessary land, as well as easements in the public roadways, will be acquired prior to award of major contracts.

##### Groundwater Protection

4.18 To safeguard against pollution of the groundwater sources, Vodovod have proposed enactment of a municipal ordinance to establish four protection zones in the Sarajevsko Polje catchment area with defined land use limitations. Vodovod will also undertake during the project construction period land purchases and relocation of about 120 residences which are in close proximity to existing wells. The City Assembly and Vodovod have agreed that within twelve months from the date of effectiveness of the loan, they will take all measures necessary to establish protection zones for the city's groundwater sources in the Sarajevsko Polje area.

### Procurement

4.19 Materials and equipment contracts estimated to cost more than US\$200,000 will be procured after international competitive bidding in accordance with Bank Group guidelines. For purpose of bid comparison, it is proposed that qualified domestic manufacturers of these goods will be given a margin of preference of 15% or customs duties, whichever is lower. Civil works contracts estimated to cost more than US\$500,000 will be awarded after international competitive bidding in accordance with Bank Group's guidelines. Other equipment supply and civil works contracts would be awarded on the basis of competitive bidding advertised locally and in accordance with the procedures of the Socialist Federal Republic of Yugoslavia which are satisfactory. Minor works, such as replacement of service connections and renovations to the existing water supply and sewer networks, may be carried out by force account, under arrangements acceptable to the Bank, up to a value in aggregate not exceeding US\$10.0 million.

4.20 Contracts for the supply of equipment for the sewage treatment plant and other specialized equipment are expected to be awarded to foreign contractors. All other equipment supply and civil works contracts are expected to be won by Yugoslav firms.

### Monitoring Criteria

4.21 Annex 17 shows the indicators which would be monitored during and after execution of the project to measure the achievement of the technical, financial, administrative and training goals set for the proposed project. Vodovod has agreed to prepare and forward to the Bank for comment quarterly and annual reports covering this monitoring criteria.

### G. Disbursements

4.22 The proposed Bank loan of US\$45.0 million would be disbursed as follows :

- |  |   |
|--|---|
| (a) <u>Equipment and Materials</u><br>(US\$ 11.5 million)    | - 100% of the C.I.F. cost of directly imported equipment, materials and pipe and 50% of the total cost of locally supplied equipment, materials and pipe. |
| (b) <u>Civil Works</u><br>(US\$18.0 million)                 | - 30% of the cost of civil works and force account work.  |
| (c) <u>Engineering Services</u><br>(US\$3.3 million)         | - 50% of the cost of consulting services and training.  |
| (d) <u>Interest During Construction</u><br>(US\$7.6 million) | - 100% of the interest during construction on the Bank loan.  |
| (e) <u>Unallocated</u><br>(US\$4.6 million)                  |   |

The estimated schedule of disbursements is in Annex 7. On completion of the project, any unused balance of the loan would be cancelled.

#### H. Environmental and Health Impacts

4.23 There are a variety of important environmental and health benefits associated with the provision of a reliable, convenient and safe supply of water and adequate collection and treatment of sewage. The proposed project facilities will eliminate many of the existing serious health threatening deficiencies of the city's water supply and sewer systems such as infiltration of sewage into corroded water pipes, the possibility of a return of an intermittent supply of water, the unsanitary conditions in areas of the city without sewers and the discharge of untreated sewage and hospital wastes into the Miljacka River.

4.24 The Miljacka River is presently an open sewage canal degrading the city's environment and polluting the Bosna River and other streams which are the source of water supply to many downstream users. The proposed sewerage project will eventually restore the Miljacka's water quality to allow the re-establishment of traditional recreational facilities along its banks and permit water contact sports. The pollutant loadings on downstream rivers will also be considerably reduced allowing greater utilization of their potential for recreational facilities and as sources of drinking water.

4.25 Predictions of water quality for the Bosna River indicate that shortly after construction of the sewage treatment plant, this river will meet the Republic's water quality standards. However, because of the uncontrolled sewage discharges throughout the city and the fact that a city-wide sanitary sewer system would be constructed gradually, it will be several years hence before the section of the Miljacka River through the city can meet the Republic's standards.

### V. THE PROJECT ENTITY

#### A. Background

5.01 Preduzece Vodovod i Kanalizacija Sarajevo (Vodovod) was established in February 1972 by a merger of the former water supply and sewerage organizations based on a referendum of the citizens and on decisions of the Workers' Council for each organization. Vodovod is responsible for the water supply, sewerage and drainage systems in the four communes forming the city of Sarajevo.

#### B. Organization and Management

5.02 In accordance with the Yugoslav law, Vodovod is an Organization of Associated Labor (OAL) which carries out its activities with socially-owned resources and is governed by a Self-Management Agreement adopted by the workers. Direct self-management is implemented through meetings of the

workers and by the election of delegates to the Workers' Council. Vodovod is further subdivided into three Basic Organizations of Associated Labor (BOAL) - Water Supply, Sewerage and Administration which are also directed by separate Workers' Councils. The BOAL Workers' Councils deal with policy matters affecting their own unit while the OAL Workers' Council deals with matters affecting the organization as a whole. However, Vodovod is not a fully autonomous organization as proposed tariff changes, construction programs, appointment of Director General and other decisions must be approved by the City Assembly. In addition, the 1974 Constitution of the Socialist Federal Republic has made provision for the establishment of Self-Managing Communities of Interest, consisting of representatives of consumers and organizations providing public services, to link the interests of these two parties. It is envisaged that these Communities of Interest will be established in Sarajevo in the near future and will take over some of the functions of the City Assembly relating to Vodovod. The City Assembly will be represented on the Communities of Interest and will have a constitutional responsibility for ensuring that decisions meet the needs of the City.

5.03 The organization chart of Vodovod is in Annex 8. The day to day operation of the organization is undertaken by the Director General assisted by the three BOAL managers. The total staff employed is 970 - Water Supply 460; Sewerage 230 and Administration 280. Vodovod has been well managed and has competent and experienced staff particularly in the water supply sector. To utilize their experienced engineering staff, Vodovod has provided consulting services to Banja Luka, Split and other cities in Yugoslavia.

5.04 Few cities in Yugoslavia have sewage treatment plants. Most of Vodovod's staff have no operational experience in sewage treatment. However, they have a high academic standard and should only require limited practical training. Provision has been made in the cost estimates for training abroad for about six engineers and technicians to form the nucleus of the plant operating staff. Furthermore, provisions for training on operation and maintenance of specialized equipment will be included in the contracts for the supply of such equipment.

5.05 The administrative, clerical and design staff are housed in numerous inadequate buildings throughout the city with resulting lack of communications and inefficiency. The project provides for the construction of a new office building for Vodovod.

### C. Operation

5.06 Operation of the present facilities is adequate. However, because of the age of the system, Vodovod is experiencing frequent pipe failures which require many of the maintenance staff to undertake emergency assignments. This work, together with the expansion program, has resulted in Vodovod paying less attention to preventive maintenance than required. Since the proposed project works will be undertaken primarily by contractors, Vodovod is expected to devote adequate attention to preventive maintenance in the future.

5.07 The present high water losses, 39% in 1975 (Annex 2) are attributed to the advanced age of a considerable amount of the distribution system. The project provides for replacement of about 51 km of corroded pipes and several thousand service connections to reduce the presently excessive water losses. Furthermore, Vodovod will continue their program of leak detection and pipe replacement in parallel with project works.

D. Accounts

5.08 In 1971, the book values of the fixed assets of the two previous enterprises were revalued at current prices in compliance with a national program. The financial accounts are kept in accordance with the system laid down by the Social Accounting Services (SAS). An adequate budgetary control and costing system is also in operation. The SAS system is based on the double entry system but some structural reorganization is required to provide financial statements in accordance with the Bank's normal format. The accounting staff are competent and should be able to make the necessary adjustments. Key board accounting machines are used but these are in poor condition and provision is included in the cost estimates for their replacement.

5.09 More than 99% of the service connections to the water supply system are metered and billed monthly. Customers with sewerage connection are surcharged according to their water consumption. However, in Sarajevo there are only about 22,000 meters as the majority of the people live in apartment buildings served by one or two meters. Vodovod bills the apartment management committee which prorates the charge to each household on a per capita basis and collects the money. The system is inexpensive and efficient and bad debts are negligible. Vodovod has had difficulty in the past collecting accounts from industrial consumers but this problem should be reduced with the enactment in 1975 of the SFRY Provision of Payments Concerning the Users of Social Resources which, among other provisions, required enterprises to settle their accounts promptly.

E. Audit

5.10 As with all Yugoslav enterprises, an annual audit of Vodovod accounts is undertaken by the Social Accounting Service (SAS). The scope and quality of SAS audit have previously been considered inadequate to meet the Bank's normal audit requirements. Recently, however, a group of SAS auditors has undertaken an intensive course and in-service training in modern auditing techniques and this staff will be utilized to audit enterprises receiving Bank funds. Sufficient qualified staff will not be available to audit all Bank projects for some time. Vodovod has agreed to make arrangements with this SAS special audit group or other independent auditors acceptable to the Bank to undertake an annual audit of Vodovod's accounts of sufficient scope and quality to meet Bank requirements and that the annual accounts and auditors' report will be submitted to the Bank within six months of the end of the fiscal year commencing with the financial statements for FY76.

## F. Insurance

5.11 Vodovod's insurance policy is established by the Workers' Council. Buildings, equipment and vehicles are insured against the normal risks. The water supply and sewerage network is not insured except for landslide and flood risks. This policy is satisfactory.

## VI. FINANCE

### A. Background

6.01 Vodovod has been a profitable enterprise since its establishment in 1972. Its main financial problem has been its inability to generate or borrow sufficient funds to expand the system to meet the rapidly growing demand. As a consequence of the proposed major investment program, substantial tariff increases will be necessary to ensure Vodovod's financial viability.

6.02 Vodovod is a financially autonomous enterprise. Its revenues are derived from monthly water and sewerage charges based on metering. For the limited number of connections not metered (less than 1%) charges are based on estimated consumption. Sewerage charges are surcharged on water consumption for consumers connected to the sewerage system. Full costs are recovered for connections to the water supply and sewerage system. Meter rents and deposits are not required.

### B. Past Performance and Present Position

6.03 In 1973, Vodovod earned an overall rate of return on average net fixed assets of 9.2% which increased to 13.1% in 1974. The increase in 1974 is due entirely to increased tariffs as water sales were constant at about 20 million m<sup>3</sup>. In 1975, the return is projected to rise to 15.4% with increased water sales and increased tariffs. Operating costs increased substantially during this period; 1974 - 13% and 1975 - 61% due mainly to increased labor and power costs. Both the water supply and sewerage sector contributed to the surpluses each year. However, the rate of return overstates the position as during these years maintenance staff and equipment were diverted to capital works and regular maintenance was neglected. It is planned to discontinue this practice in 1976.

6.04 Vodovod has not been successful in meeting its objective of providing an adequate water supply and sewerage system because of insufficient financial resources to expand the system in line with demand. A policy of low tariffs in the past did not generate the required resources. With the substantial improvements in tariffs in the period 1971-74 (water and sewerage tariffs were increased by about 200%) internal cash generation provided about 44% of the capital investment costs in 1973-74.

6.05 The debt equity ratio in 1974 at 16:84 was very satisfactory but this position was due to Vodovod's inability to borrow adequate funds. At

December 31, 1974 Vodovod loans outstanding totalled Din 71 million and consisted of over 40 loans from local institutions with repayment periods ranging from 5 to 40 years. Most of the loans are at subsidized interest with an overall average interest rate of less than 4%.

6.06 In the past, Vodovod has received grants from other local organizations to assist in financing its capital program. In 1972, all employed citizens of Sarajevo approved a referendum to contribute, in the form of a tax on salaries, towards the construction of water supply, health protection and school facilities. Funds from this contribution financed part of the water resource development work completed in December 1974.

### C. Tariffs

6.07 Responsibility for proposing tariff increases rests with Vodovod but any new tariff must be approved by the City Assembly. The Assembly has decided that Vodovod's internal cash generation must provide a substantial contribution to the financing of the proposed project. A resolution was passed approving in principle annual increase in water and sewerage tariffs up to 1988 (Annex 15). These proposed tariffs provide for a 200% and 400% increase for water supply and sewerage respectively between 1973 and 1980. However, each annual increase must be approved by the City Assembly before implementation.

6.08 The tariff schedule provides for two consumer categories: household and others. The rate for household consumers is half the rate charged to other consumers. From a resource allocation point of view, all consumers should pay a price equal to the incremental cost of supplying the service. However, in Sarajevo most families reside in multi-unit apartment buildings served by one metered connection. Water consumption per household is low (about 12 m<sup>3</sup> per month in 1974) as the average apartment is small with one bathroom, common laundry facilities and no gardens. The lower domestic tariff ensures that the necessary minimum amount of water would be available to the lower income households at reasonable cost. To implement a stepped tariff structure for domestic consumers would involve Vodovod in substantial additional costs for metering and collection with limited potential water savings.

### D. Future Performance

6.09 The project will increase the net value of fixed assets invested in water supply threefold to Din 1,115 million and sewerage investment eleven times to Din 1,222 million. The financial forecasts 1975-83 for Vodovod are in Annexes 9 through 14. Costs were escalated for price increases at 16% for 1976, 13% for 1977, 10% for 1978 and 7% per annum thereafter. The forecasts show a rate of return on average net fixed assets during the project construction period averaging over 13% and rising to a peak of about 19% in 1977. After completion of the project, the combined rate of return is reduced to about 6% because of the substantial increase in fixed assets. The rate of return for water in this period is about 9% and for sewerage about 3%. As the major part of the assets were recently constructed, this rate of return is satisfactory.

6.10 A contribution to future capital expansion requirement is more in line with the Yugoslav Socialist system than a rate of return concept. The former concept also provides an automatic adjustment against future inflation. Therefore, to ensure that the internal cash generation target is met and to provide a satisfactory contribution towards future investment, Vodovod has agreed to implement whichever is the higher of: (i) the authorized tariff scale for water supply and sewerage (Annex 15); or (ii) a modified tariff scale which, after making provision for increased working capital, will provide revenue sufficient to finance not less than 30% of the cost of investment during the period 1976-1980, and beginning with the year 1981 to finance each year not less than 35% of the average cost of investment during each consecutive three-year period comprising one actual and two forecast years.

6.11 The debt equity 1/ ratio at the end of 1980 is projected at 42:58. The debt service will require about 29% of the gross income in 1981. The debt service coverage in 1981 is projected at 1.3 and in 1982/83 at 1.5 after payment of contributions, reserve fund and taxes. Agreement was reached that except as the Bank shall otherwise agree, Vodovod will not raise further loans unless its net cash generation before depreciation and interest, exceed 1.3 times its debt service in any future year, including debt service on the amount to be borrowed.

6.12 The cost of converting the existing dump site to a sanitary landfill will be borne by Vodovod. However, the city enterprise Rad, which is presently responsible for solid waste collection and disposal, will operate the landfill. Vodovod has agreed that within twelve months of the date of effectiveness of the loan, Vodovod will conclude a contract with Rad for joint ownership of the landfill and an equitable allocation of operating costs.

## VII. BENEFITS AND JUSTIFICATION

7.01 The proposed project aims at improving the water supply facilities and abating the water pollution in the Sarajevo area. The project components were selected from various alternatives as the least cost solutions to meet the project's objectives.

### A. Water Supply

7.02 There are a variety of benefits associated with the provision of a convenient and safe water supply in Sarajevo. Among the more important benefits of the improved water supply will be the health benefits. These benefits are partially revealed through medical cost savings, a general improvement in individual well being, and a cost savings to, or an increased productivity of business enterprises. This follows from the fact that a

---

1/ Although the concept of equity does not exist in Yugoslavia, it has been used here as the best approximation to differentiate between the enterprises own funds and borrowings.

healthier population will require less health care, tend to have lower employment absentee rates, and to be more productive when they are on the job.

7.03 The internal economic rate of return was calculated using incremental water sales at 1976 tariffs as a measure of benefits. Investment costs were adjusted for taxes, inflation and replacement works. Costs of replacement of corroded distribution pipes and service connections were excluded from the investment costs as the benefits resulting from these works were not added to the incremental water sales. The internal economic rate of return on the water supply investment is estimated at 15.6% (Annex 16). If the incremental water consumption was reduced by 25%, and the other assumptions remained valid, the rate of return would be about 9.5%.

#### B. Sewerage

7.04 The benefits of the proposed investment in sewage collection and treatment in Sarajevo fall into the following categories, which are not necessarily mutually exclusive: (a) health benefits; (b) savings on future septic tank expenditures; (c) an increase in property values along waterways which are currently polluted by untreated sewage; and (d) recreation benefits which will result from the partial cleansing of the Miljacka and Bosna Rivers. These benefits, however, cannot be accurately quantified. The major justification for the sewerage investment is that the collection and treatment of sewage in Sarajevo is necessary for healthful and orderly development of the area and that the proposed method of collecting and treating the sewage is the least cost solution.

#### C. Water Supply and Sewerage Tariffs

7.05 The problems of water supply and sewerage benefits measurement highlight the need to formulate a water supply and sewerage tariff policy which reflects the true costs of supplying water and disposing of sewage in Sarajevo. The objective of this would be to assure that investment decisions can be made with greater confidence as to their economic merit. If the price of water supply and sewerage services is fixed at a level which approximates the long run marginal cost of supplying those services, then it will be demonstrable that increments in the consumption of water supply and sewerage services are valued by consumers at least as much as the resources consumed in providing those increments, i.e. approximate economic efficiency will be attained from a resource allocation point of view.

7.06 The average incremental cost of water supply and sewage disposal in Sarajevo is estimated to be approximately Din 6.6 per m<sup>3</sup> at a discount rate of 8% and Din 7.3 per m<sup>3</sup> at a discount of 10% (Annex 16). The proposed average water supply and sewerage tariff during the project construction period of about Din 6.8 per m<sup>3</sup> in real terms compares favorably with the long-term incremental cost of these services at a discount rate of 8%.

VIII. AGREEMENTS REACHED AND RECOMMENDATION

8.01 Agreement having been reached on the principal issues referred to in Chapters IV and VI and subject to the condition of effectiveness in para 4.13 the project is suitable for a Bank loan of US\$45.0 million to Preduzece Vodovod i Kanalizacija Sarajevo (Vodovod) with the guarantee of the Socialist Federal Republic of Yugoslavia. In view of the five year construction period an appropriate term for the loan is twenty five years including five years grace.

May 7, 1976



APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA

THE CITY AND ITS ORGANIZATION

Background

1. Sarajevo is the capital of the Republic of Bosnia and Herzegovina (BIH), one of the constituent Republics of the Socialist Federal Republic of Yugoslavia. The city is located along the banks of the Miljacka River, a tributary of the Bosna River. Small settlements within the city are located along the banks of the Zeljeznica and Josanica Rivers, also tributaries of the Bosna River. The altitude of the urban area varies between 480 and 720 meters above sea level (m.a.s.l.). A peak elevation of 1,630 m.a.s.l. marks the highest point of the city's recreational area. The city has a continental climate characterized by hot summers, severe winters and large diurnal temperature differences.
2. The earliest traces of organized settlement in the Sarajevo region reach back to the Neolithic period. The city developed as a military and administrative center within the Ottoman Empire and its physiognomy was strongly influenced by its Turkish rulers. In 1878, Turkish power was replaced by the Austro-Hungarian Monarchy. During the Hapsburgs forty years rule, the present commercial center of the city was constructed. Sarajevo's name became a milestone in history when the Crown Prince, Archduke Francis Ferdinand, was assassinated in the city on June 28, 1914. The economic development of the city was dormant in the inter war years. But in the post-war period a dramatic expansion of the city took place and an extensive area of high-rise apartment blocks were constructed in the Western suburbs of the city.
3. Sarajevo is the economic center of BIH; one of the less developed Republic of Yugoslavia. The city accounts for the largest segment of the Republic's economy but lags behind other Yugoslav urban centers in development. Large scale migration from the underdeveloped surrounding areas took place in the post-war period and the city's population increased threefold to over 300,000 during the last thirty years. In spite of substantial investment in the infra- and super-structures of the city, it did not keep pace with its growth and Sarajevo, in common with other rapidly developed urban centers, and is faced with problems of severe housing shortage, overstrained public utility services, traffic congestion and water and air pollution.

### The Communes and the City

4. Under the Constitution of the Socialist Federal Republic of Yugoslavia, the basic unit of local government is the commune. Communes in large urban areas may form special social-political communities entrusted with specific rights and duties normally held by communes. There are four communes in Sarajevo (Centar - the original old city, Novo Sarajevo, Ilidza, and Vogosca). They have established the social-political community of the city. The statutes of the city, which are agreed by each of the communes, define the rights and duties of the city government. Only those rights and duties pertaining to the common interest of all the communes are given to the city and rights and duties not specifically given are retained by the communes.

5. The city has been empowered to: govern the Sarajevo urban area, raise revenue through taxes, duties and other fees, maintain public services, and plan the future development of the city. The communes retain coordinating rights regarding the future development of the city and the allocation of budgeted resources. Investment funds are centralized in the city and allocated to communes for projects wholly within a commune or to the city budget for inter-communal projects.

6. Although the communes have given to the city major powers for governing the urban area, there is close coordination between the communes and the city. Communes may initiate legislation at the city level on matters over which they have constitutional authority, and most legislation prepared for the city is coordinated with the communes. Issues on which the city and the communes cannot agree are referred back to the workers and citizens of the urban area.

### Organization of the City Government

7. The City Assembly (or Skupstina Grada) is the central authority of the city (see attached organization chart). It is the city's legislative body and is composed of delegates from social sector work organizations (about one delegate per one thousand workers), private sector workers, citizens identified by regional areas and political bodies such as the League of Communists and trade union groups. Delegates serve only at the pleasure of their constituents and may be recalled at any time. The commune assemblies are organized along similar lines and elections for both are held simultaneously.

8. The day to day functions of the city government are carried out by six Secretariats. The Secretariats and their responsibilities are as follows:

- (i) Internal Affairs: Internal security such as police and fire protection,
- (ii) National Defense: Coordination with national security efforts,
- (iii) Inspections: Insures compliance with established standards such as building codes, health requirements and so on,

- (iv) Economic and Finance: In cooperation with work organizations plans and carries out the economic development of the city; oversees the activities of public service organizations; and prepares budget and tax policy,
- (v) Social Activities: Educational, scientific and cultural activities, and
- (vi) General Affairs: Building maintenance, city personnel management and execution of the budget (accounting, payroll).

The executive organ of the city government is an Executive Board responsible to the City Assembly. The Executive Board is composed of the President and Vice President of the Assembly, the secretary of each Secretariat, and two members elected by the delegates of the City Assembly. The Executive Board carries out the decisions of the Assembly and prepares all legislation going to the City Assembly for approval.

9. There are two types of special organizations, outside the Secretariats, which report directly to the City Assembly through the Executive Board. One type is commissions, composed of citizens and government officials, which serve as special advisors on specific problem areas of interest to all citizens of the city. Among the ten commissions is one for environment. It serves as a special advisor to the City Assembly on general questions of environmental protection and improvement.

10. The other type of organization reporting directly to the City Assembly is institutes created to oversee the future development of the city. There are institutes for economic research, area planning, and construction of the city. The Institute for the Construction of the City provides for and oversees the physical development of the urban area. It coordinates all city construction programs and functions as the investor in development projects on behalf of the city. It has been established as a self-financing institute whose revenues are derived from its function as a land developer--it buys and sells land, including in the selling price the cost of needed infrastructure plus one percent for the institute's operational requirements.

#### The City and the Public Service Enterprise

11. Work organizations which offer public services are under the control of the city government. Yugoslav law provides that the means of production are owned by society as a whole but they are entrusted through the system of self-management to the control of the workers that use them. When work organizations provide public services such as education, public utilities, public transport, health, welfare and so on, local governments share control of these activities with the workers. In Sarajevo the measure of control is specifically provided for in the statutes of the city. The city has the right to:

- (i) approve the working statutes of the work organization;
- (ii) review work programs and plans and approve activities financed by the city;
- (iii) approve changes in the functions or organization of the working organization;
- (iv) approve the appointment of the manager or managing body;
- (v) approve the creation of any new public service enterprise; and
- (vi) approve tariffs set for the sale of services.

The public service work organizations are obliged to:

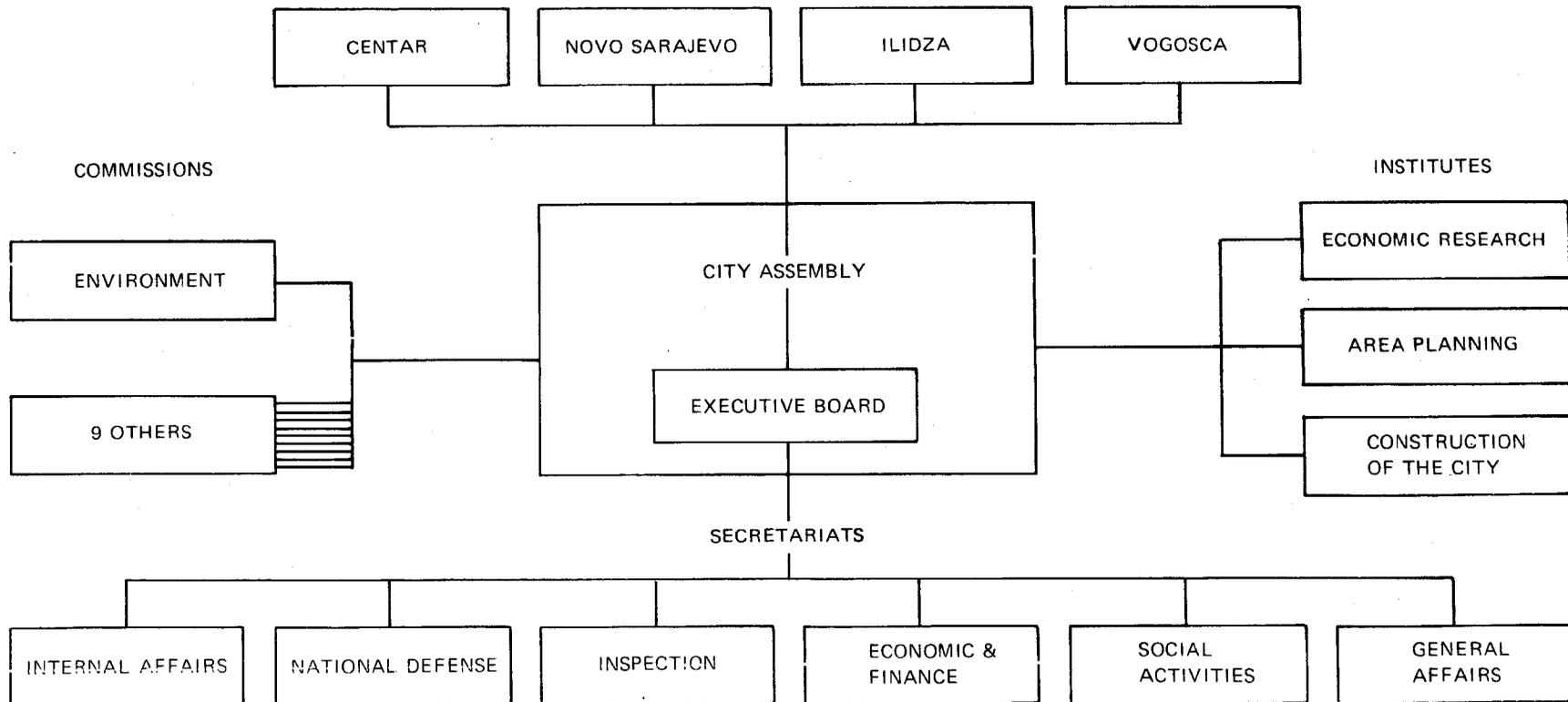
- (i) provide continuous and lasting services and, in case of failure to do so, compensate the consumers for damages incurred by the lack of service;
- (ii) plan the future expansion of services in accordance with the general development plans of the city;
- (iii) provide for public scrutiny of work performed and proposed programs and projects, and
- (iv) maintain and improve the quality of services provided.

12. Over the next few years, some of the regulatory powers currently vested in the city will be transferred to Communities of Interest. These communities will be established by self-management agreement among the work organizations providing services and the consumers of those services. The self-management agreements will provide for the regulation of the activities of the public service work organizations, the establishment of tariffs, and the planning and financing of future expansion. Establishment of the Communities of Interest will diminish the role of government in the social and economic affairs of the community. However, the City Assembly will retain ultimate authority over the activities delegated.

May 1976

CITY ASSEMBLY OF SARAJEVO  
WATER SUPPLY AND SEWERAGE PROJECT

COMMUNE ASSEMBLIES



May 1976

World Bank-9794

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT

YUGOSLAVIA

EXISTING WATER SUPPLY AND SEWERAGE FACILITIES

Water Supply

1. The original water supply system of the City, supplied by gravity from the Moscanica spring, was built in 1890. As the need for water increased, several other mountain sources were added between 1904 and 1954. The Jahorina springs, the largest and furthest (30 km away) of the mountain springs, were developed between 1917 and 1923. Groundwater from a well field in the Sarajevsko Polje (Sarajevo Plain) of the Zeljeznica River, about 12 km away, was first developed in 1962 and further expanded in 1974. At present, Sarajevo receives about 33 million cubic meter per year (1050 l/s), more than half of it comes from the Sarajevsko Polje wells.

2. Water quality of all sources is generally good; no color, less than 10 mg/l of silicate turbidity and a coliphorm bacilli count of less than 10 per 100 ml of water. However, during heavy rainfalls and periods of snow melting, higher levels of turbidity are recorded in the water from the Karst sediments of the mountain springs sources. Two of the springs (Moscanica and Tilava) are provided with filtration plants and supplies from the other springs are usually discontinued during periods of high turbidity. Bacteriological pollution has been recently detected in the Sarajevsko Polje wells particularly during heavy rainfalls. Industrial plants located upstream of the well field dispose their wastewater into the Zeljeznica River and it is believed that pollutants from this source are reaching the groundwater in increasing quantities. All water supplies are regularly chlorinated and water samples from 35 points on the distribution system are tested daily to determine the bacteriological, physical and chemical quality of the distributed water.

3. Annual water production from all sources has increased from 16.1 million cubic meter ( $10^6 \text{ m}^3$ ) in 1960 to 31.5 in 1969. Consumption also increased from 229 litre per capita per day (l/cd) to 323 l/cd during the same period. However, in 1969, the water production and transmission facilities were operating at design capacity. Because of shortage of funds, the expansion program planned for 1969 did not commence until 1973 and the increase in annual production between 1969 and 1974 was marginal. Consumption dropped to 307 l/cd in 1974 and water was supplied intermittently to most parts of the city.

Year	Population (000)	Water Produced		
		10 <sup>6</sup> m <sup>3</sup> /yr.	l/s	l/cd
1960	193	16.1	570	229
1965	233	26.6	845	313
1969	267	31.5	1,000	323
1970	276	31.9	1,010	316
1971	283	31.8	1,010	308
1972	291	32.8	1,040	309
1973	298	32.8	1,040	301
1974	305	34.2	1,090	307
1975	312	39.3	1,250	345

The new facilities comprising 5 drilled wells, 1,000 mm transmission line and a 20,000 m<sup>3</sup> reservoir which were put into operation in December 1974, has alleviated the water shortages and together with the existing facilities are expected to meet the water demand of Sarajevo through 1978.

4. Projections of population, water production and water sales are shown graphically in Annex 3 and outlined in Annex 9.

5. At the end of 1974, there were 22,600 connections (of which about 99% were metered) serving about 90% of the population. The number of persons per connection of about 12 is high due to the fact that a significant percentage of the population reside in high-rise apartment buildings which are served by a few connections. The non-connected population is served from 125 public taps, private wells and small springs. Some industrial enterprises and small settlements within the city have their own water supply systems. However, the total yield of all private supplies is very small, estimated at about 25 l/s (0.8 10<sup>6</sup> m<sup>3</sup>/yr).

6. More than one third of the water produced during the last five years was unaccounted-for and in 1975 was estimated at 39% of total production. The high water losses are attributed to the old age of considerable amount of the distribution system and high system pressure in certain parts of the city. Water sold was divided about equally between domestic and non-domestic consumptions as follows:

Year	Water Produced	Domestic Consumption	Non-Domestic Consumption	Unaccounted-for Water	
	10 <sup>6</sup> m <sup>3</sup> /yr	% Production			
1970	31.9	10.2	10.7	11.0	34.5
1971	31.8	11.1	10.8	9.9	31.1
1972	32.8	11.2	10.4	11.2	34.1
1973	32.8	11.3	10.4	11.1	33.8
1974	34.2	11.1	10.4	12.7	37.1
1975	39.3	12.4	11.6	15.3	38.9

7. The distribution system is divided into several pressure zones. However, separation of the pressure zones is incomplete resulting in very high pressure in portions of the distribution network. Expansion of the system was undertaken in the past without adequate planning and numerous small reservoirs were constructed. More than half of the 44 existing reservoirs have a capacity of 200 m<sup>3</sup> or less each. The older reservoirs are constructed of masonry concrete while the more recent ones are constructed of reinforced concrete. The total storage volume of 62,000 m<sup>3</sup> amounts to about 45% of the estimated 1975 maximum daily demand of 134,000 m<sup>3</sup>/day.

8. Water from the mountain springs flows by gravity into the city reservoirs. Groundwater from 11 wells in the Sarajevsko Polje is distributed to various parts of the city through three main pumping stations and several booster stations. The main pumping stations with the characteristics of each pump are as follows:

Pumping Station	----- Pump Characteristics -----			
	No. /1	Capacity 1/s	Head m	Motor Power KW
Bacevo	2 + 1	320	21	125
A. Most	1 + 1	210	70	209
	2 + 1	160	48	103
	1 + 1	70	150	176
Centar	1 + 1	120	77	140
	1 + 0	194	64	150

/1 (2 + 1) indicates 2 operating and 1 standby.

All pumps are electrically driven and were manufactured in Yugoslavia. None of the pumping stations is equipped with standby diesel or other fuel type power generators.

9. The distribution system consisted of some 330 km of pipes at the end of 1974 as follows:

<u>Diameter</u>	<u>Length in meters</u>			<u>Total Length</u>
	<u>Cast Iron</u>	<u>Steel</u>	<u>Asbestos</u>	
40	28,653	-	-	28,653
50	626	-	254	880
60	24,548	-	975	25,523
80	37,505	-	30,402	67,907
100	32,438	2,355	46,174	80,967
125	11,532	250	1,766	12,548
150	18,295	30	10,735	29,060
200	24,976	53	6,575	31,604
250	2,077	72	2,161	4,310
300	6,644	-	2,252	8,896
350	8,010	763	-	8,773
400	6,359	-	146	6,505
500	3,086	-	-	3,086
700	-	11,000	-	11,000
1,000	-	10,400	-	10,400
<b>Total</b>	<b>204,749</b>	<b>24,923</b>	<b>101,440</b>	<b>330,112</b>

In addition, there are some 50 km of galvanized steel pipes, mostly 1/2 inch, which are regarded as service-connections. Most of the distribution pipes are very small. Only 125 km (about one-third of the pipe network) are larger than 100 mm diameter. Most of the small distribution pipes in the old part of the city (about 100 km) were installed 50 or more years ago and are badly corroded.

#### Sewerage

10. The two cast-in-place concrete main collectors along the right bank of the Miljacka River, constructed between 1902 and 1914, were sized for sewage from the city's population of 60,000 as well as storm water from the lower areas of the old city. Sewer laterals were also installed during that period and were constructed of concrete and clay pipes. Major expansion of the original system was undertaken between 1954 and 1960. The present sewer system comprises about 250 km of collectors and sewer laterals, shown on IBRD map 11459R, and about 100 km of house connections. The network includes separate sewers (sanitary sewers to remove sewage and storm sewers to remove drainage water) and combined sewers to remove sewage as well as drainage water. The separate system covers an area of about 530 hectares (ha) which includes the city slopes, the Sarajevsko Polje along the banks of the Zeljeznica River and Vogosca along the banks of the Josanica River. The combined system covers an area of about 770 ha mostly along the banks of the Miljacka River.

11. At the end of 1974 about 17,000 buildings, mostly in the densely populated center of Sarajevo, were connected to the sewer system serving about 70% of the population. Some 20,000 non-connected households within the city discharge their sewage either directly into nearby streams and drainage channels or dispose of it in the ground using septic tanks and/or soak pits. A typical septic tank in Sarajevo is a lined or unlined hole in the ground

one to three meters deep with a concrete cover. In several sections of the town, the soil is relatively impermeable and the septic tanks have to be emptied periodically by pumping. This service is provided by an enterprise called Rad 1/ which charges Din 250-300 (US\$14 to \$17) per truckload of about 5 cubic meters.

12. The capacity of the existing sewer system is inadequate to meet the requirements of the connected population and flooding of low areas occurs after heavy rainfalls. Even during periods of light rainfall, the main collectors and many of the sewer laterals flow under pressure causing an increased seepage of sewage to the surrounding ground. Furthermore, because of their age, many of the sewer pipes have deteriorated badly and infiltration in large portion of the system is excessive.

13. The main collectors in Sarajevo discharge sewage and storm water directly into the Miljacka River. Drainage water from areas served by the separate system is discharged either directly into the Miljacka River or into canalized tributaries or creeks. Some of the canalized creeks in the old part of the city are covered and discharged into the main collectors. At present there are 23 points of discharge into Miljacka River. Sewage from settlements in the Sarajevsko Polje is discharged into the Zeljeznica River through a principal sewer which passes through the Sarajevsko Polje ground-water protection area. To reduce the seepage of sewage into the water supply source, this sewer line needs to be relocated. Sewage from the Vogosca settlement is discharged into the Josanica River, a tributary to the Bosna River.

#### Public Health Aspects

14. The storm water and sewage from the city flows into the Miljacka River without treatment or disinfection. During the summer, the sewage flow is about three times the minimum flow of the River. At this time, the Miljacka has the characteristics of an open sewage canal and is the source of an unbearable stench and a serious health hazard. Furthermore, the city hospitals, i.e., the surgical clinics the infectious disease pavillion, the tuberculosis pavillion, etc., discharge their extremely dangerous wastes into the sewage network. The discharge of untreated sewage to the Miljacka River is a health hazard not only to Sarajevo but also to the communities along the Bosna River of which the Miljacka is a tributary.

15. A more serious problem, however, is the infiltration of sewage from leaking sewers into corroded water supply pipes. In spite of the regular chlorination of the city's water supplies, bacteriological pollution of the distributed water is detected frequently, particularly in the old part of the city where water pipes are badly corroded and very often in close proximity to the sewers. Waterborne diseases are an ever-present threat to the citizens

---

1/ Rad is also responsible for solid waste collection and disposal.

of Sarajevo. Some typical waterborne bacterial diseases which could be transmitted by this route are typhoid, cholera, paratyphoid and bacillary dysentery. Waterborne viral diseases include poliomyelitis and infectious hepatitis.

16. An epidemic of diarrhea was reported in 1955, when 5,600 persons were reported ill and two of them died. The epidemic was caused by infiltration of sewage from the hospital into the water supply system. A recent diarrhea epidemic caused by sewage infiltration also was reported in 1973 when 2,477 persons were infected but none died. In 1970, an epidemic of infectious hepatitis struck the city and in certain areas which lack adequate water supply and sanitation such outbreaks recur frequently. Because of water shortages and frequent pipe failures in recent years, there have been several epidemics of hepatitis among school children, (four schools in 1971, five in 1972 and four in 1973). Records of the Department of Hygiene and Epidemiology of the Sarajevo Health Institute show the following reported cases of waterborne disease for the period 1967-1973:

Disease	Number of Patients	Treated in Hospital		Number of Deaths
		Number	Days	
Hepatitis Virosa	4,155	1,850	30	4
Typhus Abdominalis	165	131	30	1
Paratyphus A & B	38	34	30	-
Disenteria	4,033	739	14	1
Enterocolities Acuta	548	28	11	-
Intoxicatio Alimentaris	827	461	11	-
Salmonellosis	252	90	14	-

Water Quality Standards for the Bosna and Miljacka Rivers

17. The Republic of Bosnia and Herzegovina issued regulations in 1967, 1968 and 1969 concerning the "Protection of Waters, Classification of Waters, and Categorization of Streams." The regulations define measures to limit the release of harmful materials into the Republic's waterways and provide for construction of plants and equipment to process wastewater and reduce pollution. Further, four classes of waterways for surfacewater, groundwater and lake waters were established according to the purpose for which the water is intended. Class I designation represents clean, unpolluted water while Class IV is a highly polluted stream. The Republic Commission for Water Management, which is responsible for implementation of the regulations, has established the following limits for some of the indicators for each class of stream:

Indicator	Stream Classes			
	I	II	III	IV
Suspended Matter (mg/l)	≤10	≤30	≤80	-
Total Residue (mg/l)	≤350	≤1,000	≤1,500	-
Dissolved Oxygen (mg/l)	≥8	≥6	≥4	≥0.50
BOD <sub>5</sub> (mg/l)	≤2	≤4	≤7	-
PH	6.8-8.5	6.8-8.5	6.0-9.0	-

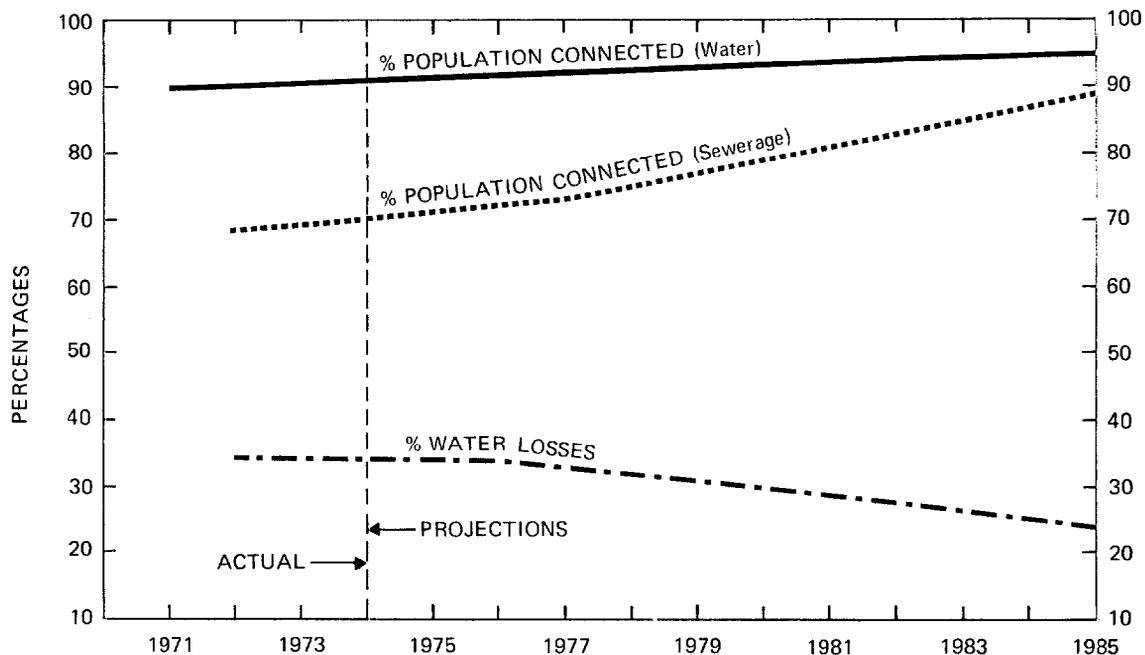
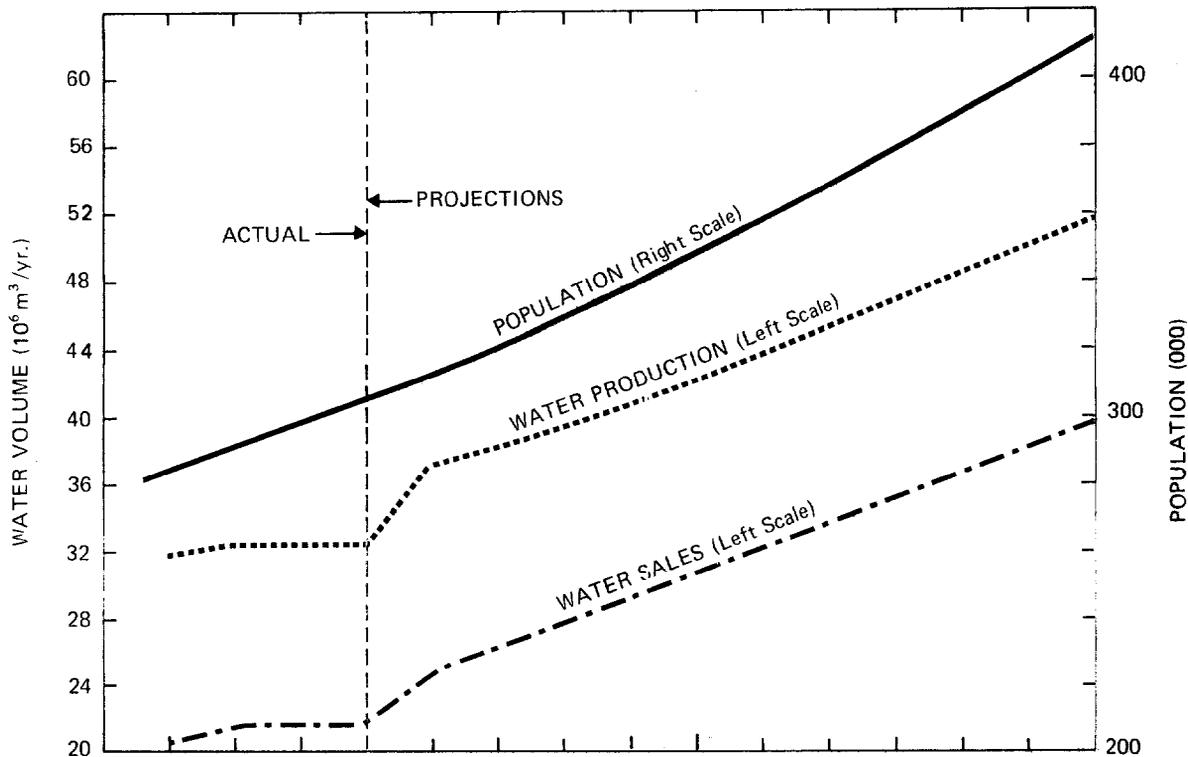
18. The Bosna River is the major river flowing through the Republic of Bosnia and Herzegovina. Its source is a large spring in the western portion of the Sarajevo metropolitan area. There are three major tributaries which join the Bosna in the vicinity of Sarajevo - the Dobrinja River, the Zeljeznica River, and the Miljacka River. According to the Republic's stream categories the Bosna River from its source until the confluence of the Zeljeznica River should be Class I, from its confluence with the Zeljeznica to the confluence with the Miljacka should be Class II, and from the confluence with the Miljacka until joining the Sava River should be Class III. The Miljacka is to be a Class II stream until reaching the point where the two main collectors from Sarajevo discharge. From this point Class III standards are to be met until the confluence with the Bosna River.

19. Stream surveys of water quality based on physical, chemical, and biological indicators have shown the quality of the Bosna River to be declining from year to year, particularly below the confluence with the Miljacka River. The Miljacka River upstream of the city of Sarajevo is slightly overloaded with organic matter, but does not show signs of degradation of the natural biological quality. Physical and chemical data gathered below the city, however, indicate the Miljacka River is no more than an open sewer for many months of the years and should be designated a Class IV stream.

20. Predictions of water quality for the Bosna and Miljacka Rivers with and without wastewater treatment have been made using a pollution equivalents technique which indicates the correct trends but is certainly not rigorous. The conclusion of this analysis is that with secondary treatment for Sarajevo, the Bosna River will fall in Class II/III as required by law. The Miljacka River downstream of the city will fall in Class III as required but it will take several years to meet Class II standards for the Miljacka through the city because of uncontrolled wastewater discharges.

May 1976

**APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
PROJECTIONS OF POPULATION, WATER PRODUCTION, WATER SALES  
AND WATER LOSSES**



APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA

DESCRIPTION OF THE PROJECT

1. The proposed project aims at improving the water supply facilities and abating the water pollution in the Sarajevo area. The project comprises rehabilitation and expansion of the water supply and sewer systems and construction of a sewage treatment plant. Improvement of the water supply facilities is needed in order to provide safe and adequate supply of water. Rehabilitation of the existing inadequate sewer system and construction of a new sewage treatment plant is essential for safeguarding the public health and abating the pollution of the Miljacka and Bosna Rivers. The project components were selected from among several alternatives as the least cost solution to meet the projected requirements. Cost estimates are provided in Annex 5 and construction schedule in Annex 6. Description of the project components are as follows:

WATER SUPPLY

2. The proposed water supply facilities are part of a master plan to expand the production facilities at the Sarajevsko Polje and to rehabilitate and extend the distribution network. Feasibility studies, prepared by Vodovod with the assistance of local and foreign consultants, call for the construction of wells, transmission lines, reservoirs, pumping stations, distribution lines and replacement of worn-out pipes and service connections. The proposed facilities are designed to provide Sarajevo with an adequate supply of water through 1985. The area served by the expanded system would be approximately twice that served by the present system. The proposed water supply facilities are shown on IBRD Map 11458R and detailed below.

Water Resources

3. According to recent hydrological studies carried out by the Institute for Water Engineering (Sarajevo), the reliable reserve of the existing sources is adequate to meet the projected water requirements of the city by 1985. Though the safe yields of the mountain springs are fully utilized, additional volumes of groundwater can be obtained by construction of new wells and/or collection galleries in the Sarajevsko Polje. The project includes development of an infiltration gallery along the banks of the Bosna River which is estimated to yield about 600 l/s. The estimated maximum daily demand to be provided for 1975 and 1985 is as follows:

<u>Year</u>	<u>Maximum Daily Requirement</u> <u>1/s</u>	<u>Source of Supply</u>	<u>Safe Yield</u> <u>1/s</u>
1975	1500	Mountain Springs Sarajevsko Polje - Existing Wells - Wells completed 1974	300  650 <u>550</u> 1500
1985	2150	Mountain Springs Sarajevsko Polje - Existing Wells - Wells completed 1974 - Proposed Gallery	300  650 600 <u>600</u> 2150

The studies further recommend that the water requirements of the city for the period 1985-2000 should be supplied from surface water of Zeljeznica River and its tributaries. The Zeljeznica River catchment area is well protected, hydrologically suitable and located at an appropriate elevation. However, hydrogeological studies are necessary to investigate alternative sites for impounding the water. The prospects for further exploitation of the groundwater sources in the Sarajevsko Polje also need to be investigated. The project includes provision for hydrogeological studies and preparation of a water resource master plan to meet the city requirements through the year 2000.

4. To safeguard against pollution of the groundwater sources, Vodovod have proposed enactment of a municipal ordinance to establish four protection zones in the Sarajevsko Polje catchment area with defined land use limitations. Vodovod will undertake, during the project construction period, land purchases and relocation of about 120 residences which are in close proximity to existing wells.

#### Reservoirs

5. Six new reservoirs will be added and three existing reservoirs will be expanded to provide for an additional storage capacity of 24,500 m<sup>3</sup> as follows:

New Reservoirs

Igman	5000 m <sup>3</sup>
Buca Potok 1	1000 m <sup>3</sup>
Lukavac	3000 m <sup>3</sup>
Tilava	1000 m <sup>3</sup>
Skenderija	8000 m <sup>3</sup>
Hatonj	500 m <sup>3</sup>

Reservoirs to be Expanded

Vraca	1000 m <sup>3</sup>
Bjelave	2000 m <sup>3</sup>
Podhrastovi	3000 m <sup>3</sup>

The total storage volume of 86,500 m<sup>3</sup> which will be available upon project completion would amount to about 50% of the 1985 maximum daily demand. The proposed reservoirs are also needed to allow proper separation of the distribution system pressure zones and to provide adequate volume of water to meet the hourly fluctuations in consumption within each zone. All reservoirs will be constructed underground using reinforced concrete.

Pumping Station

6. Infiltration gallery alongside the Bosna river and one booster pumping station will be constructed and four existing stations expanded. It is proposed to use electrically driven centrifugal pumps as follows:

New Stations

Infiltration Gallery	5 pumps 100 Kw each
Hrasno	2 pumps 60 Kw each
	4 pumps 100 Kw each

Existing Stations

Alipsan Most	3 pumps 200 Kw each
Center	3 pumps 200 Kw each
Stup	3 pumps 100 Kw each
Becevo	3 pumps 200 Kw each
	3 pumps 180 Kw each

Distribution System Extensions

7. Some 31.4 km of water mains will be added to the distribution network to improve services in existing areas and to provide water for new developments. Preliminary designs call for pipes as follows:

<u>Pipe Material</u>	<u>Diameter (mm)</u>	<u>Length (m)</u>
Steel	1000	300
	900	300
	800	800
	700	6,050
	600	1,620
	500	7,250
Cast Iron	400	4,150
	300	7,040
	200	3,900
Total		<u>31,410</u>

Steel pipes will be provided with cathodic protection to safeguard against external corrosion.

8. Vodovod will finance construction of distribution pipes (100 mm and 150 mm diameter) and service connections in the new developments.

#### Renovation of Distribution Network

9. About 180 km of the small diameter pipes (80 mm or less) are 50 to 80 years old. These pipes, mostly in the old quarter of the city, are badly corroded, leaking, operate at reduced pressure and are inadequate to meet present requirements. Vodovod is continuing their program of identifying and replacing corroded pipes to reduce water losses and improve the system.

10. The project provides for replacement of about 51 km of corroded distribution pipes and about 5000 obsolete service connections. The work will be done by force account or by small local contractors.

#### Metering and Telemetry System

11. Master meters will be installed on major water mains and existing worn-out master meters will be replaced. A telemetry control system linking major water sources, pumping stations, reservoirs, treatment plants and the control center at Bacevo pumping station will be installed.

### SEWERAGE

12. The present sewer system, mostly old and worn-out, includes sanitary sewers to remove sewage and combined sewers to remove sewage and drainage water. Several alternatives for collection of sewage and drainage water were investigated including separate sanitary sewers, combined sewers and various possible combinations of the two systems. A city-wide sanitary sewer system and a sewage treatment plant was the least cost solution. The existing combined sewers will be gradually converted to stormwater, sewers and eventually all drainage water will be discharged directly to the Miljacka River. The

proposed main sewers are designed for the projected sewage flows of the year 2000 while the principal units of the treatment plant are designed for the 1985 flows with provisions for expansion. The proposed sewerage facilities are shown on IBRD map 11459R and detailed in the following paragraphs.

Sewer System Expansion and Rehabilitation

13. Preliminary designs provide for the construction of five collectors to receive sewage from existing and proposed sewer laterals and direct it to the sewage treatment plant. Construction of sewer laterals in new areas, replacement of worn-out sewers and construction of sanitary sewers in areas presently served by combined sewers will be made gradually. Meantime, several stormwater overflows will be included with collectors along the banks of the Miljacka River to provide relief during periods of heavy rainfall until separation of the stormwater sewers are completed. Sewers layout, capacities and diameters will be reviewed during final engineering. Data on collectors, main sewer and laterals included in the project are as follows:

A. Collectors and Main Sewers

<u>Diameter (cm)</u>	<u>Length (m)</u>
50	2,200
60	6,200
70	7,150
80	2,900
90	1,350
100	2,550
110	2,800
120	3,700
130	500
140	2,700
150	<u>1,100</u>
	33,150

B. Reconstruction of sewers in areas presently served by combined system:

<u>Diameter (cm)</u>	<u>Length (m)</u>
30	2,150
40	150
50	450
60	550
90/120	550
140	<u>600</u>
	4,450

The project also provides for replacement of some 2,000 service connections, mostly in the old section of the city.

Sewage Treatment Plant

14. Several investigations were undertaken by Vodovod and their consultants to determine the present sewage organic and hydraulic loadings and to assess the probable effects of sewage treatment on the water quality of the Bosna and Miljacka Rivers. A preliminary investigation of the city's industrial and institutional wastes was also made to identify those that would require in-plant treatment prior to disposal to the sewer system.

15. Professor Van der Emde of the University of Vienna and consultants from the Civil Engineering Faculty of the University of Sarajevo studied various sewage treatment and disposal process using the data provided by the foregoing investigations. The consultants concluded that in order to meet the Republic's water quality standards for the Bosna and Miljacka Rivers and because of the relatively low assimilative capacity of these rivers during periods of minimum flow, a high degree of sewage treatment is necessary. A **sewage treatment plant employing the activated sludge process, located near the confluence of the Bosna and Miljacka Rivers, was recommended by consultants.** The sewage effluent will be discharged to the Bosna River where more **dilution water is available.** Primary treatment (screens and comminutor) was recommended for the small sewage flow from the Vogosca settlement.

16. The sewage treatment will be performed by means of a biological process, the activated sludge process, in which most of the pollution in sewage is transferred to bacteria mass and taken out from the sewage. Coarse materials are removed by screens and/or comminutors, sand settles in an aerated grit chamber and settleable solids are retained in a primary sedimentation tank. The biological treatment will be performed in an aeration tank and sewage effluent is separated from the activated sludge in the final sedimentation tanks. Primary and excess sludge will be digested in an aerobic digester and pumped to the proposed sanitary landfill at the site of the existing dump. Dewatering will be undertaken on belt filters and the dried sludge disposed of at the landfill. The supernate from the filters and landfill leachate will be returned to the treatment plant for further processing.

May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT

YUGOSLAVIA

Cost Estimates - January 1976

<u>Project Items</u>	<u>Pipes and Equipment</u>			<u>Installation and Civil Works</u>			<u>Total Costs</u>		
	<u>Local</u>	<u>Foreign</u> <u>Din (000)</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u> <u>Din (000)</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u> <u>(Din 000)</u>	<u>Total</u>
<u>WATER SUPPLY SYSTEM</u>									
1. Infiltration Gallery and River Regulation	1,050	1,950	3,000	5,600	2,400	8,000	6,650	4,350	11,000
2. Pumping Stations	6,270	6,270	12,540	3,700	1,580	5,280	9,970	7,850	17,820
3. Distribution Network Extension	20,320	20,320	40,640	33,080	14,180	47,260	53,400	34,500	87,900
4. Distribution Pipes Replacement	19,205	19,205	38,410	63,200	27,090	90,290	82,405	46,295	128,700
5. Reservoirs	-	-	-	46,510	19,930	66,440	46,510	19,930	66,440
6. Telemetry System, Power and Cathodic Protection	4,430	17,740	22,170	3,350	1,440	4,790	7,780	19,180	26,960
7. Enterprise Headquarter	-	-	-	22,350	9,580	31,930	22,350	9,580	31,930
8. Office Equipment	890	3,540	4,430	-	-	-	890	3,540	4,430
9. Water Resource Investigation	890	3,540	4,430	9,580	-	9,580	10,470	3,540	14,010
10. Engineering Services and Training	-	-	-	26,670	13,130	39,800	26,670	13,130	39,800
Sub-total	53,055	72,565	125,620	214,040	89,330	303,370	267,095	161,895	428,990
11. Physical Contingencies (15%)	7,960	10,885	18,845	32,105	13,400	45,505	40,065	24,285	64,350
Sub-total	61,015	83,450	144,465	246,145	102,730	348,875	307,160	186,180	493,340
12. Price Increases (33.5%)	13,876	18,979	32,855	93,265	38,925	132,190	102,759	62,286	165,045
Total Water Supply	<u>74,891</u>	<u>102,429</u>	<u>177,320</u>	<u>339,410</u>	<u>141,655</u>	<u>481,065</u>	<u>409,919</u>	<u>248,466</u>	<u>658,385</u>
<u>SEWERAGE SYSTEM</u>									
1. Collectors and Sewers	28,090	22,980	51,070	89,400	38,310	127,710	117,490	61,290	178,780
2. Reconstruction Sewers and Service Connections	4,280	1,830	6,110	12,840	5,500	18,340	17,120	7,330	24,450
3. Treatment Facilities	39,000	111,420	150,420	176,680	75,720	252,400	215,680	187,140	402,820
4. Sludge Disposal Site	4,435	4,435	8,870	13,410	5,745	19,155	17,845	10,180	28,025
5. Engineering Services and Training	-	-	-	25,835	17,220	43,055	25,835	17,220	43,055
Sub-total	75,805	140,665	216,470	318,165	142,495	460,660	393,970	283,160	677,130
6. Physical Contingencies (15%)	11,370	21,100	32,470	47,725	21,375	69,100	59,095	42,475	101,570
Sub-total	87,175	161,765	248,940	365,890	163,870	529,760	453,065	325,635	778,700
7. Price Increases (35.7%)	22,426	41,614	64,040	152,963	68,507	221,470	166,116	119,394	285,510
Total Sewerage	<u>109,601</u>	<u>203,379</u>	<u>312,980</u>	<u>518,853</u>	<u>232,377</u>	<u>751,230</u>	<u>619,181</u>	<u>445,029</u>	<u>1,064,210</u>
Total Project Costs	<u>184,492</u>	<u>305,808</u>	<u>490,300</u>	<u>858,263</u>	<u>374,032</u>	<u>1,232,295</u>	<u>1,029,100</u>	<u>693,495</u>	<u>1,722,595</u>

May 1976



APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT

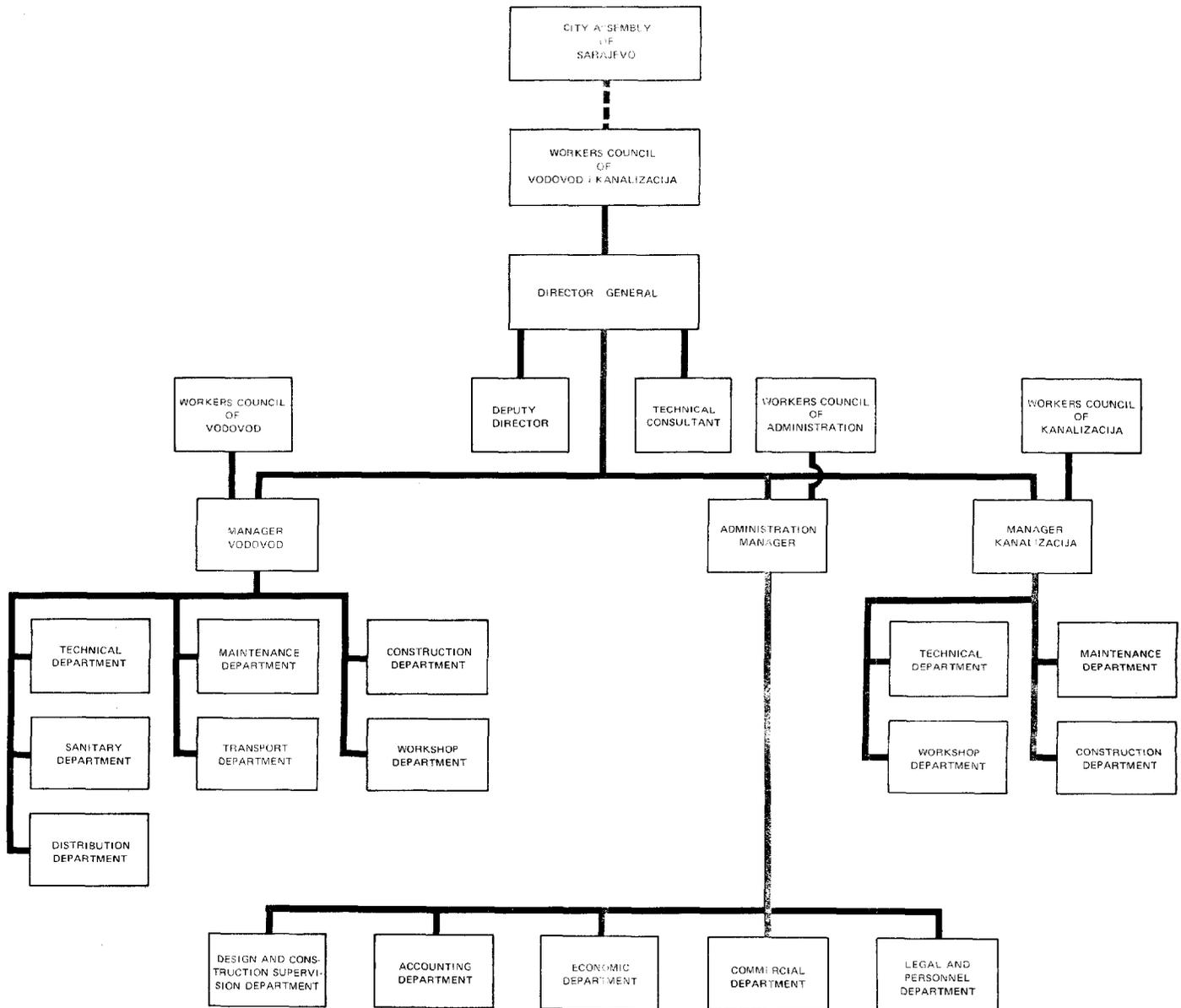
YUGOSLAVIA

Estimated Schedule of Disbursements

<u>IBRD Fiscal Year and Quarter</u>	<u>Cumulative Disbursements at End of Quarter</u> -----US\$ Million-----
<u>1976/77</u>	
September 30, 1976	nil
December 31, 1976	1.0
March 31, 1977	1.5
June 30, 1977	2.5
<u>1977/78</u>	
September 30, 1977	4.0
December 31, 1977	6.0
March 31, 1978	9.0
June 30, 1978	12.0
<u>1978/79</u>	
September 30, 1978	15.0
December 31, 1978	20.0
March 31, 1979	25.0
June 30, 1979	30.0
<u>1979/80</u>	
September 30, 1979	33.0
December 31, 1979	36.0
March 31, 1980	38.0
June 30, 1980	40.0
<u>1980/81</u>	
September 30, 1980	42.0
December 31, 1980	44.0
March 31, 1981	45.0

May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
ORGANIZATION CHART OF PREDUZECE VODOVOD I KANALIZACIJA SARAJEVO



May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
Preduzece Vodovod i Kanalizacija Sarajevo  
Income Statements for the Years 1973-1983

WATER SUPPLY  
(Din Millions)

Year Ending December 31	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>
	-----Actual-----		-----Estimated-----								
Production (million m <sup>3</sup> )	32.8	34.2	39.3	41.4	42.6	42.9	43.6	44.4	45.2	46.8	48.7
Consumption (million m <sup>3</sup> )											
Domestic	11.3	11.1	12.4	13.6	14.4	15.2	16.3	16.8	17.5	18.2	18.9
Other	<u>10.4</u>	<u>10.4</u>	<u>11.6</u>	<u>12.5</u>	<u>13.3</u>	<u>14.0</u>	<u>15.1</u>	<u>15.6</u>	<u>16.2</u>	<u>16.9</u>	<u>17.6</u>
<u>Total</u>	<u>21.7</u>	<u>21.5</u>	<u>24.0</u>	<u>26.1</u>	<u>27.7</u>	<u>29.2</u>	<u>31.4</u>	<u>32.4</u>	<u>33.7</u>	<u>35.1</u>	<u>36.5</u>
Unaccounted-for Water (%)	34	37	39	37	35	32	28	27	26	25	25
Population Served (%)	91	91	92	92	92	92	93	93	93	94	94
Average Price (Dinars per m <sup>3</sup> )	2.1	2.5	3.6	4.4	5.2	5.9	6.3	6.7	6.8	7.0	7.1
<u>Revenue</u>											
Water Sales	44.7	55.4	85.4	116.0	143.9	173.1	197.4	215.7	229.6	244.4	259.2
Other Income	<u>9.1</u>	<u>9.3</u>	<u>9.6</u>	<u>10.0</u>	<u>11.1</u>	<u>12.5</u>	<u>14.0</u>	<u>15.6</u>	<u>17.4</u>	<u>19.3</u>	<u>20.0</u>
<u>Total Revenue</u>	<u>53.8</u>	<u>64.7</u>	<u>95.0</u>	<u>126.0</u>	<u>155.0</u>	<u>185.6</u>	<u>211.4</u>	<u>231.3</u>	<u>247.0</u>	<u>263.7</u>	<u>279.2</u>
<u>Operating Costs</u>											
Wages	13.1	17.0	22.5	27.2	32.1	36.9	41.3	46.3	51.8	58.0	65.0
Common Services	5.4	7.7	10.4	12.6	14.9	17.1	19.2	21.5	24.1	27.0	30.2
Electricity	3.6	5.3	9.0	11.4	13.6	15.6	17.9	19.7	21.9	24.3	27.0
Maintenance	2.6	1.7	2.5	3.7	4.2	5.4	7.1	8.7	9.1	9.6	10.0
Other Expenditure	<u>2.9</u>	<u>2.0</u>	<u>6.8</u>	<u>8.2</u>	<u>9.7</u>	<u>11.2</u>	<u>12.6</u>	<u>14.1</u>	<u>15.8</u>	<u>17.7</u>	<u>19.8</u>
<u>Total Operating Costs</u>	<u>27.6</u>	<u>33.7</u>	<u>51.2</u>	<u>63.1</u>	<u>74.5</u>	<u>86.2</u>	<u>98.1</u>	<u>110.3</u>	<u>122.7</u>	<u>136.6</u>	<u>152.0</u>
Surplus before Depreciation and Interest	26.2	31.0	43.8	62.9	80.5	99.4	113.3	121.0	124.3	127.1	127.2
Depreciation	<u>6.4</u>	<u>8.3</u>	<u>10.6</u>	<u>11.1</u>	<u>13.6</u>	<u>18.0</u>	<u>22.8</u>	<u>27.1</u>	<u>27.5</u>	<u>28.3</u>	<u>28.5</u>
Surplus before Interest	19.8	22.7	33.2	51.8	66.9	81.4	90.5	93.9	96.8	98.8	98.7
Interest	<u>1.2</u>	<u>2.4</u>	<u>2.3</u>	<u>3.7</u>	<u>3.7</u>	<u>3.7</u>	<u>3.3</u>	<u>3.1</u>	<u>33.4</u>	<u>32.5</u>	<u>31.7</u>
<u>Net Revenue</u>	<u>18.6</u>	<u>20.3</u>	<u>30.9</u>	<u>48.1</u>	<u>63.2</u>	<u>77.7</u>	<u>87.2</u>	<u>90.8</u>	<u>63.4</u>	<u>66.3</u>	<u>67.0</u>
Rate of Return on Average Net Fixed Assets	10.1	11.3	11.6	13.8	14.2	12.3	10.4	9.0	8.8	8.9	8.9

May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA

Preduzeće Vodovod i Kanalizacija Sarajevo  
Income Statements for the Years 1973-1983

SEWERAGE  
(Din Millions)

Year Ending December 31	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	-----Actual-----		-----Estimated-----								
<u>Water Surcharged (million m<sup>3</sup>)</u>											
Domestic	-	11.0	11.7	13.1	13.9	14.7	15.8	16.3	16.9	17.6	18.3
Other	-	8.9	10.2	11.2	11.9	12.5	13.4	13.8	14.5	15.0	15.5
<u>Total</u>	<u>20.1</u>	<u>19.9</u>	<u>21.9</u>	<u>24.3</u>	<u>25.8</u>	<u>27.2</u>	<u>29.2</u>	<u>30.1</u>	<u>31.4</u>	<u>32.6</u>	<u>33.8</u>
<u>Population Served (%)</u>	70	70	71	72	73	75	77	79	81	83	85
<u>Revenue</u>											
Surcharge on Water	13.9	22.0	40.2	53.2	66.0	79.4	95.9	110.0	116.7	123.7	130.7
Other Income	3.4	2.9	5.6	6.6	7.2	8.1	9.2	10.0	10.8	11.5	12.2
<u>Total Revenue</u>	<u>17.3</u>	<u>24.9</u>	<u>45.8</u>	<u>59.8</u>	<u>73.2</u>	<u>87.5</u>	<u>105.1</u>	<u>120.0</u>	<u>127.5</u>	<u>135.2</u>	<u>142.9</u>
<u>Operating Costs</u>											
Wages	4.9	5.7	8.7	10.5	12.4	14.3	16.0	18.9	21.2	23.7	26.5
Common Services	1.6	1.9	3.5	4.2	5.0	5.7	6.4	7.2	8.0	9.0	10.1
Electricity	.1	.1	.2	.8	.9	1.0	4.3	5.0	5.6	6.3	7.1
Maintenance	1.3	.6	1.1	1.2	1.3	1.5	3.0	6.0	9.4	10.5	10.7
Other Expenditure	2.2	.8	4.5	5.4	6.4	7.4	9.3	10.4	11.7	13.0	14.6
<u>Total Operating Costs</u>	<u>10.1</u>	<u>9.1</u>	<u>18.0</u>	<u>22.1</u>	<u>26.0</u>	<u>29.9</u>	<u>39.6</u>	<u>47.5</u>	<u>55.9</u>	<u>62.5</u>	<u>69.0</u>
<u>Surplus before Depreciation and Interest</u>	7.2	15.8	27.8	37.7	47.2	57.6	65.5	72.5	71.6	72.7	73.9
<u>Depreciation</u>	2.9	2.9	3.5	3.6	3.9	6.1	13.2	27.7	35.4	37.5	38.0
<u>Surplus before Interest</u>	4.3	12.9	24.3	34.1	43.3	51.5	52.3	44.8	36.2	35.2	35.9
<u>Interest</u>	.1	.3	.3	.1	.1	.1	.1	.1	50.0	48.8	47.6
<u>Net Revenue</u>	<u>4.2</u>	<u>12.6</u>	<u>24.0</u>	<u>34.0</u>	<u>43.2</u>	<u>51.4</u>	<u>52.2</u>	<u>44.7</u>	<u>(13.8)</u>	<u>(13.6)</u>	<u>(11.7)</u>
<u>Rate of Return on Average Net Fixed Assets</u>	6.5	18.3	28.1	31.8	34.6	21.9	10.0	4.8	3.1	2.9	2.9

May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
Preduzece Vodovod i Kanalizacija Sarajevo  
Consolidated Income Statements for the Years 1973-1983  
WATER SUPPLY & SEWERAGE COMPONENTS  
(Din Millions)

Year Ending December 31	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>
	-----Actual-----		-----Estimated-----								
<u>Revenue</u>											
Water Supply	53.8	64.7	95.0	126.0	155.0	185.6	211.4	231.3	247.0	263.7	279.2
Sewerage	17.3	24.9	45.8	59.8	73.2	87.5	105.1	120.0	127.5	135.2	142.9
<u>Total</u>	<u>71.1</u>	<u>89.6</u>	<u>140.8</u>	<u>185.8</u>	<u>228.2</u>	<u>273.1</u>	<u>316.5</u>	<u>351.3</u>	<u>374.5</u>	<u>398.9</u>	<u>422.1</u>
<u>Operating Costs</u>											
Water Supply	27.6	33.7	51.2	63.1	74.5	86.2	98.1	110.3	122.7	136.6	152.0
Sewerage	10.1	9.1	18.0	22.1	26.0	29.9	39.6	47.5	55.9	62.5	69.0
<u>Total</u>	<u>37.7</u>	<u>42.8</u>	<u>69.2</u>	<u>85.2</u>	<u>100.5</u>	<u>116.1</u>	<u>137.7</u>	<u>157.8</u>	<u>178.6</u>	<u>199.1</u>	<u>221.0</u>
<u>Surplus before Depreciation and Interest</u>											
Water Supply	26.2	31.0	43.8	62.9	80.5	99.4	113.3	121.0	124.3	127.1	127.2
Sewerage	7.2	15.8	27.8	37.7	47.2	57.6	65.5	72.5	71.6	72.7	73.9
<u>Total</u>	<u>33.4</u>	<u>46.8</u>	<u>71.6</u>	<u>100.6</u>	<u>127.7</u>	<u>157.0</u>	<u>178.8</u>	<u>193.5</u>	<u>195.9</u>	<u>199.8</u>	<u>201.1</u>
<u>Depreciation</u>											
Water Supply	6.4	8.3	10.6	11.1	13.6	18.0	22.8	27.1	27.5	28.3	28.5
Sewerage	2.9	2.9	3.5	3.6	3.9	6.1	13.2	27.7	35.4	37.5	38.0
<u>Total</u>	<u>9.3</u>	<u>11.2</u>	<u>14.1</u>	<u>14.7</u>	<u>17.5</u>	<u>24.1</u>	<u>36.0</u>	<u>54.8</u>	<u>62.9</u>	<u>65.8</u>	<u>66.5</u>
<u>Surplus before Interest</u>											
Water Supply	19.8	22.7	33.2	51.8	66.9	81.4	90.5	93.9	96.8	98.8	98.7
Sewerage	4.3	12.9	24.3	34.1	43.3	51.5	52.3	44.8	36.2	35.2	35.9
<u>Total</u>	<u>24.1</u>	<u>35.6</u>	<u>57.5</u>	<u>85.9</u>	<u>110.2</u>	<u>132.9</u>	<u>142.8</u>	<u>138.7</u>	<u>133.0</u>	<u>134.0</u>	<u>134.6</u>
<u>Interest</u>											
Water Supply	1.2	2.4	2.3	3.7	3.7	3.7	3.3	3.1	33.4	32.5	31.7
Sewerage	.1	.3	.3	.1	.1	.1	.1	.1	50.0	48.8	47.6
<u>Total</u>	<u>1.3</u>	<u>2.7</u>	<u>2.6</u>	<u>3.8</u>	<u>3.8</u>	<u>3.8</u>	<u>3.4</u>	<u>3.2</u>	<u>83.4</u>	<u>81.3</u>	<u>79.3</u>
<u>Net Revenue</u>											
Water Supply	18.6	20.3	30.9	48.1	63.2	77.7	87.2	90.8	63.4	66.3	67.0
Sewerage	4.2	12.6	24.0	34.0	43.2	51.4	52.2	44.7	(13.8)	(13.6)	(11.7)
<u>Total</u>	<u>22.8</u>	<u>32.9</u>	<u>54.9</u>	<u>82.1</u>	<u>106.4</u>	<u>129.1</u>	<u>139.4</u>	<u>135.5</u>	<u>49.6</u>	<u>52.7</u>	<u>55.3</u>
<u>Rate of Return on Average Net Fixed Assets</u>											
Water Supply	10.1	11.3	11.6	13.8	14.2	12.3	10.4	9.0	8.8	8.9	8.9
Sewerage	6.5	18.3	28.1	31.8	34.6	21.9	10.0	4.8	3.1	2.9	2.9
Water Supply & Sewerage	9.2	13.1	15.4	17.8	18.5	14.8	10.2	7.0	5.6	5.7	5.8

May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
Preduzece Vodovod i Kanalizacija Sarajevo  
Cash Flow Statements for the Years 1973 - 1983

Year Ending December 31	1973	1974	1975	1976	1977	1978	1979	1980	1976 - 80	1981	1982	1983
	---Actual---		-----Estimated-----									
<b>SOURCES OF FUNDS</b>												
<u>Internal Cash Generation</u>												
Water Supply	26.2	31.0	43.8	62.9	80.5	99.4	113.3	121.0	477.1	124.3	127.1	127.2
Sewerage	7.2	15.8	27.8	37.7	47.2	57.6	65.3	72.5	280.3	71.6	72.7	72.9
<u>Total</u>	33.4	46.8	71.6	100.6	127.7	157.0	178.8	193.5	757.6	195.9	199.8	201.1
<u>Loans</u>												
Existing Loans	6.6	-	36.5	-	-	-	-	-	-	15.0	10.0	10.0
Proposed IBRD Loan	-	-	-	23.0	123.9	171.8	276.0	215.3	810.0	-	-	-
Proposed Local Bank Loans	-	-	-	-	-	103.0	39.8	9.3	152.1	-	-	-
<u>Total</u>	6.6	-	36.5	23.0	123.9	274.8	315.8	224.6	962.1	15.0	10.0	10.0
<u>Capital Contributions</u>												
Republic Water Fund	-	-	-	-	25.0	25.0	40.0	10.0	100.0	-	-	-
City Assembly Budget	42.4	51.5	13.0	-	17.0	17.0	16.0	-	50.0	-	-	-
Housing Fund	-	-	-	-	30.0	70.0	50.0	-	150.0	-	-	-
Site Preparation Fund	-	-	20.0	-	15.0	65.0	35.0	20.0	155.0	-	-	-
<u>Total</u>	42.4	51.5	33.0	-	87.0	177.0	141.0	30.0	435.0	-	-	-
<u>Increase (Decrease) in Current Liabilities</u>	1.7	16.4	(24.7)	25.1	74.0	53.0	16.0	(113.0)	55.1	(10.0)	5.0	1.0
<u>TOTAL SOURCES OF FUNDS</u>	<u>84.1</u>	<u>114.7</u>	<u>116.4</u>	<u>148.7</u>	<u>412.6</u>	<u>161.8</u>	<u>651.6</u>	<u>335.1</u>	<u>2,209.8</u>	<u>200.9</u>	<u>214.8</u>	<u>212.1</u>
<b>APPLICATION OF FUNDS</b>												
<u>Project Expenditures</u>												
Water Supply	-	-	-	32.1	153.9	209.5	197.6	65.3	658.4	-	-	-
Sewerage	-	-	-	31.8	176.8	326.6	360.3	168.2	1,064.2	-	-	-
<u>Total</u>	-	-	-	63.9	330.7	536.1	558.4	233.5	1,722.6	-	-	-
<u>Other Capital Expenditures</u>												
Water Supply	55.6	92.0	62.0	35.0	35.0	30.0	10.0	-	110.0	35.0	34.0	34.0
Sewerage	18.0	14.7	18.6	10.0	10.0	10.0	-	-	30.0	33.0	35.0	35.0
<u>Total</u>	73.6	106.7	80.6	45.0	45.0	40.0	10.0	-	140.0	68.0	69.0	69.0
<u>Interest Capitalized</u>												
IBRD	-	-	-	5.0	11.9	21.8	36.0	61.6	136.3	-	-	-
Local Loans	-	-	-	-	-	3.6	9.2	9.3	22.1	-	-	-
<u>Total</u>	-	-	-	5.0	11.9	25.4	45.2	70.9	158.4	-	-	-
<u>Debt Service</u>												
Repayment												
Existing Loans	6.0	5.0	5.0	4.2	4.2	4.2	4.6	4.8	22.0	4.8	5.0	5.0
Proposed IBRD Loan	-	-	-	-	-	-	-	-	-	16.7	18.3	19.8
Proposed Local Bank Loans	-	-	-	-	-	-	-	-	-	5.2	5.5	6.0
<u>Interest</u>												
Existing Loans	1.3	2.7	2.6	3.8	3.8	3.8	3.4	3.2	18.0	3.2	3.0	3.0
Proposed IBRD Loan	-	-	-	-	-	-	-	-	-	68.9	67.3	65.8
Proposed Local Bank Loans	-	-	-	-	-	-	-	-	-	11.3	11.0	10.5
<u>Total</u>	7.3	7.7	7.6	8.0	8.0	8.0	8.0	8.0	40.0	110.1	110.1	110.1
<u>Increase (Decrease) in Current Assets except Cash</u>	(5.0)	5.6	9.2	(3.1)	26.0	35.0	15.0	8.0	80.9	12.0	5.0	3.0
<u>Contribution and Taxes</u>	1.8	3.5	4.7	9.0	10.5	11.9	13.1	14.4	58.9	15.7	17.0	18.0
<u>Reserve Fund</u>	1.1	1.2	1.3	1.8	2.2	2.3	2.8	3.1	12.4	3.5	3.8	3.9
<u>Total Allocation of Fund</u>	<u>78.8</u>	<u>124.7</u>	<u>103.4</u>	<u>129.6</u>	<u>424.3</u>	<u>658.9</u>	<u>625.2</u>	<u>337.9</u>	<u>2,213.2</u>	<u>209.3</u>	<u>208.9</u>	<u>205.0</u>
<u>Increase in Cash</u>	5.3	(10.0)	13.0	19.1	(21.7)	2.9	(0.9)	2.8	( 3.4)	( 8.4)	9.9	8.1
<u>Cash Balance at End of Year</u>	12.1	2.1	15.1	34.2	12.5	15.4	14.5	11.7	-	3.3	13.2	21.3
<u>Debt Service Coverage</u>	4.6	6.1	9.4	12.6	16.0	19.6	22.4	24.1	-	1.8	1.8	1.8
<u>Debt Service Coverage after Contributions and Reserve Fund</u>	3.3	3.8	5.3	5.4	6.2	7.0	7.5	7.6	-	1.3	1.5	1.5

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA  
Preduzeće Vodovod i Kanalizacija Sarajevo  
Balance Sheets as at December 31, 1973-1983  
(Din Millions)

As at December 31	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
	-----Actual-----						Estimated				
<b>Assets</b>											
<b>Fixed Assets</b>											
Water Supply	280.7	318.7	470.7	517.8	686.7	929.8	1,146.6	1,520.2	1,338.0	1,372.0	1,406.0
Less Depreciation	<u>94.7</u>	<u>103.0</u>	<u>113.6</u>	<u>124.7</u>	<u>138.3</u>	<u>156.3</u>	<u>179.1</u>	<u>206.2</u>	<u>233.7</u>	<u>252.0</u>	<u>290.5</u>
Net Fixed Assets in Operation	186.0	215.7	357.1	393.1	548.4	773.5	967.5	1,114.0	1,104.3	1,120.0	1,115.5
Sewerage	118.3	122.0	156.7	170.0	200.0	400.0	800.0	1,255.0	1,372.5	1,407.5	1,442.5
Less Depreciation	<u>48.1</u>	<u>51.0</u>	<u>54.5</u>	<u>58.1</u>	<u>62.0</u>	<u>68.1</u>	<u>81.3</u>	<u>109.0</u>	<u>144.4</u>	<u>181.9</u>	<u>219.9</u>
Net Fixed Assets in Operation	<u>70.2</u>	<u>71.0</u>	<u>102.2</u>	<u>111.9</u>	<u>138.0</u>	<u>331.9</u>	<u>718.7</u>	<u>1,146.0</u>	<u>1,228.1</u>	<u>1,225.6</u>	<u>1,222.6</u>
Work in Progress	55.2	130.2	24.1	77.6	266.3	424.7	421.5	97.3	30.0	30.0	30.0
Total Fixed Assets	<u>321.4</u>	<u>416.9</u>	<u>483.4</u>	<u>582.6</u>	<u>952.7</u>	<u>1,530.1</u>	<u>2,107.7</u>	<u>2,357.3</u>	<u>2,362.4</u>	<u>2,365.6</u>	<u>2,368.1</u>
Reserve Fund Investments	3.6	4.8	6.1	7.9	10.1	12.6	15.4	18.5	22.0	25.8	29.7
<b>Current Assets</b>											
Advance Payments	11.7	12.8	3.0	12.0	24.0	29.0	6.0	5.0	5.0	5.0	5.0
Inventories	8.8	9.1	12.4	23.0	33.0	57.0	90.0	96.0	103.0	106.0	108.0
Receivables	22.3	27.0	42.7	20.0	24.0	30.0	35.0	40.0	43.0	45.0	46.0
Cash	<u>12.1</u>	<u>2.1</u>	<u>15.1</u>	<u>34.2</u>	<u>12.5</u>	<u>15.4</u>	<u>16.5</u>	<u>11.7</u>	<u>3.3</u>	<u>13.2</u>	<u>21.3</u>
Total Current Assets	<u>55.4</u>	<u>51.0</u>	<u>73.2</u>	<u>89.2</u>	<u>93.5</u>	<u>131.4</u>	<u>145.5</u>	<u>150.7</u>	<u>151.3</u>	<u>169.2</u>	<u>180.3</u>
Total Assets	<u>380.4</u>	<u>472.7</u>	<u>552.7</u>	<u>679.7</u>	<u>1,056.3</u>	<u>1,674.1</u>	<u>2,268.6</u>	<u>2,526.5</u>	<u>2,538.7</u>	<u>2,560.6</u>	<u>2,578.1</u>
<b>Liabilities</b>											
<b>Equity</b>											
Business Fund	299.8	369.5	451.4	522.7	616.4	731.1	854.6	972.6	1,003.0	1,034.9	1,068.3
Reserve Fund	3.6	4.8	6.1	7.9	10.1	12.6	15.4	18.5	22.0	25.8	29.7
Proposed Contributions	-	-	-	-	87.0	264.0	405.0	435.0	435.0	435.0	435.0
Total Equity	<u>303.4</u>	<u>374.3</u>	<u>457.5</u>	<u>530.6</u>	<u>713.5</u>	<u>1,007.7</u>	<u>1,275.0</u>	<u>1,426.1</u>	<u>1,460.0</u>	<u>1,495.7</u>	<u>1,533.0</u>
<b>Long Term Liabilities</b>											
Existing Loans	66.1	71.1	102.6	98.4	94.2	90.0	85.4	80.6	75.8	70.8	65.8
Proposed IFRD Loan	-	-	-	23.0	146.9	318.7	594.7	810.0	793.3	775.0	755.2
Proposed Local	-	-	-	-	-	101.0	142.8	152.1	161.9	166.4	170.4
Total Long Term Liabilities	<u>66.1</u>	<u>71.1</u>	<u>102.6</u>	<u>121.4</u>	<u>241.1</u>	<u>511.7</u>	<u>822.9</u>	<u>1,042.7</u>	<u>1,031.0</u>	<u>1,012.2</u>	<u>991.4</u>
<b>Current Liabilities</b>											
Contractors	-	-	-	10.0	80.0	130.0	140.0	20.0	14.0	14.0	14.0
Accounts Payable	<u>10.9</u>	<u>27.3</u>	<u>2.6</u>	<u>17.7</u>	<u>21.7</u>	<u>26.7</u>	<u>30.7</u>	<u>37.7</u>	<u>33.7</u>	<u>38.7</u>	<u>39.7</u>
Total Current Liabilities	<u>10.9</u>	<u>27.3</u>	<u>2.6</u>	<u>27.7</u>	<u>101.7</u>	<u>156.7</u>	<u>170.7</u>	<u>57.7</u>	<u>47.7</u>	<u>52.7</u>	<u>53.7</u>
Total Liabilities	<u>380.4</u>	<u>472.7</u>	<u>552.7</u>	<u>679.7</u>	<u>1,056.3</u>	<u>1,674.1</u>	<u>2,268.6</u>	<u>2,526.5</u>	<u>2,538.7</u>	<u>2,560.6</u>	<u>2,578.1</u>
<b>Ratios</b>											
Debt/Equity Ratio	18:82	16:84	18:82	19:81	25:75	34:66	39:61	42:58	41:59	40:60	39:61

May 1976

ANNEX 13

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA

Assumptions for Financial Forecasts

Income Statements

1. The Income Statements of Vodovod for 1973 and 1974 were adjusted to conform to the standard Bank format. The principal adjustment was the elimination of the "income" and "expenditure" for capital works undertaken by Vodovod and its contractors on its own behalf and on behalf of other water supply authorities.

2. Projections were based on the accounts for nine months ending September 30, 1975. The following inflation rates were used:

1976	-	16%
1977	-	13%
1978	-	10%
1979-1983	-	7% per annum

3. The revenue for water supply and sewerage were calculated using the tariff shown in Annex 16. No meter rents or deposits are charged by Vodovod.

4. Other income includes connection charges, interest charged on outstanding account, miscellaneous sales and maintenance works.

5. Wages which include indirect benefits have been increased by 5% per annum to provide for salary increments and additional staff appointments to operate the expanded system. A separate provision has been made for sewerage treatment plant staff from 1979 onwards. Wages of the Design and Construction Supervision Department are not included as this department will act as a contractor to Vodovod. The design costs are included in the project cost estimates.

6. The common services of accounting and administration have been increased by 5% per annum. Sixty-two percent was allocated to water and the balance to sewerage in accordance with Vodovod's present practice.

7. Electricity has been increased in proportion to water produced. A special provision was made for electricity for the sewerage treatment plant from 1979 onwards.

8. Maintenance costs were calculated at 0.75% of gross fixed assets at the beginning of the year.
9. Other expenditure was increased by 5% per annum.
10. By law Vodovod is required to use the following minimum depreciation rates:

	%
Water Pipes	2.0
Sewer Pipes	1.5
Water Sources	1.5
Water Treatment	2.0
Reservoirs	1.5
Building	1.2
Pumps	7.0
Motor	5.5
Vehicles	20.0
Office Equipment	10.0

However, Vodovod has increased the depreciation rates used and presently charges rates equal to 2.2% of gross fixed assets. This rate is satisfactory in view of the skilled level of Vodovod's staff. Depreciation was projected at 2.2% of gross fixed assets at the beginning of the year and increased to 2.7% in 1980 for sewerage to provide for the sewerage treatment plant.

11. Interest on loans from IBRD and local banks during the construction period has been capitalized.

Cash Flow Statement

12. The following are the details of projected loans:
- (a) An IBRD loan of Din 810.0 million (US\$45.0 million) for 25 years, including a grace period of 5 years on repayments, at 8-1/2% per annum.
  - (b) Proposed local bank loans of Din 152.1 million (US\$8.5 million) plus interest during construction, for 20 years, including a grace period of five years, at 7-1/2% per annum. The Bank's participating are:

	<u>Din million</u>
(i) Privredna Banka, Sarajevo	50.0
(ii) Jugobanka	30.0
(iii) Ljubljanska Banka	30.0
(iv) Beogradska Banka	20.0
Interest During Construction	<u>22.1</u>
Total	<u>152.1</u>

13. By law Vodovod is required to pay taxes to the City of Sarajevo and to make contributions to social funds from net income remaining after meeting legal and contractual obligations. The workers may also authorize additional contributions. The projections are based on the estimates of the accounting staff of Vodovod. Contributions which are in the nature of fringe benefits for workers are included under wages.

14. Enterprises are required by law to establish a reserve fund to be used for payment of legal obligations in case of insolvency. The contributions are based on the estimate of the accounting staff of Vodovod.

#### Balance Sheet

15. Trust funds, such as the Collective Consumption Fund, administered by Vodovod on behalf of its workers, have been eliminated from the Balance Sheets.

16. Inventories have been increased in line with the increase in gross fixed assets.

17. Receivables have been increased in line with increased revenue.

18. Accounts payable have been maintained at about 25% of operating costs.

May 1976

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE

YUGOSLAVIA

Proposed Water Supply and Sewerage Tariffs

Date	Water Supply			Sewerage		
	Price: Din per m <sup>3</sup>		Index	Surcharge: Din per m <sup>3</sup>		Index
	Household	Other Consumers		Household	Other Consumers	
January 1, 1973	1.50	3.00	100.0	0.50	1.00	100.0
July 1, 1974	2.00	4.00	133.3	1.00	2.00	200.0
January 1, 1975	2.50	5.00	166.7	1.25	2.50	250.0
January 1, 1976	3.00	6.00	200.0	1.50	3.00	300.0
January 1, 1977	3.50	7.00	233.3	1.75	3.50	350.0
January 1, 1978	4.00	8.00	266.7	2.00	4.00	400.0
January 1, 1979	4.25	8.50	283.3	2.25	4.50	450.0
January 1, 1980	4.50	9.00	300.0	2.50	5.00	500.0
January 1, 1981	4.60	9.20	306.7	2.55	5.10	510.0
January 1, 1982	4.70	9.40	313.3	2.60	5.20	520.0
January 1, 1983	4.80	9.60	320.0	2.65	5.30	530.0
January 1, 1984	4.90	9.80	326.7	2.70	5.40	540.0
January 1, 1985	5.00	10.00	333.3	2.75	5.50	550.0
January 1, 1986	5.10	10.20	340.0	2.80	5.60	560.0
January 1, 1987	5.20	10.40	346.7	2.85	5.70	570.0
January 1, 1988	5.30	10.60	353.3	2.90	5.80	580.0

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT  
YUGOSLAVIA

Justification

Background

1. There are serious deficiencies in the existing water supply and sewerage facilities in Sarajevo; the infiltration of sewage from leaking sewers into corroded water supply pipes, the possibility of a return to rationing and intermittent water supply by 1978, the discharge of untreated sewage and hospital wastes into the Miljacka River, and the resulting threat to health and economic productivity (Annex 2).

Water Supply

2. There are a variety of benefits associated with the provision of a convenient and safe water supply. Among the more important benefits of the improved Sarajevo water supply will be health benefits both immediate and long range. These health benefits will be partially revealed through medical cost savings, a general improvement in individual well being, and a cost savings to, or an increased productivity of, business enterprises. This follows from the fact that a healthier population will require less health care, will tend to have lower employment absentee rates, and will tend to be more productive when they are on the job. It is not possible to quantitatively measure these benefits, however, because the recent health statistics which summarize the incidence and prevalence of water and sanitation related diseases in Sarajevo, pertain to the period prior to December 1974 during which time most of the city had intermittent water supplies. During that period sewage infiltration into empty water pipes and the resulting water supply and sanitation related health problems would be expected to be of a different magnitude than they are currently.

3. In view of the wide variety of water uses, and of the unknown values of the exact benefits of each of those uses, the best method by which an attempt can be made to derive at least a minimum estimate of benefits is to examine the water consumers' demonstrated willingness to pay for the water which they consume. The internal economic rate of return was calculated using incremental water sales at 1976 tariff as a measure of benefits. Costs of replacement of corroded distribution pipes and service connections were excluded from the investment costs and the benefits resulting from this work were not added to the incremental water sales. The rate of return on the water supply investment is estimated at 15.6% (Table 1). If projected incremental consumption was reduced by 25%, the rate of return would be 9.5%. This indicates that the new water tariff implemented early this year is satisfactory.

The proposed water tariffs during the project construction period (Annex 16) will on average maintain the present tariff in real terms given the projected inflation rates. The proposed tariffs from 1981 onwards would not keep up with the projected 7% inflation. However, the requirement that Vodovod should adjust their tariffs to finance each year from 1981 onward not less than 35% of the average cost of investment from internal cash generation (para 6.10) should at least maintain future tariff at the present levels in real terms.

#### Sewerage

4. The benefits of the proposed investment in sewage collection and treatment in Sarajevo fall into the following categories, which are not necessarily mutually exclusive: (a) health benefits, (b) an increase in property values along waterways which are currently polluted by untreated sewage, and (c) recreation benefits which will result from the partial cleansing of the Miljacka River. These benefits, however, cannot be accurately measured for the following reasons: (a) as discussed above recent water and sanitation related health statistics relate to a prior period during which water was supplied on an intermittent basis, (b) the market for land in Sarajevo is regulated and as a result measurable land market values will not be necessarily change along the improved waterways, and (c) given that the Miljacka River has been severely polluted during the summer months in recent years, data do not exist which can be used to predict the extent to which the river and its shores will be used for recreational purposes once the river is no longer a depository for the untreated sewage of Sarajevo.

5. In addition, a minimum estimate of the benefits of sewage collection and treatment cannot be derived through consumers' observed willingness to pay since (a) for reasons of financial viability consumers are required to connect to the sewerage system and therefore free expression of the value which they place on the service cannot be revealed, and (b) the surcharge on water which consumers currently pay for sewage collection may actually be an additional amount which they are willing to pay for water, i.e. it may actually be a reflection of consumers' surplus for water supply.

6. As a result, while the benefits of the investment in sewage collection and treatment in Sarajevo could certainly be greater than the costs, it is not possible to quantitatively demonstrate that they are. The major justification for the sewerage investment is that collection and treatment of sewage in Sarajevo is necessary for the healthful and orderly development of the area and that the proposed method of collecting and treating the sewage is the least cost method. All that can be done in these circumstances is to ensure that, once the decision to provide sewerage facilities has been made, the price charged for water and its convenient disposal is set in such a way that these resources are not used wastefully.

Water Supply and Sewerage Tariffs

7. The problems of water supply and sewerage benefit measurement highlight the need to formulate a water supply and sewerage tariff policy which reflects the true costs of supplying water and disposing of wastewater in Sarajevo. The objective of this would be to assure that future investment decisions can be made with greater confidence as to their economic merit. If the price of water supply and sewerage services is fixed at a level which approximates the long run marginal cost of supplying those services, then it will be demonstrable that increments in the consumption of water supply and sewerage services are valued by consumers at least as much as the resources consumed in providing those increments, i.e. approximate economic efficiency will be attained from a resource allocation point of view.

8. In attempting to estimate the long run marginal costs of supplying and disposing of water in Sarajevo an average incremental cost calculation was carried out on incremental output and on incremental capital and operating costs for the years 1976 to 2005. The water supply and sewerage capital costs which were used in the calculation were only those required to handle the incremental volume usage. As a result, a portion of the investment in the sewage treatment plant and in the main sewage collectors was eliminated from the average incremental cost exercise since these costs are essential to rectify the present sewage disposal problems. Because of this, they should not enter into the economic pricing decision for water supply and sewage disposal.

9. An average incremental cost exercise was carried out using discount rates of 8, 10 and 12 percent for water supply and sewage disposal (Table 2). The results are summarized as follows:

<u>Discount Rate</u>	<u>Water Supply and Sewerage</u> Din per m <sup>3</sup>
8	6.55
10	7.32
12	8.16

Depending on the assumed discount rate, the tariff charged for the provision and sanitary disposal of water supply and sewage in Sarajevo should be between 6.55 and 8.16 Din per m<sup>3</sup> at 1976 price levels.

10. The city of Sarajevo has proposed to increase water and sewerage tariffs (in Din. per m<sup>3</sup>) in approximately the following manner:

<u>Water Supply and Sewerage Tariffs</u>		
<u>1976</u>	<u>Actual</u>	<u>1976 Prices</u>
Household	4.50	4.50
Other	9.00	9.00
<u>1978</u>		
Household	6.00	4.58
Other	12.00	9.16
<u>1980</u>		
Household	7.00	4.55
Other	14.00	9.06

11. Assuming that the two consumer categories (households and other) will consume approximately equal quantities of water, the mean price (in 1976 dinars) for water supply and sewage disposal during the project construction period would be approximately Din 6.8 per m<sup>3</sup>. This compares favorably with the average incremental cost price at a discount rate of 8 percent.

12. There are historical and political reasons for the two class tariff system in Sarajevo. However, on economic grounds there is no resource allocation reason why household consumers should be charged a price which is much less than the average incremental cost of supplying and disposing of water and waterborne wastes while other consumers are charged a price in excess of average incremental costs. Assuming that the price elasticity of demand for water supply and sewage disposal is not perfectly inelastic, the two-class price structure would tend to encourage excessive consumption of water by households while constraining consumption by commerce and industry at a level below that which would be desirable from an economic efficiency point of view. From a resource allocation point of view all consumers should pay a price equal to the average incremental cost of supplying and disposing of water and waterborne wastes. However, in Sarajevo most families reside in multi-unit apartment buildings. Water consumption per household is low (about 12 m<sup>3</sup> per month in 1974) as the average apartment is small with one bathroom, common laundry facilities and no gardens. The lower domestic tariff ensures that the necessary minimum amount of water would be available to the lower income households at reasonable cost. To expand the stepped tariff structure to domestic consumers would involve Vodovod in substantial additional costs for metering and collection with limited potential water savings.

May 1976

TABLE 1  
Internal Economic Rate of Return  
On the Water Supply Investment

<u>Year</u>	<u>Capital Costs</u>	<u>Incremental Operating Costs</u>	<u>Total Costs</u>	<u>Incremental Benefits</u>
-----Din Millions-----				
1976	30.0	3.2	33.2	9.6
1977	80.0	5.7	85.7	17.7
1978	90.0	8.7	98.7	25.4
1979	50.0	12.5	62.5	36.1
1980	30.0	15.7	45.7	41.4
1981	10.0	18.7	28.7	48.0
1982	10.0	21.1	31.1	55.1
1983	5.0	24.1	29.1	61.4
1984	5.0	25.6	30.6	68.1
1985	5.0	27.6	32.1	74.8
1986	25.0	28.6	53.6	81.5
1987	4.0	29.9	33.9	88.2
1988	4.0	31.2	35.2	95.0
1989	4.0	32.2	36.2	101.7
1990	2.0	33.3	35.3	108.4
1991/2005	nil	33.3	33.3	108.4

Internal Economic Rate of Return = 15.6%.  
If benefits decreased by 25% Rate of Return will be 9.5%.

TABLE 2

Average Incremental Cost for Water Supply and Sewerage

Year	Capital Costs 1976 Prices	Incremental Operating Costs (1976 prices)	Total	Incremental Volume
	-----Million Dinars-----			M <sup>3</sup> Million
1976	50.0	4.3	54.3	2.4
1977	160.0	7.5	167.5	3.9
1978	190.0	11.5	201.5	5.3
1979	150.0	20.2	170.2	7.3
1980	80.0	26.5	106.5	8.2
1981	20.0	32.3	52.3	9.5
1982	20.0	36.2	56.2	10.7
1983	15.0	40.3	55.3	11.9
1984	15.0	42.9	57.9	13.1
1985	10.0	46.0	56.0	14.3
1986	30.0	48.1	78.1	15.5
1987	9.0	50.5	59.5	16.7
1988	6.0	52.9	58.9	17.9
1989	6.0	55.0	61.0	19.1
1990	4.0	57.2	61.2	20.3
1991	4.0	59.3	63.3	21.5
1992	4.0	61.3	65.3	22.7
1993	4.0	63.3	67.3	23.9
1994	4.0	65.3	69.3	25.1
1995	80.0	67.3	147.3	26.3
1996	80.0	70.5	150.5	27.5
1997	10.0	74.0	84.0	28.7
1998	10.0	76.5	86.5	29.9
1999	4.0	79.0	83.0	31.1
2000	4.0	81.0	85.0	32.3
2001	4.0	83.2	87.2	33.5
2002	4.0	85.4	89.4	34.7
2003	4.0	87.6	91.6	35.9
2004	4.0	89.8	93.8	37.1
2005	4.0	92.0	96.1	38.3

The average incremental cost of water supply and sewerage services are as follows:

<u>Discount Rate</u>	<u>Incremental Costs</u> Din per m <sup>3</sup>
8	6.55
10	7.32
12	8.16

APPRAISAL OF  
SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT

YUGOSLAVIA

KEY INDICATORS

I. Water Supply

- water produced  $10^6 \text{ m}^3$  per year
- total water sold  $10^6 \text{ m}^3$  per year
- water sold to domestic consumers  $10^6 \text{ m}^3$  per year
- water sold to other consumers  $10^6 \text{ m}^3$  per year
- unaccounted-for water (%)
- pressure range in system
- number of system leaks repaired
- length corroded pipes replaced
- total number of connections
- population served
- number unmetered connections
- total dissolved solids
- chlorine residual of distributed water
- PH, temperature and turbidity
- Most Probable Number (MPN) for bacteria count of distributed water

II. Sewerage

- volume treated  $10^6 \text{ m}^3$  per year total
- number of connections to combined system
- number of connections to separate system
- population served
- $\text{BOD}_5$  of raw and effluent sewage
- SS of raw and effluent sewage
- percent removal (%)

III. Financial

- rate of return
- debt:Equity Ratio
- debt Service coverage
- average depreciation rate
- average revenue (a) per  $\text{m}^3$  of water sold (domestic, other)  
(b) per  $\text{m}^3$  of sewerage surcharged (domestic, other)
- number of average days bills outstanding (by customer category)
- revenue effectiveness index
- operating expenses (a) per  $\text{m}^3$  water produced  
(b) per  $\text{m}^3$  of water surcharged for sewerage

IV. Staffing and Training

- number of permanent employees
- employees per 1,000 connections
- man-months of employee training
- man-month consultants

V. Water Quality for Bosna and Miljacka Rivers

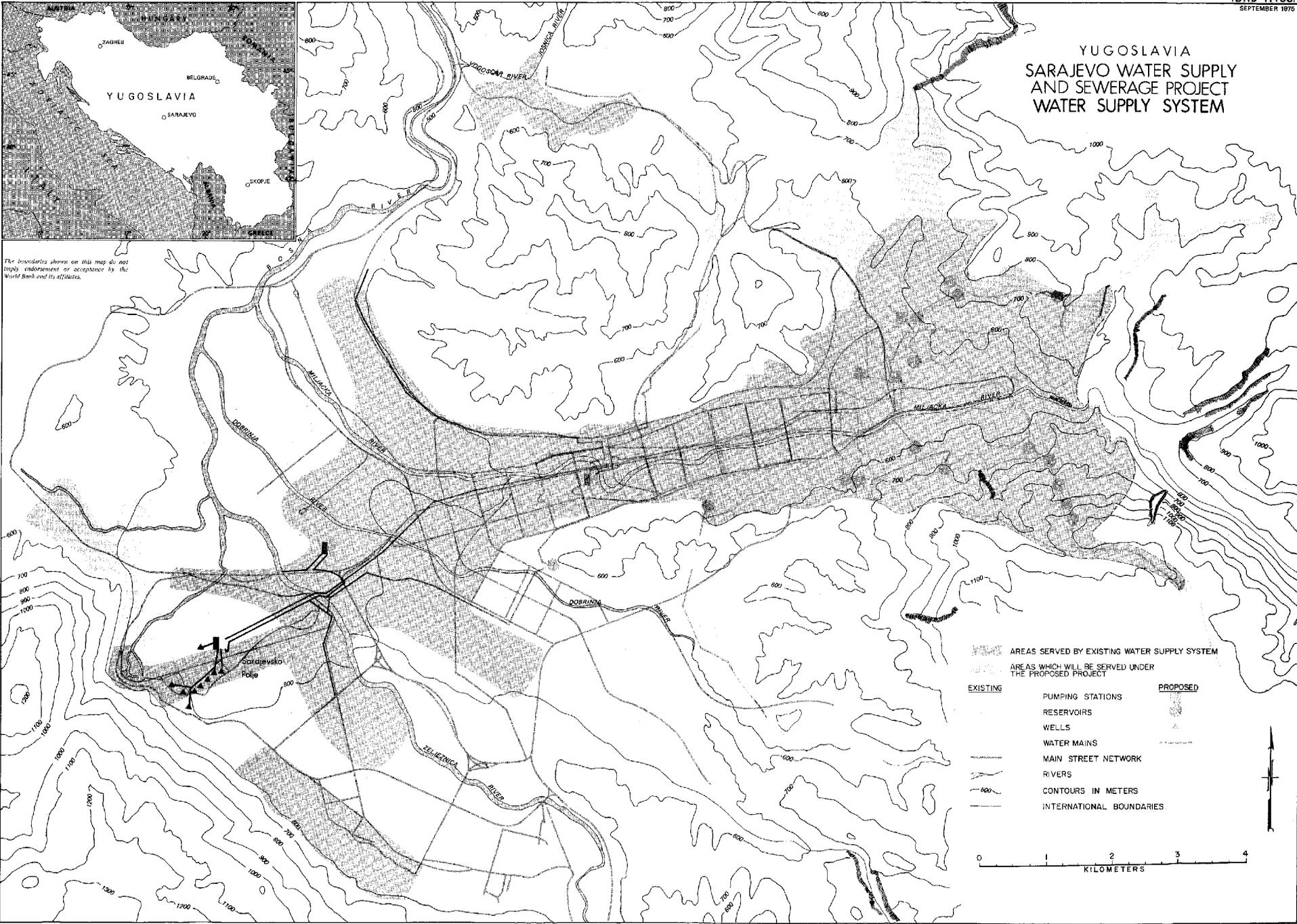
- minimum flows m/s
- average flows m/s
- DO levels near treatment plant outlet
- DO levels at existing sampling stations
- Nitrates and other chemical characteristics

May 1976

YUGOSLAVIA  
SARAJEVO WATER SUPPLY  
AND SEWERAGE PROJECT  
WATER SUPPLY SYSTEM



The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.



- AREAS SERVED BY EXISTING WATER SUPPLY SYSTEM
- AREAS WHICH WILL BE SERVED UNDER THE PROPOSED PROJECT
- EXISTING**
- PUMPING STATIONS
- RESERVOIRS
- WELLS
- WATER MAINS
- MAIN STREET NETWORK
- RIVERS
- CONTOURS IN METERS
- INTERNATIONAL BOUNDARIES
- PROPOSED**
- 
- 
- 





# YUGOSLAVIA SARAJEVO WATER SUPPLY AND SEWERAGE PROJECT SEWERAGE SYSTEM



The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.

