CHAPTER 10 FINANCIAL PLAN AND ANALYSIS

10.1 GENERAL

The construction of the WWTP requires huge amount of investment cost which is far beyond the city's affordability. Consequently, soft loan or grant schemes of international financial sources should be introduced to realize the construction. It is quite usual that an application of those schemes require certain portion of the investment cost to be covered by own sources, which would be an evidence of self-assistance efforts of the recipient. In general, the ratio of this self-financed portion is 20 to 40 %, which varies according to the international financial sources.

The problem is that even the amount of the self-financed portion of the investment cost will be far beyond the financial capacity of Galati City. It means that during the construction period of the WWTP a considerable part of the self-financed portion should be procured by a subsidy from the state, or by private sector loans. The Study strongly recommends the former solution because of the following reasons.

- Beneficiaries of direct benefit of the project are rather inhabitants downstream of the recipient watercourse than users of sewerage who have already enjoyed the service.
- The recipient watercourse of treated wastewater is the Danube River. The Danube is an international river and the Danube Delta, which is located at the most downstream of the Danube, is listed in the World Natural Heritages. The state should share the responsibility to prevent such international natural resources from degradation.
- The construction is necessary to comply with the relevant EU directives. This compliance will contribute to Romania's EU membership accession, which is one of political goals of the state. Thus, the state is also one of the beneficiaries of the project.

It seems practically and theoretically reasonable to solve the above problem by applying the state subsidy. In this financial plan, the financial arrangement after the start of plant operation will be intensively discussed.

10.2 EXTERNAL FINANCIAL SOURCES

As mentioned in Chapter 2 of Part I, there are three external financial sources which may be applicable to the project as shown in the table below.

Table II.10.1 Assumed Financing Terms for Possible External Financial Sources

Financial Organs	Financing Ratio (%)	Loan/Grant	Interest Rate (%)	Repayment Period (Years)	Grace Period (Years)
EBRD	70	Loan	6.5	15	3
ISPA	75	Grant	-	-	-
JBIC	70	Loan	2.7	30	10

Supposing, EBRD, ISPA, or JBIC agreed to finance the project, the terms and conditions would be like in *Table II.10.1.* However, they are nothing other than an example or assumption. It is necessary to make quantitative assumptions regarding financing to evaluate financial feasibility of the project. In the case of EBRD, financing ratio depends on the circumstances and interest rate fluctuates in parallel with LIBOR (London Inter-bank Offered Rate).

10.3 APPROACHES TO PREPARE FINANCIAL PLAN

10.3.1 FRAME OF FINANCIAL PLAN

The financial plan was studied based on the operational structure of the sewerage service explained in Chapter 2 of Part I. In brief, S.C. APATERM S.A. renders operation and maintenance of the sewerage service based on a concession contract with Galati City. Galati City procures necessary investment cost and pays principal and interest of loans, if any. The city owns facilities including the WWTP, and depreciates them.

(1) Account of S.C. APATERM S.A.

S.C. APATERM S.A.will collect the sewerage charges, bear the operation and maintenance cost, and pay the lease fee to the city. Financial indicators of S.C. APATERM S.A.were set as follows.

- Cumulative working capital, as an indicator of company's sustainability
- Profit rate, as an indicator of possibility of privatization

The cumulative working capital means summation of working capitals of precedent years. Unless the value falls minus, the company can escape from insolvency.

In this financial plan, the profit rate is defined as the rate of average profit after tax to average revenue over the project period. A certain level of profit rate may be required to drive a private sector's investment will in the privatization.

(2) City's Sewerage Service Account

This financial plan introduced a concept of city's sewerage service account in order to examine a financial burden of the city accrued by the project, though it was not clear for the concept to be materialized.

The city's sewerage service account will receive a lease fee, depreciate the facilities including the WWTP, and pay principal and interest of loans, if any. If the lease fee can not cover the total amount of depreciation cost and payment of principal and interest of loans, the account needs subsidies from the city's general account budget.

(3) Financial Capacity of the City

Following two (2) financial indicators of the city's general account are very important for realization of the project.

- The ratio of an annual payment of principal and interest to a current revenue of each year
- The ratio of subsidy to the sewerage service account to a current revenue of each year

The former is one of the major criteria for obtaining the state guarantee for external loans. If the ratio in any year will exceed 20 %, the ministry of finance will not agree to issue the state guarantee.

The latter shows whether the required subsidy is within the city's affordability.

10.3.2 MAJOR PRECONDITIONS AND ASSUMPTIONS

Following preconditions and assumptions were applied in the financial plan.

- The financial plan deals with only the cost and the revenue accrued by the project.
- Currency unit is ROL and the value of ROL is expressed as the June 1999 prices.
- Projection period is 30 years since the start of project implementation.
- Target year is 2010. From 2010 on the values of variables related to revenues and O & M cost are assumed to keep the 2010 level.
- Implementation period is 5 years from 2000 to 2004.
- 38 % of profit before tax is levied as a corporate tax.

Depreciation period is assumed as follows.

Table II.10.2 Depreciation Period

Item	Mechanical equipment	Civil works and sewer pipes
Depreciation period	8 years	40 years

10.4 REVENUE

10.4.1 ESTIMATION METHOD

The revenue of S.C. APATERM S.A. consists of collected domestic and non-domestic sewerage charges. In this financial plan, both charges were estimated based on following assumptions.

- The tariff of each charge is set as a unit price per m^3.
- The unit price of domestic sewerage charge is determined based on the proportion to average household income.
- The unit price of non-domestic sewerage charge is determined in proportion to that of domestic charge.

Based on the above assumptions, the unit prices and revenue of S.C. APATERM S.A. were calculated as follows.

- $UP_d = X \times Income / Q_d / H_{serv}$
- $UP_{nd} = b \times UP_d$
- Annual Revenue = $(UP_d \times Q_d + UP_{nd} \times Q_{nd}) \times$ Charge Collection Rate

where,

UP_d : unit price of domestic sewerage charge,
UP_{nd} : unit price of non-domestic sewerage charge,
X : ratio of domestic charge to household income,
b : coefficient,
$Income$: average annual household income,
Q_d : quantity of domestic sewerage per year,
Q_{nd} : quantity of non-domestic sewerage per year, and
H_{serv} : number of sewerage served household.

In above equations, all independent variables and coefficients except X were estimated as mentioned in following sub-sections. Subsequently, the revenue of S.C. APATERM S.A. can be estimated when the variable X is given.

10.4.2 SERVED POPULATION

As mentioned in the chapter 3, the sewerage served population in 2010 was estimated 377,000. It was assumed that the present population increases linearly until 2010 and ever since remains 377,000. In addition, the household size was assumed to be constant at present value of 3.1 persons/household.

The numbers of served population and served household were estimated as follows.

Table II.10.3 Number of Served Population and Household

Year	2005	2006	2007	2008	2009	2010	from 2011
Served population	356,625	360,700	364,775	368,850	372,925	377,000	377,000
Served household	115,040	116,355	117,669	118,984	120,298	121,613	121,613

10.4.3 QUANTITY OF WASTEWATER

Similar to the served population, the quantity of wastewater was assumed to increase linearly from the present value to the estimated value in 2010, and since ever to remain at the level in 2010. Non-domestic wastewater is composed of commercial, institutional and industrial ones.

The estimated quantities of domestic and non-domestic wastewater are as follows.

Table II.10.4 Quantity of Domestic and Non-domestic Wastewater

(Unit : 1,000 m^3/year)

Year	2005	2006	2007	2008	2009	2010	from 2011
Domestic	34,919	35,354	35,790	36,226	36,664	37,102	37,102
Non-domestic	31,824	32,641	33,455	34,269	35,083	35,898	35,898

The coefficient *b*, the ratio of non-domestic sewerage charge to domestic one, was estimated 3.38 based on the values in 1998 and 1999.

10.4.4 HOUSEHOLD INCOME

The average monthly household income was estimated at ROL 3,063,748 as of 1999 based on the result of the people's awareness survey conducted in this study. It was assumed to grow 3 % per year until 2010, and to remain the level of 2010 whereafter. The annual household income was calculated by multiplying the monthly value with 12.

The estimated average annual household income is as follows.

Table II.10.5 Average Annual Household Income

(Unit : 1,000 ROL/year)

Year	2005	2006	2007	2008	2009	2010	from 2011
Annual Household Income	43,899	45,216	46,573	47,970	49,409	50,891	50,891

10.4.5 COLLECTION RATE

The charge collection rate was assumed to linearly increase from 72 % in 1999 to 95% in 2010, then remain 95% ever since.

The collection rate of sewerage charge was estimated as follows.

Table II.10.6 Sewerage Charge Collection Rate

Year	2005	2006	2007	2008	2009	2010	from 2011
Collection Rate	84.5 %	86.6 %	88.7 %	90.8 %	92.9 %	95.0 %	95.0 %

10.5 PREPARATION OF ALTERNATIVES

10.5.1 EXTERNAL FINANCIAL SOURCES

Following four (4) alternatives of external financial sources were analyzed.

- Alternative I: EBRD covers 70 % of the total investment cost.
- Alternative II: EBRD covers 50 % of the total investment cost, and ISPA does 50% of that.
- Alternative III: EBRD covers 30 % of the total investment cost, and ISPA does 70%of that.
- Alternative IV: JBIC covers 70 % of the total investment cost.

10.5.2 LEVEL OF LEASE FEE

Following two (2) alternatives of lease fee level were analyzed.

- Alternative A: 100 % of repayment of principal and interest, and depreciation cost
- Alternative B: 50 % of repayment of principal and interest, and depreciation cost

The alternative A is equivalent to be the case in which all the cost related to the construction and large scale rehabilitation will be borne by the users. Under the alternative B, Galati City should absorb 50 % of the cost related to the construction and large scale rehabilitation.

10.5.3 LEVEL OF SEWERAGE CHARGE

The people's awareness survey conducted in this study revealed that the average household's monthly willingness to pay for sewerage services was ROL 17,029 as of 1999, equivalent to 0.57 % of the average monthly household income. On the other hand, the World Bank recommends 2.00 % of a household income as the affordability limit for sewerage charge. The adequate level of the charge seems between the former and the latter.

Currently, the monthly sewerage charge per household is equivalent to 0.17 % of the income. According to the preconditions and assumptions mentioned before, this portion was deducted from the revenue of this financial plan. It means that the following charge levels are increment values of sewerage service charge.

Following three (3) alternatives of sewerage charge level were analyzed.

- Alternative 1: Minimum level. 0.40 % (= 0.57 % – 0.17 %) of the income
- Alternative 2: Mean level. 1.12 % of the income
- Alternative 3: Maximum level. 1.83 % (= 2.00 % – 0.17 %) of the income

10.5.4 PREPARED ALTERNATIVE CASES

In total 24 alternative cases, which were combination of the abovementioned alternatives, were analyzed. The case code was assigned like 'Case IA1', 'Case IIIB2', and so on. For example, Case IA1 means a combination of the alternative I for external financial sources, the alternative A for lease fee, and the alternative 1 for sewerage service charge.

10.6 PROPOSED FINANCIAL PLAN

10.6.1 RESULT OF ALTERNATIVE STUDY

The financial statements were prepared for the abovementioned 24 alternative cases. The structure of applied financial statements is as follows.

Table II.10.7 Structure of Applied Financial Statements

S.C. APATERM S.A. account	
Revenue	A
Operation and maintenance cost	B
Lease fee	C
Profit before tax	D = A – B – C
Corporate tax	E = D × 0.38
Profit after tax	F = D – E
Working capital	G = F
Cumulative working capital	H = Σ G
City's sewerage service account	
Revenue from lease fee	I = C
Depreciation	J
Payment of interest	K
Profit	L = I – J – K
Loan	M
Subsidy from general budget	N
Depreciation	O = I
Sources	P = L+M+N+O
Investment cost	Q
Payment of principal	R
Applications	S = Q + R
Working capital	T = P – S
Cumulative working capital	U = Σ T
City's general account	
City general revenue	V
Corporate tax from S.C. APATERM S.A.	W = E
Revenue from lease fee	X = I
Total current revenue	Y = V + W + X
Subsidy	Z = N
Subsidy ratio	AA = Z/Y
Repayment ratio	AB = (K + R)/Y

The result of the alternative study is shown in *Table II.10.8.* Major findings are as follows.

- It is not possible for S.C. APATERM S.A. to run the service with the minimum level of sewerage service charge.
- The mean charge level is enough high for S.C. APATERM S.A. to render a sustainable WWTP operation even with the lease fee covering 100 % of repayment and depreciation.
- If 70 % of the investment cost is covered by EBRD, the ratio of the repayment to the city's current revenue will exceed 20 %, which may jeopardize an issuance of the state guarantee for the loan.

Table II.10.8 Result of Financial Alternative Study for Galati WWTP Project

Case I: EBRD 70%			S.C. APATERM S.A.		Galati City	
Lease fee	Sewerage charge level	Case code	Sustainability	Profit rate	Repayment criterion	Max subsidy ratio
100% of depreciation and repayment	Minimum (0.40 % of income)	Case IA1	×	-80.0%	× (ave. 21.6%)	
	Mean (1.12 % of income)	Case IA2	○	22.1%	× (ave. 20.6%)	
	Maximum (1.83 % of income)	Case IA3	○	37.6%	× (ave. 19.0%)	
50% of depreciation and repayment	Minimum (0.40 % of income)	Case IB1	×	-0.1%	× (ave. 24.3%)	31.7%
	Mean (1.12 % of income)	Case IB2	○	40.1%	× (ave. 22.1%)	28.9%
	Maximum (1.83 % of income)	Case IB3	○	48.6%	× (ave. 20.2%)	26.5%

Case II: EBRD 50% + ISPA 50%			S.C. APATERM S.A.		Galati City	
Lease fee	Sewerage charge level	Case code	Sustainability	Profit rate	Repayment criterion	Max subsidy ratio
100% of depreciation and repayment	Minimum (0.40 % of income)	Case IIA1	×	-53.1%	△ (ave. 16.0%)	
	Mean (1.12 % of income)	Case IIA2	○	28.1%	△ (ave. 15.1%)	
	Maximum (1.83 % of income)	Case IIA3	○	41.3%	○	
50% of depreciation and repayment	Minimum (0.40 % of income)	Case IIB1	○	8.9%	× (ave. 17.6%)	24.8%
	Mean (1.12 % of income)	Case IIB2	○	43.1%	△ (ave. 16.0%)	22.4%
	Maximum (1.83 % of income)	Case IIB3	○	50.4%	○	20.5%

Case III: EBRD 30% + ISPA 70%			S.C. APATERM S.A.		Galati City	
Lease fee	Sewerage charge level	Case code	Sustainability	Profit rate	Repayment criterion	Max subsidy ratio
100% of depreciation and repayment	Minimum (0.40 % of income)	Case IIIA1	×	-26.1%	○	
	Mean (1.12 % of income)	Case IIIA2	○	34.1%	○	
	Maximum (1.83 % of income)	Case IIIA3	○	44.9%	○	
50% of depreciation and repayment	Minimum (0.40 % of income)	Case IIIB1	○	17.3%	○	17.5%
	Mean (1.12 % of income)	Case IIIB2	○	46.0%	○	15.8%
	Maximum (1.83 % of income)	Case IIIB3	○	52.2%	○	14.4%

Case IV: JBIC 70%			S.C. APATERM S.A.		Galati City	
Lease fee	Sewerage charge level	Case code	Sustainability	Profit rate	Repayment criterion	Max subsidy ratio
100% of depreciation and repayment	Minimum (0.40 % of income)	Case IVA1	×	-50.9%	○	
	Mean (1.12 % of income)	Case IVA2	○	28.8%	○	
	Maximum (1.83 % of income)	Case IVA3	○	41.7%	○	
50% of depreciation and repayment	Minimum (0.40 % of income)	Case IVB1	○	10.5%	○	14.1%
	Mean (1.12 % of income)	Case IVB2	○	43.6%	○	12.6%
	Maximum (1.83 % of income)	Case IVB3	○	50.7%	○	11.3%

Legend :
○ = Meet the requirement, △= Slightly fail to meet the requirement, × = Not satisfy the requirement.
Sustainability : Cummulative working capital in any year > 0
Profit rate : Ratio of an average profit after tax to an average revenue over the project period
Repayment criterion : Total repayment of each year should be less than 20% of current revenue of the city (ave. means average of the ratio over the project period)
Subsidy ratio : Ratio of subsidy (depreciation + repayment - lease fee) to current revenue of the city

- The maximum ratio of the city's subsidy to the city's current revenue is dominated by the external financial source. The higher interest rate and shorter repayment period of EBRD make it difficult for the City to subsidize S.C. APATERM S.A.

10.6.2 PROPOSED FINANCIAL PLAN

Accessibility to the external financial sources of each city council highly depends on the Government's policy and the policy of the external financial sources. Those policies also vary time to time. If the study proposes a financial plan with fixing a financial source and a city council fails to access to the proposed financial source, the proposed financial plan does not work any longer. Thus, it would not be realistic to propose a financial plan with a fixed financial source.

Therefore, the study proposes the financial plans by the financial arrangements discussed in the previous section. In the preparation of the financial plans, following general rules were set out:

- To secure a sustainability of a private company, the lease fee and sewerage charge level are set out so as to keep the cumulative working capital being over zero in any year.
- To secure the progress of the privatization, the lease fee and sewerage charge level are set out so as to generate a profit more than 5 %.
- As far as the case does not require an exemption of the repayment criterion, the lease fee is set at 50%. This reflects an idea that users paying all the costs including the investment costs is a grinding charge system as beneficiary of the wastewater treatment are not limited to the users.
- In case where the exemption is required, the 100 % lease fee is adopted to show efforts of the user side to convince the state to apply the exemption.
- Satisfying above rules, a sewerage charge is set at a milder level.

The proposed financial plan for each financial arrangement is shown in *Table II.10.9*. Since the repayment period of the EBRD loan is rather short and its interest is high, the annual repayment exceeds the repayment criterion, except Case III. Therefore, utilization of EBRD loan would require exemption of the repayment criterion. It is remarkable that in Cases III and IV the minimum level of sewerage charge can implement the project with financial feasibility.

Table II.10.9 Proposed Financial Plan

Case	Financial arrangement	Lease fee	Sewerage charge	Remarks
I	70% EBRD + 30% Self-financing	100 % of depreciation and repayment	Mean level (1.12 % of income)	Over repayment criterion
II	50% EBRD + 50% ISPA	100 % of depreciation and repayment	Mean level (1.12 % of income)	Slightly over repayment criterion
III	30% EBRD + 70% ISPA	50% of depreciation and repayment	Minimum level (0.40 % of income)	
IV	70% JBIC + 30% Self-financing	50% of depreciation and repayment	Minimum level (0.40 % of income)	

10.6.3 FINANCIAL ANALYSIS BY CONVENTIONAL METHOD

The proposed financial plans were prepared to be feasible from the viewpoints of financial sustainability and privatization possibility of S.C. APATERM S.A., financial capacity of the city's budget, and the applicability of the state guarantee for external loans. For the preparation of feasible financial plan, profit and loss statements and cash flow statements were prepared for alternative cases. This method makes financial analysis more realistic and more detail.

Conventional method of financial analysis requires only the revenue and expenditure of the project. For the comparative purpose, FIRR (Financial Internal Rate of Return), which is one of indicators of conventional financial analysis, was calculated.

The revenue of the project is collected sewerage charges which vary according to a level of the sewerage charge. Thus, FIRR was calculated at three (3) levels of the charge.

The calculated FIRRs are as follows.

- FIRR is 16.6 % at the maximum level of sewerage charge.
- FIRR is 9.7 % at the mean level of sewerage charge.
- FIRR is not available at the minimum level of sewerage charge.

The result shows that the mean charge level is enough high to implement sewerage services with full financial independence in Galati. However, if charge level is set at the minimum level, a certain level of financial assistance from public sector, such as a subsidy for construction cost, is required.

CHAPTER 11 ENVIRONMENTAL IMPACT ASSESSMENT

11.1 OBJECTIVES

A preliminary Environmental Impact Assessment (EIA) has been conducted under the Study based on the Romanian regulations.

The objectives of the EIA are as follows:

- To review the existing environmental conditions in EIA study area;
- To assess environmental impacts of the proposed projects; and
- To propose countermeasures for mitigating impacts and environmental monitoring plan.

The existing environmental conditions in/around the project site and the evaluation of impacts due to the proposed project are summarized in *Table II.11.1.* The countermeasures for mitigating and environmental monitoring plan are recommended in *Table II.11.2.*

11.2 NATURAL/ENVIRONMENTAL IMPACTS

Water Quality Improvement: Poor wastewater disposal practices are one of the major causes of pollution in the region. The disposal of raw wastewaters to the Danube River and reliance on on-site wastewater disposals have resulted in pollutant loads in the waterways and the Danube River. Improvement in the quality of water in the Danube River will reduce the level of pollutants significantly, including heavy metals and other hazardous materials. Because of the expected reduction of the major pollutant loads from the sewerage system, the public living conditions, as well as fauna and flora in the area, will be improved.

Topography, Geology and Hydrological Impacts: Construction of the WWTP and relating facilities may not affect adversely to natural conditions of the surrounding areas. Topographic and geological changes due to the construction works will be minimal, and may not cause significant adverse impacts to the surrounding areas.

Temporary Hazards: Although during the construction stages, some limited areas near the construction sites or along the major roads may be affected by dusts, noise or vibrations to some extent, but these can be prevented by careful controlling measures.

11.3 ECONOMIC AND SOCIAL IMPACTS

As summarized in *Table II.11.1,* each of environmental parameters has been assessed and evaluated from the viewpoints of economic, socio-economic, physical-chemical, ecological, and aesthetic aspects.

Domestic Users: Residential areas will be served by a combination of interceptors and sewerage. This, in combination with the collection and treatment of industrial wastewater, will reduce the amount of pollutants flowing into the waterways and finally to the Danube River. The major benefits for residents will be a reduction in noxious odors and, if combined with improvement of public health, a reduction in water-related disease.

Industrial Users: An improved wastewater system will result in reduced overall costs for factories in comparison to onsite treatment, although it will mean higher operating costs for factories that are currently spending inadequate amounts on treatment or have no treatment facility at all. Factories and commercial operations will also be required to pay for the costs of their connection to the sewers. Overall, however, operating costs are likely to comprise a relatively small proportion of factory turnover.

Negative Impacts: Although every effort has been and will be made for the planning, design and construction of an optimum system, and proper methods and schedules for the construction works of the project facilities, it may not be possible to completely eliminate the impacts due to the project implementation. Such residual or unavoidable impacts in the future, although not significant, may include as follows.

- Increase in traffic volume along the roads connecting the new WWTP,
- Increase of demand for electricity of WWTP operation, and
- Loss of agricultural production due to conversion of the agricultural lands to the new WWTP site.

11.4 OVERALL REMARKS

As shown in *Table II.11.1*, the assessment has resulted that the overall project appears to be well planned to achieve maximum benefits for the local people, which will surely enhance socio-economics and quality-of-life values of the region.

The assessment results can be summarized as follows:

- The proposed project as a whole has positive environmental impacts in the area's water environment and the public health of the residents in the City through the improved service standards for the wastewater management;
- Construction or improvement activities for sewers, pumping stations and wastewater treatment plant throughout the project area may cause nuisances to the residents, but such hazards could be limited by giving careful considerations on the methods of construction and proper management of the sewerage system; and
- Connection of the wastewater currently being discharged to the public waterways to the sewer system will significantly improve the water quality in the Danube River;
- The beneficial effects of the project outweigh the adverse effects; and
- As certain items in the preliminary EIA need to be further clarified from engineering viewpoints, further studies will be made on the extent of impacts, mitigation and remedial measures, including the impacts possibly caused by the construction, operation and maintenance works of the WWTP and related facilities.

Table II.11.1 Existing Condition and Evaluation of Impacts by Proposed Project in Galati (1/2)

Item	Survey Results	Evaluation of Impacts
1. Public Health Condition	The results of wastewater characteristics survey at existing outfall revealed that the number of total Coliform Group in raw wastewater, which now is discharged directly into Danube River, is about 1×10^6 no./100ml to 1×10^8 no./100ml. While the number of total Coliform Group in Danube River (1 km downstream from the outfall of proposed WWTP) is 4.3×10^3 no./100ml to 4.9×10^3 no./100ml, which exceeded the standard (1×10^2 no./100ml, STAS 12585/1987) of water for swimming purposes. According to the F/S Study after WWTP being put into operation the existing outfall will be closed and wastewater will be collected and treated at WWTP. The number of total Coliform Group in WWTP effluent will meet the standard (1×10^5 no./100ml, NTPA 001) of wastewater discharged in water resources. Hence, during WWTP operation stage the public health condition will be improved certainly.	○
2. Waste	The capacity of solid waste disposal site in Galati is estimated to be about 200,000 m^3. In addition, the results of wastewater characteristics of leachate from SWDS in Galati indicated that the concentrations of the organic substances (BOD_5: 4,135 mg/l, COD_{Mn}: 8,780 mg/l), NH_4-N (635 mg/l) and oil (580 mg/l) have exceeded the standard (NTPA 002/1997) of wastewater discharged into municipal sewage system substantially. Meanwhile, the number of total Coliform Group in the leachate is also relative high (3.5×10^8 no./100ml). All of these may contribute a negative impact on groundwater. Therefore, a new SDWS plan properly designed and managed from the environmental viewpoint, or searching for other disposal routes such as agricultural use or incineration etc. are considered to be necessary, taking into account the groundwater pollution problem and the volume of excess sludge (108 m^3/d or 21.6 t/d) generated from WWTP.	△
3. Hazards (Risk)	Based on the results of geological survey, a careful aseismatic structure design will be considered in the planning and design of the wastewater treatment facilities.	○
4. Topography and Geology	Based on the results of geological survey, a careful aseismatic structure design will be considered in the planning and design of the wastewater treatment facilities.	○
5. Groundwater	The results of groundwater survey in/around the solid waste disposal site indicated that the number of Coliform Group ranged from 9.2×10^2 no./100ml (upstream) to 1.6×10^4 no./100ml (downstream), which already exceeded the standard (under 10 no./100ml, STAS 1342/1991) for drinking water. Hence some countermeasures for protecting groundwater from pollution should be considered.	△
6.Hydrological Situation	The effluent flow of WWTP is insignificant comparing with the flow of Danube River, so the effects of effluent on hydrological situation of the River are negligible. In addition, the pollutant diffusion and dilution characteristics are analyzed using "MIKE 11" model, the calculation results indicated that complete mixing is achieved at a distance of 3 km downstream of WWTP outfall in all cases studied here.	○
7. Fauna and Flora	Now the raw wastewater is discharged directly into Danube River, after the WWTP being put into operation, there will be no change about flow rate. In addition, as mentioned in Water Pollution Item the pollutants load will be reduced substantially. Therefore, it is expected that the living conditions of fauna and flora will be improved by implementing the Project.	○

Table II.11.1 Existing Condition and Evaluation of Impacts by Proposed Project in Galati (2/2)

Item	Survey Results	Evaluation of Impacts
8.Water Pollution	The results of industrial wastewater survey revealed that the concentrations of toxic materials, which may effect biological process for wastewater treatment, are under the standard of NTPA 002/1997. This can leads the conclusion that industrial wastewater will don't contribute a significant impact on WWTP influent characteristics. According to the F/S Study 8,176 tons of BOD$_5$ and 9,344 tons of SS per year (2010) will be no more discharged into Danube River, so the impacts on the water quality during WWTP operation will be a positive one. Moreover, 1,314 tons of BOD$_5$ and 1,606 tons of SS per year (2010) will be discharged into Danube River with WWTP effluent. Based on the results of simulation the maximum concentrations of BOD$_5$ and SS at downstream of complete mixing section (about 3 km downstream from the outfall of proposed WWTP) will be under the Maximum Allowable Concentration (MAC) of second quality category in STAS 4706/1998 (surface water quality).	○
9.Soil Contamination	According to the analysis results of soil (WWTP site, solid waste disposal site and agricultural field) and sludge generated in existing WWTP of Roman and Constanta, the heavy-metal concentrations in soil samples and sludge samples are under the Romania Standard. This creates a possibility to utilize excess sludge in agriculture.	○
10.Offensive Odor	The survey results revealed that the concentrations of H$_2$S (0.0006 mg/m^3), NH$_3$ (0.018 mg/m^3) and odor level (Level 1) on the WWTP boundary fence are under Romania Standard 12574/1987 (H$_2$S: 0.015 mg/m^3, NH$_3$: 0.3 mg/m^3 and odor level: Level 5). The results of existing WWTP survey in Constanta are presented as following: WWTP boundary fence / 150 m from WWTP boundary fence H$_2$S: 0.35mg/m^3 / 0.033 mg/m^3 NH$_3$: 0.30mg/m^3 / 0.10 mg/m^3 Odor Level: 4 / 3 Finally it is evaluated that the offensive odor levels at adjacent areas to the WWTP site would generally be within acceptable levels, considering the facts that the nearest human settlement is located at more than 300 m from.	○

○: nothing or negligible
Δ: not serious or minor

Table II.11.2 Countermeasures for Mitigating and Environmental Monitoring Plan in Galati

Impact Item	Countermeasure
1.Groundwater and Waste	1) It is necessary to plan and construct a new solid waste disposal site, considering the groundwater pollution problem and the capacity of existing SWDS as well as the volume of excess sludge generated from Galati WWTP. 2) Groundwater insulation-type landfill disposal plant is recommended to protect groundwater from polluting. In this case it is recommended to install the leachate collecting system and to discharge leachate after to be treated, especially disinfection treatment. 3) The groundwater quality (at least Cl^-, COD_{Mn}, Coliform Group and typical heavy metals) should be checked 2 to 4 times per year in order to understand the change of groundwater quality. 4) With the background that an increase in agricultural utilization and incineration and a reduction of landfill for sewage sludge is forecast, it will be recommended to consider incineration or the utilization of sewage sludge in agriculture. In this case the load limiting values of EU Sewage Sludge Directive can be applied as alternative to sewage sludge limiting values in order to maintain the soil limiting values of heavy metals. 5) The characteristics (Cd, Cr, Cu, Pb, Hg, Ni and Zn) of dewatered sludge from WWTP should be checked at least 4 times per year.
2. Water Pollution and Public Health Condition	1) It is recommended to establish a monitoring system to check the water quality of Danube River at main swimming area, intake for water supply as well as the downstream reach from WWTP outfall. 2) The detail plan (such as monitoring point, analysis items and sampling frequency etc.) should be made in cooperation with the Galati Municipality.

CHAPTER 12 PROJECT EVALUATION

12.1 TECHNICAL FEASIBILITY

The Galati City has at present no public wastewater treatment plant system in operation. Out of the total administrative population of 330,000, about 328,000 people rely on the sewerage system while some of the large industries within the City are discharging industrial wastewater directly to the public waterways after treatment.

The existing combined sewerage system covers most of the urban built-up districts of the City for the collection of domestic, commercial, institutional and industrial wastewater and, during wet weather, stormwater inflows. All the collected wastewater is being discharged either by gravity or pumping stations to the Danube River through seven large collectors.

Under the circumstances, there is an urgent need to implement a comprehensive program of the wastewater treatment system to treat all the wastewater in a manner that will meet the stringent discharge water quality control standards adapted to the Danube River.

A wide range of strategy planning options have been identified and evaluated, ranging from localized solution incorporating multiple small wastewater treatment facilities to centralized solution involving one large treatment facilities. Several short-listed options were selected and evaluated for costs, socioeconomic and technical relevance, and a series of environmental impact assessments, including Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA).

A strategy option, comprising one large central wastewater treatment plant servicing the whole sewerage districts, was selected as the optimum long-term strategy for the following reasons:

- It represents the least-cost solution;
- It can achieve the desired water quality objectives;
- It has minimal negative environmental and social impacts; and
- It is financially viable and affordable.

The recommended strategy involves collection and treatment of industrial, domestic, commercial, and institutional wastewaters, and stormwater up to twice as much as the dry weather flows during wet weather.

The strategy is based on the maximum use of the existing combined sewers and new interceptor sewers proposed along the Danube River left bank. The interceptor sewers will convey the wastewater mostly by gravity to the wastewater treatment plant located at the eastern edge of the City area.

The one large central treatment facilities will comprise a conventional activated sludge treatment process, and will be situated in remote location to minimize adverse impacts to the existing and future urban areas. The proposed treatment plant facilities will treat the daily maximum flow up to the secondary process, whereas the wet weather flows up to two times the dry weather flow will receive the primary treatment, i.e. primary settling and disinfection.

The proposed Project forms the least-cost and long-term strategy plan for the Project Area up to 2010, and will service most of the City's built-up urban districts. The Project will serve a total population of approximately 377,000 by the year 2010 and treat the maximum daily wastewater of 235,000 m^3/day, including the industrial wastewater of 83,000 m^3/day.

Upon completion of the Project, the BOD of 25,000 kg/day and SS of 29,000 kg/day estimated for the year 2010, would be cut off by more than 90 percent or 22,500 kg/day and 26,000 kg/day respectively, which would otherwise be discharged directly to the Danube River.

The reduction of the waste loads reaching the Danube River will improve the quality of environment and life for those living in the area near the waterways and the River. Improving the disposal of industrial and domestic wastewater will also contribute to the improvement in the beneficial uses from the waterways, such as freshwater fisheries and acquaculture, water transport and use of water for irrigation and industrial purposes.

12.2 ECONOMIC FEASIBILITY

12.2.1 ECONOMIC BENEFITS

In general, expected benefits of wastewater management projects are as follows.

- Sanitary improvement by eliminating untreated wastewater from roadside ditches
- Additional water uses due to water quality improvement of sewage recipient watercourse
- Amenity improvement due to water quality improvement of sewage recipient watercourse

In the Study, however, it is difficult to expect these benefits. First, sewer networks have been installed in the study area and there are no sanitary problems caused by wastewater. Second, flow quantity of Danube River downstream reach is so huge that expected positive impact of the Project could not result in additional water use.

A positive impact of the Project is supposed to be contribution to nature conservation and environmental protection of Danube Delta. Therefore, the study adopted a method to estimate the project benefits by a value of the positive impact to the nature conservation.

To estimate the value of the impact, questionnaire surveys were conducted in ten cities in Romania. The surveys asked the people about their willingness to pay (WTP) for the implementation of policies to contribute to the protection of the Danube Delta. The obtained WTP can be considered to represent the value of the positive impact, that is project benefits.

The economic benefits of the project are estimated as follows.

Table II.12.1 Estimated Economic Benefits

	Annual distribution	Total distribution
Economic benefit	665,212 million ROL	3,326,059 million ROL

12.2.2 ECONOMIC ANALYSIS

Based on the economic benefits calculated above and the cost estimated hereunder, economic analysis was performed.

Preconditions and assumptions applied are as follows:

- Currency unit is ROL and the value of ROL is expressed at the June 1999 prices.
- Project Life: 30 years since the start of project implementation.
- Target Year: 2010. From 2010 on the values of O & M cost variables are assumed to keep the 2010 level.
- Implementation Period: 5 years 2000 to 2004.
- OCC (Opportunity Cost of Capital): 10%.

- Conversion factor : 98.4% to capital cost (initial and replacement cost) taking account of customs duty for foreign components.

The economic costs, which comprises of three types of costs, were determined as follows:

Table II.12.2 Economic Costs

Initial Cost						Replacement Cost	O & M Costs
2000	2001	2002	2003	2004	Total		
73,986	283,728	394,373	486,338	418,863	1,657,289	380,808	15,638

(Unit: million ROL)

Economic criteria, EIRR (Economic Internal Rate of Return), NPV (Net Present Value) and B/C (Benefit Cost ratio) were calculated as shown in *Table II.12.3*.

Table II.12.3 Calculated Economic Indicators

NPV (million ROL)	B/C	EIRR (%)
111,708	1.07	13.1

Results of the sensitivity analysis are as shown in *Table II.12.4*.

Table II.12.4 Result of Sensitivity Analysis

Conditions	EIRR (%)	NPV (million Lei)	B/C
Costs: +20%	NA	- 210,418	0.89
Costs: +10%, Benefits: -10%	NA	- 221,589	0.87
Benefits: -20%	NA	- 232,760	0.86

12.2.3 EVALUATION

For the base conditions, the project is judged economically feasible, while the results of the sensitivity analysis indicate it vulnerable. Considering nature of the project, that is, it does not have direct benefits, the study judges the project economically feasible.

12.3 FINANCIAL FEASIBILITY

The study proposed the financial plans that make the operation of the projects financially feasible, on condition of a certain level of subsidy to the investment costs. This is because that financial affordability of the users and the city council have not become yet high enough to pay all the investment costs for the wastewater treatment plant. Therefore, conventional financial analysis, in which a total of the investment costs and operation costs, despite that some portions of the investment costs to be subsided, is compared to the revenue, a total of sewerage charge collected, did not indicate the financial feasibility.

However, the proposed financial plans showed financial soundness and operational sustainability of the private company and the city council. Therefore, the study judged that the project is financially feasible on condition of the provision of subsidy.

12.4 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

The preliminary EIA has resulted that the overall project appears to be well planned to achieve maximum benefits for the local people, which will surely enhance socio-economics and quality-of-life values of the region, thus it is judged the project is environmentally feasible.

The assessment results can be summarized as follows:

- The proposed project as a whole has positive environmental impacts in the area's water environment and the public health of the residents in the City through the improved service standards for the wastewater management;
- Construction or improvement activities for sewers, pumping stations and wastewater treatment plant throughout the project area may cause nuisances to the residents, but such hazards could be limited by giving careful considerations on the methods of construction and proper management of the sewerage system; and
- Connection of the wastewater currently being discharged to the public waterways to the sewer system will significantly improve the water quality in the Danube River;
- The beneficial effects of the project outweigh the adverse effects; and
- As certain items in the preliminary EIA need to be further clarified from engineering viewpoints, further studies will be made on the extent of impacts, mitigation and remedial measures, including the impacts possibly caused by the construction, operation and maintenance works of the WWTP and related facilities.

CHAPTER 13 CONCLUSION AND RECOMMENDATION

13.1 CONCLUSION

The study proposed the construction of the WWTP together with the installation of interceptors necessary to convey wastewater from existing sewered areas to the proposed WWTP. The proposed wastewater treatment employs a conventional activated sludge method, which is one of the basic biological treatments, and could treat the wastewater currently discharged into the Danube River without treatment, to the water quality levels to meet the international requirements, except T-N and T-P.

The feasibility study brought out the technical, economic, and environmental feasibility of the proposed projects, however, the Study revealed financial difficulty in the implementation of the projects. The initial investment cost for the construction of the wastewater is too heavy financial burden for the present city's financial conditions. Therefore, the Study evaluated the financial feasibility, premising the following financial and institutional supports from the state:

- Acceptance of the utilization of state guaranteed external loans.
- Exceptional provision for the aforementioned repayment criterion.
- Application of special subsidy to sewerage development projects

These supports seem to run counter to the spirit of the recent legislative reform that encourages financial independence of local public works from the state. It would be a quite right direction to expand the autonomy of local municipalities and to entrust local public works to the local municipalities' initiative as much as possible.

On the other hand, the state faces to necessity of the development of the wastewater treatment in the country to meet the EU Directives as the EU applicant country, and is internationally responsible for the development of the wastewater treatment along the Danube River. The development of the wastewater treatment could be one of the higher priority policies of the state. As revealed in the Study, the development of the wastewater treatment is too heavy financial burden for the local municipalities of which economy has not grown up enough. If the development is left in the local municipalities' initiative without any guidance and supports by the state, no considerable progress would be expected.

As long as the affordability of the local municipalities remains not enough to develop their wastewater treatment by themselves, the state should take the initiative in order to realize the state policy. Therefore, the Study considered it justifiable to provide the support as tools of the state initiative for the wastewater treatment development, despite of the sprit of the legislative reform.

13.2 RECOMMENDATION TO THE CITY COUNCIL

The Study concluded that the construction of the wastewater treatment plant is feasible. While the state support is essential, the city council should take the first action to realize the project.

The first action would be to take a decision of the implementation of the project. As mentioned above, the project would cause a heavy financial burden and would limit the implementation of other new projects. Every effort to squeeze out the self-financing sources should be done. Process and results of the efforts could be one of means to convince the state to provide the supports. While it is a matter of fact that the project would not work out without the state supports, it should be reminded that the project is not started by the state support but by the city council's initiative.

The Study proposed several options of financial plans by the financial arrangements. Availability of the foreign financial sources depends on the policy of the both recipient country and financing agency. To start seeking for possible finical source will be one of the city council's initiatives. It is suggested that ISPA fund may be the most preferable as it is a grant. The Study provided the city councils with information necessary for the application of such financial sources.

13.3 RECOMMENDATION TO THE STATE

As long as Romania is the EU applicant country, the state should take an initiative to develop the wastewater system in the country. The Study considers that the state supports in terms of financial and institutional assistance are essential for the city council to implement the proposed project, comparing required project costs and the city council's financial capability.

The state is required to provide an arrangement for the state guaranteed external sources, because terms of external loans without the state guarantee are far exceed the city councils' affordability. Also, the state is required to provide exceptions of repayment criterion that is one of conditions for the state guarantee external loans. As explained in the financial plan in this report, the Study proposed a sustainable financial plan that proves capability of a operation company to pay lease fee, which covers all repayment amount and depreciation, to a city council. The Study considers that it is possible to exempt the repayment criterion on security of the financial plan.

Furthermore, the state should provide a subsidy that supplements a self-financing portion of the investment cost. Even if the city council can utilize the state guaranteed external loan, most of the city councils would have a great difficulty in procuring the self-financing portion. A source of such subsidy may be very limited in the state budget. Therefore, the state should have a plan to prioritize city councils for the sewerage development. The proposed subsidy could work as a tool for the state to exert the initiative for the sewerage development. The seven (7) cities in the study area are to have higher priority in the development plan because of their location, which is along the Danube River.

PART II-3:FEASIBILITY STUDY FOR BRAILA WWTP PROJECT

CHAPTER 1 EXISTING CONDITIONS

1.1 STUDY AREA

Braila City lies in the southeastern part of Romania, at 45 degrees north altitude and 27 degrees east longitude, on the left bank of the Danube River. The ground elevations of the area range from 15 to 20 meters above the Black Sea mean water level (MWL). The present administration district covers the area of about 33.5 km^2. The eastern side of the City is bound with the Danube River from 177th to 167th km of the Danube River. City General Map is shown in *Figure II.1.1.* The City has at present a total population of 236,200 that is the tenth largest among the cities in Romania.

1.2 NATURAL CONDITIONS

1.2.1 TEMPERATURE

The climate of the City is continental in the Danube Delta, influenced by the Black Sea and the abundance of water from the inside. The annual average temperatures is 11℃, with the highest temperature of 23.1℃ in July and the lowest in January –2.3℃, as given in the following table. The maximum temperature ever recorded is 40.5℃ and the minimum -26.5℃.

Table II.1.1 Temperature in Braila City

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
Temp℃	-2.3	-0.6	4.9	11.2	17.2	20.8	23.1	22.6	18.1	12.0	5.6	0.3	11.0

Source: Braila City

1.2.2 WIND

Prevailing wind direction is NE to SW. The north wind blows from north toward northeast and is the most significant wind in terms of force and duration. The average frequencies of such wind ever recorded are from 25.4 to 28.4 % at an average velocity of 20 m/sec. The wind brings frost and snow in winter, but in summer the wind becomes dry.

Other significant wind is the dry south wind, which blows at a frequency of 13.1 % in winter and 11 % in summer, respectively. Wallachian wind blows from north to northwest, and is generally warm but followed by air of low temperature and dryness. The warm wind blows from south to west at a frequency of 9.3 % in winter and 5.8 % in summer, generally followed by major rainfalls.

1.2.3 PRECIPITATION

The average annual precipitation is at about 440 mm which is among the lowest precipitation in Romania, with humidities ranging from 60 % in summer at 2 p.m. and about 70 % in the littoral zone. Average monthly precipitation is 25 ml in April and 65 ml in July, and the maximum 24-hour storm was 91.4 ml, as shown in the following table. The average numbers of snowfalls and snow covering days are 15 and 41.6 days respectively.

Table II.1.2 Monthly Precipitation in Braila

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Precipitation (mm)	112	70.8	132	83	133	198	117	174	106	204	126	113	726

Source: Braila City

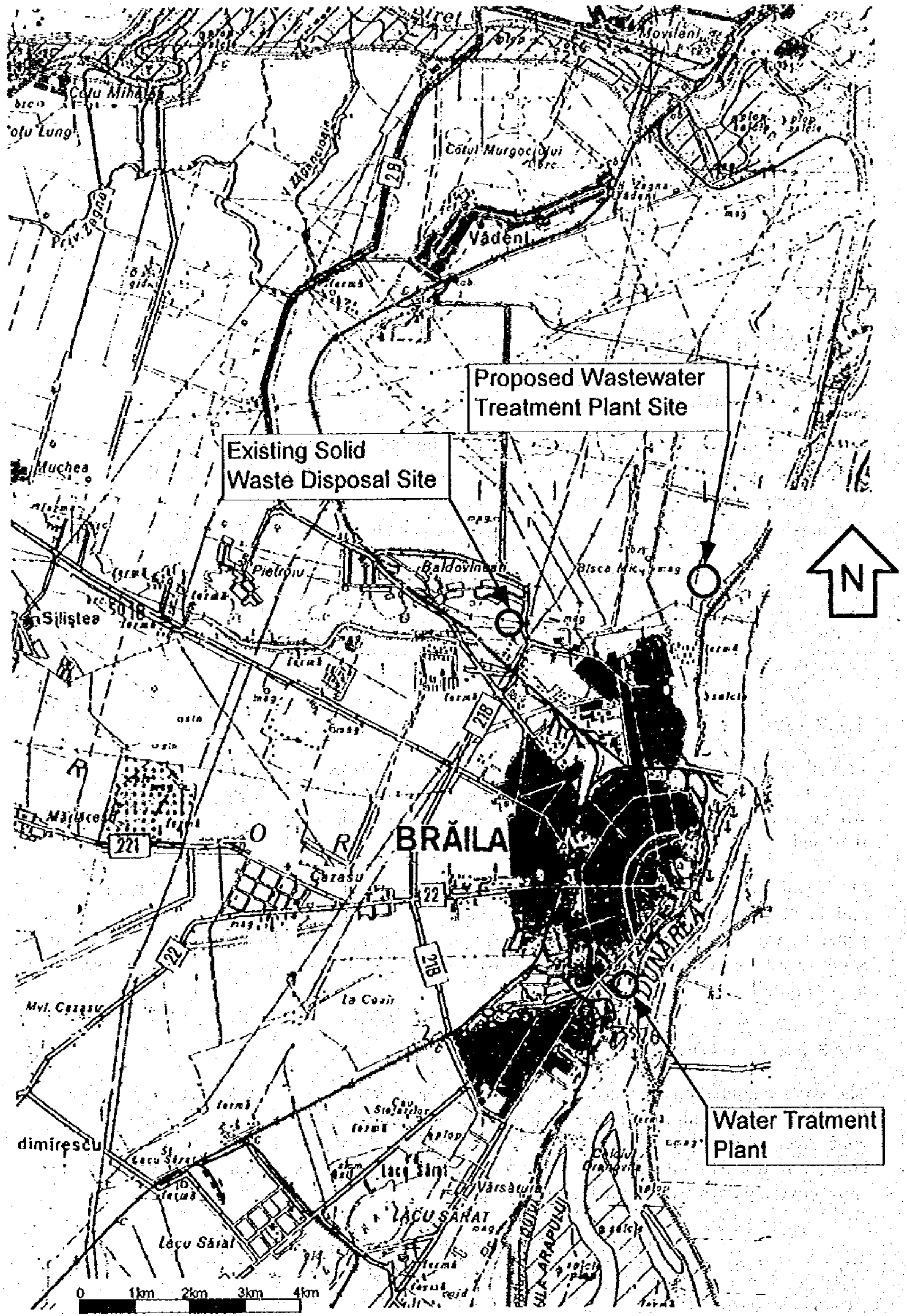

Figure II.1.1	General Map of Braila City

1.2.4 HYDROLOGY

In the City area, there exist two major water aquifers, the phreatic water bearing layer within the sandy areas at the bottom of loess and sometimes inside the loess layer, and the upward medium depth water bearing layer situated within the lower sand and gravel.

The first clay layer is homogeneously distributed within the area, thus separating the water-bearing layer from the deeper ones. The central area is characterized by both a rolling and threading process of the clay, that results in a direct contact between the sand in the lower and medium depth layers, the latter being connected to the Danubian water. Because of this connection, a depression of the phreatic level occurs, making its draining into the shallower level of lower piezometric values.

Natural water source of the phreatic layer comes from rainfalls, which usually infiltrates between the canaliculi of loess and accumulated in the basic sand layer, with a bed consisting of dusty clay at about 20 m deep. The medium depth sand and gravel are connected to Danubian waters influencing upon the area's groundwater hydrological conditions.

The Danube River flow rates and water surface elevations at the different probabilities of occurrence are given in the following table:

Table II.1.3 Hydraulic Conditions of the Danube River at Braila

Probability of occurrence (%)	0.1	1	5	10	80	95	97
River flow rates(m^3/sec)	18,750	16,170	14,290	13,410	2,120	1,690	1,580
River water surface elevation (in m above Black Sea M.W.L)	+8.498	+8.008	+7.578	+7.338	+1.326	+0.976	+0.816

Source: Braila City.

1.3 SOCIOECONOMIC CONDITIONS

1.3.1 POPULATION

The population of the city is 234,763 as of 1998, which is estimated to reach at 275,000 in 2050. The existing number of houses is estimated at 77,886 with an average family member of 3.0.

Table II.1.4 Total Population of Braila City

Year	1985	1986	1987	1988	1989	1990	1991
Population	234,600	235,620	240,851	242,595	243,353	247,902	249,633
Year	1992	1993	1994	1995	1996	1997	1998
Population	234,110	234,993	235,763	236,197	235,243	234,648	234,763

Source: Braila City

1.3.2 INDUSTRIES

Major industrial productions in Braila City are electric and thermal energy productions, various engineering, and shipbuilding. Small-scale industries produce ready-made cloths, furniture and wood products, chemicals, pulp and paper, transport, and warehouse. Agricultural products are of grains, fruits, vegetables, canned products, meat and fish.

The number of employees totaled 104,000 in 1996. It appears to be on the downward trend these years. Out of it, the primary, secondary and tertiary sectors accounted for 18.8%, 44.7% and 36.4% respectively, as shown in the following table. The predominance of the secondary sector is to be noted. Especially, the number of workers in the manufacturing industry reached 33,300, occupying 32.0% of the entire workforce.

Table II.1.5 Number of Employees by Type of Industrial Activities

Type of Industry	Employees			
	1994	1995	1996	%
Primary Industry	23,300	20,700	19,600	18.8
Secondary Industry	60,000	48,100	46,500	44.7
Mining Industry	2,400	2,200	2,100	2.0
Manufacturing Industry	42,200	34,600	33,300	32.0
Electricity, Gas and Water	3,400	3,400	3,800	3.7
Construction	12,000	7,900	7,300	7.0
Tertiary Industry	36,000	38,900	37,900	36.4
Total	119,300	107,700	104,000	100.0

Source: Braila City.

The number of factories totaled 446 in 1996. A wide range of manufacturing activities was observed. Out of it, "Food and Drinks Industry" accounted for 28.7%, followed by "Textile Garments, Fur and Leather Industry" with 22.0%, "Textile and Textile Products Industry" with 8.1%, "Furniture Production and Other Unclassified Activities" with 8.1%, "Metal Building and Metal Products Industry" with 7.0%, "Wood Manufacturing Industry (Excl. Furniture Production)" with 5.2%, etc.

Table II.1.6 Number of Factories by Types of Industries

Types	No of Factories.	%
Food and Drinks Industry	128	28.7
Textile and Textile Products Industry	36	8.1
Textile Garments, Fur and Leather Industry	98	22.0
Leather Goods and Shoes Industry	14	3.1
Wood Manufacturing Industry (Excl. Furniture Production)	23	5.2
Celluloid, Paper and Cardboard Industry	7	1.6
Publishing and Printing Industry	16	3.6
Chemicals and Synthetic and Artificial Fibres Industry	8	1.8
Rubber and Plastics Manufacturing Industry	6	1.3
Other Non-Metallic Mineral Products Industry	7	1.6
Steel Industry	4	0.9
Metal Building and Metal Products Industry	31	7.0
Machines and Equipment Industry	9	2.0
Electric Machines and Apparatus Industry	3	0.7
Radio, TV and Communications Equipment & Apparatus Industry	3	0.7
Industry of Medical, Optical and Watch Apparatus & Instruments	2	0.4
Transport Means Industry	3	0.7
Other Transport Means Industry	2	0.4
Furniture Production and Other Unclassified Activities	36	8.1
Recycling	10	2.2
Total	446	100.0

Source: Braila City.

1.3.3 ORGANIZATION

The organization chart of Braila city office is shown in *Figure II.1.2.*

Sewerage service is operated by R.A. APTERCOL. R.A. APTERCOL is a Regia Autonoma. R.A. APTERCOL has 1,473 personnel in total and operates water supply, sewerage, and district heating services. 126 employees belong to sewerage sector. The organization chart of R.A. APTERCOL is shown in *Figure II.1.3.*

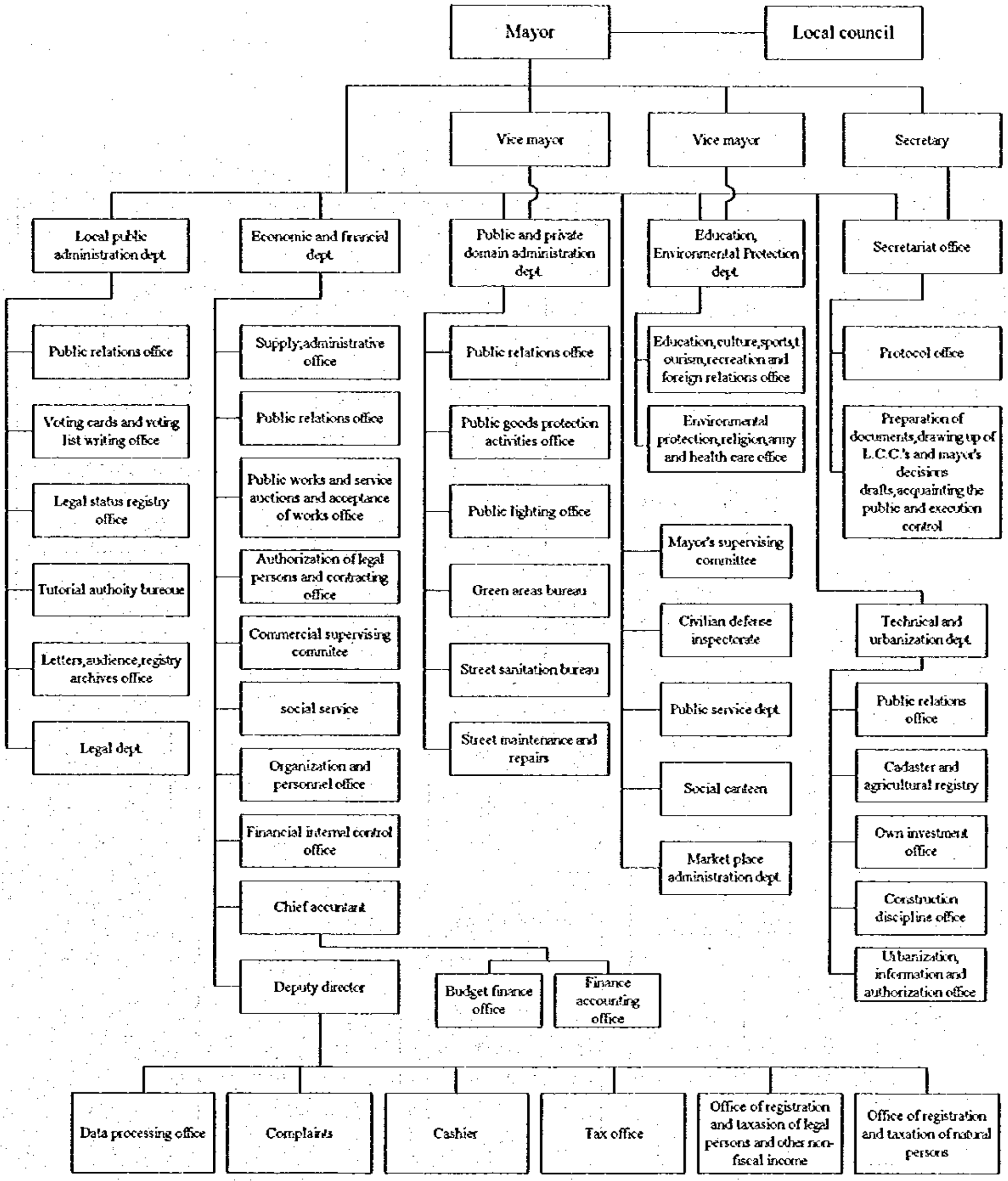

Figure II.1.2 Organization Chart of Braila City Office

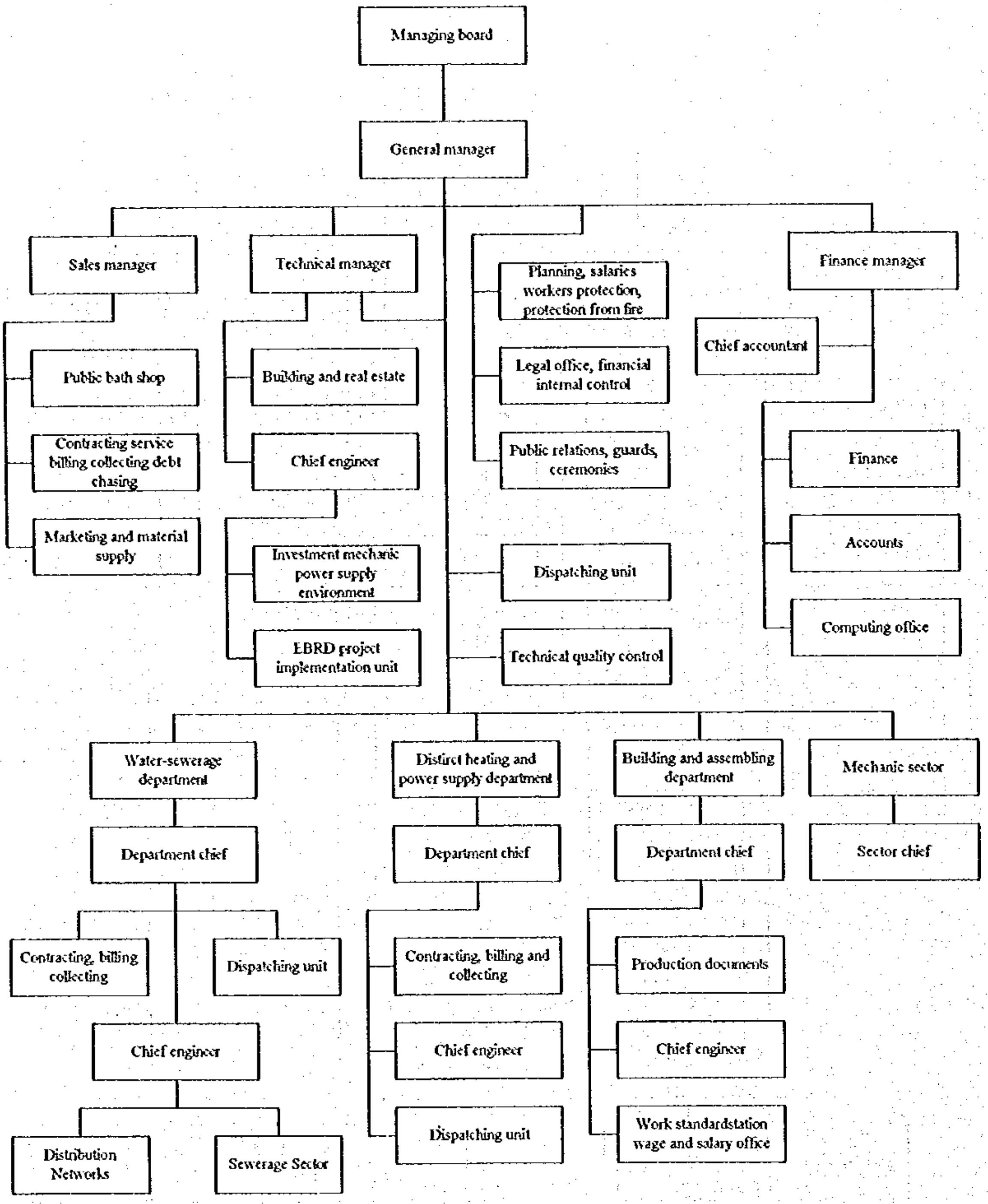

Figure II.1.3 Organization Chart of R.A. APTERCOL

1.3.4 FINANCIAL CONDITIONS OF THE CITY

The local budget of Braila for 1999 totals ROL 149.0 billion, which is by 45.7% greater compared with the budget for 1998, ROL 102.3 billion.

Because of the new local finance law which was put into force in January, 1999, there is no subsidy from the central government any longer except the carried-over one. Under the law, 31.5% of the tax on salaries goes directly to the local government. Also, 45% of this tax is allocated for the state income budget, of which a part is transferred to the local government through the county. Income from both sources is at the present moment included in the "money from the state income budget" in *Table II.1.7* due to procedural reason. Actually, most of the "money from the state income budget" consists of city's own income. That is, in principle almost all the income of the local budget now derives from its own sources. It in turn gives freedom to the local authorities to use the income in whatever way they deem proper.

As shown in *Table II.1.7*, out of the city's total income budget of ROL 149,033 million in 1999, 50.6% came from its own sources, 39.1% was the transfer from the central government (most of which actually belongs to city's own resources) and 10.3% was the subsidy. Regarding the expenditure budget, capital expenditure, which is spent for the economic development of the City accounted for 26.3 %.

Table II.1.7 Breakdown of Local Budget for 1999

Item	Amount	Ratio (%)
Total Income	149,032,858	100.0
1. Own Income	75,429,858	50.6
2. Money from State Income Budget	58,303,000	39.1
3. Subsidy for Investment	15,300,000	10.3
Total Expenditure	149,032,858	100.0
1. Current Expenditure	108,514,699	72.8
1) Personnel	10,144,074	6.8
2) Services and Materials	76,384,731	51.2
3) Subsidies	18,877,780	12.7
4) Transfer	3,100,000	2.1
5) Interest	8,114	0.0
2. Capital Expenditure	39,177,000	26.3
3. Financial Operations	1,341,159	0.9
4. Reserves	0	0.0

Source: Braila City (Unit: 1,000 ROL)

Table II.1.8 Breakdown of Local Expenditure for 1999

Item	Amount	Ratio (%)
Total Expenditure	149,032,858	100.0
1. General Public Services	10,575,731	7.1
2. Education	25,000,000	16.8
3. Health	2,000,000	1.3
4. Art and Culture	4,459,000	3.0
5. Social Assistance	9,343,047	6.3
6. Services and Public Development, Dwellings, Environment and Water	78,926,780	53.0
7. Agriculture and Forestry	600,000	0.4
8. Transport and Communications	7,629,000	5.1
9. Other Activities	1,150,000	0.7
10. Guarantee Fund for External Loans	100,000	0.1
11. Interest for Treasury Fund Loan	8,114	0.0
12. Repayment of Treasury Fund Loan	1,241,159	0.8
13. Special Destination Expenditure	8,000,000	5.4

Source: Braila City (Unit: 1,000 ROL)

Table II.1.8 shows that 53.0% or the majority of the expenditure budget went to "Services and Public Development, Dwellings, Environment and Water" which includes the sewerage sector. 16.8% was allocated for "Education".

1.3.5 FINANCIAL CONDITIONS OF R.A. APTERCOL FOR 1999

(1) Water and Sewerage Charges

Since the beginning of 1998 up to now water and sewerage tariffs were revised 8 times, as shown in *Table II.1.9.* It shows a serious endevour on the part of R.A. APTERCOL to make ends meet in this sector. Water tariffs seem to be on the high side compared with sewerage tariffs.

As of July 15, 1999 the sewerage charges for domestic and industrial customers are ROL 449 and ROL 746 respectively.

Table II.1.9 Water and Sewerage Tariff

Item	Water Supply		Sewerage	
	Domestic	Industrial	Domestic	Industrial
Jan. 1, 1998	1,320	2,180	125	215
Feb. 1, 1998	1,440	2,375	135	235
Apr. 1, 1998	1,580	2,620	200	335
Jun. 11, 1998	1,685	2,790	215	335
Jul. 1, 1998	2,135	3,535	275	450
Jan. 21, 1999	2,267	3,754	292	746
Mar. 15, 1999	2,432	4,028	313	746
Jun. 16, 1999	2,663	4,411	345	746
Jul. 15, 1999	3,505	5,816	449	746

Source: R.A. APTERCOL (Unit: ROL/m^3)

(2) Volume of Water and Sewage

As shown in *Table II.1.10*, the total volume of wastewater discharged into sewerage was 11,504,000 m^3 in the 1st half of 1999, which was broken down to 7,927,000 m^3 or 68.9% for domestic sewage and 3,577,000 m^3 or 31.1% for industrial sewage. The volume of sewage was 74.4% of that of water in the same period.

Table II.1.10 Volume of Water and Wastewater

Item	Water Supply			Sewerage		
	Domestic	Industrial	Total	Domestic	Industrial	Total
1996	28,626	8,184	36,810	20,993	10,505	31,498
1997	27,027	6,496	33,523	19,800	8,753	28,553
1998	25,575	5,956	31,531	19,009	8,184	27,193
1st Half of 1999	10,653	2,415	13,068	7,927	3,577	11,504

Source: R.A. APTERCOL (Unit: 1000 m^3)

(3) Financial Performances for Water Supply and Sewerage Services

R.A. APERCOL earned a surplus of ROL 482 million or 11.6% from sewerage services in the 1st half of 1999. As shown in *Table II.1.11*, financial management of sewerage services looks on the whole sound and stable. In the case of water supply, the degree of success is more pronounced.

Table II.1.11 Financial Performance for Water and Sewerage Services

	Item	1996	1997	1998	1st Half, 1999
Water Supply	Income	14,445,256	38,176,493	61,382,665	33,582,652
	Expenditure	11,663,084	33,014,491	45,965,120	23,808,190
	Profit	2,782,172	5,162,002	15,417,545	9,774,462
	Profit Rate (%)	19.3	13.5	25.1	29.2
Sewerage	Income	1,989,841	3,738,754	7,123,380	4,146,550
	Expenditure	1,727,041	3,918,133	6,411,026	3,664,249
	Profit	262,800	-179,379	712,354	482,301
	Profit Rate (%)	13.2	-4.8	10.0	11.6
Total	Income	16,435,097	41,915,247	68,506,045	37,729,202
	Expenditure	13,390,125	36,932,624	52,376,146	27,472,439
	Profit	3,044,972	4,982,623	16,129,899	10,256,763
	Profit Rate (%)	18.5	11.9	23.5	27.2

Source: R.A. APTERCOL (Unit: 1000 ROL)

(4) Unit Operation and Maintenance Cost for Sewerage Service

As shown in *Table II.1.12*, income, expenditure and profit per m^3 were ROL 360, ROL 318 and ROL 42 respectively in the 1st half of 1999. Out of the total expenditure per m^3 of ROL 318, ROL 149 or 46.9% was personnel cost, ROL 98 or 30.8% materials/maintenance/repairs cost, and ROL 29 or 9.1% energy cost.

Table II.1.12 Unit O & M Cost for Sewerage Service

Item	1st Half of 1999	
	Amount (1,000 ROL)	per Volume (ROL/m^3)
Income	4,146,550	360
Domestic	2,378,051	300
Others	1,768,499	494
Expenditure	3,664,249	318
Electricity	333,555	29
Depreciation	37,215	3
Wages/Social Insurance	1,710,079	149
Materials/Maintenance/ Repairs	1,131,572	98
Others	451,828	39
Profit	482,301	42

Source: R.A. APTERCOL

(5) Income and Expenditure Budget for Sewerage Services

Income from sewerage services for 1999 is budgeted to be ROL 8,175 million, which is an increase of 25.1% from the 1998 level. One sewerage project is now underway, which is financed out of central government coffer. The amount of the subsidy from the state government was ROL 4,671 million for the 1st half of 1999.

Profit of ROL 981 million or 12.0% is envisaged for the same year.

Table II.1.13 Budget for Sewerage Service

Item	1998	1999
Total Income	6,532,340	8,175,250
Total Expenditure	5,893,702	7,894,706
Maintenance and Repairs	2,177,817	2,528,962
Materials	93,915	564,170
Electricity	466,460	637,717
Personnel	2,810,580	0
Salaries	2,022,000	2,438,482
Social Insurance and Unemployment	788,580	1,155,389
Depreciation	77,180	65,050
General Administration	267,750	504,936
Profit	638,638	980,544
Profit Rate (%)	9.8	12.0

Source: R.A. APTERCOL (Unit: 1000 ROL)

58 % of collection rate of water and sewerage charges appears to be on the low side. It has been at a similar level these few years.

(6) Required Actions for Sustainable Financial Plan

The following things are essential to work out a sustainable financial plan on sewerage services.

- Estimation of the willingness and affordability of the households to pay sewerage charge to clarify the extent and limit of household income allocable to it.
- Incorporation of the actual collection efficiency in formulating income budget and cost analysis to realize proper level of cost per unit volume of sewage.
- Preparation of funds statement and balance sheet besides income statement in order to assure a long term profitability and solvency.

1.4 WATER SUPPLY SYSTEM

(1) History of the System

Braila's water supply started its service in 1888, with a total supply capacity of 4,000 m^3/day, but continuous and stable water supply service actually started in 1891. The water supply capacity had gradually been increased, and in 1899 the total water supply capaciy reached a level of 6,000 m^3/day.

Between 1918 and 1940, the water supply networks had been continuously developed, by increasing supply capacity, distribution areas, and water purification system. After the World War II, the investment amount to the water supply system improvement was further intensified. In 1959, the largest water intake was constructed in Chiscani, and in 1960, the main transmission pipelines between Chiscani and Braila started their functions.

Between 1968 and 1970, a regional water supply system covering Braila and Garati City areas was constructed, taking the groundwater at Suraia Vrancea. Sebesti-Braila aqueduct of more than 18 km long was also installed under the project. During 1970's and 1980's, the water supply networks were further expanded in Hipodrom, Obor, Viziru, Vidin-Progresu, and Serbesti-Braila districts, and aqueducts between Chiscani and Braila were doubled.

Between 1983 and 1987, a new water treatment plant was constructed in Chiscani with a total production capacity of 800 l/sec, together with Chiscani-Braila water distribution mains. During the period, storage tanks were also built. In 1983, the heating water main was installed to supply hot water from the power station in Chiscani to apartments of 630 blocks.

In 1987, construction of a new collecting mains of 4,000 mm diameter started to provide the service by 2000. A 20,000-m^3 capacity storage tank at Varsatura near Braila was constructed in 1995. Upon completion of the present water supply extension project, the current service population of 250,000 will be increased to 275,000 by 2010, covering the neighboring towns.

(2) Present Water Supply System

The major features of the present water supply system may be summarized as follows:

Surface water sources;	43,105,495 m^3/year (81.3 % of the total),
Groundwater sources;	9,917,444 m^3/year (18.7 % of the total),
Total water taken;	53,022,939 m^3/year,
In plant process consumptions;	7,953,441 m^3/year (15% of the total consumption),
Water delivered via networks;	45,069,498 m^3/year (85 % of the total consumption),
Water loss;	11,546,666 m^3/year (25.62 % of the delivered water),
Accounted-for water;	33,522,832 m^3/year (75.52 % of the delivered water)
Pipe materials;	Steel, reinforced concrete, asbestos cement, plastics and cast iron.
Pipe length;	Approximately 600 km.

(3) Future Development Plan

The improvement plan of the water supply system includes the following works;

- Provision of water meters at all houses from 2001 to 2005, and
- Rehabilitation and replacement of old and obsolete water pipes from 2001 to 2011.

1.5 SEWERAGE SYSTEM

(1) History of System

The Braila City sewerage service started in 1912 within the old urban districts bordered by the last defense wall of the former fortress. The system was planned and designed by Engineer Dionisie German and actual service started in 1916, covering most of the then town area. The original wastewater system consisted of branch and lateral sewer networks, and main collectors laid along Dorobanti Boulevard, leading the wastewater toward the Danube River. The system is a combined system to receive both domestic wastewater and stormwater runoffs to single sewers, but no wastewater treatment plant was planned.

(2) Present Conditions

All the collected wastewater, which is commingled with stormwater runoffs during rainfalls, has been discharged directly to the Danube River through four major outfalls, which are located along the left bank of the Danube River. In addition, there are seven (7) small outfalls installed throughout the City area also discharge both stormwater and wastewater. The quantity of wastewater discharged through the small outfalls accounts for about 1 % of the total wastewater discharged to the River. In low-lying areas of the City, totally 16 pumping stations have been installed to discharge the wastewater to the Danube River.

At present, the existing wastewater system collects about 80 percent of the total wastewater through branch and lateral sewer networks, which is intercepted by the main collector sewers laid along the Dorobanti Boulvard in the northern part of the urban district. The rest of the wastewater is being disposed of into ground through either individual septic tanks or pit latrines.

The industrial wastewaters from three major industries, shipyard, Promex (machinery) and rolled steel factories, are independently discharged directly to the Danube River or nearby waterways after being pretreated in their own treatment systems. The wastewaters from small-scale industries are mainly discharged to the public sewers as approved by the City, but the discharge quantities are small.

The 2,100 x 2,100 mm egg-shape section interceptor, constructed in the 1970's, are now obsolete and partly damaged. In 1984, part of the sewer was physically damaged, and as a result, wastewater flows have been intervened and overflowed at certain locations. Once heavy rain falls, stormwater inflows to the sewers often exceed sewer hydraulic capacity, causing flood in low-lying areas particularly near the street crossing of Tineretului and Plantelor. The interceptor's planned hydraulic capacity is 7 m^3/sec, but the actual peak flow rates during storms are almost double of the sewer capacity.

In view of the conditions, the City established a plan in 1986 to construct new interceptors in parallel with the old collectors to relieve the hydraulic overloading. The total length of the new interceptors is 4,146 m, running along the circumferential road from toward the eastern direction.

The new collector mains consist of four parts;

Portion 1- 816 m, circular section of 1,200 mm in diameter,
Portion 2- 891 m, semi-elliptical section of 2,600 x 2,600 mm,
Portion 3- 2,071 m, circular section of 3,400 mm, and
Portion 4- 368 m, elliptical section of 3,400 x 3,400 mm.

The interceptor sewer construction is now on-going and, by the end of March 1999, about 3,700 m sewers have already been completed. All the construction works are scheduled to complete by the year 2000. At the deepest part of the interceptors at Portion 3 is 16 m below the ground surface, thus a shield tunnel construction method is applied.

All the dry weather wastewater flow (DWF) and up to twice of the DWF during rainfalls will be transported to the wastewater treatment plant, through a new pumping station to be constructed at the terminal of the interceptor.

(3) Wastewater Quantities

Annually, an average total of 28,828,000 m^3 or daily 78,980 m^3 domestic wastewater is generated within the sewerage service districts. Breakdown of the wastewater generations by category is shown in the following table.

Table II.1.14 Breakdown of Braila City Wastewater Generation

Area Categories	Number of Inhabitants	Consumption dm^3/inhabitant/ day	Daily water consumption (m^3/day)	Daily wastewater generation*) (m^3/day)	Remarks
Flats	160,983	415	66,808	53,446	
Local well with water heating system	22,985	280	6,435	5,148	
Local well without water heating system	34,321	155	5,320	4,256	
Drinking fountain on the street	15,902	100	1,590	-	Without sewerage system
Industries	72,000 eq. inhabitants	280	20,160	16,130	
Communities with wastewater facilities	20,000	100	2,000	-	Without sewerage system
Total			103,308	78,980	

Note: *) Wastewater generation is estimated at 80 % of water consumption.
Source: R.A. APTERCOL

1.6 OTHER SANITATION SYSTEM

The wastewater networks serve approximately 80 percent of the City's population at present. The rest of about 67,000 population rely on either septic tanks or pit latrines for excreta disposal. These toilet systems are occasionally cleaned with vacuum trucks at the average frequency of once a year, but in low-lying districts, where the groundwater elevations are generally high, these systems are cleaned about twice a year.

At present, eight (8) city-owned vacuum trucks are engaged in the desludging service, at service charges of 3 to 4 US\$/m^3. The collected sludge is disposed of together with other solid wastes to the designated disposal site located at the northeast part of the City. The Braila City has a plan that the collected sludge will be disposed of to the public sewerage system in the future.

Other solid wastes collected from the City are transported to the disposal site. The municipal solid wastes are composed of about 10 % domestic origin, 40 % animal wastes, and 50 % building or construction waste materials. According to the City's estimate, the disposal site is capable of receiving the present level of solid wastes until 2002. A construction plan of new disposal site is now under consideration, which will be provided with polyethylene liners at the bottom. The collected leachate will be brought with trucks to the public wastewater system for the final treatment.

1.7 INDUSTRIAL WASTEWATER GENERATIONS

The major industrial wastewater discharges are as follows:

Metal industries;	3,750 m^3/day
Shipbuilding industry;	1,250 m^3/day
Wood industry;	4,050 m^3/day
Engineering;	3,835 m^3/day
Brewery;	2,680 m^3/day
Slaughter house;	443 m^3/day

The industrial wastewaters from major industries are independently pretreated at the sources to the degrees acceptable to the public sewers or directly disposed of to the nearby drains, lakes, or rivers. The total amount of the wastewater discharged to the public sewers accounts for only one percent of the total wastewater flows.

Table II.1.15 shows the industrial wastewater quality measured at each outfall.

Table II.1.15 Industrial Wastewater Qualities in Braila in 1997

Parameters	Ger-many	Cezar Petrescu	Targo-viste	Braila Sud	Vadu Stanca
pH	6.5	7.3	7.45	7.3	7.2
Suspended Solids (105 °C) mg/l	198	115	292	165	112
Suspended Solids (600 °C) mg/l	70	30	105	52	18
COD_{Cr}	120	60	120	700	20
BOD_5	43.7	15.3	55	375	8.7
Dissolved Substances (105 °C) mg/l	500	488	632	692	348
Dissolved Substances (600 °C) mg/l	408	380	500	480	240
Oils - mg/l	47	27.1	50	NA	NA
Detergents mg/l	1.75	0.52	1.4	0.42	0.05
Total Ammonia mg/l	42	14	25.2	100	14
Total Phosphorus mg/l	1.3	0.8	3.3	4.1	0.8
Phosphorus mg/l	4.1	2.4	10	12.5	2.4
H_2S	6.0	5.3	4.3	12.8	3.6

Source: Braila City

CHAPTER 2 REVIEW OF EXISTING PLANS

2.1 EXISTING DESIGN BASES

2.1.1 GENERAL

Design basis and criteria developed in the previous feasibility study (1997 F/S of Braila) have been reviewed and updated in light of the latest available data and information prepared by the Braila City and R.A. APTERCOL, and the results of field surveys under the present study.

The review includes:

- Braila's present and future populations;
- Present and future water supply and sewerage service populations;
- Wastewater generations and wastewater flows;
- Wastewater characteristics; and
- Planning and design criteria for the WWTP program.

2.1.2 POPULATION

The table below is a summary of the planned service population of water supply and sewerage systems. The 1997 F/S considered only the total administrative population for the year 2050, but not for service population by the water use category.

The present service population by the water supply and sewerage systems provided for the City's 1996 master plan is summarized in the following table. The present sewered population is estimated by ratios of the sewer service area to the total area.

Table II.2.1 Estimated Service Population based on 1996 Master Plan

Category (Norm)	Per capita water consumption (lcd)	Present service population* as of 1998		Service population in 2050 (1997 F/S)
		Water supply	Sewerage	
1	65	7,533	-	-
2	110	27,963	-	-
3	170	7,152	3,480**	-
4	295	42,197	41,750**	-
5	380	149,918	149,020**	-
Total		234,763	194,250**	275,000
Administrative population		234,763		275,000

Note: * Data are based on the General Urban Planning, "Plan de urbanism general (PUG)
** Show the values estimated based on the ratio of sewered area to total area.

Since these figures were developed, there have been significant changes in socioeconomic situations in the City, these are reviewed based on the latest available information. For the analysis, three scenarios for the future served population (2010) estimates are prepared, including:

Scenario A-1: No sewer network expansion in the built-up urban districts, but to suburban districts, according the City urban planning,

Scenario A-2: Expansion of sewer networks both in the urban and suburban districts to provide sewer service to all water user categories of 3, 4 and 5, and

Scenario B: Expansion of water supply and sewer services to all user categories.

The sewer service populations by the three scenarios in 2010 as provided by the City Planning range from 218,000 to 245,900, whereas the administrative population as of 2010 was estimated to be 257,000. These figures have further been analyzed and reviewed in light of the latest data, and discussed with the authorities concerned. Thus, the review has led to the conclusion that the estimated 2010 sewered population of 221,600 appears to be reasonable for planning of the WWTP Project.

2.1.3 WASTEWATER FLOWS

The Braila's present water use patterns and consumption, and wastewater flows have been reviewed, and the future wastewater flows estimated by applying generation factors as defined in the Romanian Standard Methods. The quantities of industrial wastewaters, both point and non-point sources, are also reviewed by using the collected data and field survey results. The review results indicate that the wastewater flow rate in the Scenario A-2 seems to contemplate the most realistic conditions of the wastewater system in 2010. The review results that can be used as the design bases for the preliminary engineering design are summarized in the following table:

Table II.2.2 Estimated Future Wastewater Flow Rates by Category

Water Use Category	Average Daily Flow(m^3/day)	Maximum Daily Flow(m^3/day)	Maximum Hourly Flow (m^3/day)	Wet Weather Flow (m^3/day)
Domestic/commercial/ Institutional wastewater	75,000	84,000	96,000	
Industrial wastewater	21,000	29,000	42,000	
Groundwater infiltration	2,000	2,000	2,000	
Total	98,000	115,000	140,000	280,000

2.1.4 WASTEWATER CHARACTERISTICS

The available wastewater quality data and recent field survey results have been reviewed and 2010 wastewater characteristics estimated by the water user categories. In addition, the industrial wastewater discharging to the public sewers have been checked by the latest available data and field survey results together with various socioeconomic conditions in the area.

Quantities of domestic, commercial and institutional wastewaters, industrial wastewaters, and groundwater infiltration to sewers. Taking into account the results of water quality analyses, industrial wastewater qualities being discharged to the public sewers, and other socioeconomic conditions, the influent qualities in the future are forecast as summarized in the following table:

Table II.2.3 Future Influent Quality

Wastewater	Design Flow (m^3/d)	Loads (kg/d)		Concentration (mg/L)		Loads (kg/d)		Concentration (mg/L)	
		BOD_5	SS	BOD_5	SS	T-N	T-P	T-N	T-P
Domestic, Commercial, and Institutional	74,700	9,750	11,302	131	150	1,706		23	3.0
Industrial	21,000	3,349	4,238	159	201	459		22	5.0
Groundwater Infiltration	2,300	0	0	0	0	0		0	0
Total	98,000	13,099	15,540			2,165	332.4		

2.2 WASTEWATER COLLECTION SYSTEM

Both the dry and wet weather wastewater flows are at present being discharged to the Danube River through three major outfalls. In addition, there exist several small outfall sewers but discharge mostly stormwater runoffs.

The Braila City has developed a comprehensive improvement program for the sewerage system which plans to:

- complete the currently on-going central collection system;
- expand about 100 km long sewer networks to unsewered districts in 1998 to 2008;
- rehabilitate and replace about 50 to 60 km old sewer pipes, particularly those in the old urban built-up districts; and
- construct a WWTP in 1999 to 2000.

Under the improvement program, construction of the collection sewer is now underway. The wastewater coming down from the existing and newly constructed collectors (Colector Germani and Colector general Rosiori) is planned to inflow to a confluent chamber located near the underpath of POD RUTIER.

All the dry weather wastewater flow will be led to the new pumping station via the confluent chamber, then pumped up and transported to the WWTP through a circular pressure pipeline of 1,000-mm and a 2,200 x 1,800-mm hose-shoe sewer. During wet weathers, up to twice as much the dry weather flow will be pumped to the WWTP, the excess wastewater being discharged directly to the Danube River.

The City has a plan to lay a 1,200 mm diameter pressure sewer line of about 2.8 km along the route DJ221A to the WWTP. At the WWTP influent chamber, the sewer invert elevation is estimated to be +4.36 m M.W.L, having the static head of + 9.6 m M.W.L. The estimated peak flow rate (2 x dry weather flow rate) is 3.3 m^3/sec, and hydraulically the planned pressure sewers are able to transport such flow to the WWTP.

2.3 WASTEWATER TREATMENT PLANT

2.3.1 DESIGN BASES FOR WWTP

The Braila City has developed a preliminary engineering design for the WWTP together with the collector system design. The proposed WWTP site is situated at the northern edge of the City area approximately 4 km downstream from the urban district along the road DJ221A connecting Braila to Galati.

Major features of the preliminary WWTP design are as summarized as follows:

- Hydraulic Conditions

Maximum daily wastewater inflow rate;	1,500 l/sec.
Maximum hourly wastewater inflow rate;	1,650 l/sec.
Peak flow Rate (2 x dry weather flow);	3,300 l/sec.

- Wastewater Qualities

Influent wastewater quality;	BOD_5,	150mg/l,	SS	250 mg/l
Effluent wastewater quality;	BOD_5	removal 80 %,	SS	removal 60 %

These proposed design bases for the WWTP planning have been reviewed in view of the previous review results, and necessary revisions thereon are made in the WWTP planning.

A conventional activated sludge process is proposed in the report. For the wet weather flow, up to twice the DWF will be led to the treatment plant, of which one DWF flow will be treated by the biological process, the rest being treated up to the primary treatment level.

The WWTP facilities are designed on account of the Danube River's water surface elevation at the 100-year flood. The water elevation of the Danube River at 1% probability of occurrence is estimated to be +7.86 m MWL, and 5% probability of occurrence to be +7.31 m M.W.L. The average multi-yearly elevations are 50% probability of occurrence is 3.91m and 80% probability of occurrence is at 3.42 m.

2.3.2 PROPOSED FACILITIES

The City's proposed WWTP system comprises the following component facilities:

- Preliminary treatment process, screenings; coarse and fine strainers, Grit removal; aerated grit chambers;
- Primary system, primary settling tanks;
- Biological treatment process, aeration tanks, final settling tanks, chlorine contact tanks; and
- Sludge digesters and dewatering facilities.

2.3.3 CONCLUSIONS

The WWTP facility preliminary engineering design has been developed in principle following the design criteria developed under this feasibility study and as defined in the National Standards. The City's proposed treatment method is of a conventional activated sludge process that is one of the most reliable processes to produce stable and high quality effluent, hence, which could meet the present effluent quality requirements to the Danube River.

The flexibility to improvement and upgrading of the WWTP in the future should be considered at the final design stage so that the WWTP could meet the more stringent water quality requirements that may possibly be enforced in the future. Under the present preliminary engineering design, such considerations as land requirements and additional facilities layout are to be considered for the possible upgrading or expansion of the WWTP.

The City's proposed design criteria for the WWTP are also reviewed in light of the latest available data and information, together with the results of field surveys conducted under the present study. The review work has indicated that some of the originally proposed design criteria are to be revised or upgraded in view of the present conditions, and those elaborated can be reasonably applied for the WWTP design.

CHAPTER 3 PLANNING BASIS

3.1 SERVED POPULATION

Out of Braila's 257,000 population in 2010, about 221,600 people will be served by the sewerage system. The breakdown of the served population by water categories is shown in the table below.

Table II.3.1. Present and Future Served Population

Users' category by Norm	Present served population in 1998	Served population in 2010
3	3,480	7,200
4	41,750	64,400
5	149,020	150,000
Total	194,250	221,600

3.2 WASTEWATER FLOWS

The estimated wastewater inflow rates to the Braila WWTP in 2010, including domestic, commercial, institution, groundwater and industrial wastewaters plus groundwater infiltration, are summarized as follows.

Table II.3.2 WWTP Inflow Rates in 2010

Inflows	m^3/day	m^3/sec	Remarks
Average Daily Flow	98,000	1.135	
Maximum Daily Flow	115,000	1.332	
Maximum Hourly Flow	140,000	1.621	
Peak flow (wet weather)	280,000	3.241	Two times the max. hourly flow

3.3 WASTEWATER CHARACTERISTICS

The wastewater characteristics in the year 2010 are estimated based on the review and analysis of the various field wastewater data collected by the Braila City and the present feasibility study, as summarized in the table below.

Table II.3.3 Wastewater Characteristics in 2010

Parameters	Concentrations (mg/l)	Remarks
BOD_5	150	
SS	180	
T-N	25	
T-P	4	

CHAPTER 4 INTERCEPTOR SYSTEM

4.1 EXISTING SEWERAGE SYSTEM

The sewerage system in Braila is the combined system which collects wastewater and storm water together. There are totally 12 wastewater outfalls to discharge collected wastewater and storm water into the Danube River. The existing sewerage system together with the proposed wastewater treatment plant (WWTP) site is shown in *Figure II.4.1.*

According to R.A. APTERCOL, the existing flow in dry weather of each outfall is as follows.

Table II.4.1 Flow of Existing Outfalls

Name (Code) of Outfalls	Flow in Dry Weather (l/sec)	Remark
Braila Sud (BS)	300	
Radu Negru (RN)		Only for emergency case.
PAL (B1)	20	
(B2)	10	
Franceza (B3)	15	
Danubiu and Imparat Traian (B4)	5	
Belvedere (B5)	3	Only sanitary wastewater is discharged.
Vadul Schelei (B6)	4	
Vadul Rizeriei (B7)	12	
Germany (GE)	1,200	
Cezar Petrescu (CP)	250	
Targoviste (TA)	50	
Total	1,869	

Two (2) outfalls, the BS and the RN, are equipped with emergency pumps. The pumping station SP Braila Sud (BS) operates while the water level of the Danube is higher than +6.3 m M.W.L. The pumping station SP Radu Negru (RN) is operated only in emergency case.

In the existing system, the Germany (GE) line is a main sewer discharging approximately 60 % of the total collected wastewater. Braila City has been constructing a new main sewer named Rosiori running along the GE line to solve the current shortage of wastewater discharging capacity of the GE line. The Rosiori is connected to the GE line at around 1 km upstream from the outfall GE.

According to R.A. APTERCOL, the existing transfer pumping stations are as follows.

Table II.4.2 Flow of Existing Transfer Pumping Stations

Name of Pumping Station	Existing Flow in Dry Weather (l/sec)
PS Viziru	55
PS Calarasi 4	28
PS Ship Yard	14

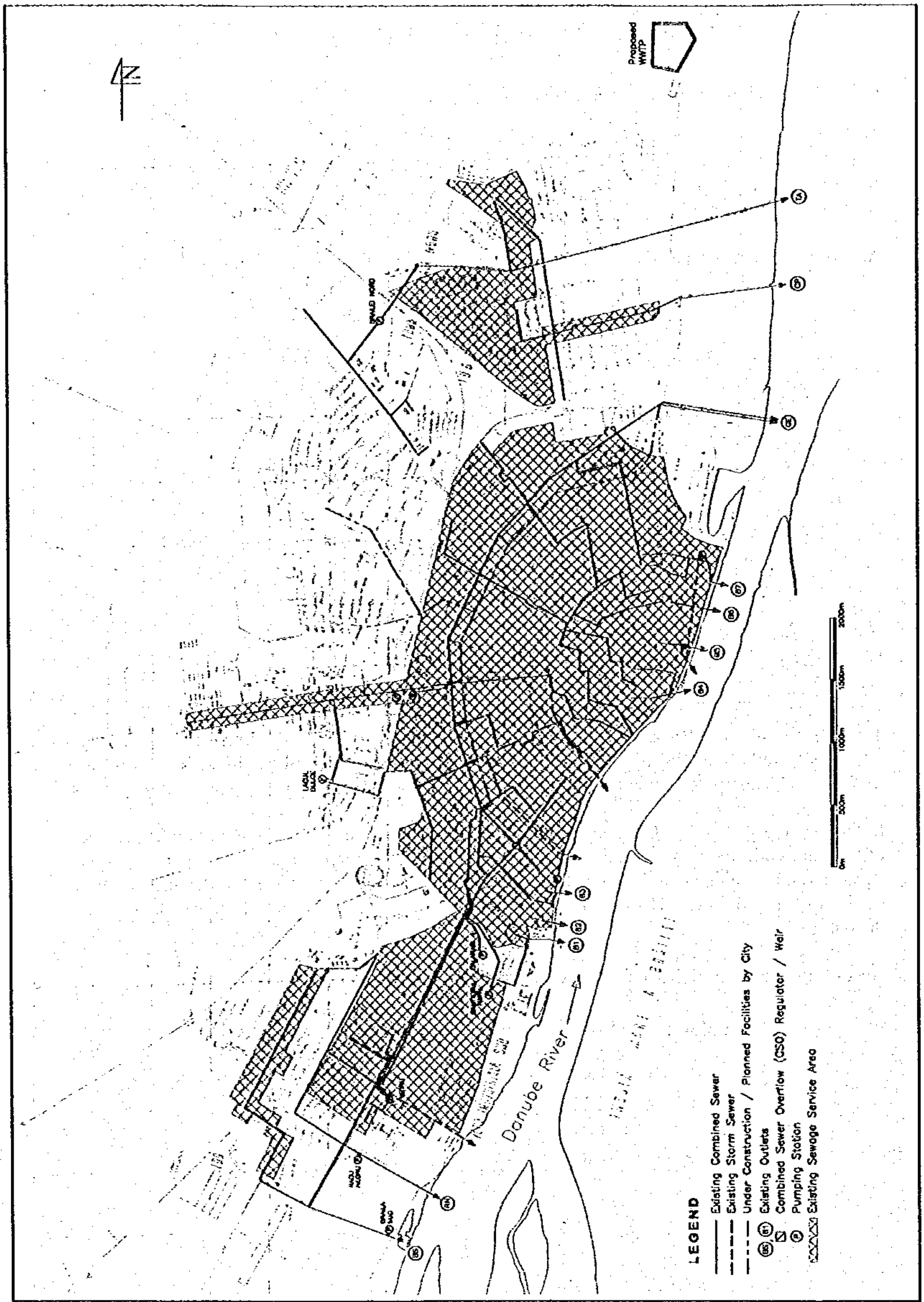

Figure II.4.1 Existing Sewerage System of Braila City

4.2 PLANNING PRINCIPLES

4.2.1 SCOPE OF THE PLAN

Previously Braila City conducted a feasibility study on a wastewater collection system and a wastewater treatment plant. In the previous study, an interceptor system was planned to convey all the dry weather wastewater generated in the City from the junction manhole of the GE and the Rosiori lines to the wastewater treatment plant. Moreover, the interceptor was designed to have a capacity of twice as much as maximum hourly dry weather wastewater flow (2Q) during wet weathers. However, the implementation plan of the interceptor has not been prepared yet.

The basic planning principle of the present study is to exploit the existing plan and facilities. Based on this principle, the scope of the plan is determined as the interceptor system which receives all the collected wastewater and storm water from the junction manhole of the GE and the Rosiori lines and conveys up to 2Q of the wastewater to the proposed WWTP. On the way to the WWTP, the interceptor sewer is to receive the wastewater from the sewer lines of Cezar Petrescu (CP) and Targoviste (TA).

4.2.2 FACILITIES TO BE DESIGNED IN THIS STUDY

The planning and design of the interceptor system consist of following components.

- Combined sewer mains from the junction of the GE and Rosiori up to the planned CSO regulator
- Combined sewer overflow (CSO) regulator
- An interceptor sewer from the CSO regulator to the planned WWTP
- Overflow sewers from the CSO regulator to the existing outfall

The schematic illustration of the interceptor system is shown in *Figure II.4.2.*

4.3 PROPOSED INTERCEPTOR SYSTEM

4.3.1 DESIGN FLOW ESTIMATION

(1) Design Flow of the CP and the TA Sewer Lines

As the planning basis, the hourly maximum flow of sanitary wastewater generated in Braila City is estimated at 1,621 l/s. It is assumed that the proportion of discharging flow from each outfall is constant. As a result, the design flows of the CP and the TA lines are estimated as follows.

- Hourly maximum flow of the CP line: 217 l/s
- Hourly maximum flow of the TA line: 43 l/s

(2) Design Flow of Storm Water

In the previous feasibility study by Braila City, total maximum hourly wastewater and storm water flow of the GE and the Rosiori lines was estimated at 20 m^3/s. As mentioned in the previous chapter, hourly maximum flow of sanitary wastewater generated in Braila City is estimated at 1.62 m^3/s. From these values, the hourly maximum storm water flow is obtained to be 18.38 m^3/s.

For the review purpose, the hourly maximum storm water flow was roughly estimated as shown in *Table II.4.3.*

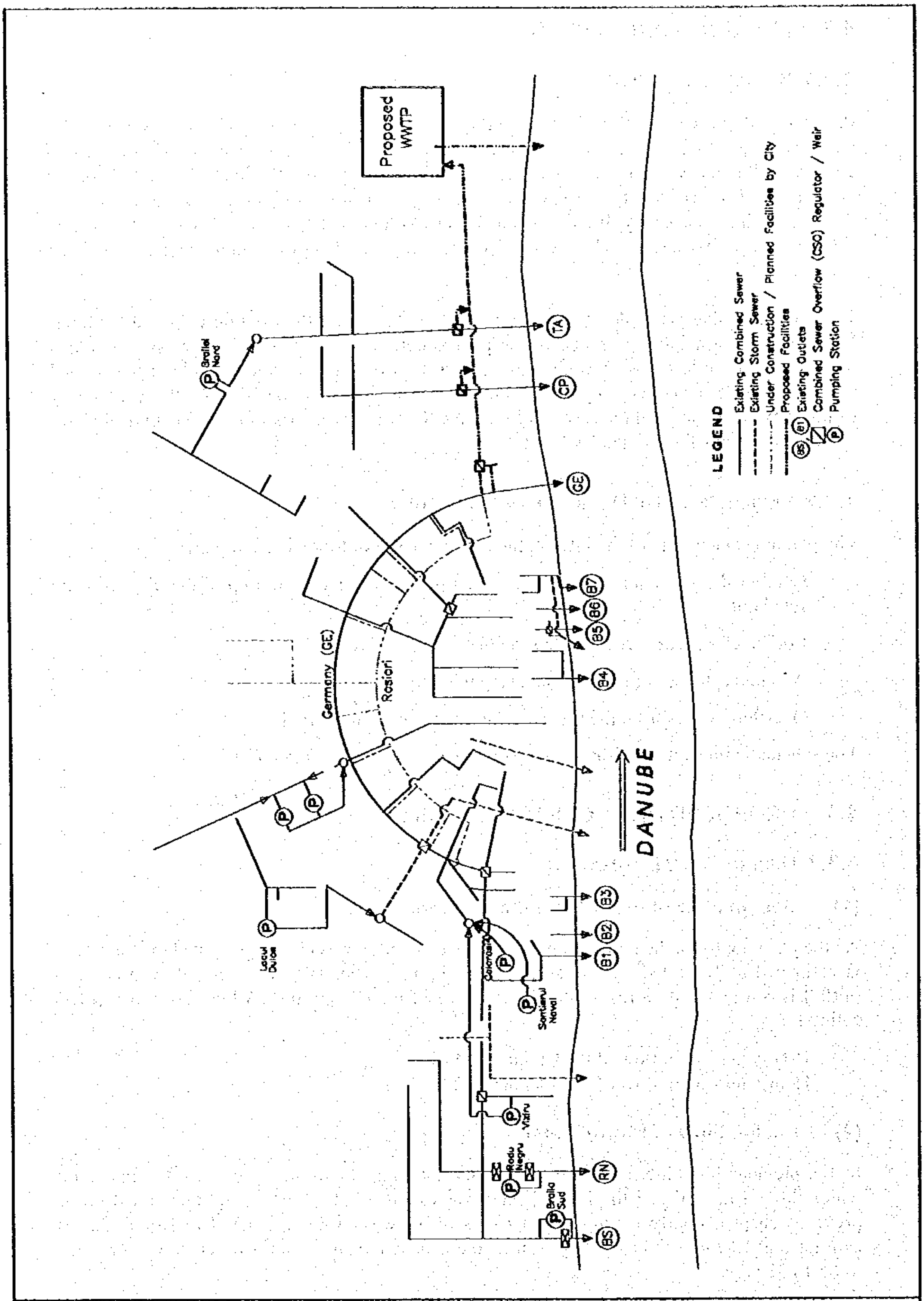

Figure II.4.2	Schematic Illustration of Interceptor System

Table II.4.3 Estimation of Hourly Maximum Storm Water Flow

Item	Value	Remarks
Drainage basin of Germany-Rosiori sewer (A)	550 ha	
Run off Coefficient (C)	0.35	
Inlet time (T1)	10 minutes	
Time of flow (T2)	92 minutes	Sewer length is 5,500 km and flow velocity is estimated to be 1 m/s.
Concentration time (T) =T1 + T2	102 minutes	
Rain fall strength (I)	42 mm/hour	Estimated assuming that Braila is of the area IV in Romania Standards, and 2-year return period of rainfall intensity.
Flow rate (A)	18.0 m^3/s	Q=1/360 x C x I x A x 0.8 The factor 0.8 is a storage factor in the sewer under the Romanian Standards.

The result shows that the estimated values in the previous feasibility study and in the Study are compatible. Therefore, the total maximum hourly wastewater and storm water flow of the GE and the Rosiori lines is estimated at 20 m^3/s.

4.3.2 PROPOSED FACILITIES

The optimal plan of the interceptor sewer from the end point of the GE to the proposed WWTP was prepared based on an alternative study of the following two (2) cases.

Table II.4.4 Alternative Cases of Interceptor Sewer

Case	Pump location	Type of sewer	Advantages	Disadvantages
Alternative-1	Near CSO regulator	Pressurized	Sewer depth is shallower.	Sewer material is expensive. High pumping head.
Alternative-2	In WWTP	Gravitaty	Operation of pumping station is easier as it is in WWTP.	Sewer depth is deeper.

As the result of the cost estimates, the Alternative-2 was more economical than the Alternative-1. Therefore, the Alternative-2 is selected.

Planned facilities consist of interceptor sewers, combined sewer overflow (CSO) regulators, connection sewers, manholes, and valves, as shown in *Figure II.4.3*. Major features of the facilities are summarized in *Table II.4.5*.

(1) Interceptor Sewers

The proposed combined sewer main, interceptor sewer and overflow sewer are as follows,

- Combined sewer main of 3,400 mm diameter, 114 m long, and earth covering of 1-3 m, from the existing junction manhole of the GE and the Rosiori to the planned CSO regulator.
- Interceptor sewer of 1,650 mm diameter, 2,740 m long, and earth covering of 1-7 m (mostly 1-5 m), from the CSO regulator to the planned WWTP.
- Overflow sewer of 3,400 mm diameter, 83 m long, and earth covering of 1-3 m, from the CSO regulator to the two existing outfalls.

The route of the planned sewer of 3,400 mm diameter will cross the existing railway over 15 m. The sewer will be constructed by open-cut method. The open-cut method will also be applied for sewers crossing the railway, but particular measures will be applied to protect the railway.

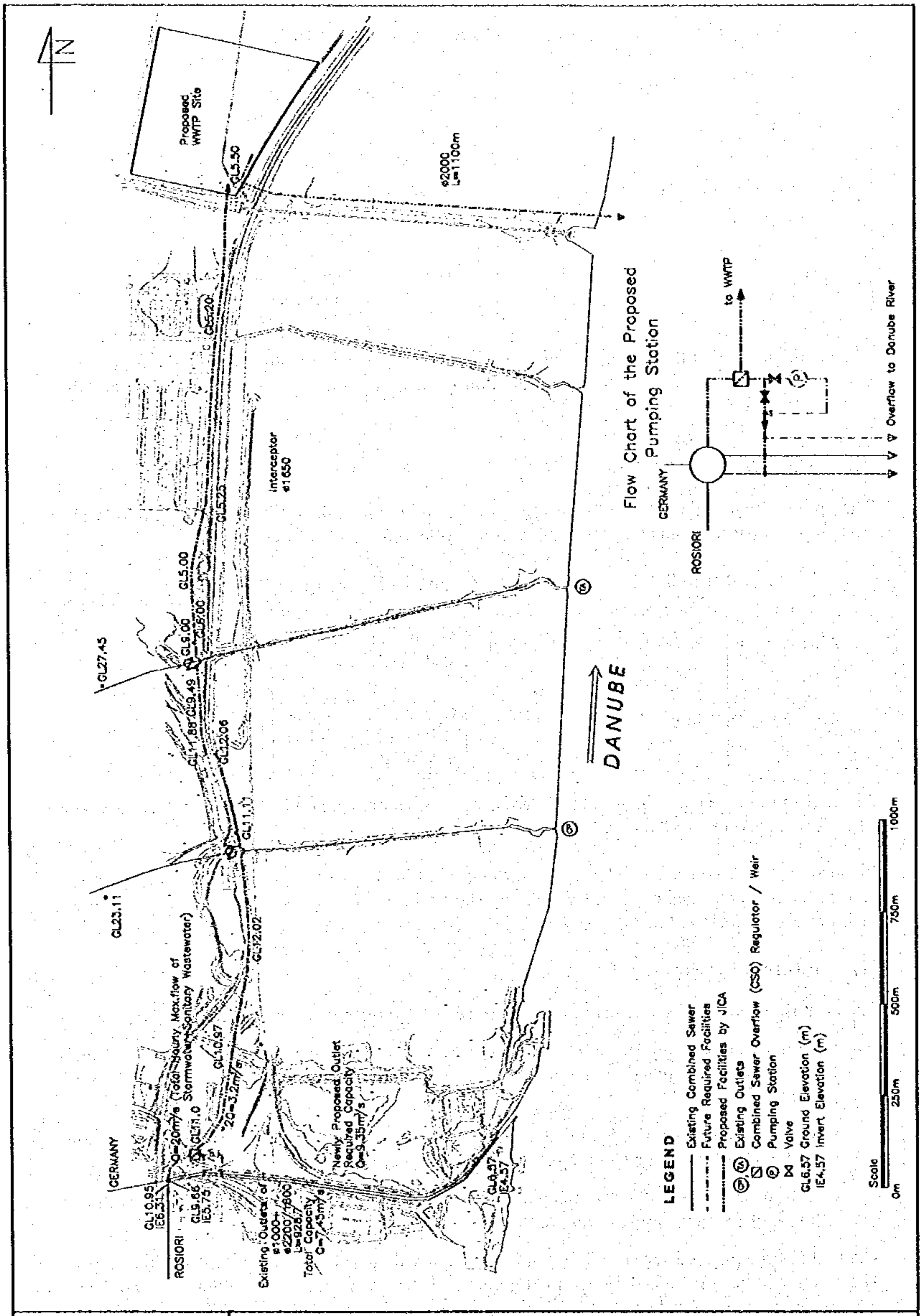

Figure II.4.3	Proposed Interceptor System of Braila City

(2) CSO Regulators

CSO regulators will be installed at the existing outfall sewers to transfer up to 2Q of wastewater to the interceptor sewer through the connection sewers. The CSO regulators overflow the excess wastewater from weirs, and discharge it to the existing outfalls.

Two (2) different sizes of CSO regulators, large type and small type, are applied in this study. They are differentiated with overflow rates, size of the combined sewers, and head of weir.

Totally three (3) units of CSO regulators will be installed, consisting of one (1) unit of large type CSO regulator for the Germany and two (2) units of small type CSO regulators for the CP and the TA.

(3) Connection Sewers

The connection sewer is to carry 2Q of wastewater from the CSO regulator to the interceptor sewer. Length of connection sewers are 20 m and 40 m for the CP and the TA, respectively, both with the earth coverage of 1-3 m. Totally two connection sewers will be installed.

(4) Manholes

Manholes are generally installed along the interceptor sewer generally at intervals of 200 m. These are also installed at the junctions of the sewers and roads. Totally 22 units of manholes will be installed along the interceptor sewer.

(5) Valves

Two valves are to be installed along the overflow sewer. One is for the future connection of the overflow pumping station, and the other is for its flow control.

Table II.4.5 Proposed Facilities of Interceptor System of Braila City

1. Interceptor Sewer

Diameter (mm)	Length by earth covering (m)				Total length (m)	Remarks
	1-3 m	3-5 m	5-7 m	7-9 m		
1650	1256	1210	234		2700	
1650	40				40	Inverted siphon
3400	182				182	
3400	15				15	Under railway

2. CSO Regulator

Type	Quantity
Small Type	2
Large Type	1

3. Connection Sewer

Diameter (mm)	Length (m)	Earth covering (m)
300	20	1-3
600	40	1-3

4. Manhole

Diameter (mm)	Quantity by earth covering				Total
	1-3 m	3-5 m	5-7 m	7-9 m	
1000	1				1
1650	7	8	3		18
2200	1				1
3400	2				2

5. Valve

Diameter (mm)	Quantity	Earth covering (m)
3400	2	1-3