3 DESIGN FLOW

3.1 METHODOLOGY

The sewerage system of the Galati city is combined, thus the collectors installed in the city convey both wastewater and storm-water and finally discharge to the Danube River. The wastewater will be intercepted and conveyed by new interceptors and finally treated at wastewater treatment plants.

To make a design of the required interceptors and wastewater treatment plants, it is necessary to determine the wastewater flows at dry weather conditions and the intercepted flows at wet weather conditions. The intercepted flow is generally determined two to five times as large as maximum hourly flow at dry weather conditions. Thus, in the following discussion, the flows at dry weather conditions are studied and determined for the necessary sewerage facilities such as interceptors, pumping stations and wastewater treatment plants.

As the design wastewater flows at dry weather conditions, the following flows are determined: Average Daily Flow, Maximum Daily Flow, and Maximum Hourly Flow.

The Average Daily Flow will be used as the basis for the estimation of pollutant loads, sludge volume generation, and O/M requirements. The Maximum Daily Flow will be used for the design of wastewater treatment facilities. The Maximum Hourly Flow will be used for the design of interceptors and pipes and channels in wastewater treatment plant.

To estimate a present wastewater generation and to determine the design flows, the following Romanian Standards are used in principle: STAS 1343 (Water Supply – Determination of water supply volumes) and STAS 1846-90 (Sewerage – Calculation of the wastewater flow).

In the course of estimating the present wastewater generation, the water supply volume is also estimated. The estimated water supply volume will be compared with the present water supply data available. In addition, the estimated present pollution loads will be checked by information available.

3.2 DOMESTIC, COMMERCIAL AND INSTITUTIONAL WASTEWATER

3.2.1 WASTEWATER GENERATION

Table AII.1.2 shows a summary of the estimated present domestic, commercial and institutional wastewater generation by a method followed by the Romania standards. The consumers of category 3, 4, and 5 have access to the public sewerage system. The total wastewater generation is estimated about 119,600 m^3/d, and the amount of 118,800 m^3/d is collected by the public sewerage system, i.e. about 99% of the wastewater generated are collected by the existing sewerage system. The wastewater generation is calculated as 80% of water demand at

water source (intake volume). Table AII.1.2 also shows that the ratio of water consumption to wastewater generation is about 100 : 97.

The estimated water requirements at water sources and the estimated water consumption are compared with the data of water intake volume and water consumption provided by the APATERM. It indicates the same magnitude for each figure as shown in the Table AII.1.3.

The per capita water consumption for domestic, commercial and institutional purposes in the standards is reviewed briefly in the followings:

The per capita water consumption for each category already contains domestic, commercial and institutional water consumption as shown in Table AII.1.4. The domestic water consumption looks reasonable as the design basis. A ratio of commercial and institutional water consumption to domestic water consumption is set about 21% to 40% for consumers of house connections. The ratio seems to be reasonable for the development level in the urban area of the city. The standards also give some allowance to add some commercial and institutional water consumption up to 15 or 25% depending on local conditions and population size of municipalities.

- up to 15% for cities ranging in population from 300,000 to 1,000,000

- up to 25% for cities having the population more than 1,000,000

3.2.2 Wastewater to be Collected by Sewerage System

Table AII.1.5 shows the average flows of domestic, commercial and institutional wastewater to be generated and to be collected by the public sewerage system in the year 2010. For a comparison, the flows of wastewater estimated in the 1992 Pre F/S are also presented in the table.

The maximum daily flow and the maximum hourly flow of the domestic, commercial and institutional wastewater are calculated with using the coefficients set forth in the Romanian Standard (STAS 1343/1) as follows. The results of calculation are summarized in *Table AII.1.6.*

3.3 Industrial Wastewater

3.3.1 Present Conditions

Totally 51 manufactures and companies are discharging wastewater to the Danube River through combined sewer collectors after pre-treatment. These manufactures are subject to the periodical wastewater quality monitoring. *Table AII.1.7* shows a list of the manufactures and companies.

According to the data provided by SC APATERM SA, the total industrial wastewater discharged through the collectors was 12,068,000 m^3 in 1998; in which amount of 9,683,652 m^3 originated from the companies discharging the wastewater more than 1,000 m^3/year, and more in detail discharges from the listed manufactures and companies are 3,704,858 m^3/year and others are

5,978,794 m^3/year. The remained 2,384,343 m^3 is originated from manufactures discharging less than 1,000 m^3 per year. When it is assumed that the operation days are from 250 to 365 days a year, the industrial wastewater flow as daily basis are in the range shown below. (In the following discussion, the flows estimated based on the operation days of 300 days a year is used as the average flows of each category.) The mentioned above is summarized in *Table AII.1.8*. It shows that the total discharge of 3,704,858 m^3/year (10,150 to 14,820 m^3/d) originates from the listed manufactures and companies, which covers about 38% of the total discharge of 9,683,652 m^3/year.

A result of questionnaire survey for major manufactures and companies conducted by JICA Study Team, in which about 30 companies replied to the questionnaire, is also presented in *Table AII.1.7.* It indicates that the total discharge from major companies is about 14,100 m^3/d having the same magnitude as the average flow of 12,350 m^3/d shown in *Table AII.1.8*.

3.3.2 WASTEWATER TO BE RECEIVED BY THE SEWERAGE SYSTEM

The wastewater discharged from the listed manufactures and companies are referred as "point-source" and others are referred as "non-point source" in the following discussion.

In *Table AII.1.9*, an average design flow of industrial wastewater is proposed for this F/S. The present average flows are presented for comparison. The table also shows the design flows set in 1992 Pre F/S. But it should be noted that the 1992 Pre F/S provides the maximum daily flow and the maximum hourly flow only.

The proposed design average flows of industrial wastewater are determined to add some allowance for future development to the present flows. The flow of point sources is set at 1.3 times as high as the present one, and the flow of non-point sources is set at 2.5 times as high as the present one. In total, the flow is set at 1.5 times as high as the present industrial wastewater.

The design flows of industrial wastewater are proposed taking into account flow variations. Since the industrial wastewater is generated from small to medium size manufactures and companies, the flow variation coefficients are set considering scale of industry as shown in *Table AII.1.10*.

The design flows of maximum daily and maximum hourly flows are calculated using the above flow variation coefficients and the calculation results are summarized in the *Table AII.1.11*.

3.4 SUMMARY OF DESIGN WASTEWATER FLOW

The design flows of domestic, commercial, institutional and industrial wastewater is combined and summarized in the table below. In conclusion, JICA Study Team proposes the following design flows for the F/S study on Galati WWTP as shown in *Table AII.1.12*. The figures in the table are rounded at thousands. These figures are used to the preliminary design of the necessary sewerage facilities such as interceptors, pumping stations and wastewater treatment plants.

Table AII.1.13 shows the design flows proposed for JICA Study to compare with those of 1992 Pre F/S. It shows that the maximum hourly flow and the wet weather flow proposed are approximately equal to the flows proposed in 1992 Pre F/S.

4 WASTEWATER CHARACTERISTICS

4.1 PRESENT WASTEWATER CHARACTERISTICS

Table AII.1.14 shows the average wastewater quality monitored at each collector. The concentration of BOD_5 and SS ranges from 18 to 47 mg/L and 54 to 109 mg/L, respectively. It indicates the wastewater is weak.

A wastewater quality survey was conducted by JICA Study Team during February to March in 1999. The samples were taken at two sites: one is the outfall of Micro 21 and another one is the outfall of SP 13 Iunie. The resulted four water quality items: BOD_5, SS, T-N, and T-P are presented in *Table AII.1.15* and *FiguresAII.1.2* and *AII.1.3*. Those concentrations are varied as shown in the figures, a weighed average concentration for each parameter was calculated and presented in *Table AII.1.15*. The results have the same magnitude as those in *Table AII.1.14*. Because residential area is the predominant in the service area of the Micro 21 and any factories are not identified in the area, the samples are typical examples of domestic wastewater. While in the service area of SP 13 Iunie, there are flats, offices, restaurants, and factories (seven companies are shown in *Table AII.1.7)*, thus the wastewater is a mixture of domestic, commercial, institutional and industrial wastewater.

The pollutant loads discharged to the Danube from each outfall were estimated and summarized in *Table AII.1.16*.

As the wastewater measured at the Micro 21 is domestic origin, the estimated pollutant loads are used to calculate the per capita unit pollutant loads. The per capita unit loads are calculated as shown in *Table AII.1.17*. It indicates the per capita wastewater generation is only 112 L/capita/day (lpcd) and the unit loads are as low as 8 g/capita/d as of BOD_5 and 9g/capita/d as of SS.

4.1.2 INDUSTRIAL WASTEWATER

Table AII.1.18 shows industrial wastewater characteristics measured for 51 manufacturers and companies in 1998. The quality data of BOD_5 and SS were mainly obtained from SC APATERM SA, combined with the information obtained through a questionnaire survey conducted by JICA Study Team with cooperation of SC APATERM SA.

Based on the information in Table AII.1.18, the estimated overall average concentration of BOD_5 and SS is about 60 and 140 mg/L, respectively. But when the wastewater discharging from one factory, SC INTFOR SA, Metal Products industry, is eliminated from the estimation, the estimated average concentration of BOD_5 and SS is increased to about 130 and 190 mg/L, respectively.

4.2 DESIGN INFLUENT QUALITY

4.2.1 INTRODUCTION

Design wastewater quality is used as the basis for evaluation of effects of wastewater treatment as well as for making design of wastewater treatment facilities. For the design of wastewater treatment facilities, influent quality and treated quality shall be determined. The latter quality, treated water quality is regulated by the Romanian Effluent Standards, as shown in *Table AII.1.19*. The detailed discussion on the treated wastewater quality for the design will be conducted in other opportunities when we will discuss wastewater treatment methods and propose an appropriate wastewater treatment method.

4.2.2 REVIEW OF THE DESIGN INFLUENT QUALITY IN THE 1992 PRE F/S

In 1992 Pre F/S, the design influent quality is set at 115 mg/L as of BOD_5 and 400 mg/L as of SS. The design figure can be calculated as shown in *Table AII.1.20*. In the table, each influent quality for domestic and industrial wastewater is estimated by given information of loads (per capita loads and service population) and the design flows. The influent quality of domestic wastewater can be estimated: 170 mg/L as of BOD_5 and 196 mg/L as of SS. These figures show that the design domestic wastewater quality is set as a typical medium strength domestic wastewater. But it should be noted that the present domestic wastewater is weak as shown in *Table AII.1.14* and *Table AII.1.15*. While that of industrial wastewater is 44 mg/L as of BOD_5 and 649 mg/L as of SS, strong inorganic industry wastewater is planned to discharge to the sewerage system. The SS concentration is set as high as 649 mg/L, this value exceeds the maximum admissible value of 300 mg/L in Romanian Standards as shown *Table AII.1.21* set for receiving wastewater to public sewerage system. Unfortunately, there is no information available to know the background of the industrial wastewater quality and loads.

4.2.3 DESIGN INFLUENT QUALITY

In the followings, we will discuss the design influent quality, especially BOD_5, SS, T-N, and T-P. The design figures will be determined take into consideration the present wastewater concentrations, present pollutants loads, and future increments of pollutants loads, and data and information available from some references.

(1) Domestic, Commercial and Institutional Wastewater

As it is explained that the present domestic wastewater is weak as shown in *Tables AII.1.14, AII.1.15* and AII.1.*16*. The estimated per capita unit loads of domestic wastewater are low. The unit loads are calculated on the estimated service population. Therefore, in stead of the per capita loads, the average concentration of each quality parameters is used to estimate the equivalent per capita loads as shown in *Table AII.1.22*. But, it should be noted that the equivalent per capita loads can only be used for domestic wastewater.

The equivalent per capita loads are used to predict the future wastewater quality as shown in the following *Tables AII.1.23* through AII.1.*26*. In the table, the equivalent per capita loads shown in the above is used for the present domestic wastewater. It assumed that the per capita unit loads for commercial and institutional wastewater is 30% of the domestic one, and that the per capita units loads increase from 10% to 50% to the present level. The influent quality is estimated based on the service population of 377,000 and the average design flow of 138,000. The results of the calculation are presented in *Tables AII.1.23* through *AII.1.26*.

The following quality of domestic, commercial and institutional wastewater is used for the design of Galati WWTP. The quality is estimated under the assumption that the per capita loads will be increased about 30%.

(2) Industrial Wastewater

The listed 51 factories are categorized by their products as shown in *Table AII.1.28*. The present industrial wastewater discharges by product categories are summarized as shown in *Table AII.1.29*.

The share of each category for the target year is assumed to be the same as the present one, the design discharge flow to the sewerage system is set as shown in *Table AII.1.30*.

For the design purpose, the industrial wastewater quality discharged to the sewerage system is set by each category as shown in *Table AII.1.31*. The quality is determined taking into account the present quality data available, the maximum permissible quality set forth in the National Effluent Quality Standards for the Wastewater discharged to Public Sewerage Systems as shown in *Table AII.1.21*, and some references.

The maximum permissible concentrations of BOD_5 and SS are set at 300 mg/L as the same as the national effluent quality standards for the wastewater discharged to public sewerage systems as shown in *Table AII.1.20*. However, regarding the concentration of total nitrogen and total phosphorus, the national effluent standards are not applied. Because the national standards do not provide any maximum permissible concentration of total nitrogen but that of ammonium nitrogen of 30 mg/L and provide that of total phosphorus of 5.0 mg/L.

The design loads from the listed 51 companies are estimated as shown in *Table AII.1.32*; the design discharge flows multiplied with the concentrations. The total loads are divided by the total flow to get the average concentration. The results are BOD_5 of 187 mg/L, SS of 199 mg/L, T-N of 21 mg/L, and T-P of 6.6 mg/L.

The design quality of overall industrial wastewater is estimated as shown in *Table 33.* In the table, the design quality of industrial wastewater originated from non-listed factories in the point source as well as that from non-point source is assumed to be the same as the domestic, commercial and institutional wastewater, i.e. BOD_5 of 120 mg/L, SS of 140 mg/L, T-N of 21 mg/L, and T-P of 2.8 mg/L. The design quality of overall industrial wastewater is estimated as follows: BOD_5 of 140 mg/L, SS of 157 mg/L, T-N of 21 mg/L, and T-P of 3.9 mg/L.

Combine the design quality of domestic, commercial, and institutional wastewater shown in *Table AII.1.27* with that of industrial wastewater discharged to the public sewerage system shown in *Table AII.1.33*, the overall influent quality to the wastewater treatment plant is estimated as shown in *Table AII.1.34*.

Consequently, the design influent quality is 130 mg/L in BOD5, 150 mg/L in SS, 20 mg/L in T-N, and 3 mg/L in T-P.

Table AII.1.1 Service Population by the Public Water Supply and Sewerage Systems

Category (Norm)	Per Capita Water Consumption (lpcd)	Present Service Pop. (as of June 25, 1999)	Service Pop. in the year 2010 (1992 Pre F/S)	Service Pop. In the year 2010 (Proposed)	Remarks
1	65	95	6,500	0	
2	110	7,443	6,500	5,000	
3*	170	0	0	0	
4*	295	20,967	0	8,000	
5*	380	307,128	369,000	369,000	
Water Supply		335,633	382,000	382,000	
Sewerage		328,095	369,000	377,000	

Note: * indicates the category includes sewerage services

Table AII.1.2 Present Wastewater Generation except Industrial Wastewater (Estimated)

Category (Norm)	Per Capita Water Consumption (lpcd)	Present Service Population (June 25, '99)	Water Consumption (m^3/d)	Water Demand at Source ** (m^3/d)	Wastewater Generation *** (m^3/d)
1	65	95	6	7	6
2	110	7,443	819	989	791
3*)	170	0	0	0	0
4*)	295	20,967	6,185	7,471	5,977
5*)	380	307,128	116,709	140,984	112,787
Total		335,633	123,719	149,451	119,561
Sewerage		328,095	122,894	148,455	118,764

Note: * : the category includes sewerage services
** : Water Demand at Source = Kp x Ks x Water Consumption
where, Ks=1.05, Kp=1.15, Kp x Ks=1.208
*** : Wastewater Generation = Kw x Water Demand at Source,
where Kw=0.8

Table AII.1.3 Water Supply Conditions in 1998

	Annual Volume (m^3/year)	Daily Volume (365 days) (m^3/d)	Estimated Daily Volume in Table AII.1.2 (m^3/d)	Remarks
Water Intake Volume				
Public Water Supply	61,066,000	167,300	149,450	
Industrial Water Supply	11,632,000	31,870		
Total	72,698,000	199,170		
Water Consumption *				
Public Water Supply	47,403,407	129,870	123,720	
Industrial Water Supply	9,040,689	24,770		
Total	56,444,096	154,640		

Note: * including estimation

Table AII.1.4 Per Capita Consumption of Domestic, Public and Commercial Water (STAS 1343)

Category No.	Classification	Domestic Consumption q_g (lpcd)	Public and Commercial Consumption q_p (lpcd)	Total q (lpcd)	q_p to q_g Ratio
1	Water distributed through street taps	40	25	65	0.625
2	Water distributed through yard taps	80	30	110	0.375
3	Houses with plumbing and sewer pipes	140	30	170	0.214
4	Houses with plumbing and sewers, with in-house water heating system	210	85	295	0.405
5	Houses with plumbing and sewers, with provisions of central water heating	280	100	380	0.357

Note: The value of q_p can be increased depending local conditions, but not exceeds the followings by the size of the city;

Table AII.1.5 Average Daily Flow of Wastewater in the year 2010

Category (Norm)	Per Capita Water Demand (lpcd)	Service Population in 1992 Pre F/S	Average Flow in 1992 Pre F/S (m³/d)	Service Population (JICA Study Team)	Average Design Flow (JICA Study Team) (m³/d)
1	65	6,500	380	0	0
2	110	6,500	650	5,000	530
3*	170	0	0	0	0
4*	295	0	0	8,000	2,280
5*	380	369,000	125,860	369,000	135,510
Total Generation		382,000	126,890	382,000	138,320
Sewerage		369,000	125,860	377,000	137,790

Note: * indicates the category includes sewerage services

Table AII.1.6 Design Flows for the Domestic, Commercial and Institutional Wastewaters

Wastewater Flow	Design Flow : JICA Study (m³/d)	(L/s)	Coefficient (STAS 1343/1)	1992 Pre F/S (L/s)
Average Daily Flow	137,790	1,595	-	1,457
Maximum Daily Flow	151,680	1,755	1.10 to 1.15 *	1,675
Maximum Hourly Flow	174,550	2,020	1.15	1,928

Note: * indicates that the coefficient for category 4 is 1.15 and that for category 5 is 1.10.

Table AII.1.7 Major Manufactures and Companies Discharging Wastewater to Sewerage

Database No	Factory name	Annex No.	Outfall ID No.	Wastewater Flow (1998) yearly	daily (/365)	daily(/250)	daily(/300)	Questionnaire Flow(m3/d)	Additional Inf. Flow(m3/d)
3	SI COCA COLA SA	20	3	84,843	232	339	283		179
8	SC GALACTA SA	6	3	443,481	1,215	1,774	1,478	400	
11	SC INTERTRANS SA	11	3	18,624	51	74	62	26	
12	SC MPG SA - Atelier 1	8	3	included	-	-	-	-	
13	SC MPG SA - Atelier 2	8	3	included	-	-	-	-	
16	SC MPG SA - DUNAREA	42	3	included	-	-	-	-	
18	SC MEHID SA	16	3	89,304	245	357	298	300	
22	SC TRANSURB SA - Depoul 1	18	3	6,396	18	26	21	250	
23	SC TRANSURB SA - Depoul 2	10	3	6,396	18	26	21	-	
27	SC TREFO SA	17	3	172,708	473	691	576	397	
28	SC TRANSGAL SA - ARA	12	3	4,746	13	19	16	12	
39	SC BERIN PROD SRL	27	3	303	1	1	1		15
41	SC CONNICOL SRL	26	3	N.A.	-	-	-		6
42	SC AUTOMECANICA SA	24	3	5,244	14	21	17		22
43	SC CALIN MERY SRL	19	3	N.A.	-	-	-	7	
44	SC SALBERO SRL - Abator	21	3	included	-	-	-	54	
45	SC REPCOM SRL	28	3	840	2	3	3		40
46	SC TIFAREX EXIM AS SRL	47	3	N.A.	-	-	-		1
47	SC SALT SRL	48	3	6,985	19	28	23	16	
49	SC GAMA SA	14	3	13,317	36	53	44		
50	SIDEX - Micro 18	50	3	882,252	2,417	3,529	2,941		
51	SC AVICOLA SA	37	3	3,600	10	14	12		
2	SC COMBAVIPOR SA (FNC)	13	3	9,555	26	38	32	22	
17	SC MARTENS SA (ROBEER)	9	3	585,436	1,604	2,342	1,951		1,154
30	SC Vinificatie Bauturi SA - Depozitare	7	3	792	2	3	3	150	
31	SC Vinificatie Bauturi SA - Imbuteliere	7	3		0	0	0	-	
34	SC CONER PRODUCT SRL	44	3	1,450	4	6	5	4	
38	SC IATSA SA	22	3	3,702	10	15	12		12
	OUTFALL NO.3 (POPASUL DE LA DUNARE)		3	2,339,974	6,410	9,359	7,799	1,638	1,429
20	SC Piase Pescaresti SA	25	4	14,241	39	57	47	0	
	OUTFALL NO.4 (LIBERTATEA)		4	14,241	39	57	47	0	0
1	SC APOLLO SA	1	5	76,950	211	308	257	239	
9	SC GALFIRTEX SA	3	5	99,516	273	398	332	251	
15	SC MPG SA - RADU NEGRU	4	5	74,258	203	297	248	364	
26	SC SF TEX SA	5	5	10,881	30	44	36		29
24	SC SALBERO SRL	15	5	26,412	72	106	88	28	
35	SC RAZBOIENI SRL	45	5	590	2	2	2		12
36	SC ROMCOMET SA	46	5	8,400	23	34	28	27	
48	SC FIROMEX SA	49	5	59,100	162	236	197	99	
5	SC FAM SA - sector 2	33	5	included	-	-	-		217
	OUTFALL NO.5 (VALURILE DUNARII)		5	356,107	976	1,425	1,188	1,008	258
4	Depoul CFR	41	6	37,044	101	148	123	200	
14	SC MPG SA - DUNAREANA	38	6	included	-	-	-	-	
21	SC PRUTUL SA	39	6	350,400	960	1,402	1,168	2,000	
32	SC INTFOR SA	31	6	387,600	1,062	1,550	1,292	7,820	
37	SC AUTOUNIVERSAL SRL	30	6	2,410	7	10	8		11
40	SC GEVAL STAR SRL	29	6	1,220	3	5	4		5
6	SC FAM SA - sector 1 and 3	2	6	63,021	173	252	210		123
	OUTFALL NO.6 (SP 13 IUNIE)		6	841,695	2,306	3,367	2,805	10,020	139
7	SC ELNAV SA	34	7	20,736	57	83	69	78	
10	SC HORTIGAL SA	32	7	2,523	7	10	8	0	
19	SC MENAROM SA	40	7	29,536	81	118	93	245	
25	SC Santier Naval - Galati SA	36	7	5,313	15	21	18	1,094	
29	SC TRANSCOM SA	35	7	92,400	253	370	308	6	
33	SC PETROM SA PECO	43	7	2,333	6	9	8	5	
	OUTFALL NO.7 (SP13)		7	152,841	419	611	509	1,428	0
	Total			3,704,858	10,150	14,819	12,348	14,094	1,826

Table AII.1.8 Industrial Wastewater Discharge through the Existing Collectors

Discharge volume	Annual Discharge (m^3/year)	Daily Discharge Range (m^3/d)	Average Daily (m^3/d)
More than 1,000 m^3/year	9,683,652	26,530 - 38,735	32,280
Listed companies	3,704,858	10,150 - 14,820	12,350
Non-listed	5,978,794	16,380 - 23,915	19,930
Less than 1,000 m^3/year	2,384,343	6,530 - 9,535	7,950
Total	12,068,000	33,060 - 48,270	40,230

Note: data source: APATERM

Table AII.1.9 Summary of Industrial Wastewater Flow

Industrial Wastewater	Present (1998) Ave. Daily* (m^3/d)	In 2010 (1992 Pre F/S) Max. Daily and Max. Hourly (m^3/d)	In 2010 (JICA F/S) Ave. Daily (m^3/d)	Remarks
Point Source				
Listed	12,350		18,000	15,920 m^3/d**
Non-listed	19,930		24,000	
Sub-total	32,280	44,930	42,000	1.3 times higher than the present one
Non-point Source	7,950	72,570	20,000	2.5 times higher than the present one
Total	40,230	117,500	62,000	1.5 times higher than the present one

Note: * shows that the figure is based on the assumptions that the operation days of the listed manufactures and companies are 300 days a year.

** shows that the figure is based on the results of questionnaire surveys and additional information

Table AII.1.10 Flow variation factors set for industrial wastewater

Industrial Wastewater source	Average Daily	Maximum Daily	Maximum Hourly	Remarks
Point Source	0.75	1.00	1.25	Medium to small scale
Non-point Source	0.75	1.00	1.50	Small scale

Table AII.1.11 Summary of Design Flow of Industrial Wastewater

Industrial Wastewater	Ave. Daily (m^3/d)	Max. Daily (m^3/d)	Max. Hourly (m^3/d)	Remarks
Point Source				
Listed	18,000	24,000	30,000	0.75:1.00:1.25
Non-listed	24,000	32,000	40,000	-ditto-
Sub-total	42,000	56,000	70,000	
Non-point Source	20,000	26,700	40,000	0.75:1.00:1.25
Total	62,000	82,700	110,000	

Table AII.1.12 The Design Flow for JICA F/S — unit: m^3/d

Wastewater	Average Daily	Maximum Daily	Maximum Hourly	Wet Weather	Remarks
Domestic, commercial and Institutional Wastes	138,000	152,000	175,000		
Industrial Wastes					
Point Source	42,000	56,000	70,000		
Listed Fact.	18,000	24,000	30,000		
Non-listed	24,000	32,000	40,000		
Non-point Source	20,000	27,000	40,000		
Sub-total	62,000	83,000	110,000		
Total	200,000 (2,320 L/s)	235,000 (2,720 L/s)	285,000 (3,300 L/s)	570,000 (6,600 L/s)	

Note: The figures are rounded.

Table AII.1.13 Comparison of Design Flows

Design Flows	This Study		1992 Pre F/S		Remarks
	(m^3/d)	(L/s)	(m^3/d)	(L/s)	
Average Daily	200,000	2,320	N.A.	N.A.	
Maximum Daily	235,000	2,720	(263,520)	3,050	
Maximum Hourly	285,000	3,300	(285,120)	3,300	
Wet Weather	570,000	6,600		6,600	

Note: The design flows proposed in the 1992 Pre F/S are expressed as Liter per second (L/s).

Table AII.1.14 Quality of Wastewater Discharged by each Collector (1998)

ID No.	Name of Collector	Number of Samples	BOD_5 (mg/L)	SS (mg/L)	Remarks
1	Micro 21	36	47	109	
3	Popasul de la Dunare	37	39	88	
4	Libertatea	37	33	79	
5	Valurile Dunarii	37	36	83	
6	SP 13 Iunie	41	29	86	
7	SP3	34	18	54	

Note: Data was obtained from SC APATERM SA

Table AII.1.15 Results of Wastewater Quality Surveys (24 hours, one sample every 3 hours)

Parameters	Micro 21		SP 13 Iunie		Remarks
	Range	Weighted Average	Range	Weighted Average	
BOD_5 conc. (mg/L)	19 - 164	71	30 - 70	49	*47, 29
SS conc. (mg/L)	35 - 132	83	99 - 172	145	*109, 86
T-N conc. (mg/L)	5.3 - 19.2	11.7	6.1 - 12.8	9.9	
T-P conc. (mg/L)	0.31 - 3.93	1.56	0.53 - 1.32	0.93	

Note: * the average concentration of BOD_5 and SS shown in *Table 13* is presented.

Table AII.1.16 Estimated Pollutant Loads based on Wastewater Quantity and Quality Surveys

Sampling Location	Average Flow (m^3/d)	Weighted Average Concentration (mg/L)				Pollutant Loads (kg/d)				Remarks
		BOD_5	SS	T-N	T-P	BOD_5	SS	T-N	T-P	
Micro 21	1,344	71	83	11.7	1.56	95	112	15.7	2.10	
SP 13 Iunie	96,096	49	145	9.9	0.93	4,709	13,934	951.4	89.37	

Table AII.1.17 Estimated Per Capita Unit Loads and Generation Rate of Domestic Wastewater

	Micro 21	Remarks
Average Flow (m3/d)	1,344	
Service Population *	12,000	
Per Capita Wastewater Generation (lcd)	112	
Loads (kg/d)		
BOD_5	95	
SS	112	
Total Nitrogen (T-N)	15.7	
Total Phosphorus (T-P)	2.1	
Per Capita Unit Loads (g/capita/d)		
BOD_5	8	
SS	9	
Total Nitrogen (T-N)	1.3	
Total Phosphorus (T-P)	0.18	

Note: * shows that the service population is based on the information provided by SC APATERM SA

Table AII.1.18 Estimation of Industrial Wastewater Quality

(The average concentration is mainly based on the data obtained in 1998, the source: APATERM)

Database No	Factory name	Average concentration (mg/l) BOD$_5$	Average concentration (mg/l) SS	Flow (m^3/day)	Load BOD$_5$ (kg/day)	Load SS (kg/day)
1	SC APOLLO SA	734		239	175.4	
2	SC COMBAVIPOR SA	39	110	22	0.9	2.4
3	SI COCA COLA SA	133	87	179	23.8	15.6
4	Depoul CFR	65	81	200	13.0	16.2
5	SC FAM SA - sector 1	17		217	3.7	
6	SC FAM SA - sector 2	27		28	0.8	
5	SC FAM SA - sector 3			95		
7	SC ELNAV SA	19	61	78	1.5	4.8
8	SC GALACTA SA	204		400	81.6	
9	SC GALFIRTEX SA	123	152	251	30.9	38.2
10	SC HORTIGAL SA	35	120	0	0.0	0.0
11	SC INTERTRANS SA		138	26		3.6
12	SC MPG SA - Atelier 1	55	244			
13	SC MPG SA - Atelier 2	59	112			
14	SC MPG SA - DUNAREANA	249	115	364	32.7	49.2
15	SC MPG SA - RADU NEGRU	19	80			
16	SC MPG SA - DUNAREA	67	125			
17	SC MARTENS SA	200	470	1154	230.8	542.4
18	SC MEHID SA	79	156	300	23.7	46.8
19	SC MENAROM SA		65	245		15.9
20	SC Plase Pescaresti SA	54	147	0	0.0	0.0
21	SC PRUTUL SA	43	132	2000	86.0	264.0
22	SC TRANSURB SA - Depoul 1		111	250		36.1
23	SC TRANSURB SA - Depoul 2		178			
24	SC SALBERO SRL	109	161	28	3.1	4.5
25	SC Santier Naval - Galati SA		134	1094		146.6
26	SC SF TEX SA	31	135	29	0.9	3.9
27	SC TREFO SA		61	397		24.2
28	SC TRANSGAL SA - ARA		137	12		1.6
29	SC TRANSCOM SA		113	6		0.7
30	SC Vinificatie Bauturi SA - Depozitare	321	249	150	48.2	37.4
31	SC Vinificatie Bauturi SA - Imbuteliere	321	249			
32	SC INTFOR SA	8	88	7820	62.6	688.2
33	SC PETROM SA PECO	35	83	5	0.2	0.4
34	SC CONER PRODUCT SRL	309	282	4	1.2	1.1
35	SC RAZBOIENI SRL	409	144	12	4.9	1.7
36	SC ROMCOMET SA	24		27	0.6	
37	SC AUTOUNIVERSAL SRL		448	11		4.9
38	SC IATSA SA		116	12		1.4
39	SC BERIN PROD SRL		654	15		9.8
40	SC GEVAL STAR SRL		594	5		3.0
41	SC CONNICOL SRL		194	6		1.2
42	SC AUTOMECANICA SA		317	22		7.0
43	SC CALIN MERY SRL	104	182	7	0.7	1.3
44	SC SALBERO SRL - Abator	123	172	54	6.6	9.3
45	SC REPCOM SRL		543	40		21.7
46	SC TIFAREX EXIM AS SRL		261	1		0.3
47	SC SALT SRL	201	212	16	3.2	3.4
48	SC FIROMEX SA	69	276	99	6.8	27.3

TOTAL	Flow (m^3/day)
	15920
	Flow (l/s)
	184.3

			BOD$_5$ (kg/day)	SS (kg/day)
Flow (BOD$_5$)	(m^3/day)	13,683	843.7	
Flow (SS)	(m^3/day)	14,914		2,036.0

Excluding INTFO

Flow	BOD loads	SS loads
67.86	781.16	1347.81
82.11		

Flow (BOD$_5$)	(l/s)	158.37
Flow (SS)	(l/s)	172.62

Average concentration		Concentration
BOD$_5$ (mg/l)	61.66	133.23
SS (mg/l)	136.51	189.98

Table AII.1.19 Major Effluent Quality Standards to Public Receiving Water Bodies.

No.	Quality Parameters	Units	Max. Admissible	Methods of Analysis
A. Physical Parameter				
1.	Temperature	°C	30°C	-
B. Chemical Parameters				
2.	Hydrogen ion concentration (pH) For Danube River	Unit pH	6.5 – 8.5 6.5 – 9.0	STAS 8619/3-90
3.	Total Suspended Solids	mg/dm³	60.0	STAS 6953-81
4.	Biochemical Oxygen Demand (BOD_5)	mg/dm³	20.0	STAS 6560-82
5.	Chemical Oxygen Demand (COD-Mn)	mg/dm³	40.0	STAS 9887-74
6.	Chemical Oxygen Demand (COD-Cr)	mg/dm³	70.0	STAS 6954-82
7.	Ammonium Nitrogen (NH_4^+-N)	mg/dm³	2.0	STAS 8683-70
8.	Total Nitrogen (N)	mg/dm³	10.0	STAS 7312-83
9.	Nitrates (NO_3^-)	mg/dm³	25.0	STAS 8900/1-71
10.	Nitrites (NO_2^-)	mg/dm³	1.0	STAS 8900/2-71
11.	Sulfides (as H_2S)	mg/dm³	0.1	STAS 7510-66
12.	Sulphites (SO_3^{2-})	mg/dm³	1.0	STAS 7661-89
13.	Phenols (C_6H_5OH)	mg/dm³	0.05	STAS 7167-92
14.	Oil and Fats	mg/dm³	5.0	STAS 7587-66
16.	Phosphates (PO_4^{3-})	mg/dm³	4.0	STAS 10064-75
17.	Total phosphorus (P)	mg/dm³	1.0	STAS 10064-75
C. Bacteriological Parameters				
42.	Total coliform (MPN)	Nr/100 cm³	1 mil	STAS 3001-91
43.	Fecal coliform (MPN)	Nr/100 cm³	10,000	STAS 3001-91
44.	Fecal streptococci (MPN)	Nr/100 cm³	5,000	STAS 3001-91

Source: ORDER No. 730/1997, Norms for establishing the limits of pollutants in the wastewater before to be discharged into water resources, NTPA 001/1997

Table AII.1.20 The Design Influent Quality in the 1992 Pre F/S

Parameter	Wastewater	Per Capita Loads (g/capita/d)	Loads (kg/d)	Design Flow (m3/d)	Influent Quality (mg/L)	Remarks
BOD_5	Domestic**	65	*24,830	146,060	**170	
	Industrial	-	5,170	117,505	**44	
	Total		30,000	263,565	114	≒ 115
SS	Domestic**	75	*28,650	146,060	**196	
	Industrial	-	76,300	117,505	**649	
	Total		104,950	263,565	398	≒ 400

Note: * The domestic wastewater also includes commercial, institutional wastwaters.

** shows the figures which are calculated that the per capita loads multiplied with the sewerage service population of 38,200 in 2010.

*** shows the figures calculated that the loads are divided by the design flow.

Data: The 1992 Pre F/S Report prepared by PROED, on September 1992.

Table AII.1.21 Major Permissible Effluent Quality Standards for the Wastewater Discharged into Public Wastewater Systems

No.	Quality Parameter	Units	Permissible Values	Methods of Analysis
1.	Temperature	°C	40°C	-
2.	Hydrogen ion concentration (pH)	-	6.5 – 8.5	STAS 8619/3-90
3.	Suspended Solids	mg/dm^3	300	STAS 6953-81
4.	BOD_5	mg/dm^3	300	STAS 6560-82
5.	COD-Cr	mg/dm^3	500	STAS 6954-82
6.	Ammonium Nitrogen (NH_4^+-N)	mg/dm^3	30	STAS 8683-70
7.	Total Phosphorus (as P)	mg/dm^3	5.0	STAS 10064-75

Source: Norms regarding the discharge conditions of wastewater into sewerage, NTPA 002/1997

Table AII.1.22 Estimated Equivalent Per Capita Loads

Quality Parameter	Average Concent-ration* (mg/L)	Design Average Flow (m^3/d)	Pollutant Loads (kg/d)	Planned Service Population (-)	Equivalent Per Capita Loads (g/capita/d)	Remarks
BOD_5	71	138,000	9,798	377,000	26	
SS	83		11,454		30	
T-N	12		1,656		4.4	
T-P	1.6		220.8		0.6	

Note: * shows the data of Micro 21 as presented in *Table 14*.

Table AII.1.23 Estimated BOD_5 Concentration in Domestic, Commercial and Institutional Wastewater based on Per Capita Loads

Per Capita Loads (g/capita/d)			Loads**	Influent Quality**	Remarks
Domestic	Commercial and Institutional *	Total	(kg/d)	(mg/L)	
26.0	7.8	33.8	12,743	92	Present Level***
28.6	8.6	37.2	14,024	102	10% increase
31.2	9.4	40.6	15,306	110	20% increase
33.8	10.1	43.9	16,550	120	30% increase
36.4	10.9	47.3	17,832	129	40% increase
39.0	11.7	50.7	19,114	139	50% increase

Note: * : The per capita loads of commercial and institutional wastewater is assumed 30% of that of domestic wastewater

**: The planned service population is 377,000 and the design average flow is 138,000 m^3/d

***: Domestic Per Capita Load is at present level

Table AII.1.24 Estimated SS Concentration in Domestic, Commercial and Institutional Wastewater based on Per Capita Loads

Per Capita Loads (g/capita/d)			Loads**	Influent Quality**	Remarks
Domestic	Commercial and Institutional*	Total	(kg/d)	(mg/L)	
30.0	9.0	39.0	14,703	107	Present level***
33.0	9.9	42.9	16,173	117	10% increase
36.0	10.8	46.8	17,644	128	20% increase
39.0	11.7	50.7	19,114	139	30% increase
42.0	12.6	54.6	20,584	149	40% increase
45.0	13.5	58.5	22,055	160	50% increase

Note: * : The per capita loads of commercial and institutional wastewater is assumed 30% of that of domestic wastewater

**: The planned service population is 377,000 and the design average flow is 138,000 m^3/d

***: The Domestic Per Capita Load is at present level

Table AII.1.25 Estimated T-N Concentration in Domestic, Commercial and Institutional Wastewater based on Per Capita Loads

Per Capita Loads (g/capita/d)			Loads**	Influent Quality**	Remarks
Domestic	Commercial and Institutional*	Total	(kg/d)	(mg/L)	
4.5	1.4	5.9	2,224	16	Present level ***
5.0	1.5	6.5	2,451	18	10% increase
5.4	1.6	7.0	2,639	19	20% increase
5.9	1.8	7.7	2,903	21	30% increase
6.3	1.9	8.2	3,091	22	40% increase
6.8	2.0	8.8	3,318	24	50% increase

Note: * : The per capita loads of commercial and institutional wastewater is assumed 30% of that of domestic wastewater

**: The planned service population is 377,000 and the design average flow is 138,000 m^3/d

***: The Domestic Per Capita Load is at present level

Table AII.1.26 Estimated T-P Concentration in Domestic, Commercial and Institutional Wastewater based on Per Capita Loads

Per Capita Loads (g/capita/d)			Loads **	Influent Quality **	Remarks
Domestic	Commercial and Institutional *	Total	(kg/d)	(mg/L)	
0.60	0.18	0.78	294.1	2.1	Present level ***
0.66	0.20	0.86	324.2	2.3	10% increase
0.72	0.22	0.94	354.4	2.6	20% increase
0.78	0.23	1.01	380.8	2.8	30% increase
0.84	0.25	1.09	410.9	3.0	40% increase
0.90	0.27	1.17	441.1	3.2	50% increase

Note: * : The per capita loads of commercial and institutional wastewater is assumed 30% of that of domestic wastewater

**: The planned service population is 377,000 and the design average flow is 138,000 m^3/d

***: The Domestic Per Capita Load is at present level

Table AII.1.27 The Design Influent Quality of Domestic, Commercial, and Institutional Wastewater for the JICA F/S

Quality Parameter	Planned Service Population	Per Capita Loads (g/capita/d)	Loads (kg/d)	Design Average Flow (m^3/d)	Influent Quality (mg/L)	Remarks
BOD_5	377,000	44	16,588	138,000	120	
SS		51	19,227		140	
T-N		7.7	2,903		21	
T-P		1.01	381		2.8	

Note: The Domestic wastewater includes commercial and institutional wastewater.

Table AII.1.28 Major Industry classified by Product Category

Database No.	Factory name	Annex No.	Category	Outfall ID No.	Wastewater Flow yearly	daily (/300)	Share (%)	Wastewater Quality (mg/L) BOD_5	SS
24	SC SALBERO SRL	15	1211	5	26,412	88		109	161
54	SC CONER PRODUCT SRL	44	1211	3	1,450	5		309	282
55	SC RAZBOIENI SRL	45	1211	5	590	2		409	144
43	SC CALINMERY SRL	19	1211	3	N.A.	-		104	182
44	SC SALBERO SRL - Abator	21	1211	3	included	-		123	172
51	SC AVICOLA SA	37	1211	3	3,600	12			
	Sub-total				32,052	107	0.90%		
1	SC GALACTA SA	6	1212	3	443,431	1,478		204	N.A.
	Sub-total					1,478	12.00%		
47	SC SALT SRL	43	1224	3	6,955	23		201	212
	Sub-total					23	0.20%		
12	SC MPG SA - Abator 1	8	1271	3	included	-		55	244
13	SC MPG SA - Abator 2	8	1271	3	included	-		59	112
14	SC MPG SA - DUNAREANA	38	1271	6	included	-		249	115
15	SC MPG SA - RADU NEGRU	4	1271	5	74,258	248		19	80
16	SC MPG SA - DUNAREA	42	1271	3	included	-		67	125
	Sub-total				74,258	248	2.00%		
21	SC FRUTUL SA	39	1251	6	350,400	1,168		43	132
	Sub-total				350,400	1,168	9.50%		
	Food Processing					3,024	24.5%		
3	SI COCA COLA SA	20	1311	3	84,843	283		133	87
	Sub-total				84,843	283	2.30%		
30	SC Vinificata Bauturi SA - Capsulare	7	1321	3	792	3		321	249
17	SC MARTENS SA (ROBEER)	9	1322	3	555,436	1,851		200	470
31	SC Vinificata Bauturi SA - Imbuteliere	7	1324	3	included			321	249
	Sub-total				556,228	1,854	15.80%		
	Beverage					2,237	18.1%		
2	SC COMEAVIPOR SA (FNC Galati)	13	1351	3	9,555	32		39	110
	Sub-total				9,555	32	0.30%		
	Feedstuff					32	0.3%		
20	SC Plase Pescaresti SA	25	1472	4	14,241	47		54	147
26	SC SF TEX SA	5	1472	5	10,881	36		31	135
	Sub-total				25,122	83	0.70%		
48	SC FIROMEX SA	49	1494	5	59,100	197		69	278
	Sub-total				59,100	197	1.60%		
9	SC GALFIRTEX SA	3	1599	5	99,516	332		123	152
	Sub-total				99,516	332	2.70%		
	Textile					612	5.0%		
45	SC GAVA SA	14	1622	3	13,317	44			
	Sub-total				13,317	44	0.40%		
	Furniture					44	0.4%		
1	SC APOLLO SA	1	2052,53,54	5	76,950	257		734	
	Sub-total				76,950	257	2.10%		
	Chemical Products (Soaps, etc)					257	2.1%		
7	SC ELNAV SA	34	2641,43	7	20,736	69		19	61
32	SC INTFOR SA	31	2641,43	6	387,600	1,292		8	88
	Sub-total				408,336	1,361	11.00%		
27	SC TREFO SA	17	2751	3	172,708	576		N.A.	61
	Sub-total				172,708	576	4.70%		
36	SC ROMCONET SA	45	2841,42	5	8,400	28		24	N.A.
5	SC FAM SA - sector 1 & 3	33	2829	6	included	-		17	N.A.
6	SC FAM SA - sector 2	2	2829	5	63,021	210		27	N.A.
	Sub-total				71,421	238	1.90%		
	Metal Products					2,175	17.6%		
18	SC MEHID SA	15	2975,77	3	89,304	298		79	158
	Sub-total				89,304	298	2.40%		
25	SC Santier Naval - Galati SA	36	3141	7	5,313	18		N.A.	134
	Sub-total				5,313	18	0.10%		
19	SC MENAROM SA	40	3191	7	29,536	98		N.A.	65
	Sub-total				29,536	98	0.80%		
	Machinery					414	3.4%		
4	Depoul CFR	41	-	8	37,044	123		65	81
10	SC HORTIGAL SA	32	-	7	2,523	8		35	120
11	SC INTERTRANS SA	11	-	3	18,624	62		N.A.	138
22	SC TRANSURB SA - Depoul 1	18	-	3	6,396	21		N.A.	111
23	SC TRANSURB SA - Depoul 2	10	-	3	6,396	21		N.A.	178
28	SC TRANSGAL SA - ARA	12	-	3	4,745	16		N.A.	137
29	SC TRANSCOM SA	35	-	7	92,400	308		N.A.	113
33	SC PETROM SA PECO	43	-	7	2,333	8		35	83
37	SC AUTOUNIVERSAL SRL	30	-	6	2,410	8		N.A.	443
38	SC IATSA SA	22	-	3	3,702	12		N.A.	118
39	SC BEFIN PROD SRL	27	-	3	303	1		N.A.	654
40	SC CEVAL STAR SRL	29	-	6	1,220	4		N.A.	594
41	SC CONICOL SRL	26	-	3	N.A.	-		N.A.	194
42	SC AUTOMECANICA SA	24	-	3	5,244	17		N.A.	317
46	SC REFCOM SRL	23	-	3	840	3		N.A.	543
49	SC TRAPEX EXIM AS SRL	47	-	3	N.A.	-		N.A.	261
50	SIDEX - Mare 18	50	-	3	882,252	2,941			
	Not Categorized				1,066,433	3,553	28.80%		
	Total				3,704,858	12,348			

Table AII.1.29 Present Industrial Wastewater Discharges by Product Category

Category	Present Discharge Flow (m^3/d)	Share (%)	Remarks
Food Processing	3,024	24.5	Meat products, dairy products, bread, vegetable oil, etc.
Beverage	2,237	18.1	Beer, wine, distillery, soft drinks, etc.
Textile	612	5.0	Cotton fiber, textile fiber, etc.
Metal Products	2,175	17.6	Metal semi-finished products, etc.
Other Manufactures	747	6.0	Machinery, chemical products, furniture, feed stuff, etc.
Others	3,553	28.8	Service industries
Total	12,348	100.0	

Table AII.1.30 Design Industrial Wastewater Discharge Flow by Categorized Factories

Category	Share (%)	Design Discharge Flow (m^3/d)	Remarks
Food Processing	25.0	4,500	
Beverage	18.0	3,240	
Textile	5.0	900	
Metal Products	18.0	3,240	
Other Manufactures	6.0	1,080	
Others	28.0	5,040	
Total	100.0	**18,000**	Design Average Flow

Table AII.1.31 Design Industrial Wastewater Characteristics Classified by Product Category

Category	Quality Parameters (mg/L)				Remarks
	BOD_5	SS	T-N	T-P	
Food Processing	300	200	40	10	
Beverage	300	300	30	10	
Textile	200	300	30	20	
Metal Products	80	100	10	5	
Other Manufactures	100	100	20	2	
Others	100	200	5	1	

Table AII.1.32 Design Quality of Industrial Wastewater by Categorized Factories

Category	Design Flow (m^3/d)	Concentration (mg/L)		Loads (kg/d)		Remarks
		BOD_5	SS	BOD_5	SS	
Food Processing	4,500	300	200	1,350	900	
Beverage	3,240	300	300	972	972	
Textile	900	200	300	180	270	
Metal Products	3,240	80	100	259	324	
Other Manufactures	1,080	100	100	108	108	
Others	5,040	100	200	504	1,008	
Total	**18,000**			**3,373**	**3,582**	
Average Concentration (mg/L)		**187**	**199**			
Category	Design Flow (m^3/d)	Concentration (mg/L)		Loads (kg/d)		Remarks
		T-N	T-P	T-N	T-P	
Food Processing	4,500	40	10	180	45.2	
Beverage	3,240	30	10	97	32.4	
Textile	900	30	20	27	18.0	
Metal Products	3,240	10	5	32	16.2	
Other Manufactures	1,080	20	2	22	2.2	
Others	5,040	5	1	25	5.0	
Total	**18,000**			**383**	**118.8**	
Average Concentration (mg/L)		**21**	**6.6**			

Table AII.1.33 Design Quality of Industrial Wastewater

Source	Design Flow (m^3/d)	Concentration (mg/L)		Loads (kg/d)		Remarks
		BOD_5	SS	BOD_5	SS	
Point Source						
Listed Factories	18,000	187	199	3,373	3,582	
Non-listed Factories	24,000	120	140	2,880	3,360	
No-point Source	20,000	120	140	2,400	2,800	
Total	**62,000**			**8,653**	**9,742**	
Average Concentration (mg/L)		**140**	**157**			
Source	Design Flow (m^3/d)	Concentration (mg/L)		Loads (kg/d)		Remarks
		T-N	T-P	T-N	T-P	
Point Source						
Listed Factories	18,000	21	6.6	383	118.8	
Non-listed Factories	24,000	21	2.8	504	67.2	
No-point Source	20,000	21	2.8	420	56.0	
Total	**62,000**			**1,307**	**242.0**	
Average Concentration (mg/L)		**21**	**3.9**			

Table AII.1.34 Design Influent Quality

Wastewater	Design Flow (m^3/d)	Loads (kg/d)		Concentration (mg/L)		Remarks
		BOD_5	SS	BOD_5	SS	
Domestic, Commercial, and Institutional	138,000	16,588	19,227	120	140	
Industrial	62,000	8,653	9,742	140	157	
Total	200,000	25,241	28,969			
Average Concentration (mg/L)				126 => 130	145 => 150	
Wastewater	Design Flow (m^3/d)	Loads (kg/d)		Concentration (mg/L)		Remarks
		T-N	T-P	T-N	T-P	
Domestic, Commercial, and Institutional	138,000	2,903	381	21	2.8	
Industrial	62,000	1,307	242	21	3.9	
Total	200,000	4,210	623			
Average Concentration (mg/L)				21 => 20	3.1 => 3	

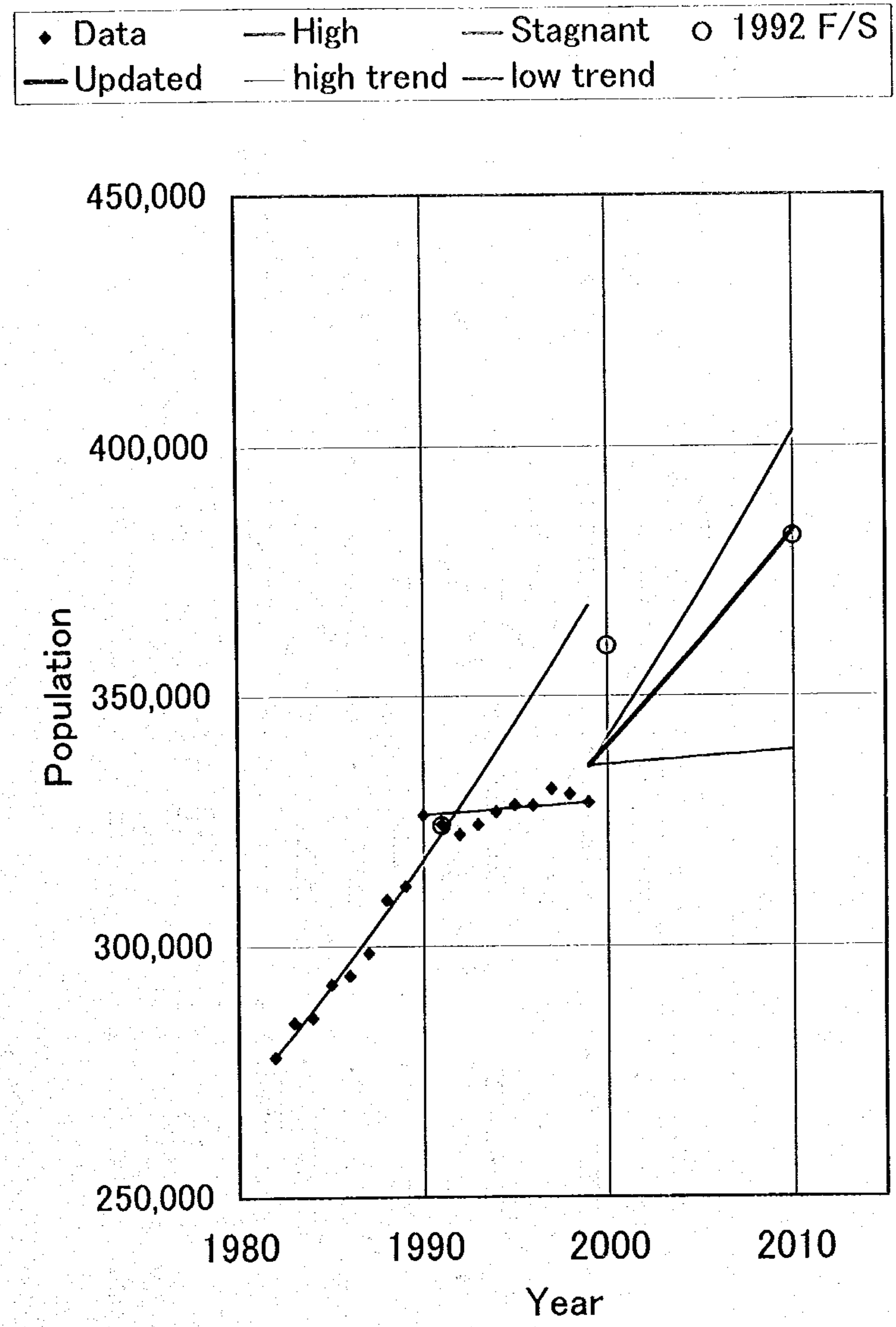


Figure AII.1.1	Population Projection for Galati City

City: Galati
Sampling Point: Outfall No.1

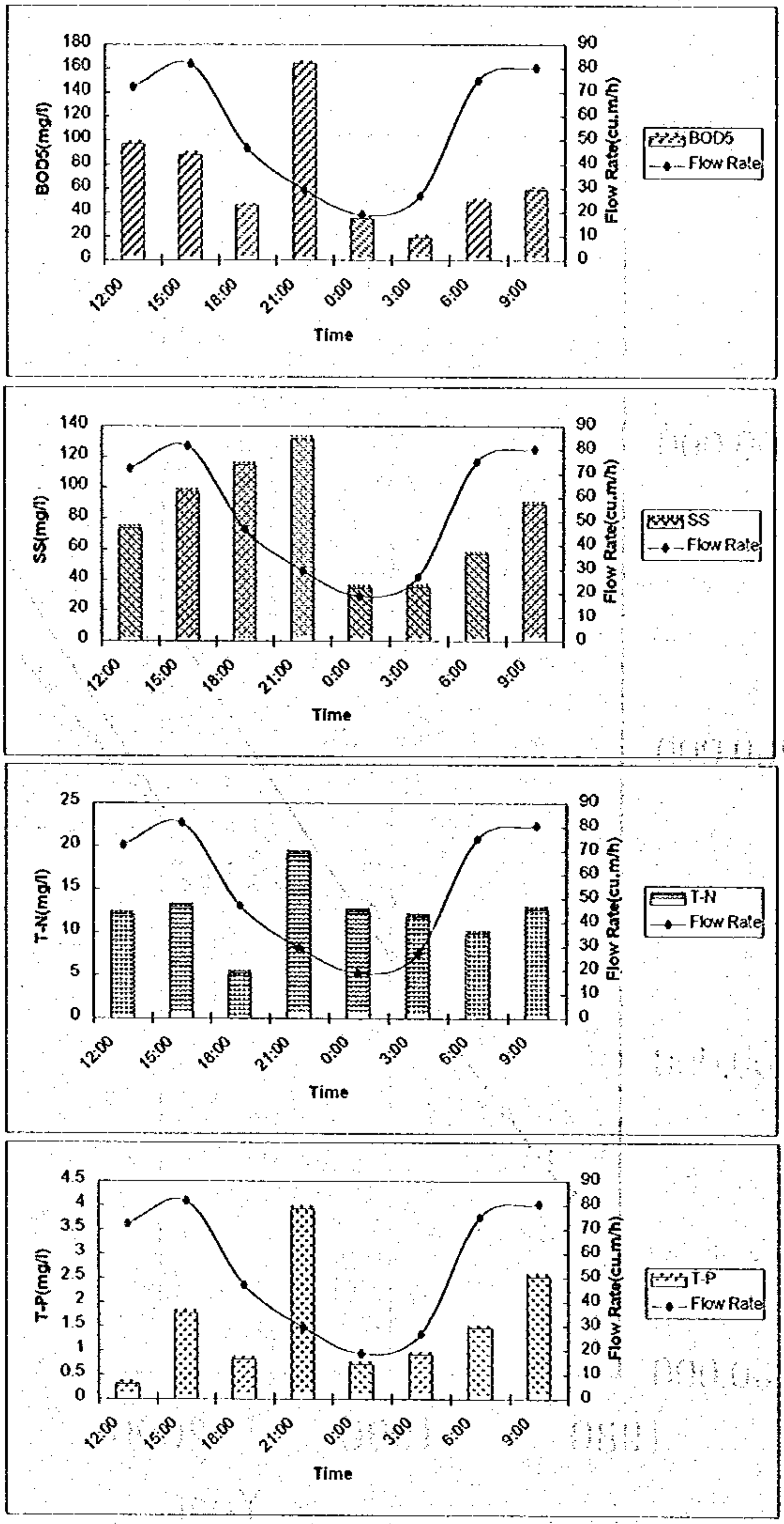


Figure AII.1.2	Result of Wastewater Quality Survey at Micro 21 in Galati City

City: Galati
Sampling Point: Outfall No.2

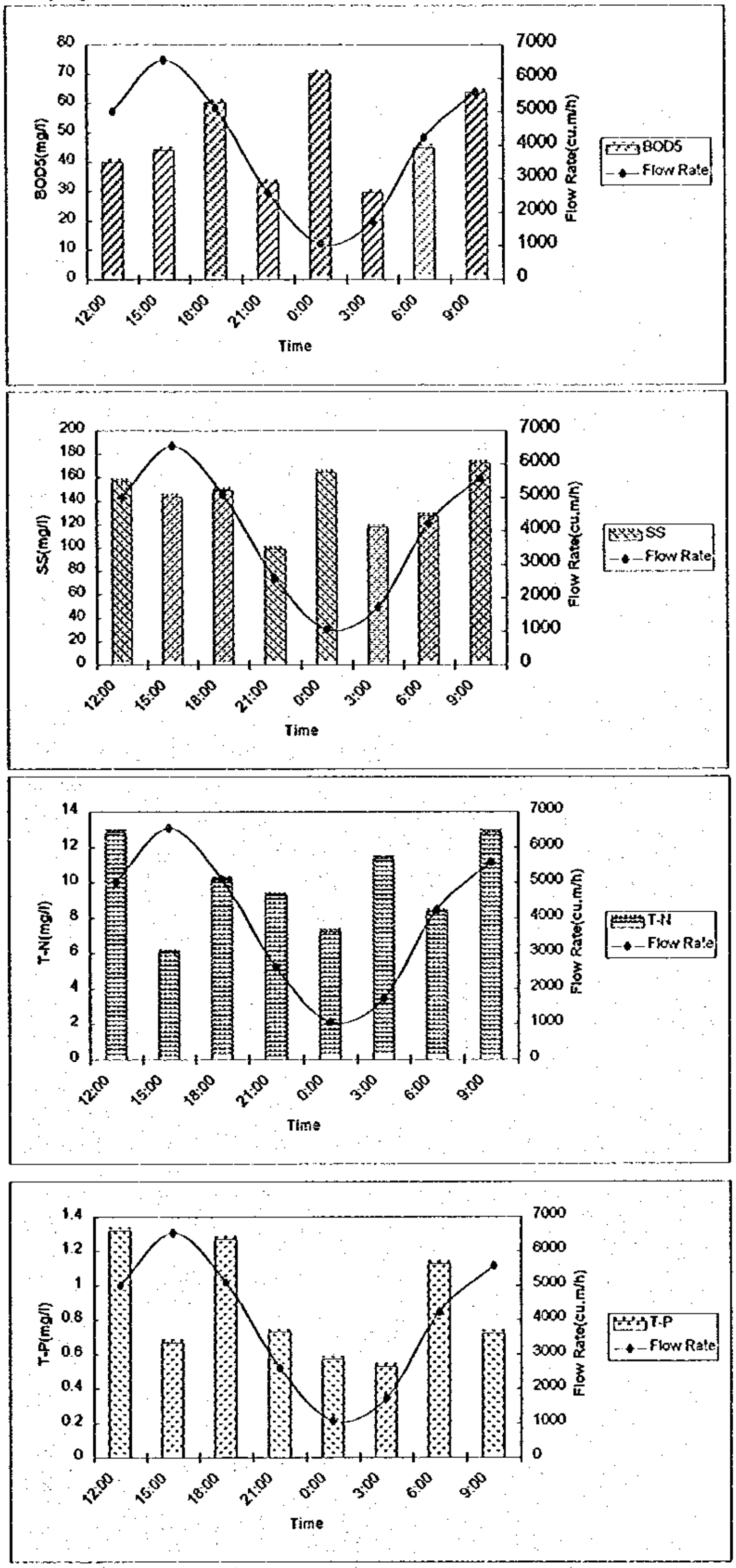


Figure AII.1.3	Result of Wastewater Quality Survey at SP 13 Iunie in Galati City

APPENDIX-2

WWTP SITE SELECTION

1. CANDIDATE PLANT SITE(S)

1.1 CANDIDATE SITES

As the possible construction sites for the Galati WWTP, the following six candidate lands are first selected as shown in *FigureAII.2.1*. Each of the sites is then evaluated with regard to its socioeconomic aspects, topography, environs, expandability, and the magnitude of treatment plant capacity the land can accommodate.

Alternative WWTP Sites

Alternative Sites	Land area (ha)	Remarks
Alternative site 1	7.3	Flat agricultural and wasteland near the Siret River mouth
Alternative site 2	2.5	Located southeast to the stadium
Alternative site 3	1.8	Located close to the Danube River
Alternative site 4	9.45	Located close to the stormwater pump station
Alternative site 5	>20	About 300 m north to Alt.4 site
Alternative site 6	>7	North to Free Economic Zone close to the Danube River

1.2 AFFORDABLE TREATMENT CAPACITIES BY LANDS

The maximum capacities of WWTP, facilities of which could be accommodated within the available land area, have been estimated. The plant available site areas are considered to include such spaces as process facilities, roads, and buffer zones, but no allowances for future expansion space is considered. The maximum plant capacities corresponding to the alternative sites are shown in the following table:

Maximum Wastewater Treatment Capacity by Site

Alternative Sites	Available Area	(*)Maximum plant capacity (m^3/day)	Remarks
Alternative site 1	7.3	60,000	Land is fully usable
Alternative site 2	2.5	11,000	"
Alternative site 3	1.8	6,000	"
Alternative site 4	9.45	40,000	About 40 % land area may be unusable.
Alternative site 5	>20	300,000	Further expansion may be possible
Alternative site 6	>7	60,000	More land can hardly be acquired

Note: Calculated from an equation in the form $A = 4.78Q^{0.633}$ by the Ministry of Construction, Japan, based on the data obtained from 117 conventional activated sludge WWTP.

1.3 Evaluation of Alternative Lands

In order to treat the maximum daily DWF of 234,400 m^3 in a centralized conventional activated sludge WWTP, a land of 18 to 20 ha. (depending upon the land shape) will be required. At present, however, no WWTP site has either been acquired or preserved yet, and it is still unknown whether or not such a wide single land is readily available. Under the circumstances, there is a possibility that the multiple numbers of independent treatment plants separately treat the wastewater. In view of this, each candidate land is evaluated as discussed in the following:

Alternative site 1: This 7.3 ha. land owned by the City is located at left bank of the Siret River mouth, which is currently being used for agricultural purpose or wasteland. The ground surface is relatively flat with the elevation ranging from 6.5 m to 7.8 m above M.W.L. This land could accommodate WWTP facilities with treatment capacity up to 57,000 m^3/day, which accounts for about 20 percent of the total wastewater production. Because of the limited area, this site cannot be used as a centralized WWTP, but as a local plant to treat a portion of the wastewater. The closest residences are located to the north about 300 m from the site, and at the east is a military prohibited area. This land alone is considered not sufficient to treat the wastewater from Collectors 1, 2 and 3, and needs several more hectares land, preferably a total of 16 ha., if a WWTP is to be constructed here.

Alternative sites 2 and 3: Both sites are too small to accommodate the WWTP. Alternative 2 is a narrow land surrounded by sharp slope hills with a small flat area of about 0.5ha. The topographic conditions make this site unfavorable for WWTP construction. Moreover, even if the site were fully utilized, the expected plant capacity could be no more than 12,000 m^3/day, accounting for only 4 percent of the total wastewater production of the City.

Alternative 3 site is also a small land measuring 70 m by 260 m, with about 1.8 ha. land surface area. This land of this size can accommodate a treatment plant with 7,000 m^3/day or less capacity. Furthermore, both sites are closely located to residential districts, as such; both of Alternatives 2 and 3 lands appear to be not suitable for WWTP sites.

Alternative 4: This land is the City's property located in a narrow land between the two railway lines. Presently, the sewage pumping station, stormwater sedimentation tanks, and several houses and buildings exist within the land. The land measures 675 m by 140 m with a surface area of 9.45 ha.

Because of the existing railway lines running both at the north and south sides, no spaces for future possible expansion exist in the vicinity. Moreover, since much portion of the land is occupied by the structures the usable land for the WWTP is quite limited. If the half of the land were used for the WWTP site, the expected maximum treatment capacity of the plant would be only at around 40,000 m^3/day.

Another constraint in selecting this site for the WWTP will be the railway crossing. Large inflow and outflow pipelines are to be laid crossing the railway lines either by shield tunneling or other underground construction methods.

Alternative 5: This land is presently being used for agricultural purpose. The land is flat and more than 20 hectares area would be available. There are wide agricultural lands in the vicinity of the site thus the future expansion may be possible without much difficulty. Major constraint to provide the plant here is again the influent and effluent sewer crossing under two railway lines, thus adding more construction costs.

Alternative 6: This land was originally planned as the WWTP site, but now designated as "Free

Economic Zone." Some construction works have already taken place in part of the Zone. To the south of the Zone close to the Danube River, City owns a 7-hectare land, which the City implies it might be possible to exchange this land with a part of the Free Economic Zone, hopefully 15 hectares or so. If this land were obtained, most of the wastewater could be treated here.

1.4 WWTP System Options

Although there still remain some uncertainties in particular for land acquisition, from the foregoing studies on the possible WWTP sites, the following two WWTP strategy options are selected for further economic and technical comparison:

- One centralized WWTP to treat all the wastewater at Alternative 5(20 ha) site; and
- Two separated WWTP each at Alternative 6 site (15 ha.) and Alternative 1 site (will require 16 ha. land for treating wastewater from Collectors 1, 2 and 3).

These two strategy options have further been evaluated in details from both technical and economic viewpoints to select the optimum regional WWTP system in the following sections.

2. REGIONAL WASTEWATER MANAGEMENT SYSTEM OPTIONS

2.1 System Options

Two wastewater management strategy options have been selected to further scrutinize on the advantages and disadvantages accruing to each option. Major features of the alternative programs are as follows:

<u>Option 1</u>; This option, the centralized WWTP covers the whole sewer service area and treat the daily maximum DWF of 3.05 m^3/sec and WWF of 6.1 m^3/sec at the WWTP site at the east of the existing pumping station (Alternative site 5), comprising, force mains, and a concentrated large-scale WWTP.

<u>Option 2</u>; The plan divides the whole sewerage area into two separate independent sewerage districts, East and West Districts, following the topography, and layout of existing sewer networks and collectors. Under this plan, two separate wastewater management systems will be provided.

2.2 Strategy Option 1

This WWTP system will treat the wastewater coming from the whole Galati sewerage system. Most of the wastewater generated in the City flows down by gravity to lift pumping stations and will then be transmitted through a total of 10-km long interceptor sewers to the WWTP located in the northeast of the City area. The capacity of the interceptor system should be such that it could accommodate the anticipated flows in the year 2010 from the sewerage districts. The wastewater will be conveyed to the WWTP.

2.3 Strategy Option 2

Under this system, the whole sewerage area is divided into two separate sewerage districts, East and West, and the collected wastewater will be treated separately with two independent WWTP. The Each district will independently collect, convey and treat the wastewater within its own district. Due considerations are to be given to the topographic conditions in the area so that the sewers could lead the collected wastewater by gravity to the maximum extent possible.

The wastewater coming from the Collectors 1, 2 and 3 will be collected through the interceptor sewers and conveyed to the West WWTP, which capacity needs to be of 171,850 m^3/day. The WWTP will require a land of about 16 ha. located close to the river mouth of the Siret.

2.4 Cost Comparison

For purposes of cost comparison between the two alternative wastewater management programs, an analysis was made of all costs accruing to each alternative over the 25-year period.

For the comparison purpose, it is assumed that the fund is available for all the construction, and operation and maintenance costs, and the year 2005 is considered to be the earliest year that any wastewater management facilities can be made operational.

Capital costs of wastewater conveyance and treatment facilities included in the alternative systems, and annual operation, maintenance, and energy costs for those facilities were estimated. All costs are at 1999 level; for purposes of economic comparison between alternatives, no cost escalation was considered. It is to be emphasized that these cost estimates are order-of-magnitude, or reconnaissance level only, and that while they are satisfactory for planning purposes and comparisons between alternative courses of action, they are not adequate for detailed financial planning.

Future capital and operating costs were discounted to present worth values in 1999 using 5 percent discount rate. For the estimation of the costs, the plant sites for the WWTP are assumed to be acquired. For simplicity, stage-wise construction schedules for the various facilities are not prepared, assuming that the total capital investment required for each facility would be made in the year in which the facility would need to be completed.

A summary of total construction, operation and maintenance costs, and economic costs accruing to the four alternative wastewater management programs through the 25-year period are set forth in the following tables. The detail calculation of the economic cost is shown in Table AII.2.1.

Construction and O/M Costs of Options (US$ 1,000)

Alternative Plans	Capital Costs	O/M Costs(per year)
Option 1	65,643	3,854
Option 2	79,294	4,982

Economic Costs of Options (US$ 1,000 discounted at 5 p.a.)

Alternative Plans	Capital Costs	O/M Costs	Total Costs
Option 1	67,432	38,944	106,380
Option 2	78,399	50,691	129,091

The above table shows that Option 1 would be the less costly management program than Option2 in terms of economic costs. This could be explained that Option 1 with a concentrated WWTP has a merit of economy of scale, which could trade off the costs for a lift station.

The O/M costs of Option 2 with the two independent plants are higher than those for the single treatment plant with the same treatment capacity, thus making the total O/M cost higher than Option 1. The difference in the economic costs between the Options is, however, not so significant.

As it is presumed that at the initial stage of the implementation only limited fund would be available, Option 1 system would be the more realistic plan in terms of the project financing. However, both alternatives were formulated on the assumption that all the costs would be readily available for implementation of the programs, and at the same time both of the alternatives would be environmentally acceptable.

2.5 Comparison of Intangible Considerations

In view of the lack of a clear distinction between alternative wastewater management programs on a cost basis, non-quantifiable considerations become of importance in the selection of the recommended program. The most important such non-quantifiable considerations have been identified, and an evaluation made of the degree to which each is responded to by the various alternatives analyzed. The non-quantifiable considerations deemed of major importance in selecting among alternatives are:

- Flexibility;
- Speed of project implementation; and
- Community/environmental impact.

A rating of four grades (excellent, good, fair, poor) of the two alternatives with reference to each of these is adopted with supporting commentary presented in the following:

Flexibility: Option 1 has a less flexibility than Option 2. Option 1 has a large-scale concentrated system that would require high initial investments for the construction of the large WWTP and conveyance facilities. Such major investments would dictate the course of regional wastewater management for many years to come, and would render these alternatives inflexible. In adapting to future change in conditions, Option 1 is rated "poor" in terms of flexibility.

Option 2 is more flexible program than Option 1, and is rated "good," because after initial construction of the system these would be possible to start operation at a relatively early stage, and possibly later if wastewater flows from the districts do not grow to the extent presently anticipated, they could be modified.

There are many advantages to retaining flexibility in the regional program to the extent possible, including:

- As time passes, additional and further technological advances become known and available, and as experience is acquired in the initial stage facilities, it may be that improvement and upgrading of the facilities can be provided. If future experience shows that the capacity of the plants need to be or not to be expanded beyond the originally planned capacity, the expansion of the plants could be done or deferred substantially in time or possibly not required at all.

- The potential for such deferral would be lost under Option 1. There is a possibility that wastewater flows from the area will not grow to the extent presently anticipated because of the possible wastewater reuse or other reasons.

Almost certainly there will be technological advances within the next decade which will render wastewater treatment less costly and less esthetically objectionable than at present, possibly by a substantial amount. Option 2 would offer the opportunity to take advantage of such technological advances, while Option 1 would not.

Speed of Implementation: In Option 1, the WWTP would be an enlarged one. The large mains, force mains, and pump stations would surely require considerable time to complete the construction. There would be some delay in receiving the services in such wastewater districts far removed from the WWTP, thus delaying an early implementation of the woks. Option 2 has smaller interceptors that can be laid in a relatively short time.

In view of the above discussions, Option 1 is rated as "poor" as is inferior to Option 2 in terms of capability to rapidly alleviate the existing sanitary problems within the areas. Option 2 is on the other hand rated "fair" in this respect.

Community/Environmental Impacts: Under the Project, a detailed environmental impact assessment is conducted during the feasibility study stage. However, for the strategic planning purpose such impacts were briefly made (refer to Section 3.9 EIA).

Community impacts can be measured best by the readiness with which wastewater treatment facilities are accepted by the community within which they are located. Although such facilities are not generally as a desirable additions to any community, an assessment of the relative impact of the three alternatives examined herein can be made.

Option 1 could be rated as "good" in terms of community impact because the treatment facilities involved would be located in an area presently devoted to agricultural land. The site is separated from residential and property. Residential property to the site it is by more than 2 km away. The land is, however, owned by private and needs to acquire the land, which may take some time to secure a sufficient land for the WWTP facilities.

Option 2 could be considered somewhat less acceptable than Option 1, because the West WWTP site is located less than 1 km to residential area. There might also be some other social problems relative to siting of the plant facilities, such as interference with other utilities, blocking access and involuntary resettlement. As the site would be located near the communities, thereby and that require considerations for minimizing hazards and nuisance such as provision of buffer zones and fences, noise, vibrations, odor, aerosol abatement, etc. In view of these, Option 2 is rated as "poor."

Rating of Alternative Wastewater Management Options

with Reference to Non-quantifiable Considerations

Option	Flexibility	Speed of implementation	Environmental/ social impact
Option 1	poor	poor	good
Option 2	good	fair	poor

3. CONCLUSIONS

Option 2 is superior to Option 1 in the flexibility and the shorter time required for its implementation, but has two independent locations of WWTP facilities that makes the project more costly in a long-range program.

From the foregoing analysis, it is concluded that Option 1 represents a satisfactory long-range regional wastewater management program from the economical and technical viewpoints; hence this should be adopted as the plant site for the wastewater management system.

All necessary steps should be taken immediately to ensure that land would be available at the potential WWTP site to enable construction of such a plant when and if the decision is made to do so.

Table AII.2.1 Economic Costs of Strategy Option No.1and No.2

Option No.1

Discount Rate = 5.0 (% per annum) (All costs expressed in US$ 1,000)

Year	WPS				WWTP				Wastewater Production Inflow(m^3/d)
	Capital	Capital P.V.	O/M	O/M P.V.	Capital	Capital P.V.	O/M	O/M P.V.	
1	1,706	1,706	0	0	13,129	13,129	0	0	233,280
2	1,706	1,625	0	0	13,129	12,503	0	0	236,640
3	1,706	1,547	0	0	13,129	11,908	0	0	240,000
4	1,706	1,474	0	0	13,129	11,341	0	0	243,360
5	1,706	1,403	0	0	13,129	10,801	0	0	246,720
6	0	0	59	46	0	0	3,643	2,855	250,080
7	0	0	59	44	0	0	3,673	2,741	253,440
8	0	0	60	42	0	0	3,702	2,631	256,800
9	0	0	60	41	0	0	3,730	2,525	260,160
10	0	0	61	39	0	0	3,759	2,423	263,520
11	0	0	61	37	0	0	3,759	2,308	263,520
12	0	0	61	36	0	0	3,759	2,198	263,520
13	0	0	61	34	0	0	3,759	2,093	263,520
14	0	0	61	32	0	0	3,759	1,993	263,520
15	0	0	61	31	0	0	3,759	1,899	263,520
16	0	0	61	29	0	0	3,759	1,808	263,520
17	0	0	61	28	0	0	3,759	1,722	263,520
18	0	0	61	27	0	0	3,759	1,640	263,520
19	0	0	61	25	0	0	3,759	1,562	263,520
20	0	0	61	24	0	0	3,759	1,488	263,520
21	0	0	61	23	0	0	3,759	1,417	263,520
22	0	0	61	22	0	0	3,759	1,349	263,520
23	0	0	61	21	0	0	3,759	1,285	263,520
24	0	0	61	20	0	0	3,759	1,224	263,520
25	0	0	61	19	0	0	3,759	1,166	263,520
	8,529	7,754	1,211	620	65,643	59,682	74,891	38,324	

Capital	67,436	O/M	38,944	Total PV	106,380

Option No.2

Discount Rate = 5.0 (% per annum) (All costs expressed in US$ 1,000)

Year	WPS				WWTP				Wastewater Production Inflow(m^3/d)
	Capital	Capital P.V.	O/M	O/M P.V.	Capital	Capital P.V.	O/M	O/M P.V.	
1	0	0	0	0	17,246	17,246	0	0	233,280
2	0	0	0	0	17,246	16,425	0	0	236,640
3	0	0	0	0	17,246	15,643	0	0	240,000
4	0	0	0	0	17,246	14,898	0	0	243,360
5	0	0	0	0	17,246	14,188	0	0	246,720
6	0	0	0	0	0	0	4,819	3,776	250,080
7	0	0	0	0	0	0	4,858	3,625	253,440
8	0	0	0	0	0	0	4,896	3,479	256,800
9	0	0	0	0	0	0	4,934	3,340	260,160
10	0	0	0	0	0	0	4,972	3,205	263,520
11	0	0	0	0	0	0	4,972	3,052	263,520
12	0	0	0	0	0	0	4,972	2,907	263,520
13	0	0	0	0	0	0	4,972	2,769	263,520
14	0	0	0	0	0	0	4,972	2,637	263,520
15	0	0	0	0	0	0	4,972	2,511	263,520
16	0	0	0	0	0	0	4,972	2,392	263,520
17	0	0	0	0	0	0	4,972	2,278	263,520
18	0	0	0	0	0	0	4,972	2,169	263,520
19	0	0	0	0	0	0	4,972	2,066	263,520
20	0	0	0	0	0	0	4,972	1,968	263,520
21	0	0	0	0	0	0	4,972	1,874	263,520
22	0	0	0	0	0	0	4,972	1,785	263,520
23	0	0	0	0	0	0	4,972	1,700	263,520
24	0	0	0	0	0	0	4,972	1,619	263,520
25	0	0	0	0	0	0	4,972	1,542	263,520
	0	0	0	0	86,230	78,399	99,058	50,691	

Capital	78,399	O/M	50,691	Total PV	129,091

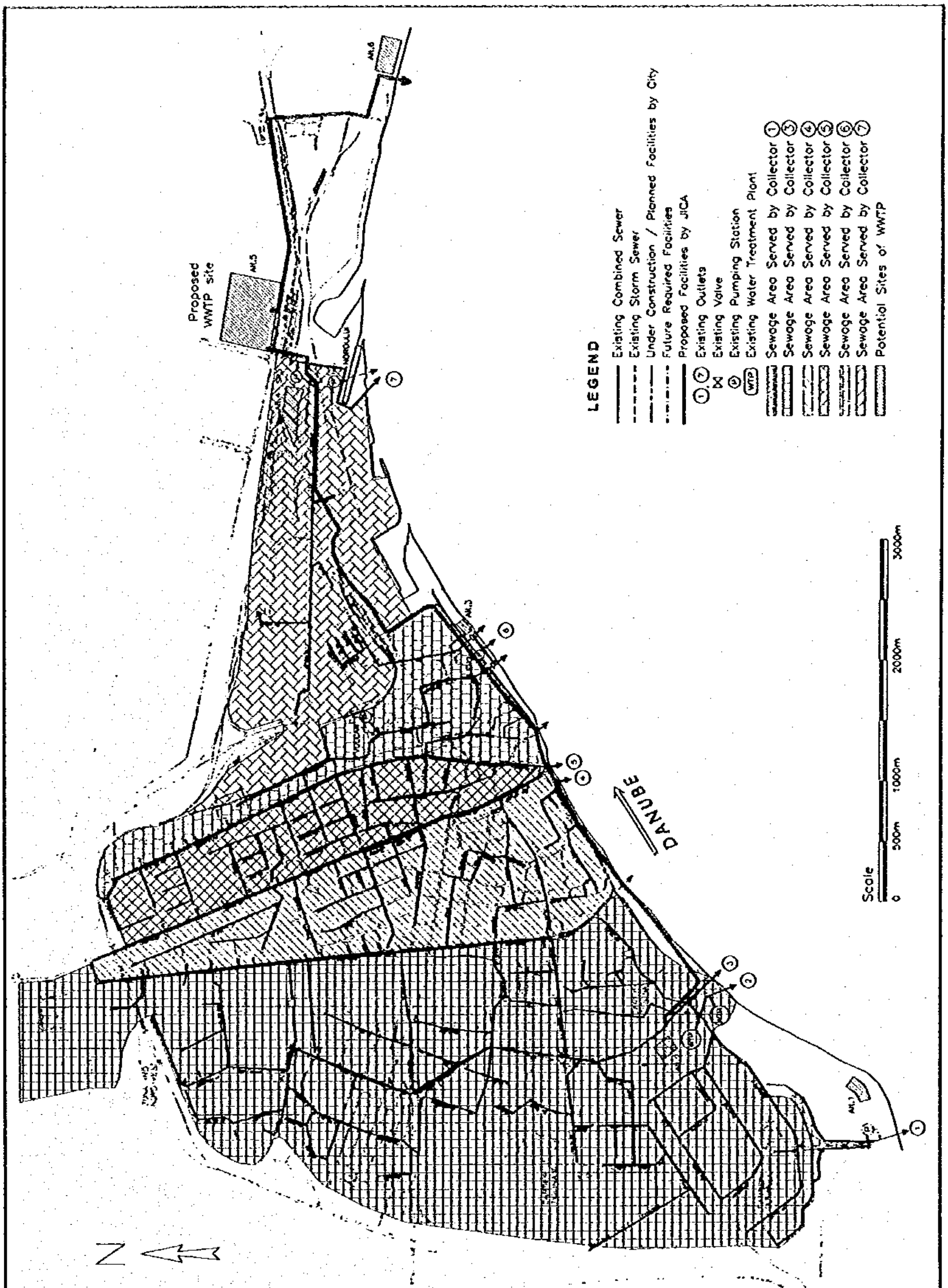
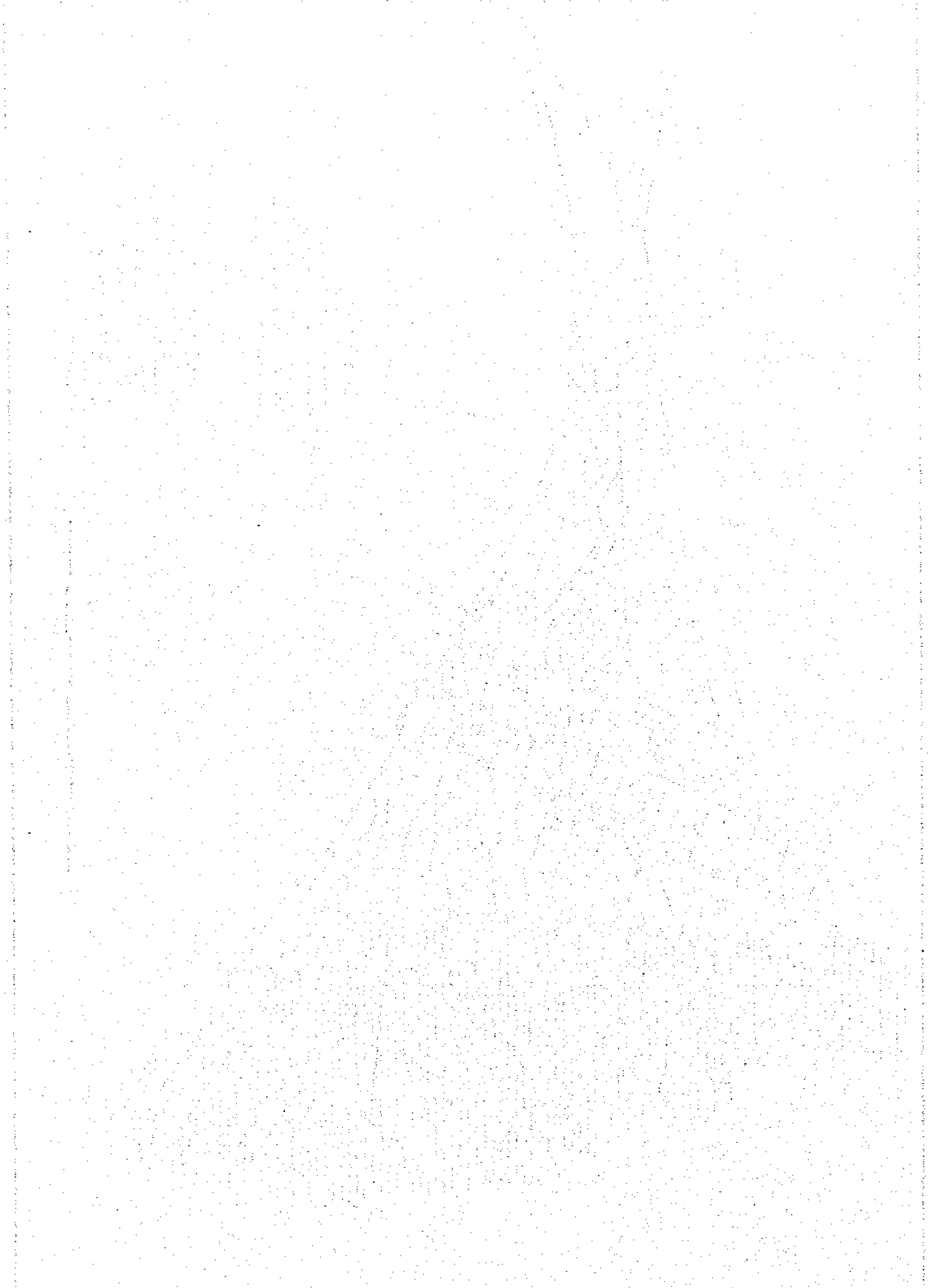


Figure AII.2.1	Location of Possible WWTP Sites for Galati City



APPENDIX-3 INTERCEPTOR SYSTEM

1. EXISTING WASTEWATER OUTFALLS

The Galati City's sewerage system is of a combined system to collect both of the wastewater and stormwater together into a single sewer line. There are seven (7) outfalls to discharge the combined wastewater into the Danube River, as shown in *Figures AII.3.1* and *AII.3.2.*

The outfall No. 1 discharges the wastewater into the Siret River, whereas the outfalls No. 2, 3, 4, 5, 6 and 7 discharge the wastewater into the Danube River. The outfall No. 6 discharges the wastewater through pumping station SP2 (13 Iunie) when the Danube water surface rises to the level to which the wastewater gravity flow is no longer possible. The outfall No. 7 discharges wastewater through pumping station SP3. Other outfalls discharge the wastewater by gravity.

The outfall No. 2 discharges wastewater generated at an only water purification plant, and that the plant itself manages the treatment of the wastewater, thus that this is not included in the present study. The wastewater flow from each outfall is estimated as shown in the following table:

Wastewater Flows from Existing Outfalls

Name and No. of Outfall		Wastewater Generation *1) m3/day	Hourly Max. Flow *2) (Q) m3/day	2Q m3/day	Hourly Max. Flow (Q) L/s	2Q L/s
1	Micro 21	6,377	11,971	23,942	0.139	0.278
2	WTP	0	0	0	0.000	0.000
3	Popasul de la Dunare	108,211	203,131	406,262	2.351	4.702
4	Libertatea	7,097	13,322	26,644	0.154	0.308
5	Valurile Dunarii	17,909	33,618	67,236	0.389	0.778
6	SP 13 Iunie	7,952	14,927	29,854	0.173	0.346
7	SP3	4,278	8,031	16,062	0.093	0.186
Total		151,824	285,000	570,000	3.299	6.598
1+3			215,102	430,204	2.490	4.980

*1) Wastewater generation of each outfall is estimated based on the service population and industrial wastewater.

*2) Total maximum hourly flow in 2010 is estimated at 570,000 as discussed in Planning Basis. The flows of each outfall in 2010 are estimated based on this value and the wastewater generations of each outfall.

2. PROPOSED INTERCEPTOR SYSTEM

2.1 WASTEWATER COLLECTION PLANNING

The WWTP site was selected at the eastern part of the City near the existing pumping station SP3, of which location is indicated in *Figure AII.3.1.* It is planned that wastewater from these outfalls be intercepted and transmitted to the WWTP by installing an interceptor sewer. The interceptor sewer system is planned to collect up to twice as much the maximum hourly wastewater flow (2Q). The combined sewer overflow (CSO) regulators and connection pipes are to be installed to divert the wastewater flow into the interceptor sewer. The excess combined wastewater, it is over 2Q, is discharged to the River through the existing outfalls after overflowing the planned CSO regulators.

The interceptor sewer route is planned to run along the Danube River starting from the point near the outfall No.3 to the planned WWTP. The interceptor sewers will collect the wastewater from the existing outfalls No. 3, 4, 5, 6 and 7, as illustrated in *Figures AII.3.1 and AII.3.2.* Topographically, the interceptor system needs no intermediate pumping station on the way to the WWTP to lift the wastewater.

The wastewater from the existing outfall No. 1 is to be diverted into the existing sewer network, which is finally connected to outfall No. 3. There is an idea to install a pumping station to pump up the wastewater to the existing sewer network as shown in *Figure AII.3.1 and AII.3.2.* The collection system including the pumping station and the sewer is not designed under the present study, since there are many such constraints and uncertainties in designing as hydraulic conditions of upstream flow, connection sewer flows, existing sewer routes and sewer invert elevations.

Planning of the interceptor sewer is conducted based on present main sewer routes, the diameter and the invert elevation. The Water Company provides most of these data, but elevations of grounds and some sewer inverts are surveyed under the present study. In spite of these data and survey results, some of the existing sewer routes or other data are still left unclear. Where some of sewer routes, diameters or invert elevation data are not available, some assumptions are made for the sewer planning under this study. Four main sewers are connected to outfall No.3, but exact locations of the connection points are hardly identifiable. Under the circumstances the first line of the interceptor sewers is planned to carry all the wastewater coming from the four sewer connections, despite the fact that the existing four sewers seem to be independently connected into the main sewers as shown in *Fig. AII.3.2.*

Sewer layout, flow calculations and longitudinal profiles are prepared based on these basic data for sewer planing, which are discussed in the following sections.

2.2 Alternative Study on Connection of Existing Outfalls to Proposed Interceptor

Two (2) alternatives are studied prepared Alternative 1 is to connect the existing outfalls to the proposed interceptor without using the existing pumping station SP2 (13 Iunie), while Alternative 2 plans the use of the pumping station SP2. A flow chart of the existing sewer layout and the alternative interceptor plans are shown in *Figure AII.3.3.*

The existing pumping station SP2 has the following features:

Pump Capacity of SP2, 13 Iunie

No.	Pump Name	Flow (m3/hr)	Flow (m3/sec)	P (kW)	Remark
1	Brates 400	2000	0.556	100	
2	Brates 600	2400	0.667	110	
3	MK'S	1400	0.389	38	
4	Brates 600	2700	0.75	110	
Total		8500	2.36		
5	Motor pump	400 x 3 = 1200	0.333		This pump works in emergency with generator.

Source: S.C. APATERM S.A., Galati water company

The present pump capacity is allegedly 6,500 m^3/hr (1.81 m^3/s) although the design flow of the total pump is 8,500 m^3/hr (2.36 m^3/s). The estimated wastewater flow (Q) at the outfall No.6 and SP2 is 0.173 m^3/s and 2 Q is 0.346 m^3/s, which are smaller than the present pump capacity of 1.81 m^3/s. In view of this, it is considered that the pumping station SP2 has a sufficient capacity to send the wastewater up to the planned interceptor sewer.

Sewer computation sheets and profiles of Alternative 1 and Alternative 2 are shown in *Table AII.3.1 and Figure AII.3.4, and Table AII.3.2 and Figure AII.3.5,* respectively. Since Alternative 2 has sewers shallower than those required for Alternative 1, Alternative 2 plan is recommended. Layout of planned interceptor Alternative 2 is shown in *Figure AII.3.6.*

2.3 PROPOSED FACILITIES

Planned facilities comprise combined sewer overflow (CSO) regulators, connection sewers, interceptor sewers and manhole, which are described in *Table AII.3.3.* Major features of these facilities are described in the following:

(1) INTERCEPTOR SEWERS

The sewer will generally be laid by open cut excavation method, but for deep sewers with the earth coverage of more than 5 meters, will be of a shield-tunneling method.

Installation of the interceptor starts near the outfall No.3 and ends at the entrance of the planned WWTP. The sewer diameters range from 1,500 mm to 2,200 mm with the total length of 7,762 m.

The open cut excavation method will be applied from GI1 through GI5-3, and the shield-tunneling method will be applied from GI5-3 through the WWTP. Lengths of the open cut and shield tunneling methods are 5,048 m and 2,714 m, respectively.

Typical sewer construction is shown in *Figure AII.3.7.*

(2) CONNECTION SEWERS

Connection sewer is to carry maximum wastewater of 2Q of wastewater from the CSO regulator to the interceptor sewer. Generally length of the connection sewer is estimated 20 m and the earth coverage is 1-3 m. However, length of connection sewer from main sewer No.3-4, which comes from southeast part of Galati, is estimated 300 m in order to keep the potential head.

Installed connection sewers are 7 in number.

(3) CSO REGULATORS

Combined sewer overflow (CSO) regulators are installed at main sewer. The CSO regulators let exceeding wastewater overflow from weirs to the existing outfalls.

Typical structures of the CSO regulators are shown in *Figure AII.3.8.*

(4) MANHOLE

Manholes will be installed along the interceptor sewer generally at 200 m interval, and also at the junctions of sewers and roads.

Total number of the manholes along the interceptor sewer is 28.

Typical structures are shown in *Figure AII.3.9.*

3. WWTP OUTFALL SEWER

The outfall sewer of the WWTP is to be laid from the outlet of the chlorine contact tank to the

Danube River, along the existing public road. Although the selected sewer route is relatively long (about 3,200 m), there exists no other alternative route for the sewer.

The outfall sewer is under pressure from the chlorination chamber in the WWTP to the discharge point. When the Danube River water surface elevation becomes to or higher than the water level of once a year probability of occurrence, effluent pumps start operation to lift treated wastewater and discharge to the River. The pumping station receives the treated wastewater from the chlorination chamber and discharges it to the sewer.

The sewer diameter is designed to be 2,800 mm based on the estimated head losses and flow velocity in the sewer pipe. When two times of the maximum hourly wastewater (wet weather flow of 570,000 m3/day = 6.598 m3/s) inflows the sewer, the flow velocity is about 1.1 m/s.

Earth covering of the sewer pipes is determined considering the conditions that; the chlorination chamber water level is +7.5 m M.W.L. with the water depth of 4.0 m; and the ground level at the chamber is +7.0 m M.W.L. As the elevations of sewer invert and crown are about + 3.0 m M.W.L. and +6.0 m M.W.L. respectively, the sewer earth coverage is about 1.0 m. However, for the protection of the sewer pipe against the possible physical damage, the earth covering of 1.5 m is to be provided.

Length of the sewer from the starting point near the chlorination chamber to the outfall discharge point at the River is 3,200 m. At the outfall discharge point, the ground elevation in the River is to be almost same as the sewer invert elevation of +3.0 m M.W.L.

Table AII.3.1 Computations of Planned Interceptor in Galati (Alt.1)

Line No.	Line No. of	Sewer Length (m)		Max. Flow (m3/s)			Sewer Line				Sewer Invert Elevation (m)		Ground Elevation (m)		Earth Covering (m)	
	Lower Sewer	Increment	Total	Sewage	Infilt.	Total	Diameter (mm)	Slope (o/oo)	V (m/s)	Cap. (m3/s)	Upper end	Lower end	Upper end	Lower end	Upper end	Lower end
GI1	GI2-1	296	296	4.980	0.000	4.980	1500	5.6	3.000	5.301	21.820	11.940	26.420	14.440	3.100	1.000
No3	GI2-1	-	-	0.000	0.000	4.980	700	-	-	-	-	12.500	-	14.440	-	1.240
GI2-1	GI2-2	187	483			4.980	1500	5.6	3.000	5.301	11.940	8.820	14.440	11.320	1.000	1.000
GI2-2	GI3	163	646			4.980	1500	5.6	3.000	5.301	8.820	5.540	11.320	7.540	1.000	0.500
GI3	GI4	1908	2554			4.980	2000	1.2	1.679	5.275	5.040	2.750	7.540	7.000	0.500	2.250
No4	GI4	-	-	0.308	0.000	0.308	500	-	-	-	-	5.000	-	7.000	-	1.500
GI4	GI5-1	290	2844			5.288	2200	1.2	1.789	6.801	2.550	2.202	7.000	6.950	2.250	2.548
No5	GI5-1	-	-	0.778	0.000	0.778	800	-	-	-	-	5.000	-	6.950	-	1.150
GI5-1	GI5-2	216	3060			6.066	2200	1.2	1.789	6.801	2.202	1.943	6.950	7.070	2.548	2.927
GI5-2	GI5-3	125	3185			6.066	2200	1.2	1.789	6.801	1.943	1.793	7.070	7.720	2.927	3.727
GI5-3	GI5-4	188	3373			6.066	2200	1.2	1.789	6.801	1.793	1.567	7.720	7.110	3.727	3.343
GI5-4	GI6	390	3763			6.066	2200	1.2	1.789	6.801	1.567	1.099	7.110	6.890	3.343	3.591
No.6-1	GI6	-	-	0.173	0.000	0.173	500	-	-	-	-	0.550	-	6.890	-	5.840
GI6	GI7-1	336	4099			6.239	2200	1.2	1.789	6.801	-1.650	-2.053	6.890	7.010	6.340	6.863
No.6-2	GI7-1	-	-	0.173	0.000	0.173	500	-	-	-	-	1.100	-	7.010	-	5.410
GI7-1	GI7-2	327	4426			6.412	2200	1.2	1.789	6.801	-2.053	-2.445	7.010	6.800	6.863	7.045
GI7-2	GI7-3	499	4925			6.412	2200	1.2	1.789	6.801	-2.445	-3.044	6.800	6.550	7.045	7.394
GI7-3	GI7-4	500	5425			6.412	2200	1.2	1.789	6.801	-3.044	-3.644	6.550	7.390	7.394	8.834
GI7-4	GI7-5	500	5925			6.412	2200	1.2	1.789	6.801	-3.644	-4.244	7.390	7.110	8.834	9.154
GI7-5	GI7-6	30	5955			6.412	2200	1.2	1.789	6.801	-4.244	-4.280	7.110	5.500	9.154	7.580
GI7-6	GI7-7	301	6256			6.412	2200	1.2	1.789	6.801	-4.280	-4.641	5.500	5.500	7.580	7.941
GI7-7	GI7-8	29	6285			6.412	2200	1.2	1.789	6.801	-4.641	-4.676	5.500	7.230	7.941	9.706
GI7-8	GI8-1	936	7221			6.412	2200	1.2	1.789	6.801	-4.676	-5.799	7.230	7.460	9.706	11.059
No7	GI8-1	-	-	0.186	0.000	0.186	400	-	-	-	-	3.000	-	7.460	-	4.060
GI8-1	GI8-2	149	7370			6.598	2200	1.2	1.789	6.801	-5.799	-5.978	7.460	5.780	11.059	9.558
GI8-2	GI8-3	315	7685			6.598	2200	1.2	1.789	6.801	-5.978	-6.356	5.780	4.920	9.558	9.076
GI8-3	WWTP	77	7762			6.598	2200	1.2	1.789	6.801	-6.356	-6.448	4.920	4.500	9.076	8.748

Table AII.3.2 Computations of Planned Interceptor in Galati (Alt.2)

Line No.	Line No. of Lower Sewer	Sewer Length (m)		Max. Flow (m3/s)			Sewer Line				Sewer Invert Elevation (m)		Ground Elevation (m)		Earth Covering (m)	
		Increment	Total	Sewage	Infilt.	Total	Diameter (mm)	Slope (o/oo)	V (m/s)	Cap. (m3/s)	Upper End	Lower End	Upper End	Lower End	Upper End	Lower End
GI1	GI2-1	296	296	4.980	0.000	4.980	1,500	5.6	3.000	5.301	21.820	11.940	26.420	14.440	3.100	1.000
No3	GI2-1	-	-	0.000	0.000	4.980	700	-	-	-	-	12.500	-	14.440	-	1.240
GI2-1	GI2-2	187	483			4.980	1,500	5.6	3.000	5.301	11.940	8.820	14.440	11.320	1.000	1.000
GI2-2	GI3	163	646			4.980	1,500	5.6	3.000	5.301	8.820	5.540	11.320	7.540	1.000	0.500
GI3	GI4	1,908	2,554			4.980	2,000	1.2	1.679	5.275	5.040	2.750	7.540	7.000	0.500	2.250
No4	GI4	-	-	0.308	0.000	0.308	500	-	-	-	-	5.000	-	7.000	-	1.500
GI4	GI5-1	290	2,844			5.288	2,200	1.2	1.789	6.801	2.550	2.202	7.000	6.950	2.250	2.548
No5	GI5-1	-	-	0.778	0.000	0.778	800	-	-	-	-	5.000	-	6.950	-	1.150
GI5-1	GI5-2	216	3,060			6.066	2,200	1.2	1.789	6.801	2.202	1.943	6.950	7.070	2.548	2.927
GI5-2	GI5-3	125	3,185			6.066	2,200	1.2	1.789	6.801	1.943	1.793	7.070	7.720	2.927	3.727
GI5-3	GI5-4	188	3,373			6.066	2,200	1.2	1.789	6.801	1.793	1.567	7.720	7.110	3.727	3.343
GI5-4	GI5-5	390	3,763			6.066	2,200	1.2	1.789	6.801	1.567	1.099	7.110	6.890	3.343	3.591
GI5-5	GI6-1	286	4,049			6.066	2,200	1.2	1.789	6.801	1.099	0.756	6.890	7.010	3.591	4.054
No6	GI6-1	-	-	0.346	0.000	0.346	500	-	-	-	-	3.960	-	7.010	-	2.550
GI6-1	GI6-2	377	4,426			6.412	2,200	1.2	1.789	6.801	0.756	0.304	7.010	6.800	4.054	4.296
GI6-2	GI6-3	499	4,925			6.412	2,200	1.2	1.789	6.801	0.304	-0.295	6.800	6.550	4.296	4.645
GI6-3	GI6-4	500	5,425			6.412	2,200	1.2	1.789	6.801	-0.295	-0.895	6.550	7.390	4.645	6.085
GI6-4	GI6-5	500	5,925			6.412	2,200	1.2	1.789	6.801	-0.895	-1.495	7.390	7.110	6.085	6.405
GI6-5	GI6-6	30	5,955			6.412	2,200	1.2	1.789	6.801	-1.495	-1.531	7.110	5.500	6.405	4.831
GI6-6	GI6-7	301	6,256			6.412	2,200	1.2	1.789	6.801	-1.531	-1.892	5.500	5.500	4.831	5.192
GI6-7	GI6-8	29	6,285			6.412	2,200	1.2	1.789	6.801	-1.892	-1.927	5.500	7.230	5.192	6.957
GI6-8	GI7-1	936	7,221			6.412	2,200	1.2	1.789	6.801	-1.927	-3.050	7.230	7.460	6.957	8.310
No7	GI7-1	-	-	0.186	0.000	0.186	400	-	-	-	-	3.000	-	7.460	-	4.060
GI7-1	GI7-2	149	7,370			6.598	2,200	1.2	1.789	6.801	-3.050	-3.229	7.460	5.780	8.310	6.809
GI7-2	GI7-3	315	7,685			6.598	2,200	1.2	1.789	6.801	-3.229	-3.607	5.780	4.920	6.809	6.327
GI7-3	WWTP	77	7,762			6.598	2,200	1.2	1.789	6.801	-3.607	-3.699	4.920	4.500	6.327	5.999

Table AII.3.3 Quantity of Planned Interceptor System in Galati

Line No.	Line No. of Lower Sewer	Sewer Line: Sewer Length (m)	Sewer Line: Diameter (mm)	Sewer Line: Earth Covering (m) Upper end	Sewer Line: Earth Covering (m) Lower end	CSO: Small Type	CSO: Large Type	Connection Pipe: Dia(mm)	Connection Pipe: L(m)	Connection Pipe: EC(m)	Interceptor Sewer: Diameter (mm)	Interceptor Sewer: Earth Covering (m) 1-3	3-5	5-7	7-9	Total	Construction Method	Under Railway (length in sewer line)	Manhole: Diameter (mm)	Manhole: Earth Covering (m) 1-3	3-5	5-7	7-9	Total
GI1	GI2-1	296	1,500	3.100	1.000		1				1,500	282	14			296	▲		1,500					
No.3-2		20	300			1		300	20	1-3										1				1
No.3-3		20	400			1		400	20	1-3														
No.3-4	GI2-1	300	700	-	0.940	1		700	300	1-3										1				1
GI2-1	GI2-2	187	1,500	1.000	1.000						1,500	187				187			1,500	1				1
GI2-2	GI3	163	1,500	1.000	0.500						1,500	163				163			1,500	1				1
GI3	GI4	1,908	2,000	0.500	2.250						2,000	1908				1908			2,000	10				10
No4	GI4	20	500	-	1.200		1	500	20	1-3														
GI4	GI5-1	290	2,200	2.250	2.548						2,200	290				290			2,200	2				2
No5	GI5-1	20	800	-	0.950		1	800	20	1-3							Open Cut							
GI5-1	GI5-2	216	2,200	2.548	2.927						2,200	216				216			2,200	1				1
GI5-2	GI5-3	125	2,200	2.927	3.727						2,200	11	114			125			2,200		1			1
GI5-3	GI5-4	188	2,200	3.727	3.343						2,200		188			188			2,200		1			1
GI5-4	GI5-5	390	2,200	3.343	3.591						2,200		390			390			2,200		1			1
GI5-5	GI6-1	286	2,200	3.591	4.054						2,200		286			286			2,200		2			2
No6	GI6-1	20	500	-	2.350		1	500	20	1-3														
GI6-1	GI6-2	377	2,200	4.054	4.296						2,200		377			377		5	2,200		2			2
GI6-2	GI6-3	499	2,200	4.296	4.645						2,200		499			499		15	2,200		2			2
GI6-3	GI6-4	500	2,200	4.645	6.085						2,200		123	377		500	▼		2,200			1		1
GI6-4	GI6-5	500	2,200	6.085	6.405						2,200			500		500	▲	5	2,200					
GI6-5	GI6-6	30	2,200	6.405	4.831						2,200		3	27		30			2,200					
GI6-6	GI6-7	301	2,200	4.831	5.192						2,200		141	160		301			2,200					
GI6-7	GI6-8	29	2,200	5.192	6.957						2,200			29		29			2,200					
GI6-8	GI7-1	936	2,200	6.957	8.310						2,200			30	906	936	Shield Method		2,200				1	1
No7	GI7-1	20	400	-	3.960	1		400	20	1-3														
GI7-1	GI7-2	149	2,200	8.310	6.809						2,200			19	130	149			2,200					
GI7-2	GI7-3	315	2,200	6.809	6.327						2,200			315		315			2,200					
GI7-3	WWTP	77	2,200	6.327	5.999						2,200			77		77	▼		2,200					
Total		8,182				4	4					3057	2135	1533	1036	7762				17	9	1	1	28

Sammary

CSO

Small Type	Large Type
4	4

Connection Sewer

Dia(mm)	L(m)	EC(m)
300	20	1-3
400	40	1-3
500	40	1-3
700	300	1-3
800	20	1-3

Interceptor Sewer

Dia(mm)	Earth Covering (m) 1-3	3-5	5-7	7-9	Total Length (m)	Construction Method	Remark
1500	282	14			296	Open Cut	
2000	2258				2258	Open Cut	
2200	517	1957			2474	Open Cut	
2200		20			20	Open Cut	Under Railway
2200		144	1533	1036	2714	Shield Method	
Total	3057	2135			7762		

Manhole

Dia(mm)	Earth Covering (m) 1-3	3-5	5-7	7-9	Total
1500	3				3
2000	10				10
2200	4	9	1	1	15

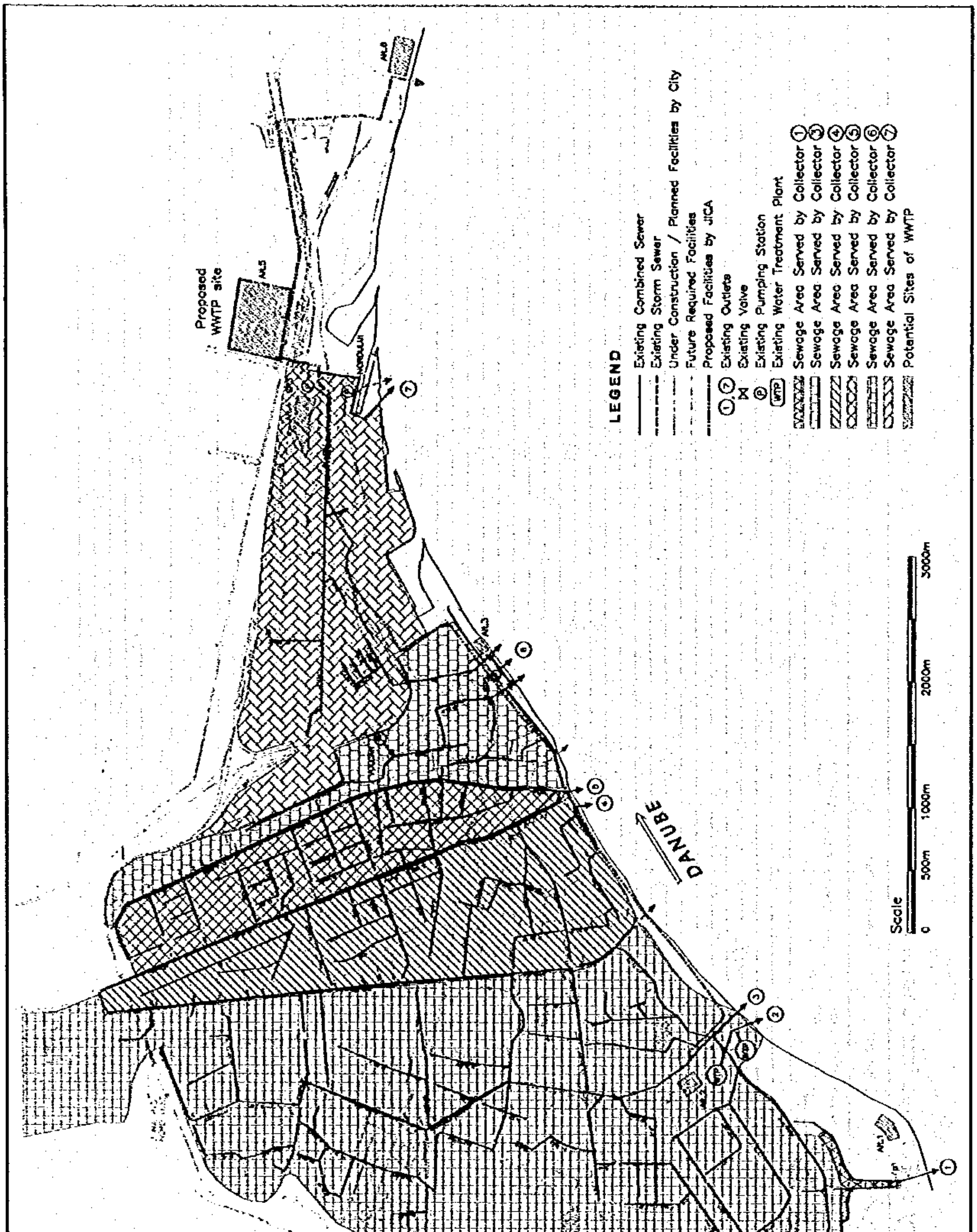


Figure AII.3.1	Galati Sewerage System (Existing and Planning)

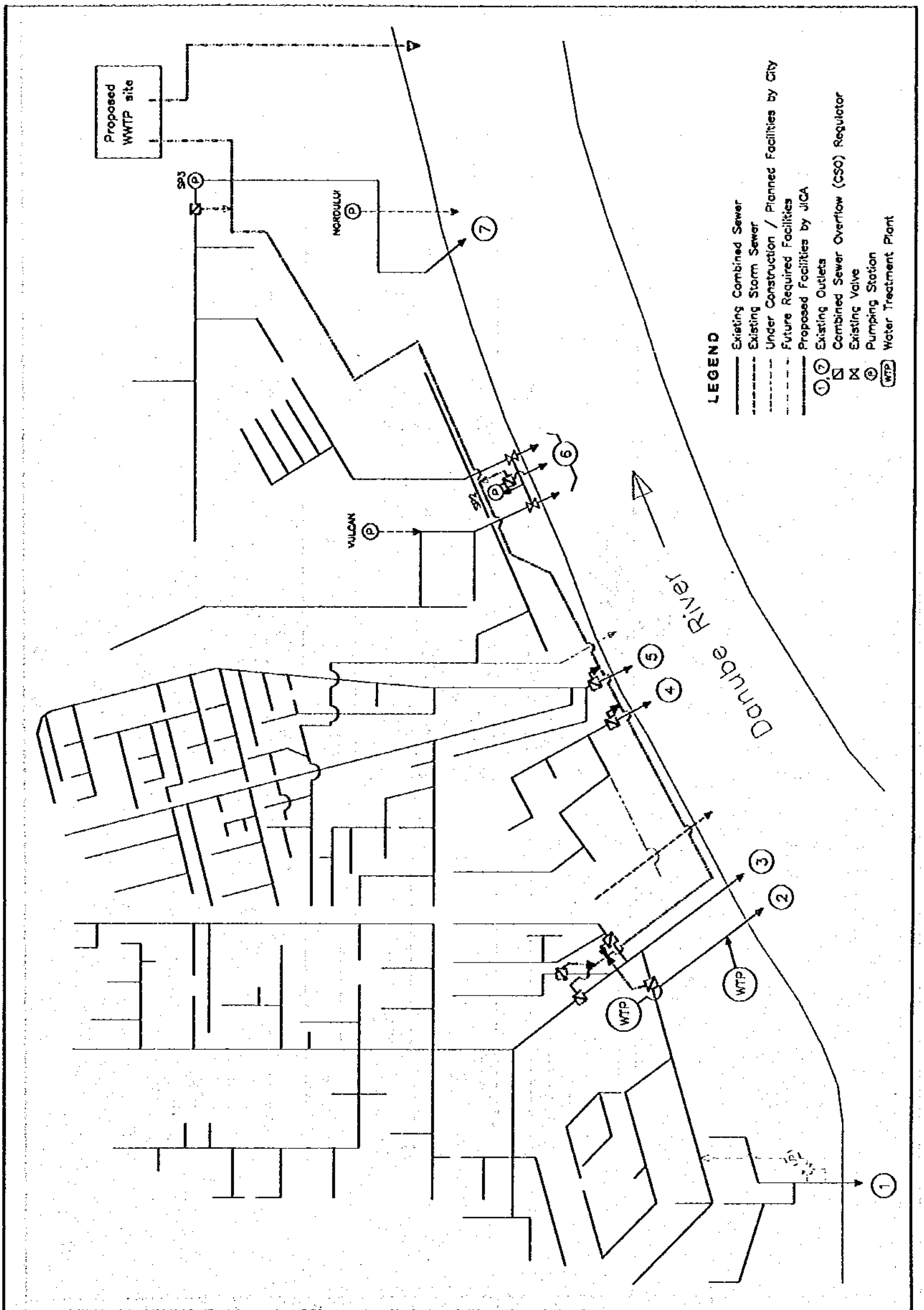
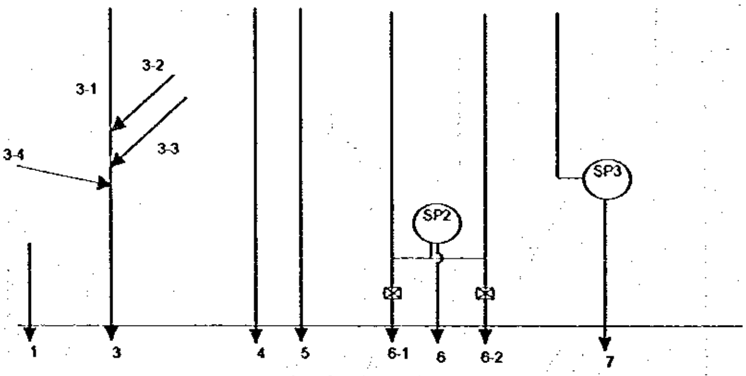
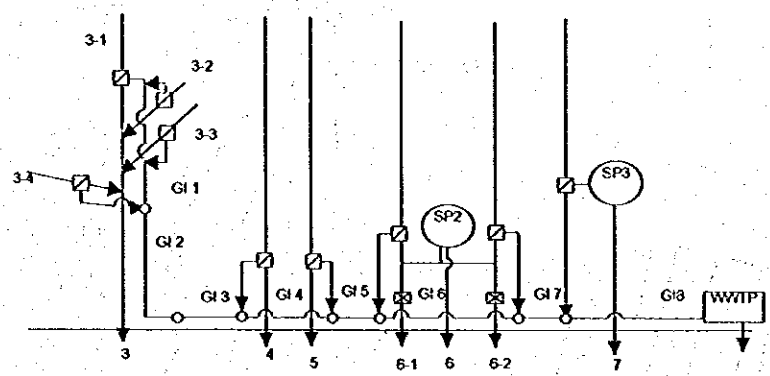


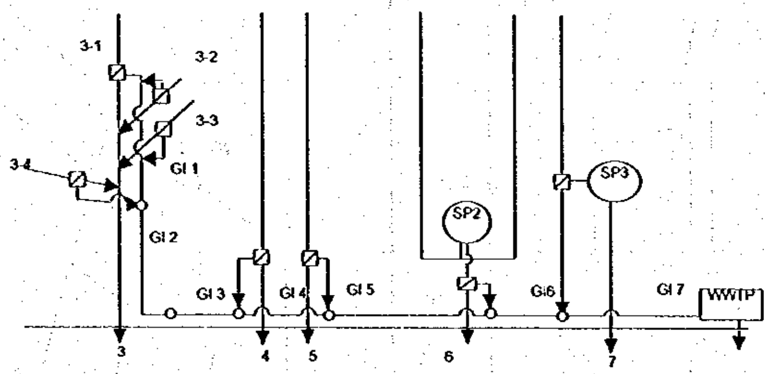
Figure AII.3.2	Schematic Representation of Galati Sewerage System (Existing and Planned)



Existing Sewer Layout



Interceptor Plan (Alt. 1)



Interceptor Plan (Alt. 2)

Figure AII.3.3	Flow Chart of Existing Sewer and Planned Interceptor of Galati

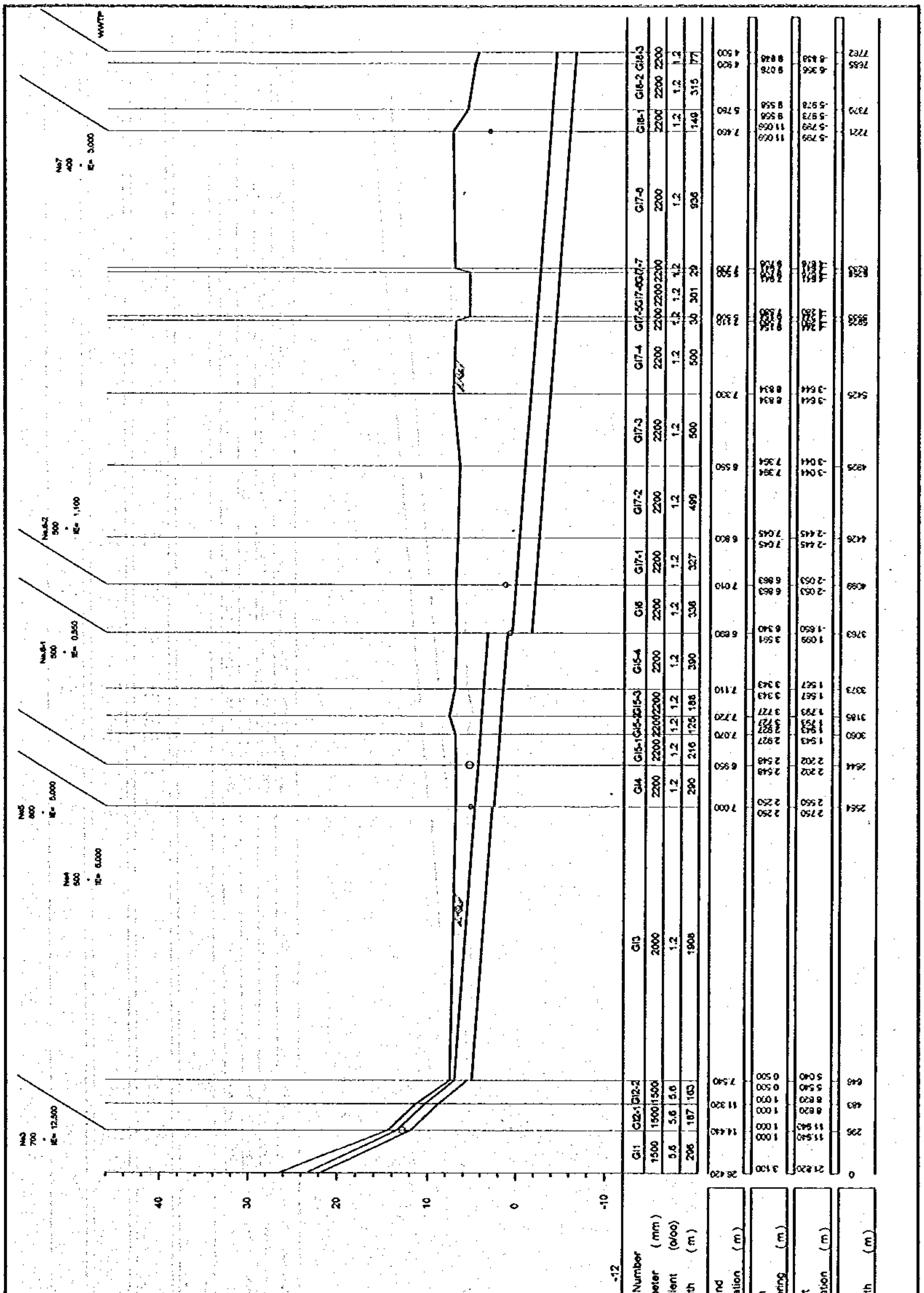


Figure AII.3.4 Longitudinal Profile of Planned Interceptor in Galati (Alt.1)

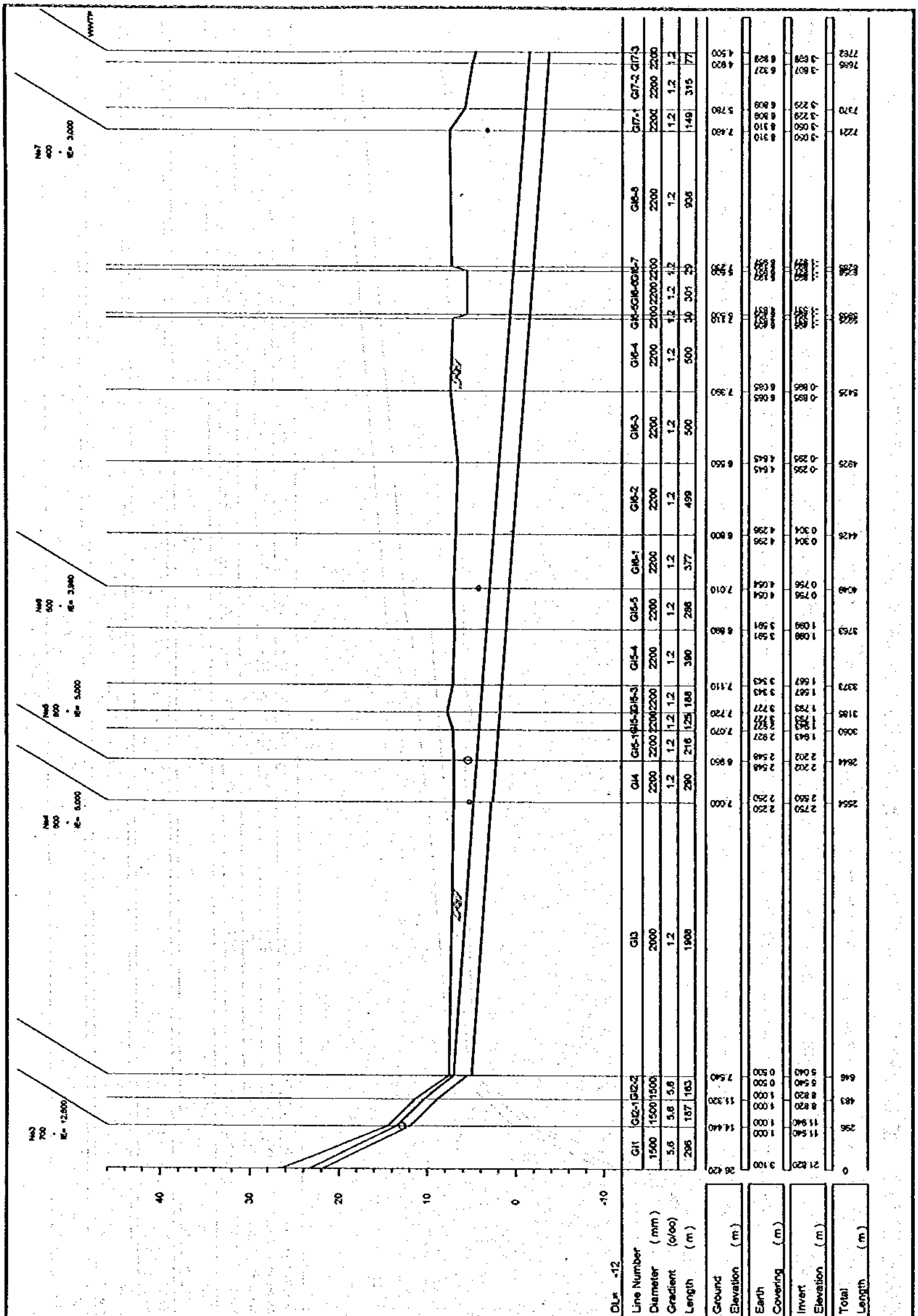


Figure AII.3.5 Longitudinal Profile of Planned Interceptor in Galati (Alt.2)

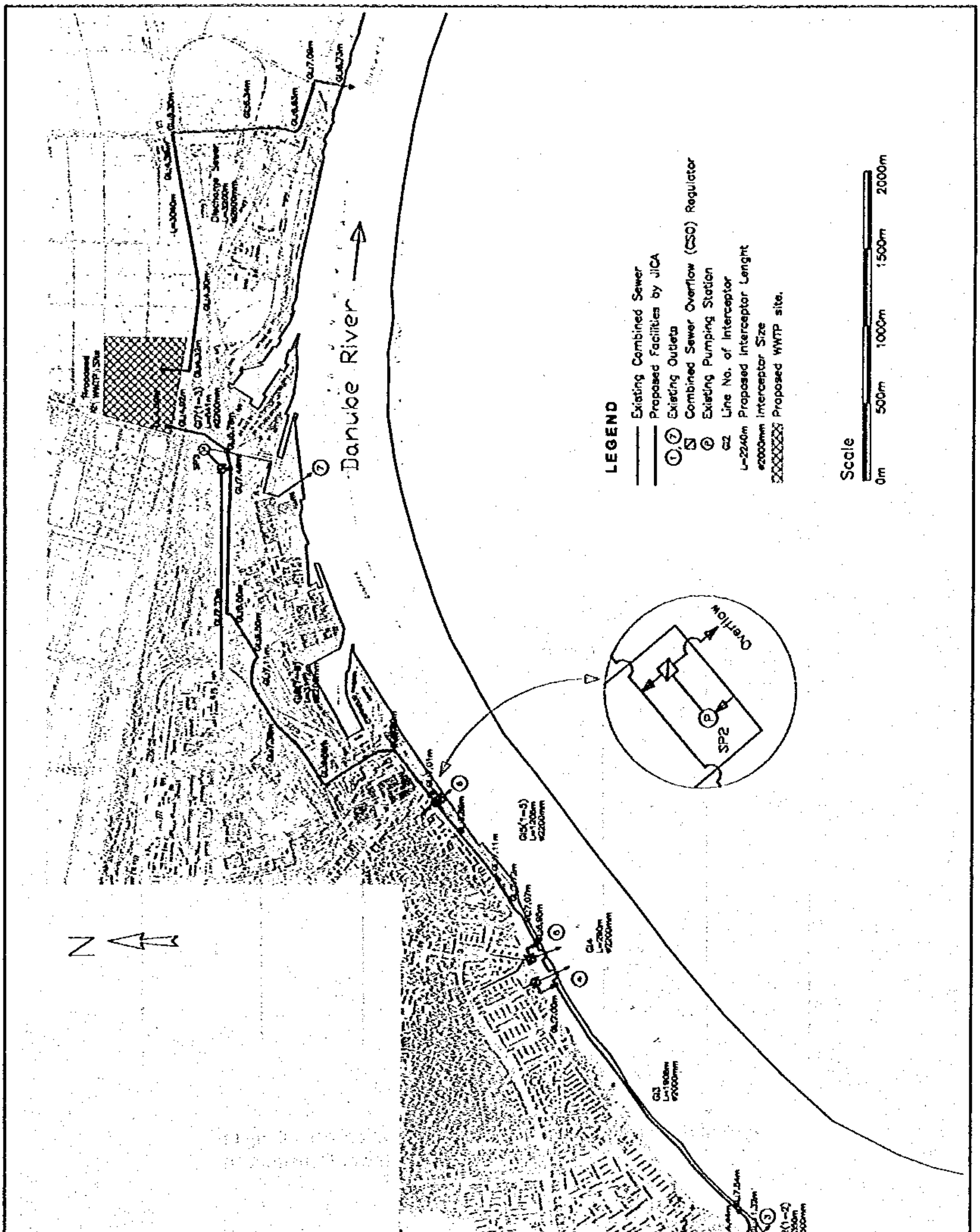
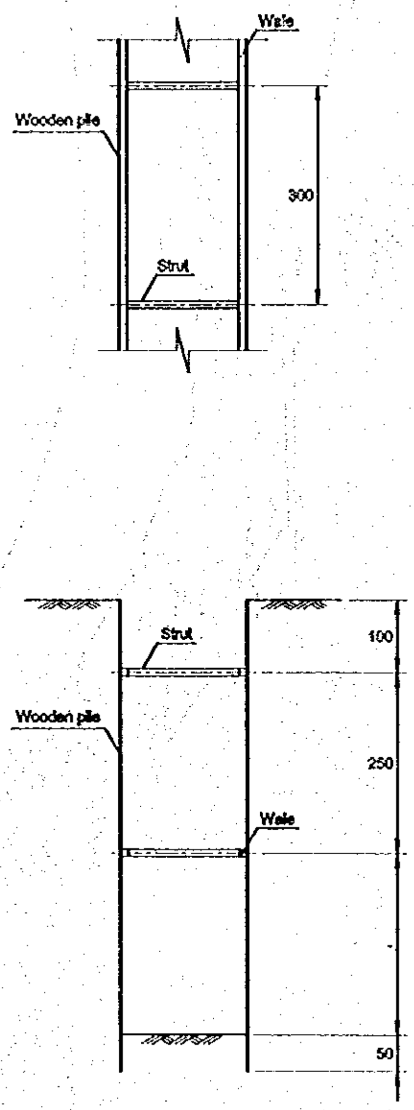
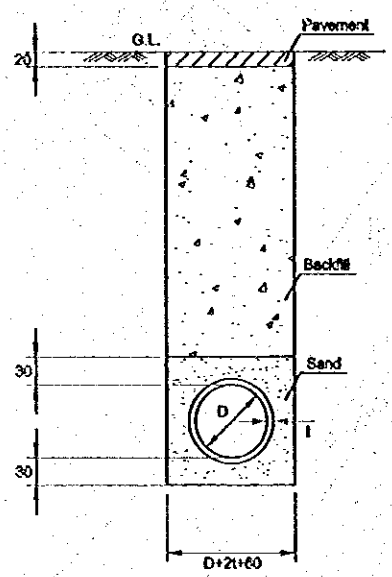


Figure AII.3.6	Layout of Proposed Interceptor in Galati (Alt.2)



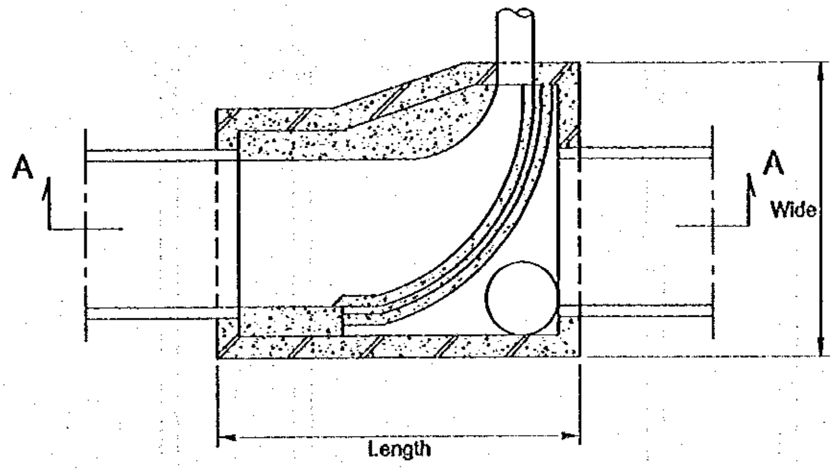


Typical Sewer Bedding

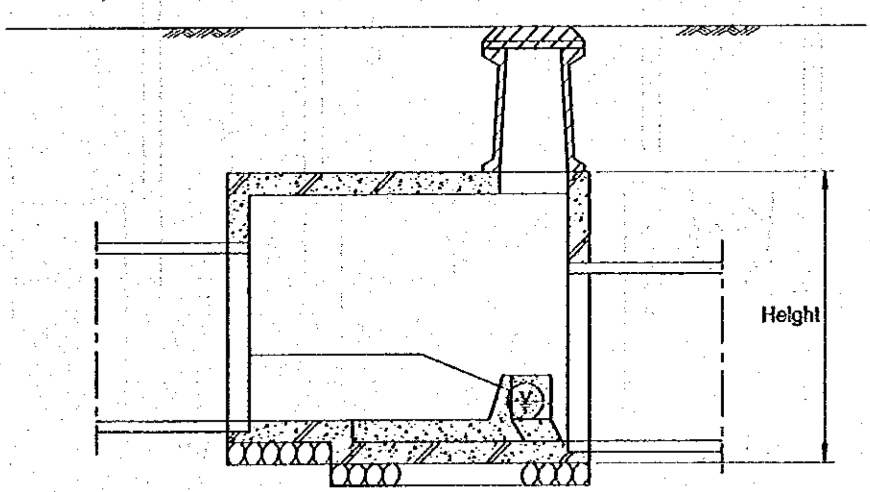
Typical Sheathing on
Sewer Construction

(unit : cm)

Figure AII.3.7	Typical Sewer Bedding and Typical Sheathing on Sewer Construction



Plan



Section A-A

(unit : m)

	Wide	Length	Height
Small Type	2	3	2
Large Type	4	5	4

Figure AII.3.8 Typical Combined Sewer Overflow (CSO) Regulator

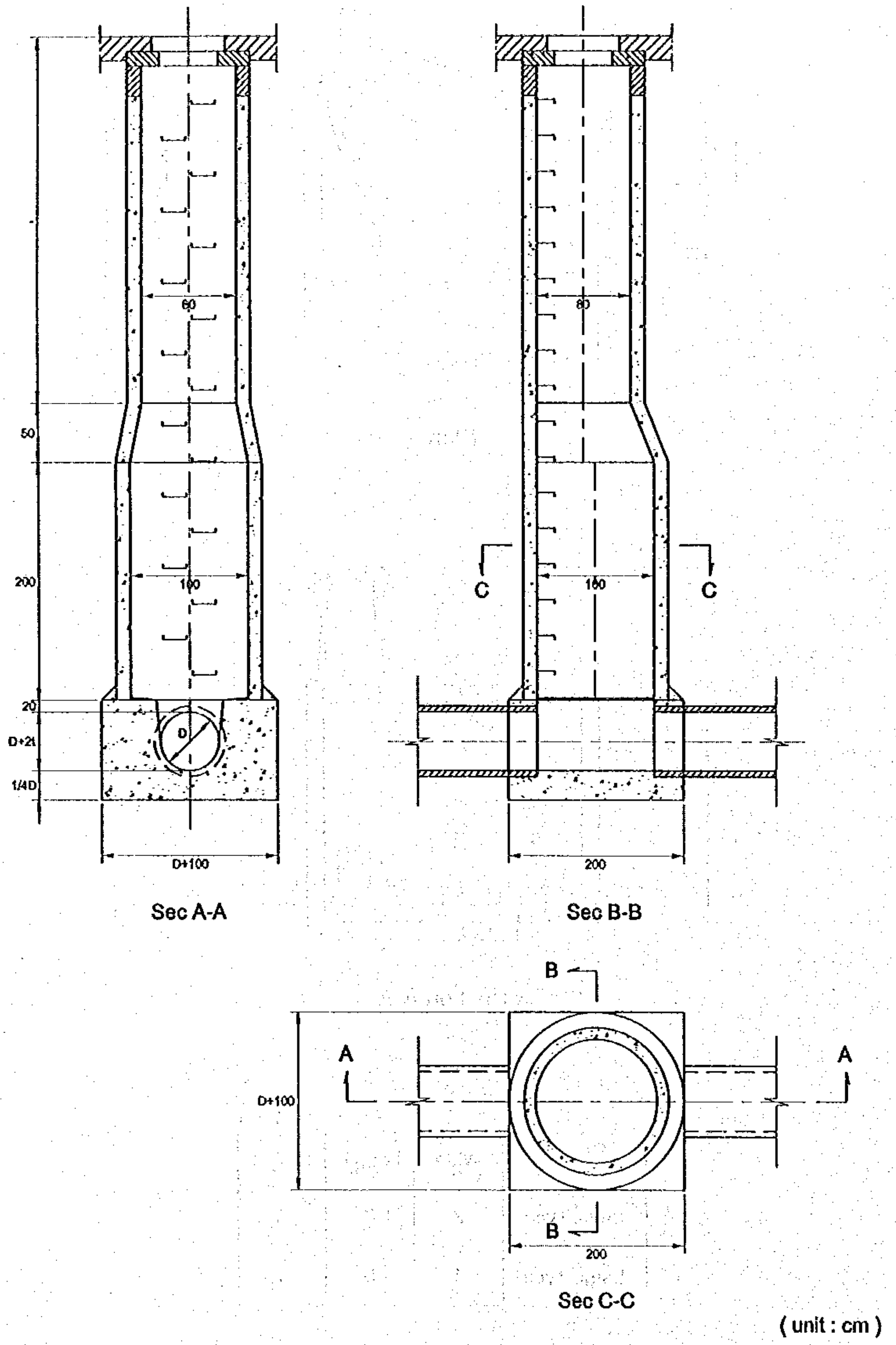


Figure AII.3.9	Typical Stucture of Manhole