APPENDIX 10, PART I (B/P)

Surveys

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APPENDIX 10 SURVEYS

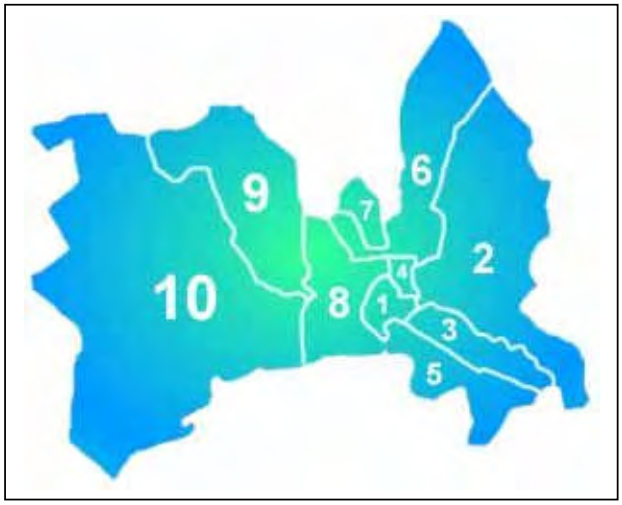
10.1 Social Survey

KRAFTING GRUP

Project: Study on Wastewater Management in Skopje

SOCIAL SURVEY

FINAL REPORT



Map of municipalities in Skopje

January, **2008**
Skopje

Client	:	**Japan International Cooperation Agency**
Project	:	**Study on Wastewater Management in Skopje**
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Date	:	**29 October 2008**

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List of Abbreviations

EIA	Environmental Impact Assessment
EIONET	European Information and Observation Network
FIDIC	International Federation of Consulting Engineers
GoM	Government of Macedonia
HH	Households
HZW(M)	Hazardous Waste (Management)
IFI	International Financial Institution
LEAP	Local Environmental Action Plan
LSG	Local Self Government
MEIC	Macedonia Environmental Information Centre
MoEPP	Ministry of Environment and Physical Planning
MoLSG	Ministry for Local Self Government
NEAP	National Environmental Action Plan
NGO	Non Governmental Organization
No	Number
NWMP	National Waste Management Plan
PPP	Public Private Partnership
SWM	Solid Waste Management
TA	Technical Assistance
ToR	Terms of Reference
WM	Waste management
WTP	Willingness to pay
ZELS	Association of the Units of Local-Self Government

BACKGROUND INFORMATION

Skopje is an administrative division within the Republic of Macedonia constituted of 10 municipalities (Aerodrom, Butel, Centar, Cair, Suto Orizari, Saraj, Kisela Voda, Gjorce Petrov, Karpos, Gazi Baba). As a such administrative unit Skopje is the capital of the Republic of Macedonia. According to the 2002 census, the population of Skopje was 506,926 people.

The pollutants originated from domestic and industrial wastewater have been discharged to the rivers without any treatment. Exeption are only few industries that have their own waste water treatment station. That results in deterioration of sanitary environmental condition and contamination of the river waters.

In order to decrease the pollutants loads discharging into the rivers from various pollution sources and to improve the sanitary and water environment in the City of Skopje, the Japan International Cooperation Agency, dispatched the JICA Study Team to conduct the Study on Wastewater Management in Skopje to formulate the Sewerage System Improvement Basic Plan and carry out the Feasibility Study for selected priority projects in the Basic Plan.

Within the realization of the above mentioned Study on Wastewater Management in Skopje, the Consalting Team of Krafting Grup – Skopje is appointed by JICA Study Team as Local Consultant to conduct Social Survey.

1. Introduction

The improvement of the current waste waters discharging/treatment practices in Skopje Region will involve upgrading of technical standards of the services towards compliance with EU requirements. In this regard the reinforcement of the existing sanitary practice and financial patterns to achieve full cost recovery of operations should be the first step taken by the authorities. This needs to be accompanied by public awareness campaigns that target the beneficiaries of the service and aim to create an understanding of the key issues of waste water treatment.

When making any decision to increase household charges it is clear that affordability is the most critical concern. It is difficult to get accurate income data from the official statistics, due to the gray economy not being recorded in any statistical record and there are no data available on income / expenditure situation. Next to the ability, the willingness to pay for improved services is an important precondition to start any investment which would most probably require comparable increase of the fee collection rate. Thus Social Survey is required as part of the Study on Wastewater Management in Skopje. Issues identified by the Social Survey will be used in the process of planning, design construction and operation of the sewerage system in Skopje City.

The questionnaire also covered the current quality and appreciation of service provided, the perceptions on deficiencies and ways to overcome them, the interest of HHs for connection on sanitary water supplying and sewerage system in the areas not receiving any at present, as well as the range of the fee level increase considered as acceptable by those who would be willing to pay more for better services, or to pay for initiation of service.

In the following chapters results of both HH survey and Water utilization survey (survey in the companies/organizations) are outlined following the format of the questionnaires. In some cases cross references are made to check both accuracy and relevance of the answers, or to reflect their interrelation.

2. Objective of the survey

Main objective of the Social Survey is to obtain relevant data (results) that will be used both in the process of facility planning and Operational and Maintenance planning. The results will also serve as basis for economical and financial analyses, Initial Environmental Evaluation and Environmental Impact Assessment.

During the planning and execution of the survey the following project related objectives were set:

- Providing information on consumer demand for improved water supply and waste water treatment
- Providing information on affordability and willingness to pay for the improvements;
- Assess the respondent's views on the existing charging policies and ways to change them if required; and
- Obtain information about public awareness on rivers pollution issues

3. Activities within the Social Survey

In order to address the main objective of the social Survey, the consultant has been performed following activities:

1. **Detailed implementation schedule of the work (**submitted within the Inception Report**)**. This schedule contains information about activities, persons involved in each activity, detailed location and timeframe of the activity.
2. **Pre-questionnaire survey (**conducted within the Inception Period**)**. Using preliminary questionnaire sheet initial data have been obtained and the questionnaire has been modified.
3. **Preparatory activities** for implementation of Social Survey:
   - Initial training for field surveyors and data entry operators (held 24.11.2007),
   - copying questionnaires,
   - enabling writing tools
   - Subsequent instructions for field surveyors and data entry operators
4. **Implementation of Social Survey;** During the questionnaire survey at the site, data about sampling day, time, location, personnel etc. were recorded. Photos that show the surrounding and the interviews have been made. The exact location of sampling was recorded on map.

4. Implementation Schedule

The Survey has been executed in 10 municipalities in Skopje region, on two levels as follows:

1. Social survey and
2. Water utilization survey

4.1. Social Survey implementation

Social Survey has been approached 403 households in total. The purpose was to identify the public's awareness of sanitation and water pollution, water usage, preferences for future sewerage/sanitation service levels, willingness and ability to pay sewerage charges.

Social survey was performed as questionnaire survey in interview-style, using questionnaire sheet separated in following 5 categories:

A Respondent profile
B Socio-economic characteristic of the household
C Information on water supply
D Information on waste water
E Sanitary practice
F Health & Hygiene
G River pollution

Municipality (residence area) and economic condition of the household have been chosen as selection criteria. The consultant distributed equal number of samples per municipality (40 samples per municipality). Interviewed households were selected randomly. Initial determination of the household economic condition was made according to the visual perception of the field surveyor. Table 1 presents economic condition of the interviewed households in each municipality.

Table 1 Distribution of the households according to economic condition

	Economic condition							
	Low class	**Middle-low class**		**High-middle class**			**High class**	
Monthly income (MKD) of the interviewed households	**up to 8,000**	**8,001-14,000**	**14,001-18,000**	**18,001-24,000**	**24,001-35,000**	**35,001-50,000**	**over 50,000**	**Not presented**
Municipality								
Aerodrom	3	5	4	11	5	8	6	0
Butel	3	9	4	11	6	4	2	1
Centar	2	4	8	12	11	3	1	0
Cair	7	10	3	6	3	2	0	9
Gazi Baba	3	12	7	7	9	1	1	0
Gjorce Petrov	3	6	10	9	9	2	0	1
Karpos	1	8	8	9	5	5	4	0
Kisela Voda	4	4	7	15	4	3	1	2
Saraj	5	9	14	1	6	4	1	0
Suto Orizari	26	9	1	0	0	0	0	4
Total	**57**	**74**	**66**	**77**	**55**	**30**	**16**	**17**
Total in %	**14.1%**	**18.9%**	**16.4%**	**20.1%**	**14.4%**	**7.9%**	**4.0%**	**4.2%**

4.2. Water utilization survey implementation

Water utilization survey has been approached 50 organizations within 10 municipalities in the City of Skopje. The purpose was to understand how water is utilized in terms of water source, amount of water consumption, affordability and willingness to pay more for better service. Similar to the social survey, the water utilization survey was performed as questionnaire survey in interview-style, using questionnaire sheet divided in 5 categories of questions, as follows:

A Basic information about organization
B Socio-economic characteristic of the organization (Management authority, sales etc)
C Information on water supply
D Information on waste water
E Sanitary practice
G River pollution

Sampling design was created in accordance with the requirements given in the ToR.

The consultant has been redistributed the number of organizations that should be interviewed in order to reflect wastewater condition in Skopje and to ensure the appropriate representation from each segment of activities per municipality. The total number of visited organizations was not changed. Table 2 presents the number and type of organizations interviewed within the surveying process.

Table 2 Distribution of organizations per municipality

Area	Hospital	School	Recreation Facilities	Office	Others (Specify)	Total
Aerodrom	1	1	1	1	1 (Coffe bar)	5
Butel	1	1	0	2	1 (Fast food shop)	5
Centar	1	1	1	1	1 (Ramstore Mall)	5
Cair	1	1	0	2	1 (Restaurant)	5
Gazi Baba	2	1	0	2	0	5
Gjorce Petrov	1	1	1	1	1 (Pizza Restaurant)	5
Karpos	1	1	1	1	1 (Fast food shop)	5
Kisela Voda	1	1	1	1	1 (Restaurant)	5
Saraj	1	2	1	1	0	5
Suto Orizari	1	1	0	2	1 (Restaurant)	5
Skopje City	11	11	6	14	8	50

5. Responses

The high majority of the selected households and organizations co-operated exceptionally well. Problems only arose in some households for the questions related to socio-economic characteristics (average monthly income) and organizations (average monthly sales and expenditure).

About 5% of the respondents was approached again during the data analyses to clarify some answers whenever inconsistency was recognized upon checking of controlling questions.

The interviewers perceived welcoming and full confidence of households. The small gift given to householders upon the interviews (100gr. coffee or chocolate) was seen as a sign of gratefulness supporting a positive attitude of the respondents.

A general remark can be drawn that the means of controlling the given information is too limited to depict reliable conclusions for almost every type of answers, however the activity resulted in a reasonable indication of the participation of the low income household within the total sample (those who are not able to pay even the current fee levels).

The interviewers reported that people rather answered in accordance to the official data than admitting that they are unofficially employed or in some other way gaining money. The income from agriculture was rarely presented by households or neglected if regarded as non - monetary income.

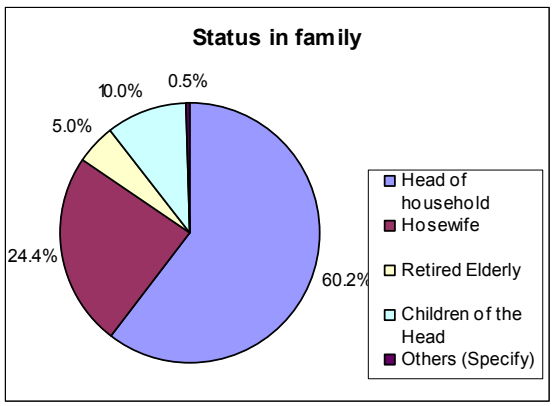
6. Results

6.1 Results of the Social Survey

6.1.1 Respondent profile

In 61 % of interviewed households (403 HH in total), the respondent was the Head of the HH. Data on the respondent status in the family are presented on Figure 1:

Figure 1



The gender aspects shows that the number of male respondents is 276 (68,5%), and number of female respondents is 127 (31,5%)

Age structure of the respondents is presented on the Figure 2. Majority of the interviewed persons were between 41 and 55 years old.

Figure 2

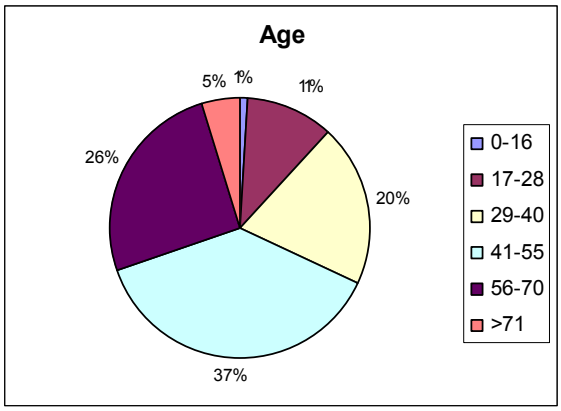


Table 3 shows that high majority of the interviewed person were Christians- ortodox (67,0%) and 30,8 percent were Muslims. This religion structure for City of Skopje is similar to those presented officially by State Statistical Office.

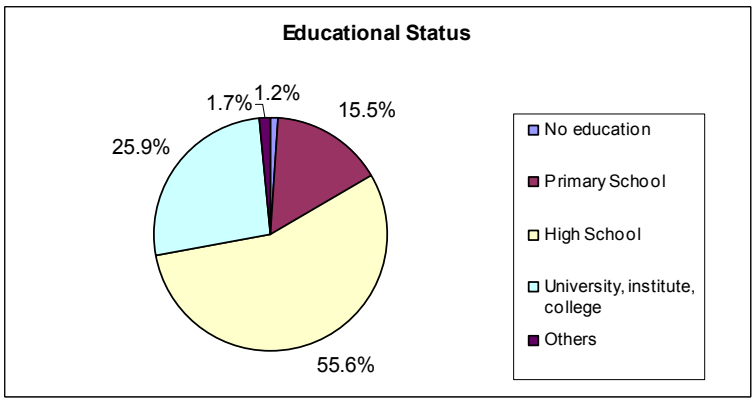
Table 3 Respondent's religion

Religion	Number of respondents	Percentage
Ortodox	270	67.0%
Catholic	2	0.5%
Muslim	124	30.8%

Few municipalities show specific religion constellations. In Saraj and Chair 97,5% of interviewed HHs were Muslims, in Suto Orizari more than 80% declared as Muslims. In other municipalities the Christian religions dominate.

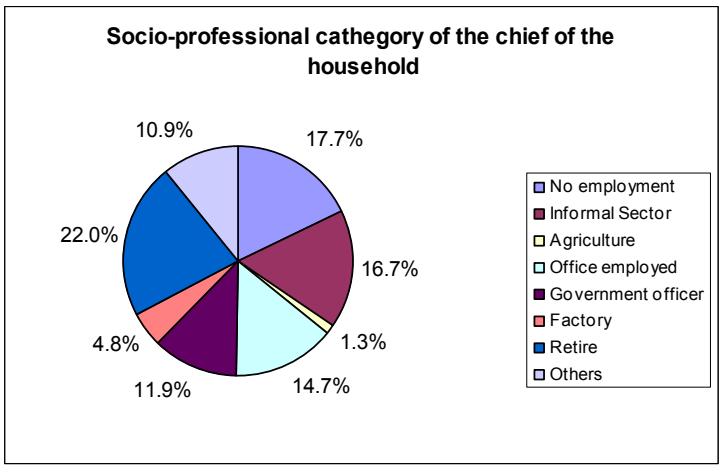
Figure 3 indicates the educational level of the households' members. The table indicates an expected high level of high school -secondary education and a low number of persons with no or incomplete education as usual in former socialistic countries. The percentage of people having university level of education is expectable for urban environment.

Figure 3



Data indicating socio-professional category of the head of HH are presented on Figure 4 . Overall, 59,1 % of the households' heads (238 persons) are according to their answers classified as economically active. These belong to the following groups of employments:, agriculture office-employed, government officer, employed in factory, unemployed and retired, all being over 18 years old. Out of these, 16,4% are employed in the informal sector and 1.2% are agricultures, 14,4 are office-employed, 11,7% are Government officers, 4,7% are employed in factory. 10,7 % have professions different form described ones. Consequently, the survey indicates economically inactive population comprises of unemployed and retired respondent (17,4 and 21,6% respectively).

Figure 4



6.1.2 Socio-economic characteristic of the household

Socio-economic characteristic of the interviewed HH has been evaluated though set of questions reflecting respondents' wealth.

Data on housing ownership presented on Table 4, indicates that high majority of the respondents (283 persons) own a house (70,2%) and 100 respondents own an apartment (24,8%) That high percentage of ownership can be explained by relatively high rents for house or apartment in Skopje and mentality of local population for permanent housing.

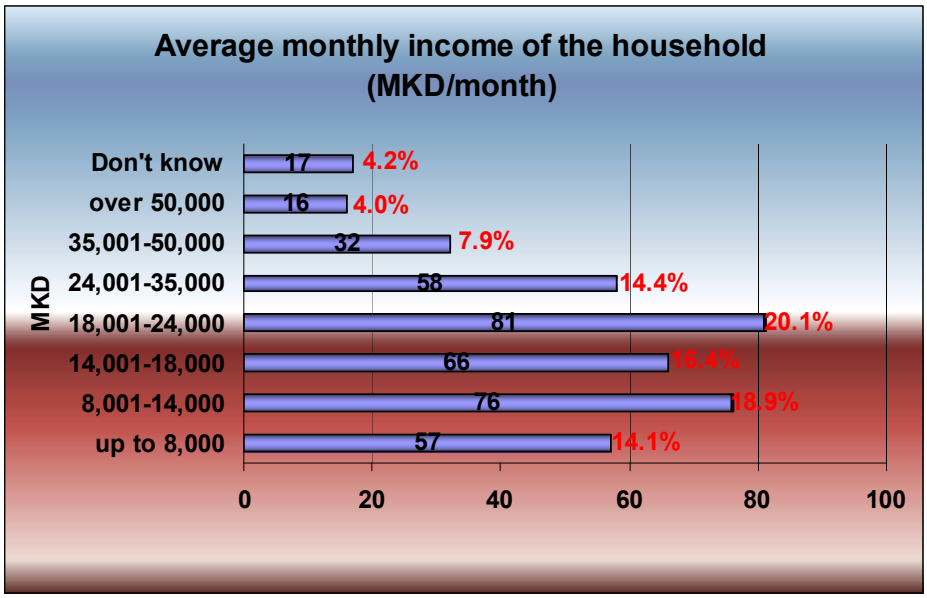
Table 4 Housing ownership

	Owns a house	Rent a house	Own an apartment	Rent an apartment	Others
Number of respondents	283	9	100	3	8
Percentage	70.2%	2.2%	24.8%	0.7%	2.0%

The most usual type of dwellings are concrete dwellings 67,7 % (273 respondents) while 30% of interviewed persons (121 respondents) lives in bricks dwellings.

Bearing in mind the sensitivity of the income issue, the survey tried to overcome problems of inappropriately presented household revenues by including further means of evaluating the respondents' wealth, e.g. by evaluating to each respondent's self assessment of their household's purchasing power and types of expenditures made recently. In any case, it is generally accepted that nominal income values within Macedonia should be considered with taking into account the impact of the shadow economy.
The responses on the households' income for the project area are presented in the Figure 5:

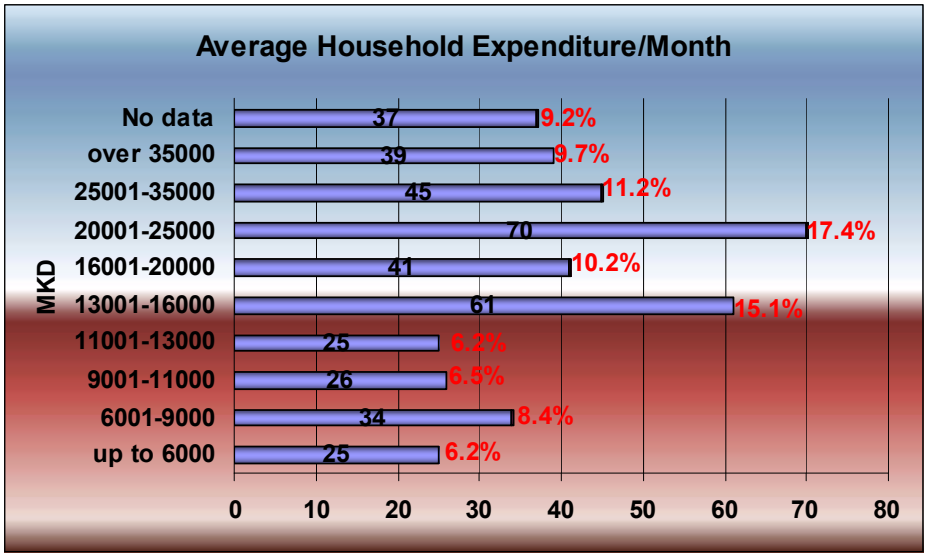
Figure 5



The results show that a considerable number of HH belong to the middle and high income group whereas only few can be considered as below poverty level (up to 8000 MKD/month). The reliability of those HH having been classified as very poor is difficult to assess. It is often discussed how honestly households answer questions on their income due to the fact that most of them receive social benefits, which would be lost if any additional and not registered source of income would be presented. The same explanation can be used for relatively high percentage of "Don't know" answers.

To assess the purchasing power of individual HH the respondents were asked to make the self evaluation and to indicate average monthly expenditure per HH. Data are outlined on the Figure 6. It is indicative that relatively high number of the respondents (mainly HH wilh low income rate) doesn't like to give answer on this question. That can be explained by the above mentioned treat of loosing social benefit.

Figure 6



Monthly expenditures per HH were selected in 6 categories as follows: Water and Wastewater, Solid waste disposal, Telephone, Electricity, Heating and Food; Indication of amount spent per category is presented on Table 5:

Table 5 Monthly expenditures in MKD spent per HH

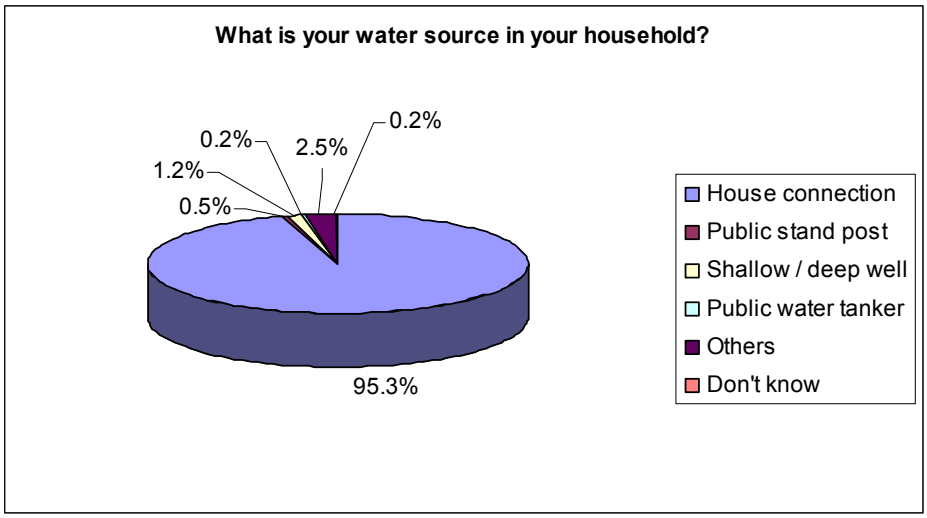
Water and Wastewater	<300	301-500	501-800	801-1200	> 1200	No data
No. of respondents	89	158	93	42	11	10
Percentage	22.1%	39.2%	23.1%	10.4%	2.7%	2.5%
Solid waste	<300	301-500	501-800	801-1200	>1200	No data
No. of respondents	152	94	61	21	5	70
Percentage	37.7%	23.3%	15.1%	5.2%	1.2%	17.4%
Telephone	<600	601-900	901-1300	1301-2000	>2000	No data
No. of respondents	28	67	100	106	50	52
Percentage	6.9%	16.6%	24.8%	26.3%	12.4%	12.9%
Electricity	<600	601-900	901-1300	1301-2000	>2000	No data
No. of respondents	12	19	89	190	79	14
Percentage	3.0%	4.7%	22.1%	47.1%	19.6%	3.5%
Heating	<1000	1001-1800	1801-2500	>2500	No data	
No. of respondents	15	65	139	51	133	
Percentage	3.7%	16.1%	34.5%	12.7%	33.0%	
Food	< 5000	5001-9000	9001-15000	>15000	No data	
No. of respondents	48	97	142	72	44	
Percentage	11.9%	24.1%	35.2%	17.9%	10.9%	

6.1.3 Information on water supply

The general perceptions about the current water supply (status of the service levels and deficiencies), water consumption, the actual fee, options for improvement of the current water supply and willingness to pay for improved or initiated services were analyzed and presented in the following paragraphs.

Figure 7 shows the water source in interviewed households. It is evident that high majority of households (95,3% or 384 out of total 403 HH), including households in rural parts of the Skopje City have sanitary water house connection.

Figure 7



Data on water consumption, presented on Table 6 indicate consumption of water per household. It is important to note that respondents living in apartments mostly have monthly consumption of water not bigger than 10m^3. Respondents living in housed have presented different water consumption that can be explained with fact that some of the house and garden owners use sanitary water also for irrigation of gardens.

Table 6 Average monthly water consumption per HH

Water consumption	Number of respondents	Percentage
<10 m3	35	8.7%
10-20 m3	165	40.9%
20-30 m3	101	25.1%
30-40 m3	39	9.7%
>40 m3	16	4.0%
No data	47	11.7%

Household expenditure for water supply are presented on Table 7 .

Table 7 Monthly expenditure in MKD for water supply per household

	up to 300	300-400	400-500	500-600	600-1000	1000-2000	over 2000
Number of respondents	82	52	61	60	70	40	20
Percentage	21.3%	13.5%	15.8%	15.6%	18.2%	10.4%	5.2%

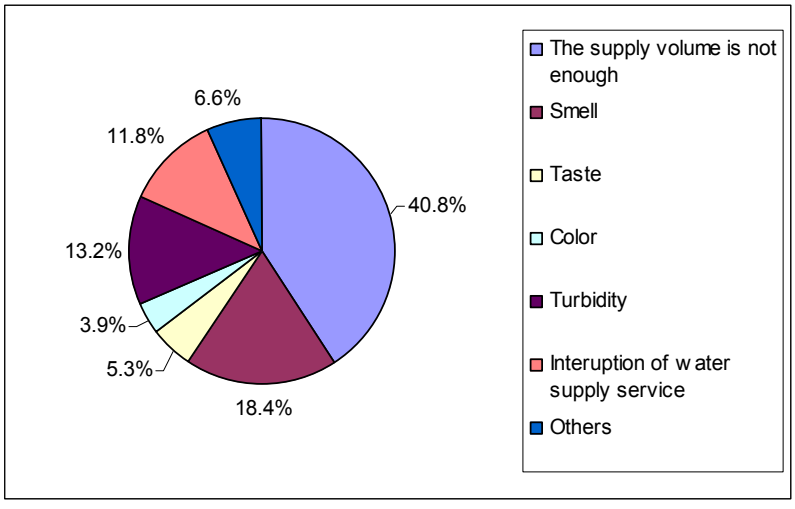
Besides obtaining information on the household's expenditure for water supply, one important aim of the investigation was identification of the respondent's perceptions on the existing water quality.

Once asked for their general impression about satisfaction with current water supply (simple yes - no question –see Table 8), the respondents were set to think about the reasons in case of negative answer. Results are presented on Figure 8.

Table 8 Satisfaction with the current water supply service (WSS)

Municipalities	Are HH satisfied of the service			
	No		Yes	
	HH	%	HH	%
Aerodrom	13	3.3	29	7.2
Butel	4	1.0	36	8.9
Centar	3	0.8	38	9.4
Cair	3	0.8	37	9.2
Gazi Baba	9	2.3	31	7.7
Gjorce Petrov	7	1.8	33	8.2
Karpos	0	0.0	40	9.9
Kisela Voda	10	2.5	30	7.4
Saraj	5	1.3	35	8.7
Suto Orizari	11	2.8	29	7.2
Total	65	16.3	338	83,7

Figure 8 What are the deficiencies of current water supply



6.1.4 Information on waste water

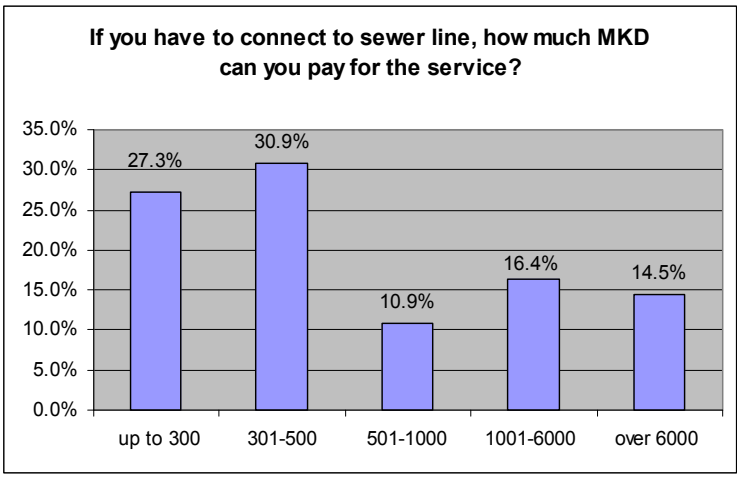
In parallel with respondents' satisfaction with current water supply, the survey investigates current waste water management practice. On a question about discharging waste water from toilets high majority (80%) answer that they have connection to the sewer line and 16 % of the household (64 HH) use septic tanks for toilet waste water discharging. The results presented on the Table 9 shows that more than 95% of the respondents who use septic tanks explain that there is no sewer line close to their house.

Table 9 Why you don't connect to sewer line?

	Number of respondents	Percentage
There is no sewer line near the house	68	95.8%
Too expensive to connect	2	2.8%
I don't feel the necessity to connect	1	1.4%
I don't want to spend money for it	0	0.0%

Affordability of the interviewed households not connected to sewer line, to pay for this service is different and the responds are presented on Figure 9:

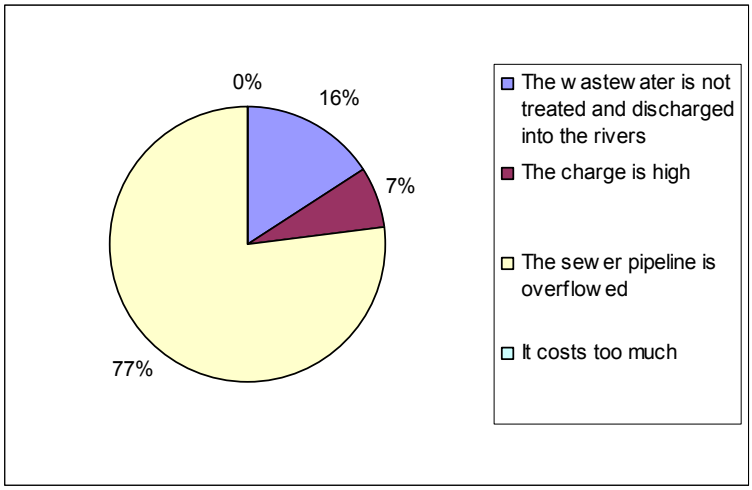
Figure 9



Survey investigation on respondents' satisfaction from current dispersal of waste water shows that 61,8 % of the households are satisfied from provided service; 56 households or 13,9% present moderate satisfaction while 7,9 % of the respondents were not satisfied at all.

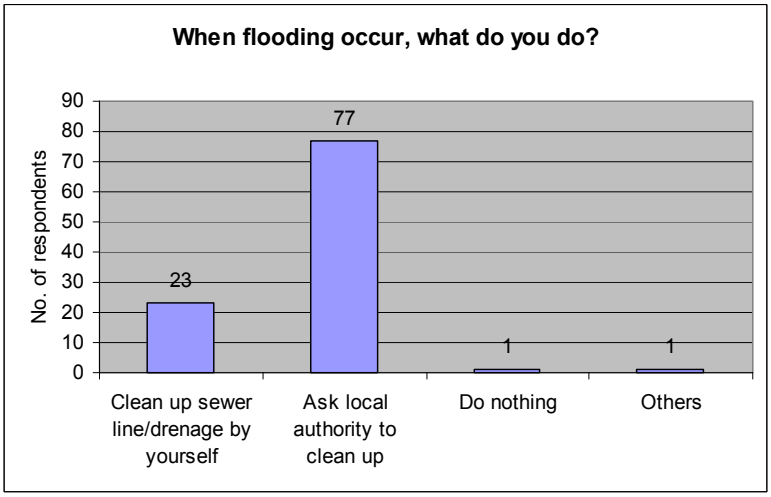
Respondents, who were moderately satisfied or were not satisfied at all, were asked to present the reason for their perception. Results are given on Figure 10. These results show that people are the most concern about sewer pipe overflowing.

Figure 10 Reasons of dissatisfaction



Respondents were asked to present if they have experience with overflowing and to present its frequency. 20 % of the respondents confirmed their experience with sewer line overflowing. Next question of the questionnaire was to explain their activity when overflow occur. The answers are presented on Figure 11:

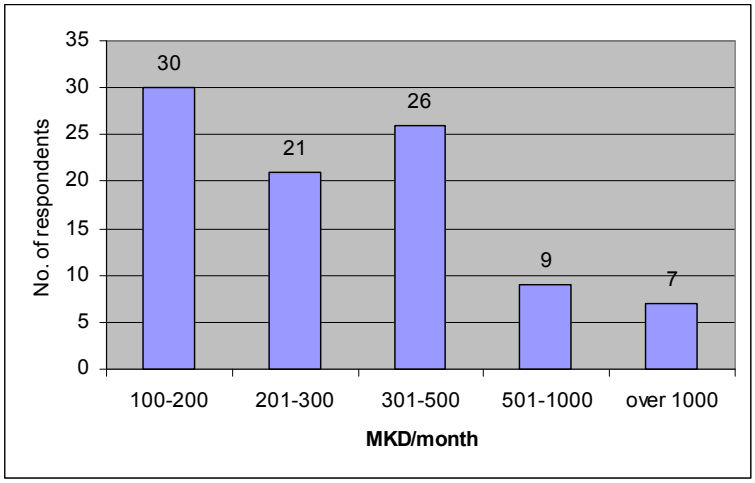
Figure 11



Along with the general perceptions about the current waste water management practice an important issue in this chapter was to identify willingness to pay for improved services. Analyzed results shows that 56,4 % of the respondents are not willing to pay for improved sewerage service, while 105 respondents (43,6%) are prepared to pay more.

Respondents were asked to indicate the amount they are prepared to pay. The results presented on Figure 12, shows that majority of the respondents are willing to pay not more than 500 MKD per month.

Figure 12 Willingness to pay more for improved waste water services



6.1.5 Sanitary Practice

Next figures present sanitary practice in the interviewed HH. Asked about current practice for disposal of HH solid waste, 367 respondents answered that they dispose the solid waste on designated place for its collection. In the rural settlements, where waste collection is not in place, the waste is disposed on the streets or just in the drainage canals. Results are presented on following table:

Table 10 Where do you dispose the HH solid waste?

	Number of respondents	Percentage
Designated place for its collection	367	92.0%
Street nearby house	15	3.8%
Drainage canal	14	3.5%
Rivers (Vardar)	3	0.8%

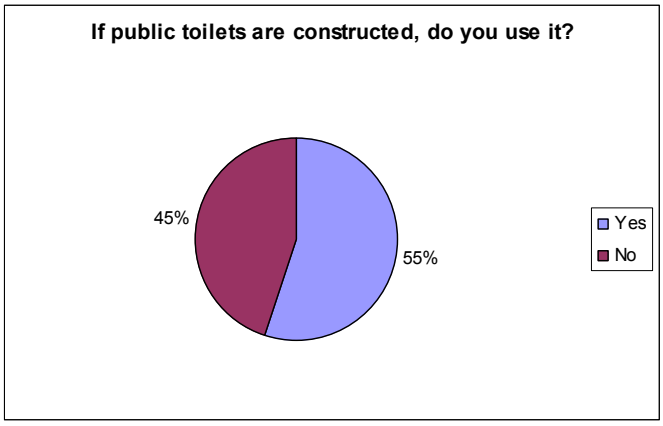
Reasons for not using of designated places for solid waste disposal are presented on Table 11 . Based on presented answers it is obvious that along with technical improvements in the solid waste management, public awareness is needed (answers like “everyone is doing that” or “I don’t know it is not good”).

Table 11 Why you don't dispose the HH waste to the designated place?

	Number of respondents	Percentage
The disposal place is far away from home	11	40.7%
Because everyone dispose on the streets	12	44.4%
I don't think it is not good	4	14.8%

On a question about usage of public toilets there are relatively equal numbers of confirmative and negative answers. Data are presented on Figure 13:

Figure 13



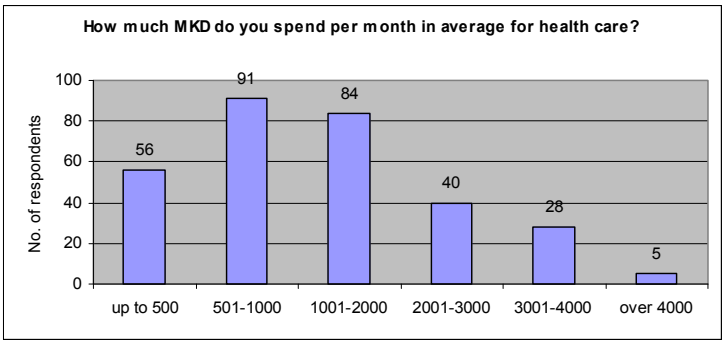
6.1.6 Health & Hygiene

This chapter intends to present data about respondent main diseases caused both by improper sanitary water quality or unsatisfactory waste water management practice.

Asked about major illness in the family in the last year, 375 respondents (94,9 %) give negative answer. Three respondents explained that they suffer from skin diseases and only two answered that have problems in the family with diarrhea.

In case of illness the majority (76,4%) of the respondents said that go to the nearest health care center, 11,2 % use medication and treatment, while 8,9 % of the respondents go to pharmacy to buy medicines. Budget per household spent on health care (visiting doctors or buying medicines) is presented on Figure 14.

Figure 14



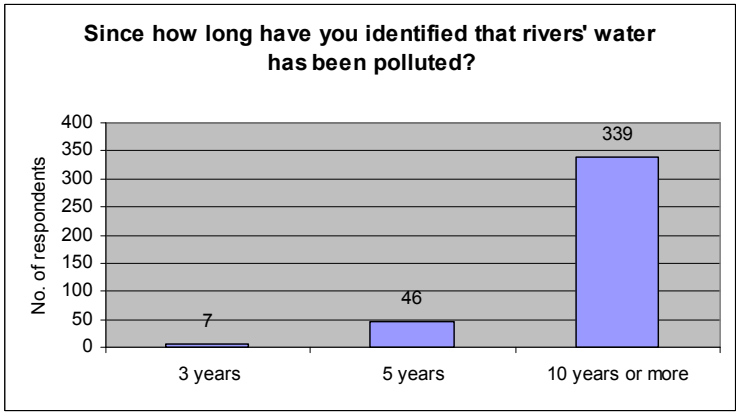
6.1.7 River Pollution

Last chapter of the questionnaire intends to indicate public awareness on the issues related to river waters pollution. The results show that majority of the respondents recognize the water in Vardar River as polluted. Responds are presented on Table 12. Subsequently, respondents were asked to determine how long they know that water has been polluted. It is indicative that more than 86% of the respondents answered that they are long time ago informed about pollution of the waters in Vardar River (see Figure 15).

Table 12 Do you think the water of Vardar River is polluted?

	Number of respondents	Percentage
Yes	391	98.2%
No	6	1.5%
Don't know	1	0.3%

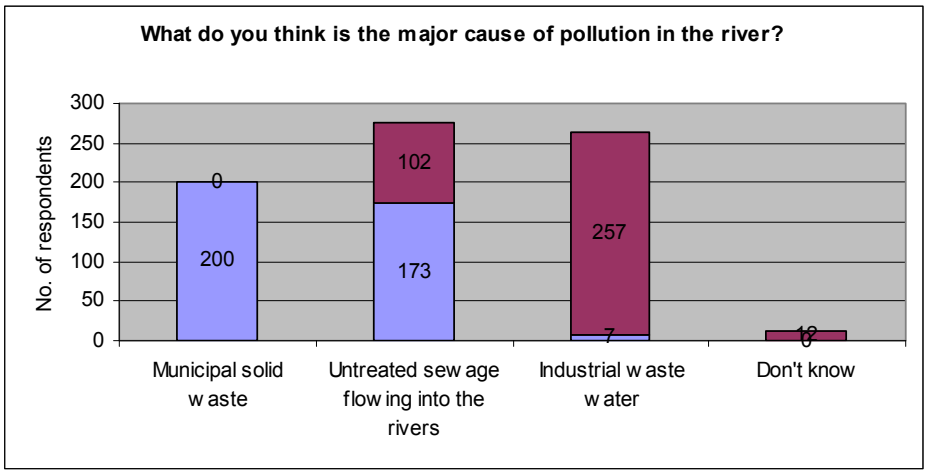
Figure 15



It was important to investigate respondent's perception about reason for river waters pollution Respondents were set to choose two answers per question. The results presented on

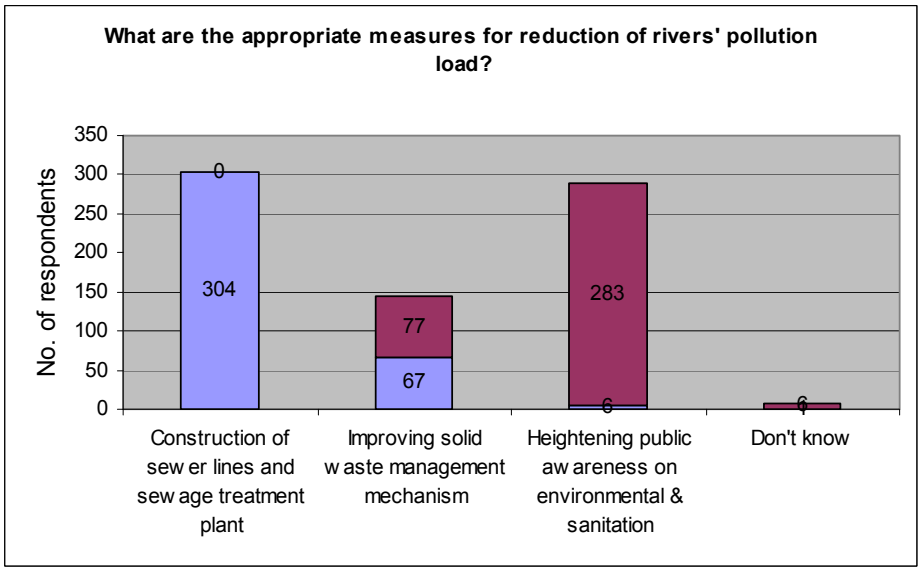
Figure 16 indicate that respondents found untreated sewage discharging and industrial waters as main sources for pollution.

Figure 16



Asked about their opinion on appropriate measures for reduction of rivers' pollution load, respondents give almost equal importance to construction of sewer lines and sewage treatment plant and to strengthening public awareness on environmental issues and sanitation. Results are presented on Figure 17:

Figure 17



6.2 Results of the Water Utilization Survey

6.2.1 Organization profile

In a frame of the water utilization survey 50 organizations have been approached. Even that the number of interviewed organization is not representative to make statistic, data presented in this chapter make reflection on water consumption in organization different by type of business, size of area as well as number of users. Type of interviewed organizations and their distribution per municipality in the City of Skopje are presented on Table 2. Size of lot area per organization is presented on Table 13. Along with these data it was also important to classify interviewed organization by number of sanitary water users per organization. This number includes number of employees and average number of visitors per day. Data on number of users per organization are presented on Table 13

Table 14.

Table 13

Size of lot area	Number of organizations
0-100 m2	18
101-400 m2	10
401-900 m2	3
>901 m2	19
Total	50

Table 14

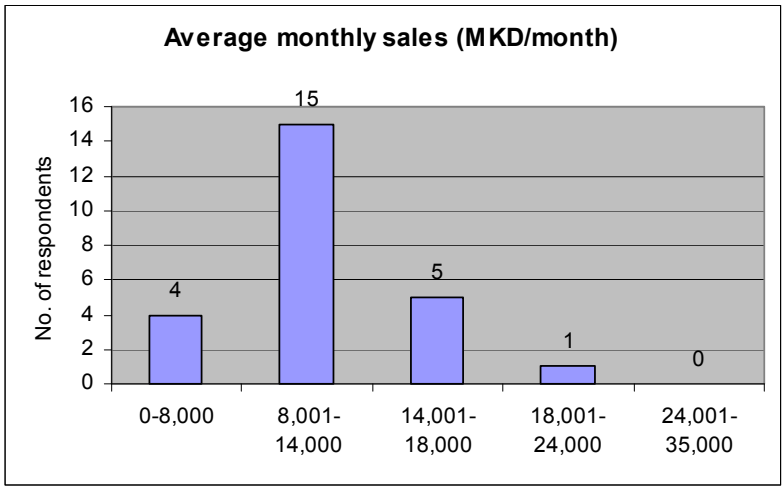
Number of users	Number of organizations
up to 50	21
51-100	6
101-500	8
501-1000	9
over 1001	5
Total	50

6.2.2 Socio-economic characteristic of the organization

Socio-economic characteristic of the interviewed organization has been evaluated though set of questions reflecting respondents' economic condition. Management authority in 30 out of 50 interviewed organizations is private.

Bearing in mind the sensitivity of the salary issue, the respondents were asked to indicate average monthly salary choosing from several classes of amounts. The results (see
Figure 18) show that a considerable number of organizations have presented average salary between 8000-14000 MKD/month. It is indicative that some of the respondents from private organization refuse to answer this question explaining that it is confidential information.

Figure 18



To assess the purchasing power of organization the respondents were asked to make the self evaluation and to indicate ones average monthly expenditure in the organization (data are outlined on the Figure 19) as well as to split the overall monthly expenditure to 6 the most frequent categories as follows: Water and Wastewater, Solid waste disposal, Telephone, Electricity and Heating; Indication of amount spent per category is presented on Table 15.

Figure 19

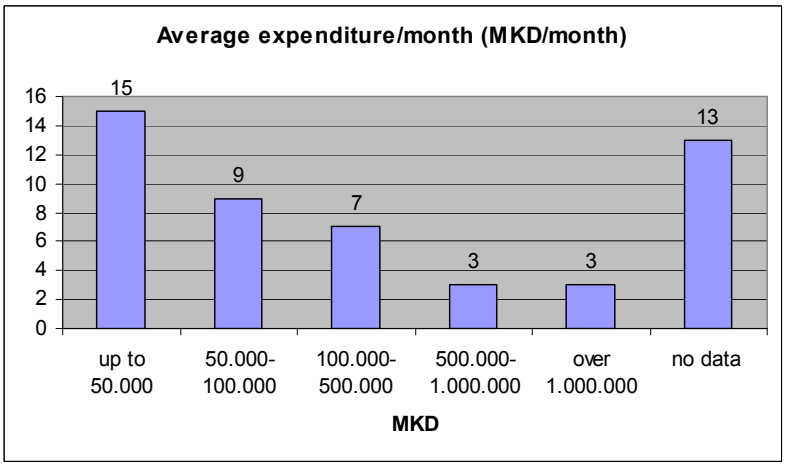


Table 15 Monthly expenditures of organizations in MKD

	Water and Wastewater	Solid waste	Telephone		Electricity	Heating
	No. of respondents				No. of respondents	
<1.500	12	17	5	<5.000	17	21
1.501-5.000	14	8	21	5.001-10.000	7	3
5.001-10.000	5	4	5	10.001-50.000	12	4
10.001-50.000	10	7	7	50.001-100.000	4	2
50.001-100.000	1	1	1	100.001-200.000	1	4
100.001-200.000	1	1	2	200.001 -250.00	2	2
>200.000	1	0	2	>250.000	2	8

6.2.3 Information on organizations water supply

Perceptions of the respondents about status of the water supply service and deficiencies, water consumption, the actual fee, options for improvement of the current water supply, as well as willingness of the organization to pay more for improved services were analyzed and presented in the following paragraphs.

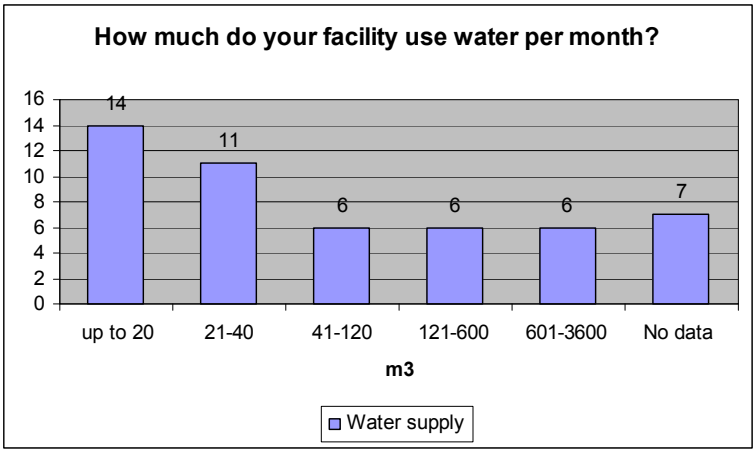
Table 16 shows the water source in interviewed organizations. It is evident that high majority of organizations (49 out of total 50), including organizations in rural parts of the Skopje City have sanitary water connection.

Table 16 What is water source in your organization

Water supply connection	49
Shallow / deep well	1
Total	50

Data on water consumption, presented on Figure 20, indicate consumption of water per organization. It is important to note that some of the respondents who represents small size organizations located in private houses, can't figure water consumption of the organization because they don't have separate water meters only for the organization (Coffee Bars or small Fast Food Restaurants).

Figure 20



In order to evaluate satisfaction of current water supply the respondents were asked about their general impression on current water supply satisfaction. The results show that 42 organizations respond positively. Then the respondents were set to think about the reasons in case of negative answer. Presented results indicate that only few respondents comply on water smell (1 respondent); taste (2 respondents); Insufficient volume (1 respondent) and water turbidity (1 respondent)

6.2.4 Information on waste water discharged from the organizations

In parallel with current water supply in the organizations, the survey investigates current waste water management practice. On a question about discharging waste water from toilets majority (44 out of 50 respondents) answer that their organization have connection to the sewer line and 16 organizations said that they use septic tanks for toilet waste water discharging. Similar responds were presented on a question about discharging waste water other that waste water from toilets (42 organization use sewer line).

Water utilization survey also investigates respondents' satisfaction from current dispersal of waste water. The responds show that 34 out of 50 organizations are satisfied from provided service; 5 organizations present moderate satisfaction while 4 of the interviewed respondents were not satisfied at all.

Respondents, who were moderately satisfied or were not satisfied at all, were asked to present the reason for their impression. Seven respondents note the sewer pipe overflowing as their main problem related to waste water discharging. Asked to explain their activity when overflow occur, 3 respondents said that they clean up sewer line by themselves.

Along with the general perceptions about the current waste water management practice an important issue in this chapter was to identify willingness to pay for improved services. Results shows that 17 organizations are not willing to pay more for improved sewerage service, while 15 organizations are prepared to pay more.

Respondents were asked to indicate the amount they are prepared to pay. The results presented on Figure 21 .

Figure 21 Willingness of organizations to pay more for improved waste water services

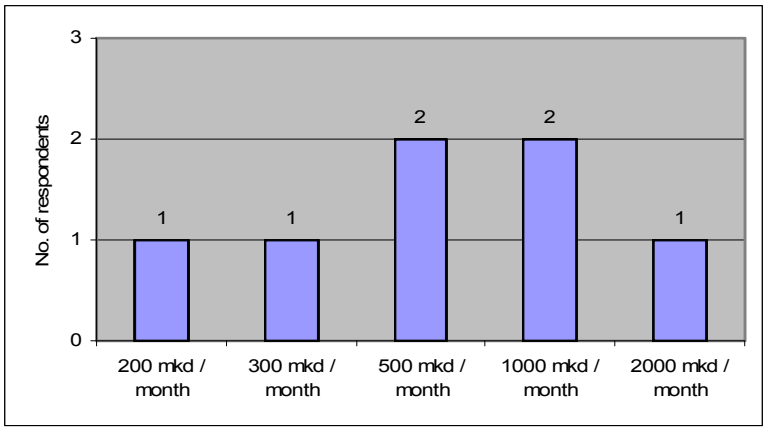


Table 17 shows that 5 respondents who use septic tanks explain that there is no sewer line close to their house and only one said that for their organization it is too expensive.

Table 17 Why your organization is not connect to sewer line?

	Number of respondents
There is no sewer line near the organization	5
It is too expensive to connect	1

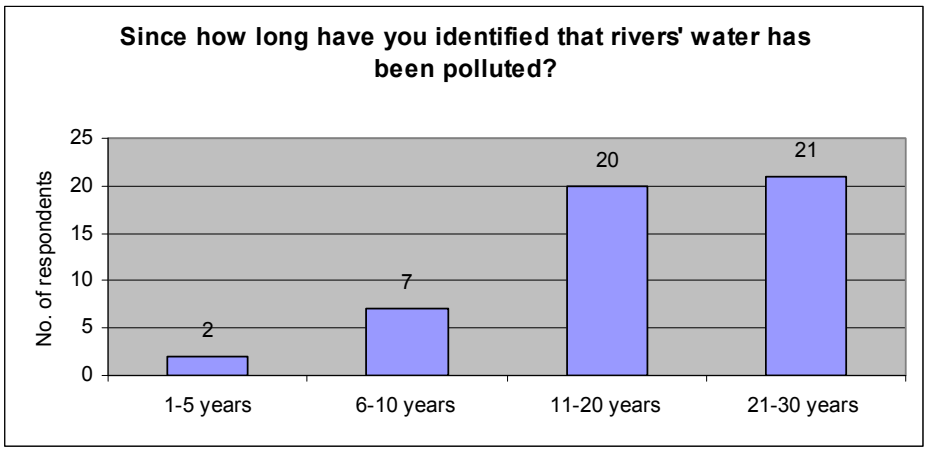
Organizations that are not connected to sewer line were asked to indicate their affordability to pay for this service. Only two organizations stipulated that they are willing to pay 500 MKD per month for discharging waste water in sewer line.

6.2.5 Sanitary Practice and river pollution

Asked about current practice for disposal of solid waste generated in the organizations, 48 respondents answered that they dispose the solid waste on designated place for its collection. Representatives of 2 organizations explain that are not satisfied at all from current Solid Waste management service and as result of that they are disposing the garbage in the derange canal. Presented answers show that along with technical improvements in the solid waste management, public awareness strengthening is of equal importance.

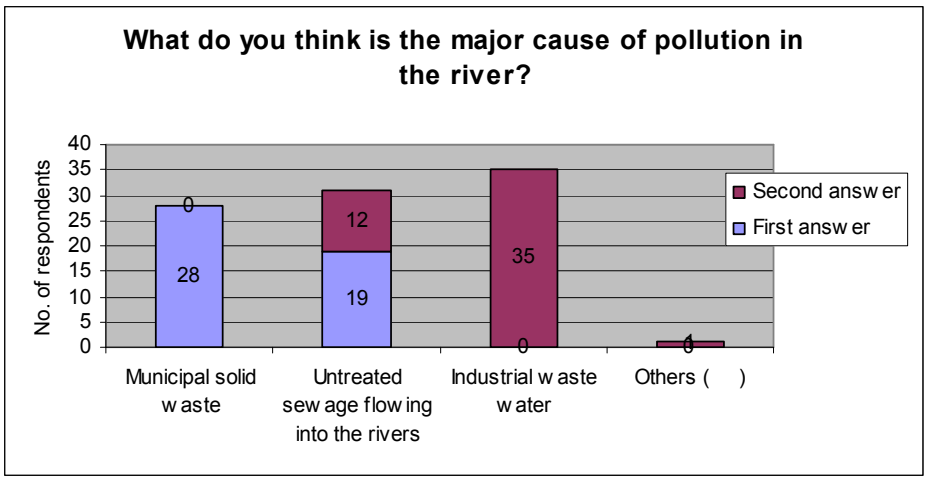
It is very indicative that all respondents from the organizations (50 in total) recognize the water in Vardar River as polluted. Asked to determine how long they know that water has been polluted, majority of the respondents answered that they have known this situation for more than 10 ago. Results are presented on Figure 22.

Figure 22



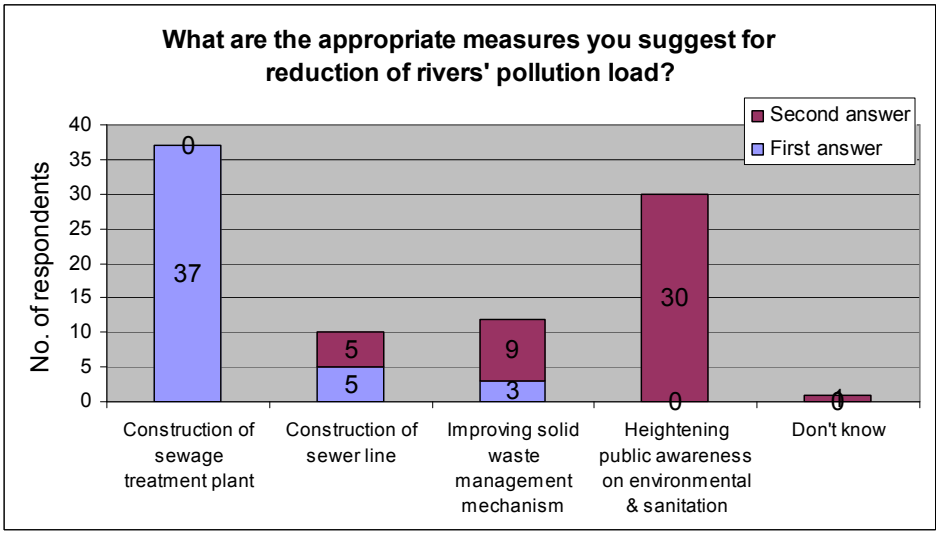
It was important to investigate respondent's perception about reason for river waters pollution Respondents were set to choose two answers per question. The results presented on Figure 23 indicate that similar to the social survey, organizations found untreated sewage discharging and industrial waters as main sources for pollution.

Figure 23



Respondents from the interviewed organizations found construction of sewage treatment plant as the most appropriate measure for reduction of rivers' pollution load, respondents give almost equal importance to construction of sewer lines and sewage treatment plant and to strengthening public awareness on environmental issues and sanitation. Results are presented on Figure 17:

Figure 24



7 CONCLUSION

Social Survey has been approached 403 households in total. The demographic situation in this study deviates from the official statistics in certain cases, which is explained due to the small sample.

In order to assess the wealth and income four groups were established according to monthly income of the HH. The results show that 14.1% of respondents belong to the low income class (up to 8.000 MKD/month), 35,3% are middle-low income class, 43,4% was ranked within the high-middle income levels and 4% belongs to high class (over 50.000 MKD/month). Although the absolute amounts are disputable due to the grey economy and reluctance to present additional sources of income, the distribution of HHs within respective income groups seems reasonable.

High majority of households (95,3%), including households in rural parts of the Skopje City have sanitary water house connection. Respondents living in apartments mostly have monthly consumption of water not bigger than $10m^3$. Respondents living in housed have presented different water consumption that can be explained with fact that some of the house and garden owners use sanitary water also for irrigation of gardens. More than 80% of the respondents are satisfied from current water supply. Unsatisfied respondents mainly comply on volume of supplied water.

Survey investigation on respondents' satisfaction from current dispersal of waste water shows that 61,8 % of the households are satisfied from provided service; 13,9% of the respondents present moderate satisfaction while 7,9 % were not satisfied at all. Main reason for dissatisfaction belongs to overflowing of sewer pipeline. Along with the general perceptions about the current waste water management practice an important issue was to identify willingness to pay for improved services. Analyzed results shows that (43,6%) are prepared to pay more for better service.

Asked about disposal of HH solid waste, 92% of the interviewed HH respond that use designatd place for HH solid waste collection

Respondents did not indicate big problems related to illness caused by insufficient sanitation.

Last chapter of the questionnaire intends to indicate public awareness on the issues related to river waters pollution. The results show that majority of the respondents recognize the water in Vardar River as polluted. Construction of sewer lines & sewage treatment plant and strengthening public awareness on sanitation issues were selected as appropriate measures for reduction of rivers' pollution load.

Water utilization survey has been approached 50 organizations within 10 municipalities. Even that the number of interviewed organization is not representative to make statistic, data presented in that chapter make reflection on water consumption and wastewater management in organization different by type of business, size of area as well as number of users. Performed water utilization survey indicates

ANNEX 1

QUESTIONNAIRE SHEET FOR SOCIAL SURVEY

SOCIAL SURVEY

Questionnaire

Study Team of Japan International Cooperation Agency (JICA) and Ministry of Transport and Communication (MTC), Ministry of Environment and Physical Planning (MEPP), Skopie City, and PE Water Supply and Sewerage Agency in Skopje (VODVOD) are executing the Study on Wastewater Managemant in Skopje.

Public Awareness and Water Usage Survey is being conducted in the form of the questionnaire to collect information on household characteristics and public awareness related sanitation / sewerage. Tha data and information collected will be used to formulate sewerage plans and to evaluate sewerage projets proposed finacially, economically, and socially sounds.

To acomplish this task, the residents are kindly requested to answer the questions in the questionnaire sheet. It may be difficult to answer some ot the questions but please make the best effort to answer the all questions. It is important that you answer questions as honestly and truthfully as you can so that the actual status of survey items are obtained.

The information collected from each household will be treated confidentially with utmost and used only for the Study purpose.

JICA Study Team and MTC, MEPP, Skopje City and VODVOD sincerely request all residents for their kind cooperation to make survey successful.

Code No. _____ – _____

Area No. – Serial No.

Name of the Area	1. Aerodrom 2. Butel 3. Chair 4. Centar 5. Gazi Baba
Survey Site	6. Gjorche Petrov 7. Karpos 8. Kisela Voda 9. Saraj 10. Shuto Orizari
Survey Data (day / month)	/ 2007 Time (AM / PM)
Name of Interviewers	

Questions	**Answer**			
A. Respondent Profile				
A1 Name				
A2 Status in family	1. Head of household	2. Hosewife	3. Retired Elderly	4. Children of the Head
	5. Others (Specify.)			
A3 Sex (M/F)	1. Male	2 . Female		
A4 Age	( ) years			
A5 Religion	1. Orthodox	2. Catholic	3. Muslim	4. Others ( )
A6 Socio-professional Category of the chief of household	1. No employment	2. Informal Sector	3. Agriculture	4. Office employed
	5. Government officer	6. Factory	7. Retire	8. Others ( )
A7 Educational Status	1. No education	2.Primary School	3. High School	
	4. University, institute, college	7. Others ( )		
B. Socio-economic Characteristics of the Household				
B1 Housing ownership (If rent, how much is it per month?)	1. Owns a house	2. Rent a house ( ) MKD	3. Own an apartment	4. Rent an apartment ( ) MKD
	5. Others( )			
B2 Type of Dwelling	1. Concrete	2. Wood	3. Tin-shed	4. Bricks
	5. Others( )	6. Don't know		

B3	Number of persons usually live in your household	1. Adult man ( ) persons	2. Adult women ( ) persons	3. Children (<16years) ( ) persons	4. In Total ( ) persons
B4	Average monthly income of the household (MKD/month)	1. 0-8,000	2. 8,001-14,000	3. 14,001-18,000	4. 18,001-24,000
		5. 24,001-35,000	6. 35,001-50,000	7. 50,000-	8. Don't know
B5	Average Household Expenditure/Month	( ) MKD / month			
B6	The amount spent on each item per month	Water & Wastewater ( ) MKD	Solid waste ( ) MKD	Phone ( ) MKD	Electricity ( ) MKD
		Heating ( ) MKD	Food ( ) MKD		
C. Information on Water Supply					
C1	What is your water source in your household?	1. House connection	2. Public stand post	3. Shallow / deep well	4. Public water tanker
		5. Others ( )		6. Don't know	
C2	How much do your household use water per month?	( ) m^3			
C3	How much do your household pay for water per month?	( ) MKD / month			
C4	Are you satisfied with current water supply?	1. Yes (go to D1)	2. No (go to C5)		
C5	If no, why? (max 2 answers)	1. The supply volume is not enough	2. Smell	3. Taste	4. Color
		5. Turbidity	6. Interuption of water supply service	7. Others ( )	
D. Information on Waste Water					
D1	Where is the wastewater from toilets discharged?	1. Sewer line (go to D2)	2. Septic tank (go to D9)	3. Discharging into open drain or river (go to D9)	4. Countyard (go to D9)
		5. Others ( )		6. No toilet (go to D9)	
	For SEWERAGE system household only				
D2	Are you satisfied with the current dispersal of your human wastewater?	1. Yes	2. Moderately	3. Not at all	
D3	If no, why? (max 2 answers)	1. The wastewater is not treated and discharged into the rivers	2. The charge is high	3. The sewer pipeline is overflowed	4. It costs too much
		5. Others( )			
D4	Do you have experience of overflowing or flooding from sewer pipeline or drainage facility?	1. Yes _____ times a year _____ days for every flooding		2. No (go to D7)	
D5	When flooding occur, what do you do?	1. Clean up sewer line / drinage by yourself	2. Ask local authority to clean up	3. Do nothing	4. Others( )
D6	Are you willing to pay more for improved sewerage service?	1. Yes	2. No		

D7	If yes, how much?	( ) MKD / month (go to E1)			
	For NON-SEWERAGE system household only				
D8	Why you don't connect to sewer line?	1. There is no sewer line near the house	2. Too expensive to connect	3. I don't feel the necessity to connect	4. I don't want to spend money for it
		5. Others ( )		6. No reason	
D9	If you have to connect to sewer line, how much can you pay for the service?	( ) MKD / month			
E. Sanitary Practice					
E1	Where do you dispose the garbage?	1. Designated place for its collection (go to E3)	2. Street nearby house (go to E2)	3. Drainage canal (go to E2)	4. Rivers (Valdal) (go to E2)
E2	If you answer 2, 3, 4, why you don't dispose to the designated place?	1. The disposal place is far away from home	2. Because everyone dispose	3. I don't think it is not good	4. Others( )
E3	If public toilets are constructed, do you use it?	1. Yes	2. No		
F. Health & Hygiene					
F1	Did any major illness suffered in your family in last one year?	1. Yes	2. No		
F2	If yes, which of following desease? (maximum 2)	1. Hepatitis	2. General Diarrhea	3.Skin disease	4.Typhoid
		5. Dysentery	6. Others( )		
F3	When your household members get sick, what do you do? (first action)	1. Self medication and treatment	2. Go to a pharmacy to get medicines	3. Go to the nearest health center	4. Go to hospital
		5. Others( )			
F4	How much do you spend per month in average?	( ) MKD / month			
G. River Polllution					
G1	Do you think the water of Vardar River polluted?	1. Yes	2. No (END)	3. Don't know (END)	
G2	Since how long have you identified that rivers' water has been polluted?	1. 3 years	2. 5 years	3. 10 years or more	4. Don't know
G3	What do you think is the major cause of pollution in the river? (maximum 2 answers)	1. Municipal solid waste	2. Untreated sewage flowing into the rivers	3. Industrial waste water	4. Don't know
		6. Others ( )			
G4	What are the appropriate measures you suggest for reduction of rivers' pollution load? (maximum 2 answers)	1. Construction of sewer lines and sewage treatment plant	2. Improving solid waste management mechanism	3. Heightening public awareness on environmental & sanitation	4. Don't know
		5. Others ( )			

ANNEX 2

QUESTIONNAIRE SHEET FOR WATER UTILIZATION SURVEY

WATER UTILIZATION SURVEY

Questionnaire

Study Team of Japan International Cooperation Agency (JICA) and Ministry of Transport and Communication (MTC), Ministry of Environment and Physical Planning (MEPP), Skopie City, and PE Water Supply and Sewerage Agency in Skopje (VODVOD) are executing the Study on Wastewater Managemant in Skopje.

Water Utilization Survey is being conducted in the form of the questionnaire to collect information on water source and amount of water consumption related sanitation / sewerage. Tha data and information collected will be used to formulate sewerage plans and to evaluate sewerage projets proposed finacially, economically, and socially sounds.

To acomplish this task, the residents are kindly requested to answer the questions in the questionnaire sheet. It may be difficult to answer some ot the questions but please make the best effort to answer the all questions. It is important that you answer questions as honestly and truthfully as you can so that the actual status of survey items are obtained.

The information collected from each household will be treated confidentially with utmost and used only for the Study purpose.

JICA Study Team and MTC, MEPP, Skopje City and VODVOD sincerely request all residents for their kind cooperation to make survey successful.

Code No. _____ – _____
Area No. – Serial No.

Name of the Area		1. Aerodrom 2. Butel 3. Cair 4. Centar 5. Gazi Baba
Survey Site		6. Gjorge Petrov 7. Karpos 8. Kisela Voda 9. Saraj 10. Suto Orizari
Survey Data (day / month)		/ 2007 Time (AM / PM)
Name of Interviewers		
Questions		**Answer**
A. Basic Information		
A1	Name of establishment	
A2	Type of business	1. Hospital 2. School 3. Recreation Facilities 4. Office 5. Others (Specify.)
A3	Size of lot area	1. 0～100m2 2 .101 ～400m2 3 . 401～900m2 4 . 901m2～
A4	Number of user	
B. Socio-economic Characteristics		
B1	Management authority	1. Private sector 2. Public sector 3. Others( )
B2	Average monthly sales	( ) MKD / month
B3	Average Expenditure/Month	( ) MKD / month
B4	The amount spent on each item per month	Water & Wastewater ( ) MKD Solid waste ( ) MKD Phone ( ) MKD Electricity ( ) MKD Heating ( ) MKD
C. Information on Water Supply		
C1	What is your water source in your facility?	1. Water supply 2. Shallow/deep well 3. Public water tanker 4. Don't know 5. Others( )

C2	How much do your facility use water per month?	1. Water supply ( ) m3	2. Other source ( ) m3		
C3	Are you satisfied with current water supply?	1. Yes (go to D1)	2. No (go to C4)		
C4	If no, why? (max 2 answers)	1. The supply volume is not enough	2. Smell	3. Taste	4. Color
		5. Turbidity	6. Interuption of water supply service	7. Others ( )	
D. Information on Waste Water					
D1	Where is the wastewater from toilets discharged?	1. Sewer line	2. Septic tank (go to D9)	3. Discharging into open drain or river (go to D9)	4. No toilet (go to D9)
		5. Others ( )			
D2	Where is the wastewater from other than toilets discharged?	1. Sewer line	2. Industrial pretreatment facility	3. Discharging into open drain or river (go to D9)	4. No toilet (go to D9)
		5. Others ( )			
	For SEWERAGE system				
D3	Are you satisfied with the current dispersal of your human wastewater?	1. Yes	2. Moderately	3. Not at all	
D4	If no, why? (max 2 answers)	1. The wastewater is not treated and discharged into the rivers	2. The charge is high	3. The sewer pipeline is overflowed	
		4. Others( )			
D5	Do you have experience of overflowing or flooding from sewer pipeline or drainage facility?	1. Yes _____ times a year _____ days for every flooding		2. No (go to D7)	
D6	When flooding occur, what do you do?	1. Clean up sewer line / drinage by yourself	2. Ask local authority to clean up	3. Do nothing	4. Others( )
D7	Are you willing to pay more for improved sewerage service?	1. Yes	2. No		
D8	If yes, how much?	( ) MKD / month		(go to E1)	
	For NON-SEWERAGE system				
D9	Why you don't connect to sewer line?	1. There is no sewer line near the house	2. Too expensive to connect	3. I don't feel the necessity to connect	4. I don't want to spend money for it
		5. Others ( )		6. No reason	
D10	If you have to connect to sewer line, how much can you pay for the service?	( ) MKD / month			
E. Sanitary Practice					

E1	Where do you dispose the garbage?	1. Designated place for its collection	2. Illegal dumping (go to E2)	3. Drainage canal (go to E2)	4. Rivers (Vardar) (go to E2)
E2	If you answer 2, 3, 4, why you don't dispose to the designated place?	1. The disposal place is far away from office	2. Because everyone dispose	3. I don't think it is not good	4. Others( )
G. River Polllution					
G1	Do you think the water of Vardar River polluted?	1. Yes	2. No (END)	3. Don't know (END)	
G2	Since how long have you identified that rivers' water has been polluted?	1. 1-5 years	2. 6-10 years	3. 11-20 years	4. 21-30 years of more
		5. Don't know			
G3	What do you think is the major cause of pollution in the river? (maximum 2 answers)	1. Municipal solid waste	2. Untreated sewage flowing into the rivers	3. Open defecation / urination	4. Industrial waste water
		5. Don't know	6. Others ( )		
G4	What are the appropriate measures you suggest for reduction of rivers' pollution load? (maximum 2 answers)	1. Construction of sewage treatment plant	2. Construction of sewer lines	3. Construction of toilet facilities	4. Improving solid waste management mechanism
		5. Heightening public awareness on environmental & sanitation	6. Don't know	7. Others ( )	

Comment from Interviewer

ANNEX 3

PHOTOS OF THE SURROUNDING ENVIRONMENT OF SAMPLING LOCATIONS

Photos from HH and organizations interviewed in Gazi Baba Municipality

Photos from HH and organizations interviewed in Aerodrom Municipality

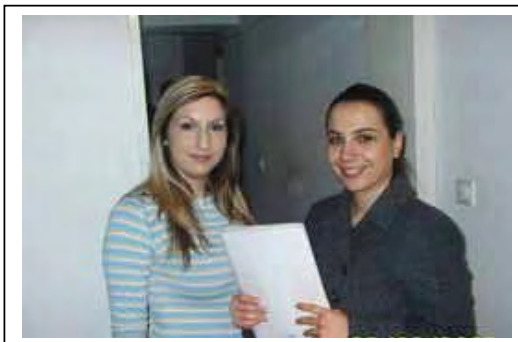
Photos from HH and organizations interviewed in Kisela Voda Municipality

Photos from HH and organizations interviewed in Centar Municipality

Photos from HH and organizations interviewed in Butel Municipality

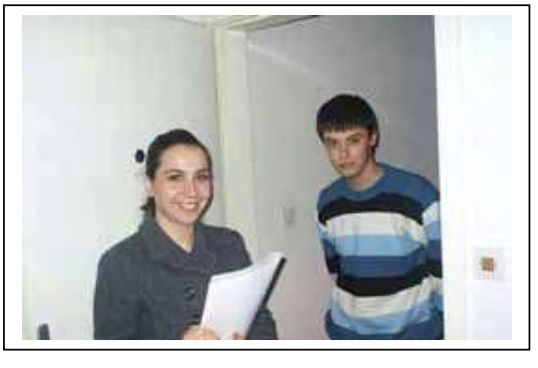
Photos from HH and organizations interviewed in Karpos Municipality

Photos from HH and organizations interviewed in Suto Orizari Municipality



Photos from HH and organizations interviewed in Saraj Municipality

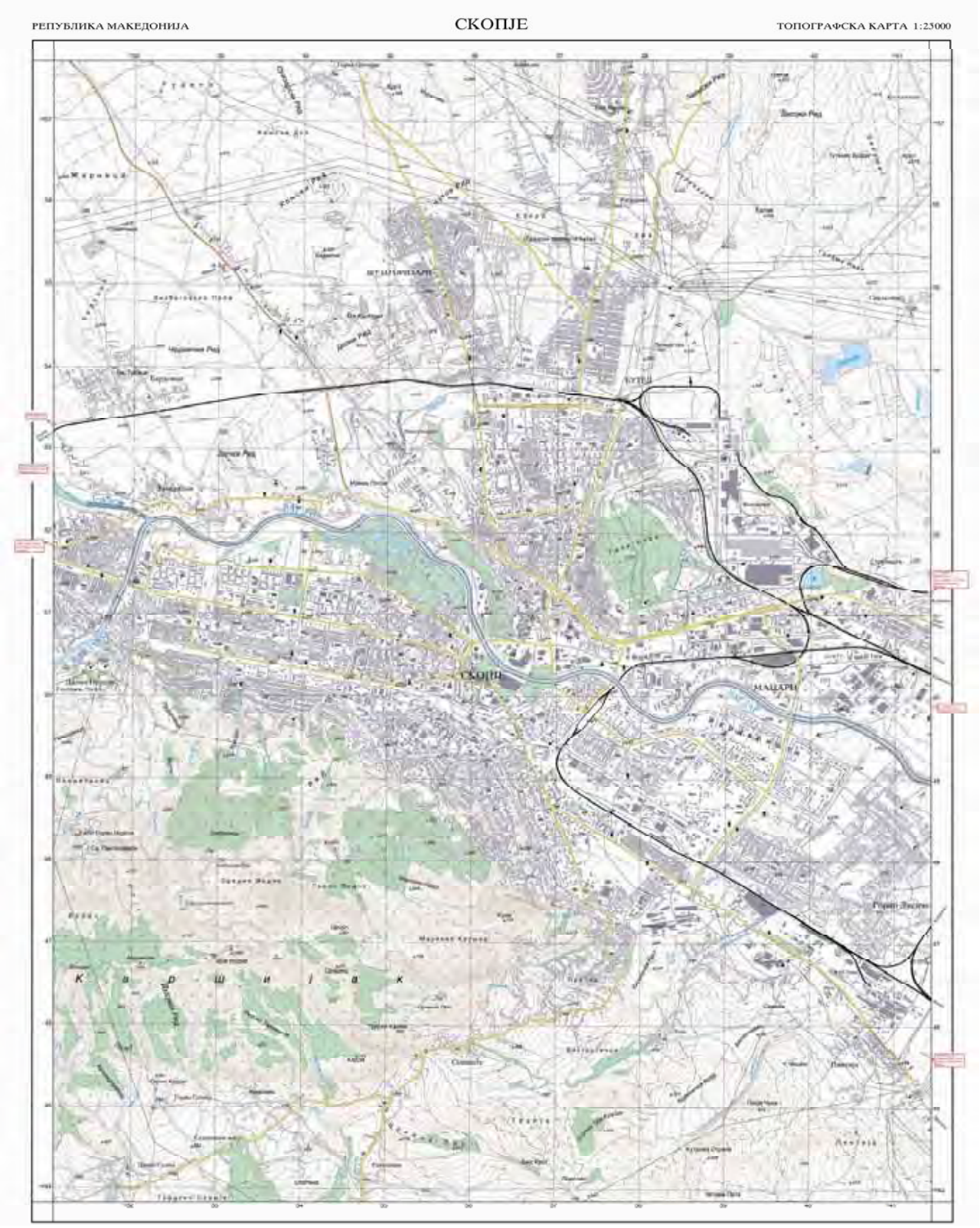
Photos from HH and organizations interviewed in Gjorce Petrov Municipality



Photos from HH and organizations interviewed in Chair Municipality

ANNEX 4

MAP WITH SAMPLING LOCATIONS


РЕПУБЛИКА МАКЕДОНИЈА
СКОПЈЕ
ТОПОГРАФСКА КАРТА 1:25000
Скопје
Кадшиjак

10.2 Water Quality Survey

WATER DEVELOPMENT INSTITUTE OF THE REPUBLIC OF MACEDONIA

STUDY ON WASTEWATER MANAGEMENT IN SKOPJE IN REPUBLIC OF MACEDONIA

WATER QUALITY EXAMINATION

Final Report

January, 2008

WATER DEVELOPMENT INSTITUTE OF THE REPUBLIC OF MACEDONIA

STUDY ON WASTEWATER MANAGEMENT IN SKOPJE IN REPUBLIC OF MACEDONIA

WATER QUALITY EXAMINATION

Final Report

Director,

Ph.D. Ivanco Kaevski, B.Sc. Civ.Eng.

January, 2008

Part I: A10-56

C O N T E N T

ATTACHMENTS

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22. Attachment N^{o} 22 – Pumps performance curve in Pump Station Dracevo
23. Attachment N^{o} 23 – Results of pipe flow rate measuring Phase 1 and Phase 2 – MP6
24. Attachment N^{o} 24 – Results of pipe flow rate measuring Phase 1 and Phase 2 – MP9
25. Attachment N^{o} 25 – Results of pipe flow rate measuring Phase 1 and Phase 2 – MP10
26. Attachment N^{o} 26 – Results of pipe flow rate measuring Phase 1 and Phase 2 – MP12
27. Attachment N^{o} 27 – Results of pipe flow rate measuring Phase 1 and Phase 2 – MP18
28. Attachment N^{o} 28 – Flow rate as a result of pumps work Phase 1 and Phase 2 – MP18
29. Attachment N^{o} 29 – Control measurement with current meter – MP12
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31. Attachment N^{o} 31 – Time schedule
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34. Attachment N^{o} 34 – Results from Laboratory at Republic Health Protection Institute – Bio – chemical and Physic – chemical parameters, Phase 1
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36. Attachment N^{o} 36 – Results from Laboratory at Republic Health Protection Institute – Heavy Metals parameters, Phase 1
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38. Attachment N^{o} 38 – Results from Laboratory at Republic Health Protection Institute – Microbiological parameters, Phase 1
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40. Attachment N^{o} 40 – Report from Institute for Accreditation of Republic of Macedonia

The Final Report on Water Quality Examination - STUDY ON WASTEWATER MANAGEMENT IN SKOPJE IN REPUBLIC OF MACEDONIA was prepared by:

- Water Development Institute of the Republic of Macedonia - Skopje

  Emilija Spirovska, Graduated Civil Engineer

Laboratory Water Quality Examination was performed by:

- Laboratory at Republic Health Protection Institute of Republic of Macedonia
- Central Laboratory of Ministry of Environment and Physic Planning

Director,

Ph.D. Ivanco Kaevski, B.Sc. Civ.Eng

1. INTRODUCTION

The Skopje City, the capital city of the Republic of Macedonia, is Macedonia's political, cultural and economic center. The pollutants originated from domestic and industrial wastewaters have been discharged to the rivers without any treatment, which resulted in deterioration of sanitary environmental conditions and contaminating the river water environment.

Under the circumstances, to decrease the pollutants loads discharging into the rivers from various pollution sources in order to improve the sanitary and water environment in the Skopje City, the Japan International Cooperation Agency, the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, dispatched the JICA Study Team to conduct the Study on Wastewater Management in Skopje to formulate the Sewerage System Improvement Basic Plan and carry out the Feasibility Study for selected priority projects in the Basic Plan. In order to identify the issues that should be addressed during the planning, design, construction and operation of the sewerage system in Skopje City it was necessary to carried out Water Quality Examination, which results, will be used by the JICA Study Team for the preparation of the Study such as facility planning and Operation and Maintenance planning. The results will also serve as the basic plan, industrial water quality analysis and water quality simulation of Vardal River.

Water Quality Examination was carried out by Water Development Institute of Republic of Macedonia (WDI) as Local Consultant starting from 19th November during period of two months as shown in Time schedule - Attachment 31. The main members of Local Consultant Team with their positions are as follows:

- Manager : Emilija Spirovska, Graduated Civil Engineer
- Field Surveyor's Leader : Zoran Dopcev, Technician
- Hydraulic analyst: Ivanco Kaevski, Phd of Hydrology, Graduated Civil Engineer

The rest of WDI team consists of 5 person including 3 data entry operators and 2 field surveyors.

In order to fulfill all tasks Local Consultant hired team with diving equipment and boat from "Fluid" Company for field survey support and has contract with two Laboratories for water quality examination:

– Laboratory at Republic Health Protection Institute and

– Central Laboratory of Ministry of Environment and Physic Planning

As defined in Terms of reference, Water Quality Examination activities were as follows:

1. Cross sections survey of Vardar River and Lepenec River
2. Flow rate measuring
3. Water sampling
4. Measurement of water quality

2. CROSS SECTIONS SURVEY

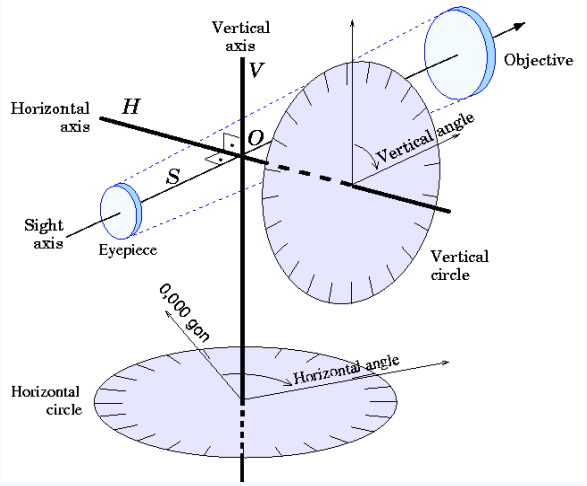
In order to measure flow rate of Vardar River it was necessary to perform survey of cross sections determined by responsible person from JICA Study Team.

Those three cross sections on Vardar River where river flow rate had to be measured were surveyed as well as additional two cross sections (one of Lepenec River and one of Vardar River). The locations of the surveyed cross sections are shown in Attachment 1 marked as CS1 to CS5.

Cross section survey

A cross sections survey was performed on November 24th by team of 3 surveyors from Water Development Institute supporting by one diver hired from Fluid Company and using optical geodetic instrument Teodolit - Dalta 10 owned by Water Development Institute.

A theodolite is an instrument for measuring both horizontal and vertical angles, as used in triangulation networks. It is a key tool in surveying and engineering work, but theodolites have been adapted for other specialized purposes in fields like meteorology and rocket launch technology. A modern theodolite consists of a telescope mounted movably within two perpendicular axes, the horizontal or trunnion axis, and the vertical axis. When the telescope is pointed at a desired object, the angle of each of these axes can be measured with great precision, typically on the scale of arcseconds. Both axes of a theodolite are equipped with graduated circles that can be read out through magnifying lenses.



The axes and circles of a theodolite

The point on the river bank where instrument was placed is taken to be reference point for cross sections survey with level reference value of 10m. Data of cross section survey are listed as numeric results in Attachment 8, while their graphic presentations are shown in Attachment 3 to Attachment 7.

3. FLOW RATE MEASUREMENT

As defined in Terms of reference, flow rate measurement was performed for three Vardar River profile and for five flow rates in sewer and industrial wastewater pipes. According to details of work flow rate measurement was preformed in two phases with distance of 7 days between them. First phase was performed on November 27th, while the second one on December 5th, both on sunny days with air temperature during daily hours of 7 ºC to 8ºC, water temperature 5 ºC to 7.5 ºC for Phase 1 and air temperature of 5.5 ºC to 7.2ºC, water temperature 5.2 ºC to 7 ºC for Phase 2 . A day before Phase 1, it was raining during 24 hours while the day before Phase 2 was rainy in morning hours but with small quantity of rain.

Methods of measuring and calculating of flow rate are different for river water and wastewater pipes, so they will be presented as:

- Flow rate measuring of Vardar River profiles
- Flow rate measuring of sewer and industrial pipes

The locations of the flow rate measuring point are presented graphically in Attachment 1 where all measuring point for flow rate as well as for water sampling are labeled starting from MP1 to MP18. Those locations where water flow rate was measured are additionally marked as FW with information about frequency of flow rate (1h for river flow rate and 24 h for pipe flow rate considering that measuring was performed for consecutive 24 hours). The list of all measuring points with description of locations, type of water and frequency of flow rate measuring are listed in Attachment 2.

3.1. Flow rate measurement of Vardar River profiles

Flow rate measurement was performed for three Vardar River profiles (CS3, CS4, CS5) using an indirect method by measuring the velocity and water section area to estimate water flow. The velocity measurements are used in combination with channel geometry to obtain discharge estimates.

The average value of the velocity was calculated and disclosed the real river section area at the measured natural geometry profile.

Team consisted of 2 field surveyors from Water Development Institute performed flow meter measuring and of team of 4 people hired from Fluid Company gave support with boat and diving equipment. Fields work had started during morning hours around 10:00 AM beginning with Cross Section 3 on Vardar River near pedestrian bridge and continuing with CS4 Cross Section 4 on Vardar River in Center at 11:30 AM while the last one CS5 Cross Section 5 on Vardar River in Ljurumljari was measured around 2:00 PM. Team of 6 people was moving from one to another location during this time of the day. Temperature of the air and water is shown in Attachments for every cross section measurement.

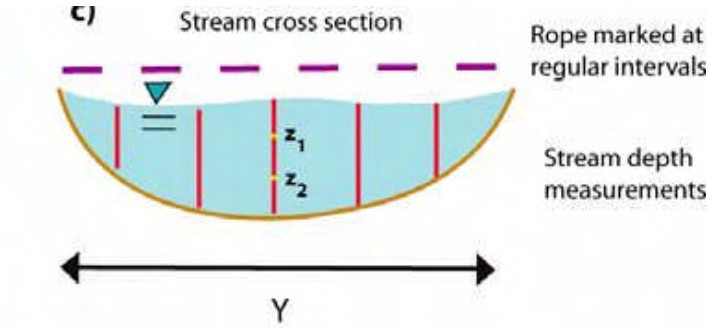
3.1.1. Velocity measurement.

A technique of stream gauging with a propeller-type flow meter was used for water flow measurement. The flow meter (propeller velocity meter) measures average water velocities within a stream using a propeller. When the Flow meter is immersed in the stream the propeller is activated and the velocity at which this propeller is moving is recorded by the instrument. The Flow meter was moved vertically from the surface to the bottom, up and down, slowly and smoothly for 20-40 seconds to obtain a good average.

Propeller velocity meter

Flow meter has graduated markings on the side that can serve to measure flow depth (up to 4 m).

The Flow meter measures a small volume of the river flow (a few centimeters in cross-sectional area) so the Flow meter was placed directed upstream to minimize effects on the velocity measurement.



Stream cross sectional view of the stream depth measurements showing an example of the two velocity observation points (z_1 and z_2) to be taken at each cross section segment.

Field surveyors settled in the boat had performed flow meter measuring on 3 to 4 cross section segments depending of flow conditions (CS5 has big flow velocities so on certain cross section segments it was impossible to hold flow meter still on same positions long enough to obtain the results) and on 3 to 4 depth measurements depending on water level.

Two readings were taken for each depth in two different intervals (mostly 15 sec and 30 sec) and recorded in the field notebook (R1 and R2) so the average velocity had to be calculated later on using following equation:

$$V = 0{,}262 \times R_{(rot/\sec)} + 0{,}004$$

The results from flow probe measuring Phase 1 are listed as Attachment 9 to Attachment 11 and for Phase 2 as Attachment 12 to Attachment 14.

Flow rate measuring with flow probe at Cross Section CS4 – Center on Vardar River

3.1.2. Total discharge by velocity-area method

The cross section geometry is used to determine the cross-sectional area of the river, as well as other parameters such as hydraulic radius and wetted perimeter. Then, the cross sectional area of the river can be approximated by drawing a series of rectangles and summing individual sub-section areas.

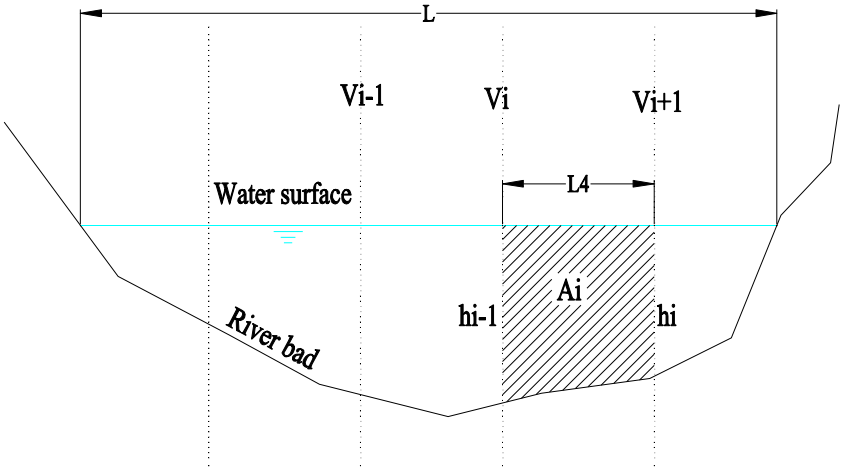
The total discharge (QT) can be calculated based on the cross sectional area value and the river velocity measured at each interval within the river. We used the velocity-area method to obtain the total river flow.

The river transect is divided into subsections and draw this in a diagram obtaining a vertical flow profile at the center of each subsection: zero the averaging function. The average velocity times the area of the subsection equals the flow for the subsection (Eqn. 1). Once the flow of each subsection is obtained, add all the subsections discharge to obtain total stream discharge (Eqn. 2).

$$Q = V A \qquad (1)$$

$$Q_T = \sum_i Q_i = \sum_i V_i \times A_i \qquad (2)$$

where: Q_i is the discharge at each individual sub-section, V_i is the average velocity over depth **Z** at each subsection, and A_i is the area of each subsection (depth Z_i times interval width Y_i). The total discharge $\mathbf{Q_T}$ is estimated via the velocity-area method.



For most of cross section measurements, the number of segments was 4 so equation which was used for calculation is as follows:

$$Q = k\times V_{1av}\times A_0 + 0.5\times (V_{1av} + V_{2av})\times A_1 + 0.5\times (V_{2av} + V_{3av})\times A_2 + 0.5\times (V_{3av} + V_{4av})\times A_3 + k\times V_{4av}\times A_4$$

where: k is corrective coefficient witch value is depending of roughness of the river bank and is usually from 0,5 to 0,9 (for this condition it is taken 0,75)

The graphic presentation of cross sections with its sub-section segments are shown in drawing as Attachment 15 to Attachment 17 for Phase 1 and Attachment 18 to Attachment 20 for Phase 2. The results for river flow rate calculation for three cross sections CS3, CS4 and CS5 and both phases are as follows:

Phase 1 – 27.11.2007

Profile	CS3	Bardovci			
Segmet's Area		**Average Valocity**		**Calculated Flow rate**	
(m^2)		(m/sec)		(m^3/sec)	
A0=	13,87				
A1=	18,1	V1av=	1,0018		
A2=	12,72	V2av=	1,2065		
A3=	21,31	V3av=	1,5138		
A4=	11,6	V4av=	0,9821	**Q=**	**82,845**
Aprofile	77,6				

Phase 1 – 27.11.2007

Profile	CS4	Center			
Segmet's Area		**Average Valocity**		**Calculated Flow rate**	
(m^2)		(m/sec)		(m^3/sec)	
A0=	5,06				
A1=	10,3	V1av=	1,226		
A2=	16,26	V2av=	1,912		
A3=	9,5	V3av=	1,652		
A4=	13,94	V4av=	1,696	**Q=**	**83,43**
Aprofile	55,06				

Phase 1 – 27.11.2007

Profile	CS5	Ljurumljari			
Segmet's Area		**Average Valocity**		**Calculated Flow rate**	
(m^2)		(m/sec)		(m^3/sec)	
A0=	8,78				
A1=	20,82	V1av=	1,1306		
A2=	44,21	V2av=	1,3042		
A3=	17,2	V3av=	1,1426		
A4=	2,84	V4av=	0,2702	**Q=**	**99,60**

Phase 2 – 05.12.2007

Profile	CS3	Bardovci			
Segmet's Area		**Average Valocity**		**Calculated Flow rate**	
(m^2)		(m/sec)		(m^3/sec)	
A0=	7,35				
A1=	19,36	V1av=	0,781		
A2=	9,67	V2av=	1,256		
A3=	13,34	V4av=	1,047	**Q=**	**45,633**
Aprofile=	49,72				

Phase 2 – 05.12.2007

Profile **CS4** **Center**					
Segmet's Area		**Average Valocity**		**Calculated Flow rate**	
(m^2)		(m/sec)		(m^3/sec)	
A0=	4,5				
A1=	6,9	V1av=	1,103		
A2=	15,3	V2av=	1,160		
A3=	13,3	V3av=	1,049		
A4=	8,3	V4av=	1,039	**Q=**	**48,78**

Phase 2 – 05.12.2007

Profile **CS5** **Ljurumljari**					
Segmet's Area		**Average Valocity**		**Calculated Flow rate**	
(m^2)		(m/sec)		(m^3/sec)	
A0=	6,87				
A1=	12,97	V1av=	0,80856		
A2=	19,29	V2av=	0,98323		
A3=	29,39	V3av=	0,85878		
A4=	7,46	V4av=	0,6066	**Q=**	**58,48**

Sublimated results for both phases are listed below:

Cross section	**Phase 1 Flow rate 27.11**	**Phase 2 Flow rate 05.12**
	(m^3/s)	(m^3/s)
CS3 - Bardiovci	**82,84**	**45,63**
CS4 - Centar	**83,43**	**48,78**
CS5 - Ljurumljari	**99,60**	**58,48**

It is obvious that there is difference in quantity of flow rate between first and second phase as well as of velocity value. A rainy day on 26th of November caused bigger flow rate on following day – Phase 1 and larger flow velocity as well.

3.2. Flow rate measurement of sewer and industrial pipes

According to details of work flow rate measurement of sewer and industrial pipes had to be accomplished on five different location marked on map (Attachment 1) as MP6, MP9, MP10, MP12, MP18 with frequency of flow rate measurement for consecutive 24 hours to grasp hourly flow, conducted in two Phases with distance of 7 days between them as it was specified in previous text. Two of them are expected to be industrial wastewater pipes (MP9 and MP10) but in reality they are mixed with sewage water from these two largest factories in the City.

Because of specific requirements for 24 hour measuring, we organized two groups consisted of two field surveyors for locations MP6 and MP18 (two field surveyors for each of them) who were changing their position on every 6 hours. Locations MP9, MP10 and MP12 are suited near one to

another so it was most effective to organize one team to perform consecutive hourly measurements for all three location moving from one to another during one hour. In that purpose two teams of two persons each, were organized shifting their position on every 6 hours. All field surveyors are stuff from Water Development Institute, as well as person responsible for field survey for flow rate measurements – Zoran Dopcev. Fields work had started at 8:00 AM at dates specified earlier, when all teams were on their positions and had finished at 7:00 AM the following day.

In order to determine flow rate of pipes two different methods were evaluated:

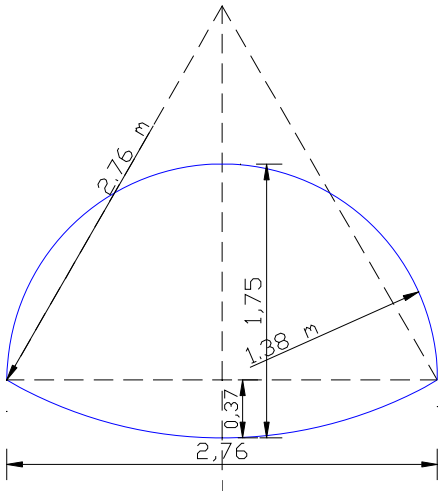
- Flow measurement in circular pipe by measuring critical height
- Flow measurement in circular pipe by measuring velocity with flow meter (control measurement for verification of first method)

3.2.1. Pipe geometry

All pipes outlets are with circular shape and different diameter size, except MP12 (N.Lisice sewer pipe) which has tunnel shape. Four of specified outlets are flowing out directly into Vardar River with water level above river water level, except MP18 (Pump Station Dracevo) which outlet is flowing out into collecting manhole connected to pump reservoir.

It was necessary to obtain exact pipes geometry and dimensions of pump reservoir as well as pumps performance curve, so we contacted Public Enterprise Vodovod – Skopje to provide needed data. In the mean time, field survey was performed to obtain pipe geometry and pump reservoir height by two surveyors from WDI so data we obtain as result of these activities are listed bellow, while drawing of pump reservoir and collecting manhole are presented as Attachment 21 and pump performance curve as Attachment 22.

No	Cod	Description of location	Type of Pipe	Pipe Diameter (mm)	Shape	Slope ‰
MP6	S	Sewage pipe - Bardovci	Sewage	500	Circular	8.2
MP9	I	Industry outlet Pivara	Industry	1000	Circular	2.5
MP10	I	Industry outlet Makstil	Industry	2000	Circular	
MP12	S	Sewage pipe - Aerodrom - N.Lisice	Sewage	2760/1750	Tunnel	
MP18	S	Pump station Dracevo	Sewage	400	Circular	



Tunnel shape of sewage pipe of outlet N.Lisice – Twin Bridge

3.2.2. Flow measurement in circular pipe by measuring critical height

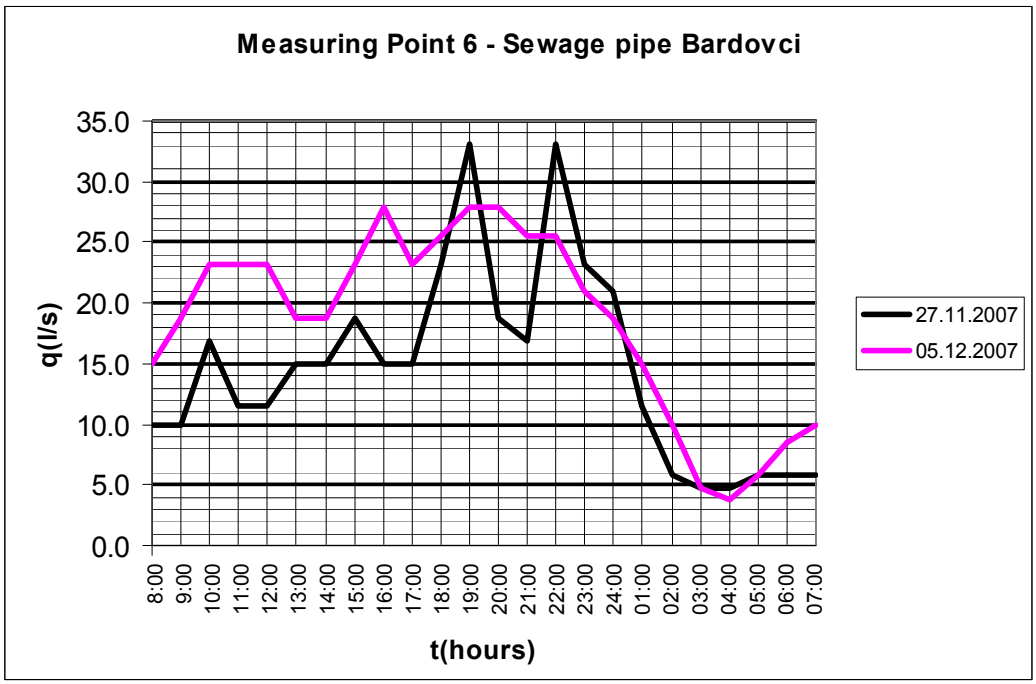
When the pipe bottom is above the water river level, and it is known that the sewage systems are designed with slope less than critical slope, we could take into the consideration that the pipe end is like sharp edge overflow so on edge outlet, water level has critical height, while Fraud's number gets value 1. According to this critical flow condition, dependency between critical height and critical flow rate can be expressed as:

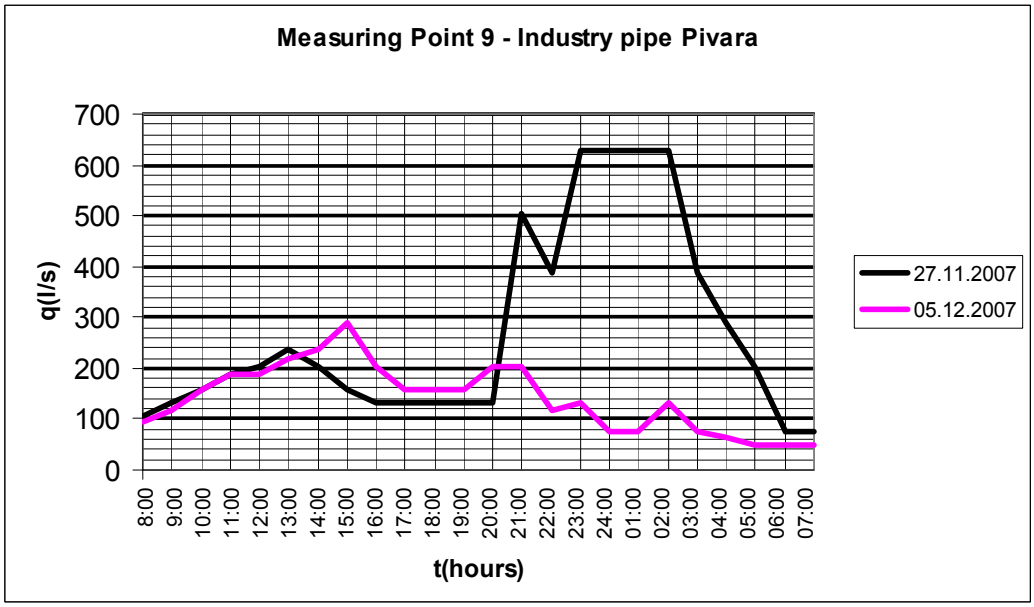
$$Fr = \frac{\alpha Q^2}{g} \cdot \frac{B}{A^3} = 1 \quad \Rightarrow \quad \frac{\alpha Q^2}{g} = \frac{A^3}{B}$$

$$Q = f(h_{cr})$$

Measuring the water level height on edge of the outlet with measuring bar every hour during 24 hours measurement and having all data for pipe geometry, it is simple to calculate value of flow rate for measuring points MP6, MP9, MP10 and MP12 while it was necessary to perform some additional calculations which will be explained bellow in this chapter for calculating flow rate of MP18.

The presentation of the results for 24 hours flow rate calculation for both phases of MP6 is presented as Attachment 23, MP9 as Attachment 24, MP10 as Attachment 25 and MP12 as Attachment 26, while graphic presentation of 24 hours flow rate for this four measuring points is given in following charts for both Phases.


Measuring Point 6 - Sewage pipe Bardovci
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
q(l/s)
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
24:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
t(hours)
27.11.2007
05.12.2007


Measuring Point 9 - Industry pipe Pivara
700
600
500
400
300
200
100
0
q(l/s)
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
24:00
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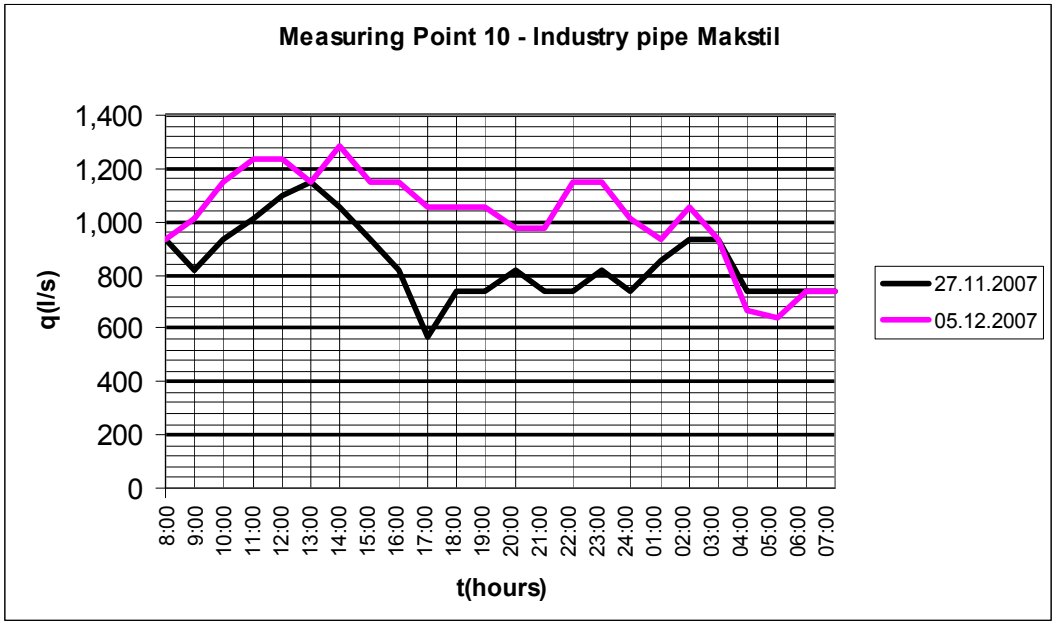
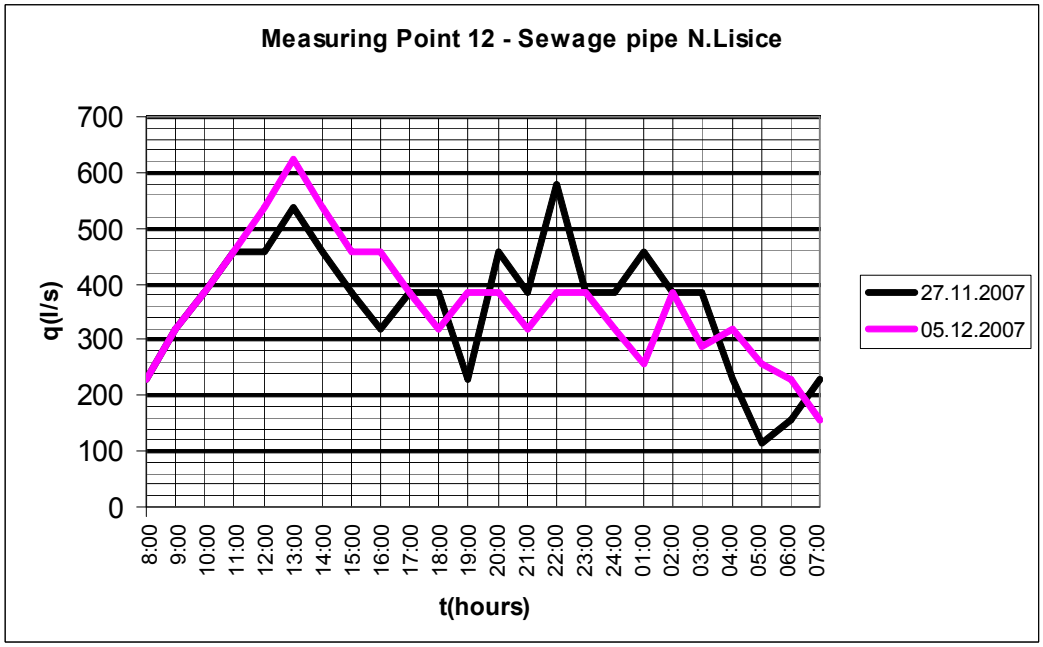
07:00
t(hours)
27.11.2007
05.12.2007





As presented in previous charts, the 24 hour flow rate distribution for sewage pipes MP6 and MP12 is similar for Phase 1 and Phase 2 with some difference in values but still following the tendency of distribution, while there is big difference in 24 hour flow rate distribution for both industry pipes, probably because of different work regime of two factories on dates we performed measurement.

Calculation of flow rate of measuring point MP18 – Outlet of sewage pipe in Pump Station Dracevo required some further analyses mostly because of difficult approach to outlet edge (the pipe is flowing out into collecting manhole with depth of 3.75m on distance from the manhole top of 2.30m as shown on drawing in Attachment 21). Using measuring bar we measured water level height on edge of the outlet every hour during 24 hours measurement and the calculation of flow rate was done as it was explained above for the rest of the outlets (the results are presented in

Attachment 27). In aim calculation of flow rate to be more accurate we performed some additional measurement. Water level in collecting manhole and pump reservoir were measured on every hour as well as time of hourly pump work during 24 hours. On the basis of this data, W_{inflow} - Volume of inflow into reservoir can be calculated by summarizing W_{pump} - Volume of pumped water and dW – change of reservoir volume during one hour.

$$W_{\inf low} = W_{pump} + \Delta W \quad \left(m^3\right)$$

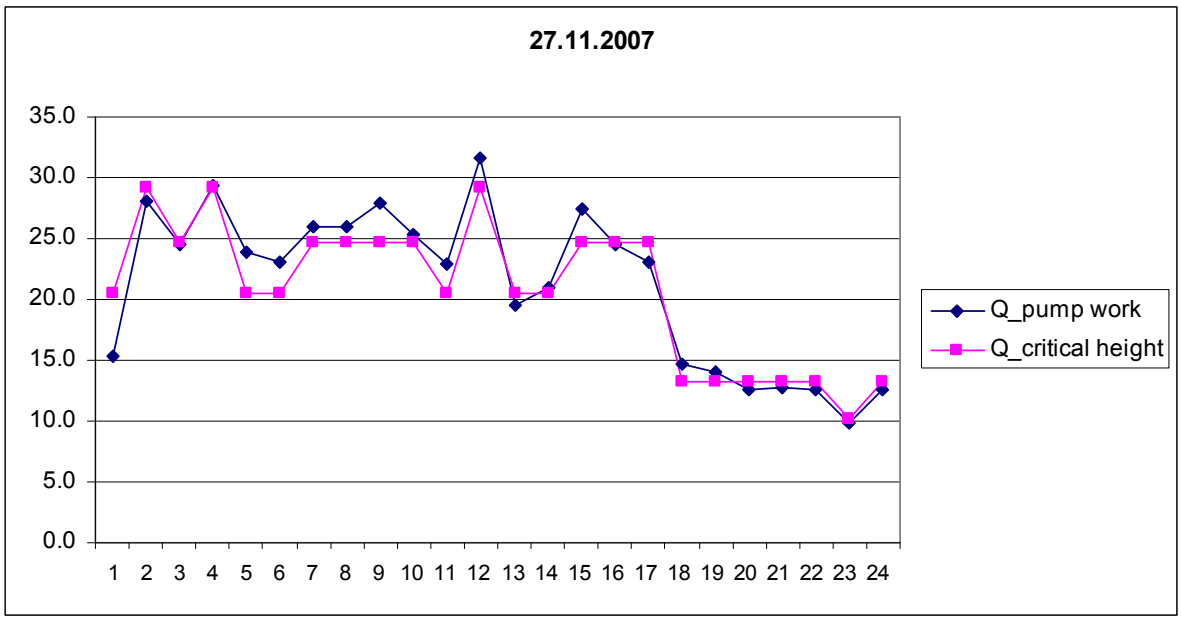
Hourly inflow was calculated as:

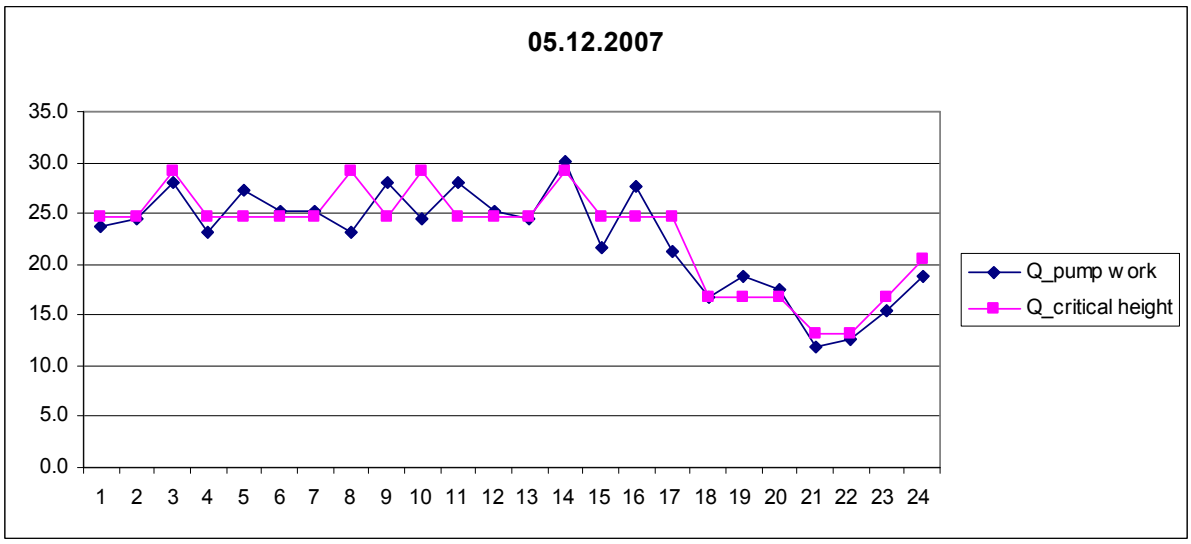
$$Q_{\inf low} = \frac{W_{\inf low}}{\Delta t} \quad \left(l/s\right)$$

Input data for this calculation such as dW are calculated with results from 24 hours measuring, while flow of the two pumps is examined from few sides with intention to gain more accurate input data for this value. According to data obtained from PE "Vodovod" – Skopje installed pumps in Pump Station Dracevo are manufactured in 1994 the first one and another one in 2000, both by manufacturer Flygt CP 3152 with N= 2x 13,5 kW. Performance curve of the pumps is given as Attachment 22 where it can be seen that pump are working with flow of 50 l/sec – 55 l/sec for height of 15m. Considering performance curve and according to experience from PE "Vodovod" stuff, summary pump's flow for both pumps is between 60 l/sec and 70 l/sec. In order to determine accurate pump flow rate, we performed one control measurement by detecting the change of volume in reservoir during two short periods of time beginning with start of pump work and lasting: first - 160 sec and second - 60 seconds. The flow rate is simply calculated with change of water volume in reservoir and in collecting manhole during period of time without taking influence of water inflow into pump reservoir being in opinion that for that short time water level change is caused mostly by pump work with very little influence of water inflowing.

Calculated Pumps Flow rate (by measiring of water level reservoir)	T pump	dh	Q pump	Q pump
	(sec)	(m)	(m3//sec)	(l/s)
1 measurement	160	0.21	0.07298	**72.97**
2 measurement	60	0.07	0.06487	**64.86**
			Q pump	**70.00**

Taking in consideration all information we had and summarizing all this results, quantity of 70 l/s is taken as hourly pump flow and used for calculation of hourly inflow using previously described calculation. The presentation of the results for 24 hours flow rate calculation for both phases of MP18 is presented as Attachment 28, while graphic presentation of 24 hours flow rate calculated as described above and with measuring critical height on pipe outlet is given on following charts. It can be concluded that the result are similar with no significant difference between two methods for calculating flow rate.





3.2.3. Flow measurement in circular pipe by measuring velocity with flow meter

In order to verify calculated flow rate determined by measuring critical height in pipe, a control measurement for two measuring points: one for circular pipe MP9 and one for tunnel shape pipe MP12 was performed using an indirect method by measuring the velocity with flow meter and water section area to estimate water flow during second Phase on December 5th. The method for velocity measuring using flow meter has been described in chapter 3.1.1 and 3.1.2. Velocity measurement with flow meter was performed on the same date as the second Phase of flow rate measurement at 13:00 on MP12 and 15:00 on MP9.

Two readings were taken for each profile in two different intervals (mostly 15 sec and 30 sec) and recorded in the field notebook (R1 and R2) so the average velocity had to be calculated later on using following equation:

$$V = 0{,}262 \times R_{(rot/\sec)} + 0{,}004$$

The results of flow meter measuring on MP12 are listed as Attachment 29 and on MP9 as Attachment 30 using data and equation as presented, while compared results of calculation by two methods are shown in Attachment 26 and Attachment 24 on the bottom of the pages and listed below:

Control measurement with curent meter (propeler) MP12											Qmeasured /Qcalculated
13:00		5.1%	0.28	2.77	0.91		2.50	0.500	0.64	635	1.270	102%

Control measurement with curent meter (propeler) MP9											Qmeasured /Qcalculated
15:00		30.0%	0.30	0.50	2.32		0.92	0.198	0.33	327	1.652	113%

The difference between results calculated by these two methods is 2% for tunnel shape and 13% for circular shape so it can be concluded that method by measuring height critical provide enough accuracy to be reliable.

4. WATER SAMPLING

Sampling is an extremely important consideration in properly characterizing wastewater for biological phosphorus removal. Flow rate and wastewater quality change continuously, and these changes may affect the ability of a wastewater treatment plant to achieve consistent biological phosphorus removal. Obtaining samples that will actually represent the wastewater flow throughout the months and years to come is difficult at best. Diurnal fluctuations occur in concentration and flow volume; seasonal fluctuations occur in concentration, flow volume, and temperature; and industrial contributions to the collection system may cause wastewater characteristics to change on a short- or long- term basis. Given the variable nature of wastewater and the necessity of attaining consistent phosphorus removal, it may be necessary to collect samples that will represent "average" characteristics and approximate characteristics under more extreme conditions.

4.1. Methodology of water sampling

According to Terms of Reference water sampling was preformed on 18 sampling points in two phases with distance of 7 days between them as previously described and shown in Time schedule as Attachment 31. The total number of samples according to the Terms of Reference is 36. Sampling was performed depending on type of water which was going to be examined. Sewer and industrial wastewater sampling (3 sewage pipes and 2 industrial pipes) was performed by composite sampling which consists of a collection of numerous individual discrete samples taken at regular intervals over 24 hours. The material was collected in a common container by flow rate measuring team over the sampling period started from 8:00 AM until 7:00 AM next day, when it was taken by team of 2 qualified person from Republic Health Protection Institute and one field surveyor from WDI, previously being poured into sampling bottles. River water sampling was performed by grab sampling which means taking sample directly from river where the effluent was free – flowing and had sufficient velocity to keep solids in suspension. Samples from 13 sampling points were taken using this technique taking water directly to sampling bottles.

Water sampling started at 6:30 AM at specified dates from MP1 and moving from one to other sampling points as they are numbered so the last one was MP18 at pump station Dracevo ending at 12:00 AM and delivering sampling bottles to the two laboratories they were going to be examined:

– Laboratory at Republic Health Protection Institute and

– Central Laboratory of Ministry of Environment and Physic Planning

4.2. Water sampling equipment

The sampling equipment was taken from the Laboratory and sterilized in appropriate way. The sample quantity is in accordance to the laboratory recommendations:

- 0,25 l sterile bottle for bacteria analyze
- 0,1 l for DO in Winkler bottle
- 0,1 l for BOD in Winkler bottle
- 1 l bottle for Normal – hexan Extracts (not fully filled)
- 1 l bottle for Phenols
- 1 l bottle for Silica and COD_{cr}
- 1,5 l bottle for rest of the parameters

It was necessary to perform conservation of phenols in situ with 10ml of $CuSO_4$ was used, 2-3 drops of indicator and few drops of H_3PO_4.

Methods of preservation included cooling.

5. MEASUREMENT OF WATER QUALITY

For evaluating plant performance regardless of size, large scope of parameters regarding water quality has to be monitored such as: biochemical oxygen demand (BOD), total suspended solids (TSS), pH, total coliform, fecal coliform, temperature, dissolved oxygen, total volatile solids, total solids, settleable solids, nitrogen, phosphorus, chlorine residual, dissolved solids, alkalinity, metals, COD, oil and grease, and organic priority pollutants as required.

5.1. Parameters of Analysis

Parameters listed in Terms of References necessary to examine for caring out water quality measurement.

Category	Testing Item
General	**Odor, Color, Transparency**
	Temperature, pH, Electric Conductivity, DO, BOD_5
	COD_{cr}, SS, Nitrogen (T-N, NH_4^+, NO_2^--N, NO_3^--N), Phosphorus (T-P, PO_4^{3-}, P), CN, F, Na
Oil	**Normal-hexan Extracts**
Bacteria	**Total Coliform, Fecal Coliform**
Heavy Metals	**As, Cd, Cr^{6+}, T-Cr, Fe, Mn, Hg, Pb, Zn, Ni,**
Others	**Phenol, Cl^-, SO_4^{2-}, SiO_2**

5.2. Laboratories and their Organization Chart

Taking in consideration that no laboratory which perform examination of water quality in Republic of Macedonia, wasn't able to do all required examination of parameters listed in Terms of References, it was necessary to divide examination into two Laboratories:

– Laboratory at Republic Health Protection Institute and

– Central Laboratory of Ministry of Environment and Physic Planning

Laboratory at Republic Health Protection Institute is Accredited Laboratory for testing of waste water with Ion Chromatography method for heavy metals as it is proved by document presented in Attachment 40, while no other Laboratory has accreditation at Institute for Accreditation of Republic of Macedonia. Central Laboratory of Ministry of Environment and Physic Planning is in process of accreditation for some of their methods. Laboratory at Republic Health Protection Institute was able to perform almost every of the required parameters listed above while those which they couldn't were analyzed at Central Laboratory of Ministry of environment and physic planning. These parameters are listed bellow:

- COD_{cr}
- Phenol
- Silicium SiO_2
- Normal-hexan Extracts
- T-N

Larger scope of work for water quality examination was performed by Laboratory at Republic Health Protection Institute so they activities were organized by four departments:

1. Department for Physic- chemical analysis – in charged by Svetlana Tosevska, technologic engineer (plus 2 technicians)
2. Department for Heavy Metals analysis – in charged by Biljana Manevska, specialist of sanitary chemistry (plus 2 technicians)
3. Department for Toxicology – in charged by Vesna Kostik, PhD of medical science
4. Department for Microbiology – in charged by Elizabeta Coneva, Dr (plus 1 technician)

Water quality examination performed by Central Laboratory of Ministry of Environment and Physic Planning was preformed by three people with Lilija Ralevska, technologic engineer as person in charge

5.3. Analysis Method and Analyzers

The analyses method were performed in accordance to the Standard Methods for Water Quality Test in Republic of Macedonia, and justified with Environmental Protection Agency Guidelines.

Republic Health Protection Institute Laboratory methods and analyzer for samples analyzing

Parameter	**Method and Analyzer**
Odor and color	Spectroquant
pH	ISO 10523 ; 424 - with pH-meter
Electro conductivity	ISO 7888 ; 205 - with conductometer
COD	ISO 8467 ;508 - COD (dichromate); (potassium permanganate after Kubel – Timannu)
SS	208D - Total Nonfilterable Residue Dried at 105 ^{0}C

Nitrogen	Spectroquant
NO_2	420 - Spectrophotometric (1-napthuldiamine and sulfanilic acid)
NO_3	419A - Ultraviolet Spectrophotometric Method with hydrochloric acid
NH_4	418 - Nesslerization Method
PO_4^{3-}, CN, Na	Ion Chromatography
DO	422A - Iodometric Method
BOD5,	507 - Iodometric Method after 5 days
SO_4^{2-}	427C - Turbidimetric Method with barium chloride
Cl^-	408A - Argentometric Method
Heavy Metals	AAS (Atomic Absorption Spectrometer) with graphite furnace, type PERKIN ELMER, HGA 800 with Auto sampler AS-70 ISO 15586 and for Hg-IEN 13806 with FIM
Bacteria analyze	ISO 9308-2 with VITEK (Authomatic identificator)

Central Laboratory of Ministry of Environment and Physic Planning methods

Parameter	**Method**
$COD_{K2Cr2O7}$	M54 ISO 6060
Phenol	M54 ISO 6439
Normal - hexan Extracts	M54 1303
SiO_2	M54 ISO 11885
TN	M54 ISO 11905

5.4. Pre-treatment equipment

Pre – treatment required for heavy metals examination - microwave digestion with NHO_3

5.5. Result of water quality measurement

The results of water quality examination performed by Central Laboratory of Ministry of Environment and Physic Planning including 5 parameters for Phase 1 are presented as Attachment 32 and Attachment 33 for Phase 2.

The results of water quality examination performed by Republic Health Protection Institute Laboratory which include Bio-chemical and Physic - chemical parameters presented as Attachment 34 and Attachment 35 for both Phases, Heavy metals parameters presented as Attachment 36 and Attachment 37 for both Phases and Micro biological parameters as Attachment 38 and Attachment 39 for both Phases.

It can be summarized that registries level of dissolved oxygen in river water was low, while results in BOD and COD showed big variations from Phase 1 to Phase 2.

The results of Physic - chemical parameters such as NO_2, NO_3 i NH_4 point to organic pollution (especially presence of ammonia).

Comparing PH values sampling water is in group with normal PH value with very small number of samples of low alkali water.

Comparing conductivity, suspended solids, sulfate and chloride, waste water samples are with higher level comparing to surface river water.

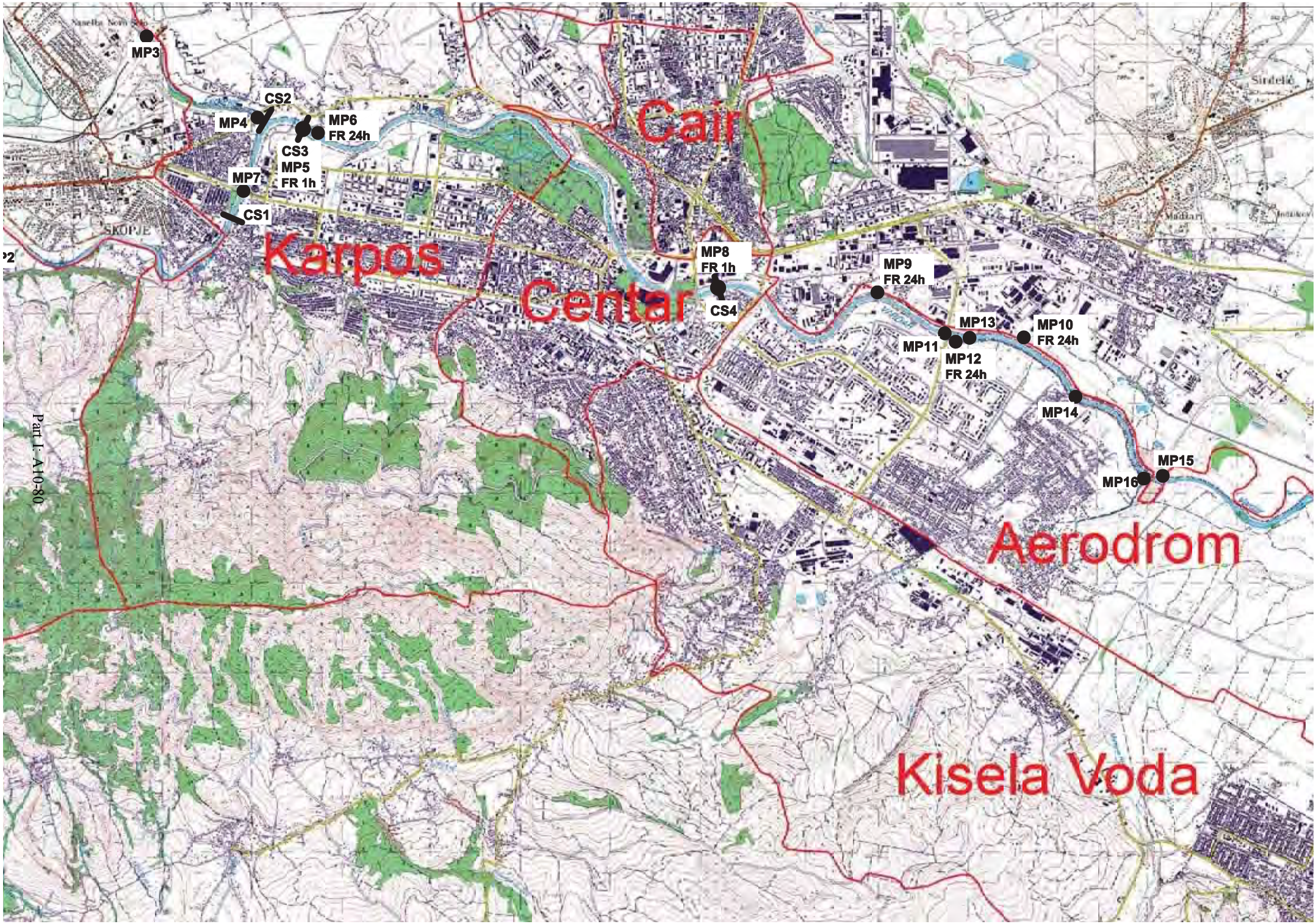
From heavy metals parameters it is obvious that there is no cyanide in any sample. All heavy metals parameters are lower than maximum allowed concentration excluding Nickel for MP15 – Phase 1 with very small increasing of allowed concentration and Hg on MP3, MP4, MP8, MP2, MP9, MP10 and Mp14.

Concentration of fluoride is very low while phosphor is in big diapason from 0 to 55,46 as PO4.

From analysis of the results concerning color, odor and turbidity it cab be summarized that expressive odor is registered at MP18 as well as largest turbidity (35 NTU) while at other sampling points is from 0 – 33 NTU.

From microbiological analysis it can be concluded that river water according to classification in Republic of Macedonia is III class of water (No 19/99) and that thermo tolerant coliform bacteria were isolated.

ATTACHMENTS


MP3
CS2
MP4
MP6
FR 24h
CS3
MP5
FR 1h
MP7
CS1
SKOPJE
Karpos
Cair
Centar
MP8
FR 1h
CS4
MP9
FR 24h
MP13
MP11
MP12
FR 24h
MP10
FR 24h
MP14
MP15
MP16
Aerodrom
Kisela Voda
Part I- A10-80