Modernization of local public services in the Republic of Moldova

- Intervention area 1: Local services -

Feasibility Study for Aggregating Water Supply Services for Rayon of Cahul with options for wastewater services

Draft report

June 2014

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Chisinau, June 2014

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Acronyms and abbreviations

(S)CW	(small scale) constructed wetland
ABR	Anaerobic baffled reactor
A-C	Apa Canal
ADB	Asian Development Bank
AgeoM	Agentie pentru geologie si resurse minerale din Republica Moldova
ANRE	The National Agency for Energy Regulation
ASP	Activated sludge process
BAU	Business as usual
BOD	*biochemical oxygen demand*
CH4	Methane
Co2	*Carbon dioxide*
COD	*chemical oxygen demand*
EC	European Commission
ESL	ECOSAN latrines
EU	European Union
EU	European Union
EUR	Euro
GDP	Gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IWRM	Integrated water resource management
JSC	Joint Stock Company
lcd	Litters per capita per day
LLC	Limited Liability Company
LPA	Local Public Administration
LPA 1	Local Public Administration of first level
MC	Municipal Company
MDL	Moldovan Lei
MLPS	Modernization of Modernization of Local Public Services in the Republic of Moldova
NGO	Non-Governmental Organization
NPV	Net present value
O&M	Operation and maintenance
O&M	Operating and Maintenance
PE	Population equivalents
PRSP	Republic of Moldova: Poverty Reduction Strategy Paper
SEDS	Social and Economic Development Strategy
ST	Septic tank
TAU	Territorial-Administrative Unit
TSS	Total suspended solids
UWWTD	The EU Urban Waste Water Treatment Directive Directive 91/271/EEC, OJ L135 of 30.5.1991
WSS	Water Supply and Sanitation
WWTP	Wastewater treatment plant
The amount of ions (mineralization)	The total content of the main cations and anions per one liter of water, mg / l. Maximum permissible concentration (MPC) – 1000 mg / l;
Sulphates	The content of SO_4 anion per one liter of water, mg/l, MPC – 100 mg/l;
Hardness	The amount of calcium and magnesium conditioning the water hardness, mg-eq. MPC – 10 mg-eq;
Dissolved Oxygen	The amount of Oxygen dissolved in one liter of water, MPC - 4.0 ÷ 10 mg/l
Water Output	The amount of water that flows through the cross-section of the river or water pipe

	per second ; m^3/sec, l/sec;
Runoff Depth	The amount of water that flows down from the catchment area in a certain period of time, mm;
Low-water period	The phase of the hydrological regime of river, which is characterized by low runoff, i.e. the lowest water output;

0 Executive Summary

Acting upon the request of Rayonal Council of Cahul, the GIZ project Modernization of Modernization of Local Public Services in the Republic of Moldova commissioned a team of experts to conduct a Feasibility Study to investigate and assess the proposed project on aggregating water supply services for Rayon of Cahul with options for wastewater services.

This would enable domestic and international donors to consider the possibility to provide grant funds.

This Feasibility Study is based on the data provided by Rayonal Socio-Economic Developing Strategy and data collected from the Rayon administration and from communes (LPA1) from the territory of Rayon of Cahul.

In 2011 Rayon of Cahul, together with RDA South and with support from GIZ project Modernization of Modernization of Local Public Services in the Republic of Moldova, started to work on updating the chapter of Water and Sanitation Services (WSS) of the Socio-Economic Developing Strategy. The updated chapter on WSS takes into account different options of the water supply, like underground water sources (artesian wells) and surface water, and provides recommendations on how to organize a drinking water supply. This feasibility study is a step towards implementation of the strategy.

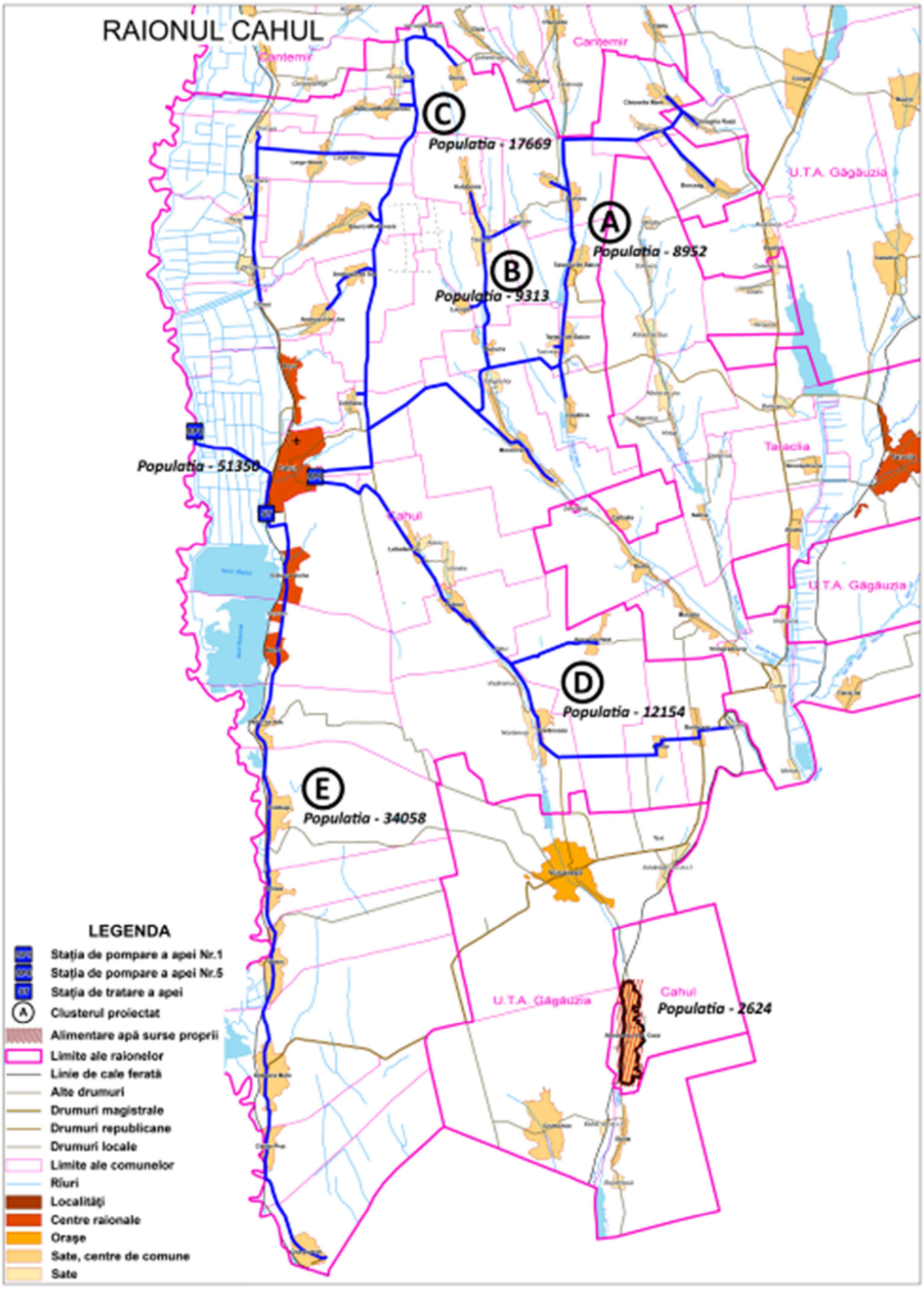
The objective of the project is to provide the population of the Rayon of Cahul with a safe drinking water through aggregated water supply as defined by updated chapter on Water and Sanitation Services of the Socio-Economic Developing Strategy.

0.1 Scope of the project

The entire rayon has been divided into clusters, as defined in the Socio-Economic Development Strategy. Clusters were defined by optimising localities for their proximity to one another, their similarities in terms of network density, topography, etc., and for design of future service provision. The following table presents the localities in the rayon according to cluster. Four remote villages are not included in the main clusters.

Table 0-1: Definition of clusters

Cluster	Number of towns	Number of localities	Population	Estimated number of households
Cluster 0	1	4	51 591	17 466
Cluster A		5	6 120	1 875
Cluster B		7	8 786	2 950
Cluster C		15	16 913	5 374
Cluster D		12	11 466	3 891
Cluster E		7	25 555	7 946
Borceag Frumusica, Chioselia		3	3 207	1 068
Alexandru Ioan Cuza		1	2 624	884
TOTAL	**1**	**54**	**126 262**	**41 454**



0.2 Investment costs for water supply

The total investment outlays amount to **579 million MDL (33,977 million EUR)**. The outlays involve the construction of:

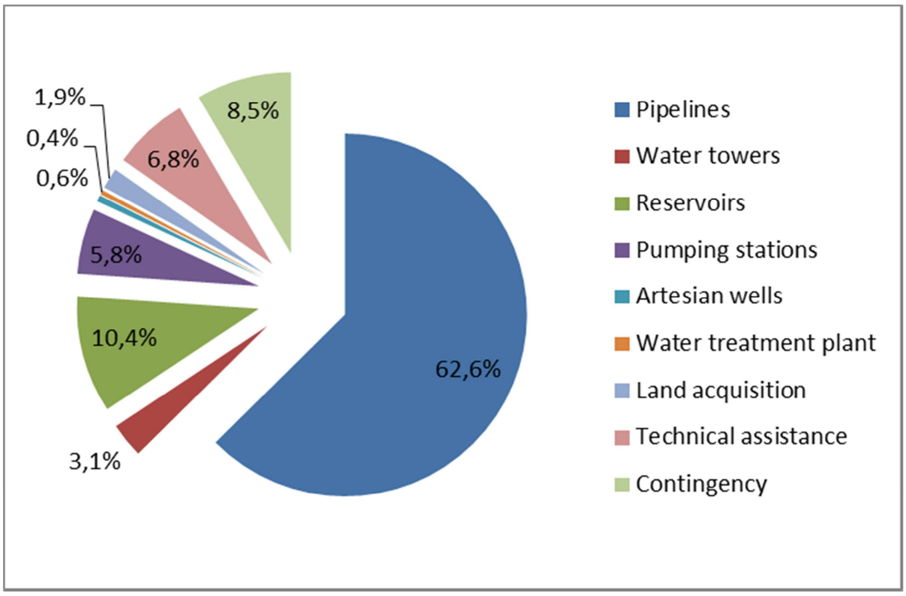
- 23 pumping stations,
- water towers and reservoirs of total capacity of 12,400 m3,
- main distribution pipelines of 190.6 km,
- secondary distribution pipelines of 53.7 km,
- distribution pipelines (in villages) of 365.2 km,
- 3 artesian wells,

- land appropriation of 1,260,600 m2,
- technical assistance during construction period.

Table 0-2: Summary of the investment costs [MDL M]

	TOTAL
Pipelines	362,4
Water towers	17,9
Reservoirs	60,2
Pumping stations	33,8
Artesian wells	3,2
Water treatment plants	2,3
Land acquisition	10,7
Technical assistance	39,3
Contingency	49,1
Total	579,0

Figure 0-1: Structure of project investment outlays



0.3 Project financing plan

The total investment outlays will be financed by:

- Communes and towns participating in the project
- Rayon administration
- Citizens providing local contribution
- Water utility
- Domestic and international donors.

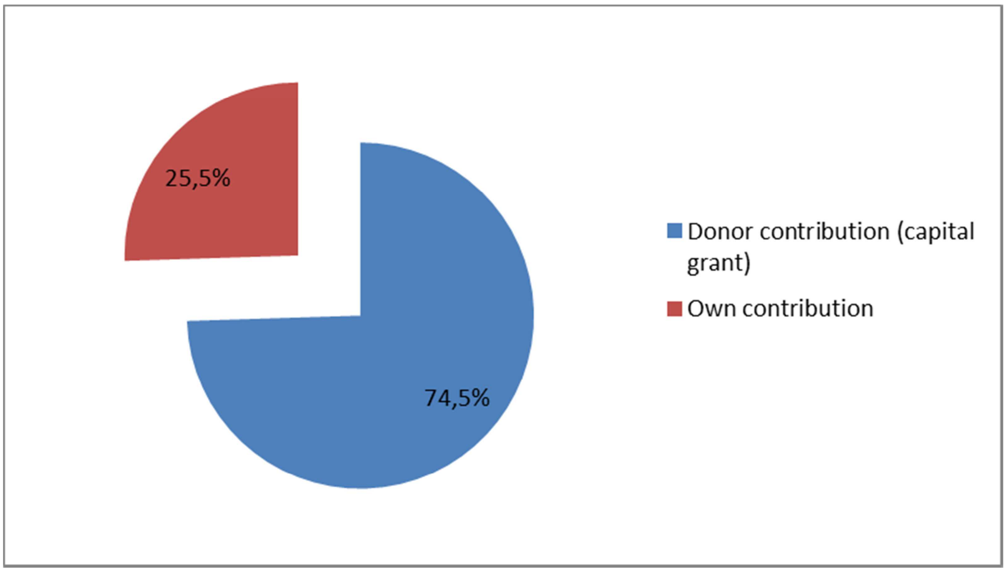
Table 0-3: Summary of the investment outlays and financing structure [MDL M]

Project investment outlays	
Pipelines	362,4
Water towers	17,9
Reservoirs	60,2
Pumping stations	33,8
Artesian wells	3,2
Water treatment plants	2,3
Land acquisition	10,7
Technical assistance	39,3
Contingency	49,1
Total	**579,0**

Project financing	
Communes and towns participating in the project	11.1
Rayon administration	2.5
Citizens providing local contribution	20.1
Domestic and International donors	431.3
Other domestic sources	113.9
Water utility	0.0
Total	**579.0**

The donor contribution was estimated as 74.5% of the total investment costs, while the local sources' contribution is 25.5%.

Figure 0-2: Structure of project financing [%]



The project will be implemented during the period of 5 years and implementation schedule is as indicated in the following table.

Table 0-4: Summary of the investment implementation schedule [MDL M]

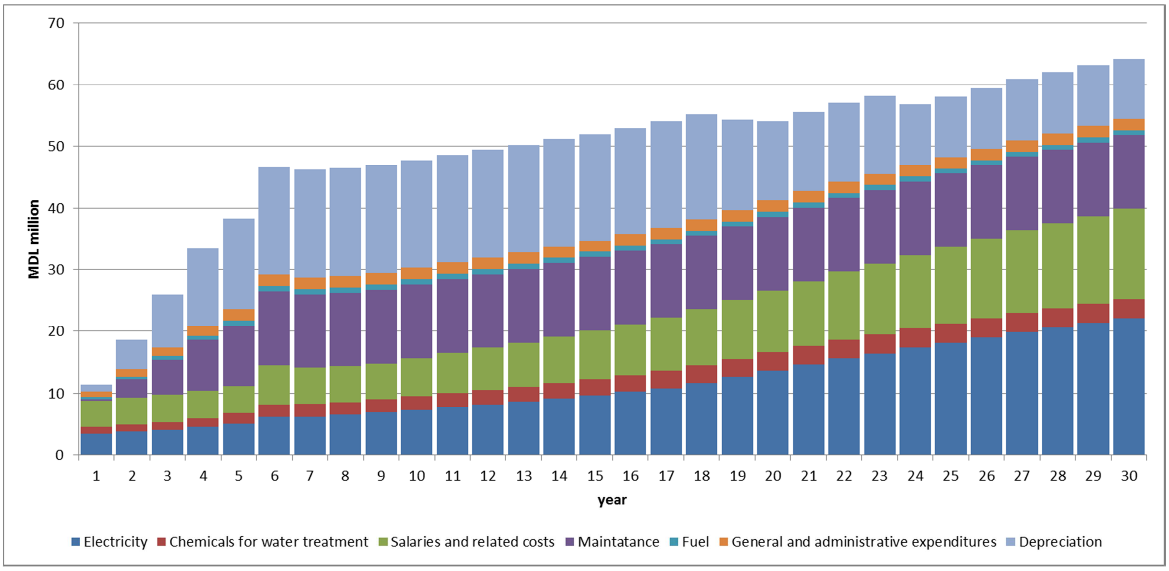
	2014	2015	2016	2017	2018	Total
Pipelines	87,8	80,4	72,1	46,8	75,3	362,4
Water towers	8,6	5,4	3,0	0,3	0,6	17,9
Reservoirs	6,6	18,4	18,5	6,9	9,8	60,2
Pumping stations	5,6	7,6	12,3	3,0	5,5	33,8

Artesian wells	0,0	0,0	0,0	3,2	0,0	3,2
Water treatment plant	0,0	0,0	0,0	2,3	0,0	2,3
Land acquisition	3,1	2,0	4,0	0,6	1,0	10,7
Technical assistance	8,9	9,1	8,8	5,1	7,4	39,3
Contingency	11,2	11,4	11,0	6,3	9,2	49,1
Total	87,8	80,4	72,1	46,8	75,3	579,0

0.4 Operating costs

The following charts illustrate the operating costs forecast.

Figure 0-3: Operating costs forecast [MDL M]



0.5 Tariffs

To estimate revenues for the water utility in the future, an average tariff has to be assessed. This is done by taking into account:

- Operating and maintenance cost of the system: this includes direct costs of labour, energy, chemicals, fuel, maintenance, financial and administrative costs;
- The need to respect the polluter pays principle and charge a full cost recovery tariff (including depreciation) in the long run;
- The need to have a positive cumulative cash flow in the water utility to maintain sustainable operations. This means that the tariff calculation shall include reserve for irregular receivables; the forecast of irregular receivables is described in sensitivity analysis;

The proposed tariff takes into account changes in the water demand (caused by price elasticity) and affordability. If tariff with depreciation exceed affordability level, lower tariff is proposed.

Based on the foregoing, the future tariff is proposed as illustrated in the following table.

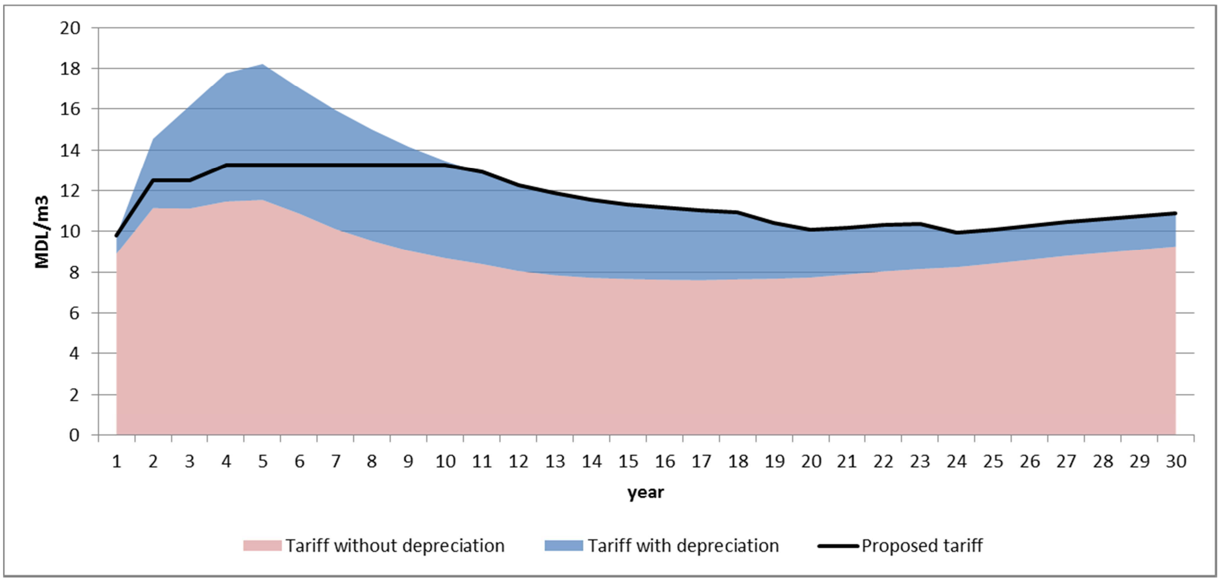
Table 0-5: Tariff calculation for the option with the project [MDL M]

	1	2	3	4	5	10	20	30

Total costs for tariff calculation	12.79	20.13	27.69	35.25	40.02	49.42	55.54	65.82
Water sale [m3]	1 304 855	1 384 574	1 714 802	1 984 456	2 196 394	3 674 869	5 519 315	6 059 536
Tariff [MDL/m3] without depreciation	8.90	11.14	11.12	11.46	11.54	8.68	7.73	9.26
Tariff [MDL/m3] with depreciation	9.80	14.54	16.15	17.76	18.22	13.45	10.06	10.86
Proposed tariff [MDL/m3]	9.80	12.47	12.47	13.23	13.23	13.24	10.07	10.87

The following chart illustrates how the tariff was proposed. During the construction period, when capital costs raises significantly while water sale is limited, it is proposed that tariff does not contain depreciation costs of new assets. This would stimulate the water consumption and will keep the tariffs below affordability constrains. After the project is completed and water consumption will rise, the tariff may include depreciation (so it will be a full cost recovery tariff). The estimation shows that full cost recovery tariff can my applied since year 10 of the forecast. The chart below illustrates the proposed tariff (black line). Blue zone represents the tariff calculated without depreciation (lower boundary of the blue zone) and tariff calculated with depreciation (upper boundary of the blue zone).

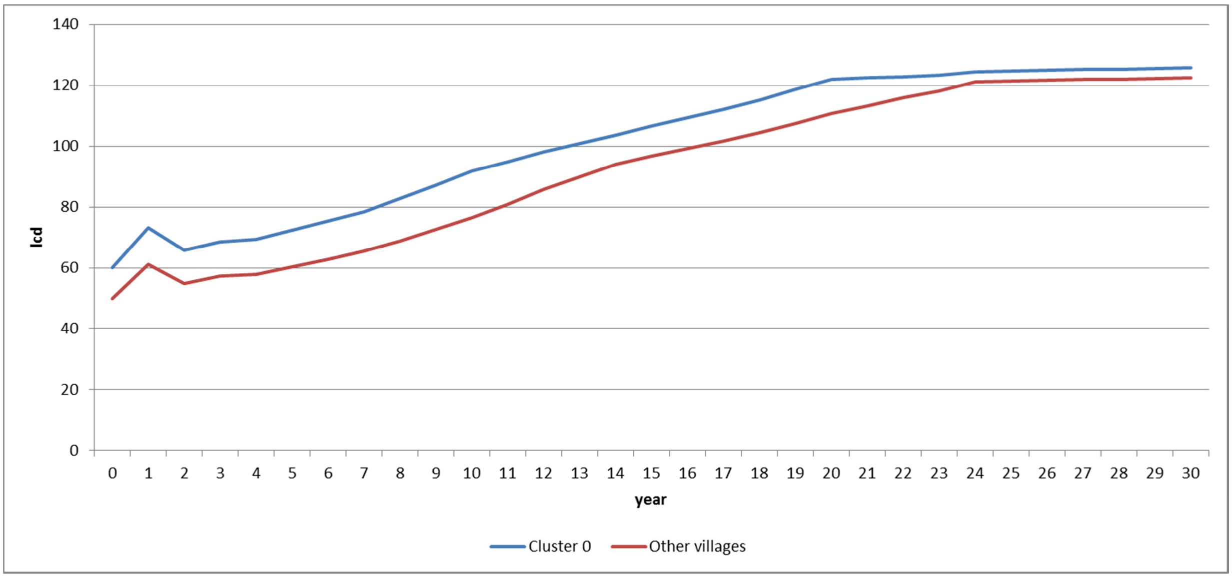
Figure 0-4: Forecast of the tariff [MDL/m3].



0.6 Water demand

The following chart presents the changes in unit consumption of water caused by tariff increase. After initial small decrease in consumption, due to rise of the tariff, it is forecasted future increase in consumption. This increase will be caused because unit cost will decrease when the entire project is completed and due to income elasticity.

Figure 0-5: Forecast of the unit consumption of water in Cluster 0 and in other clusters [lcd].

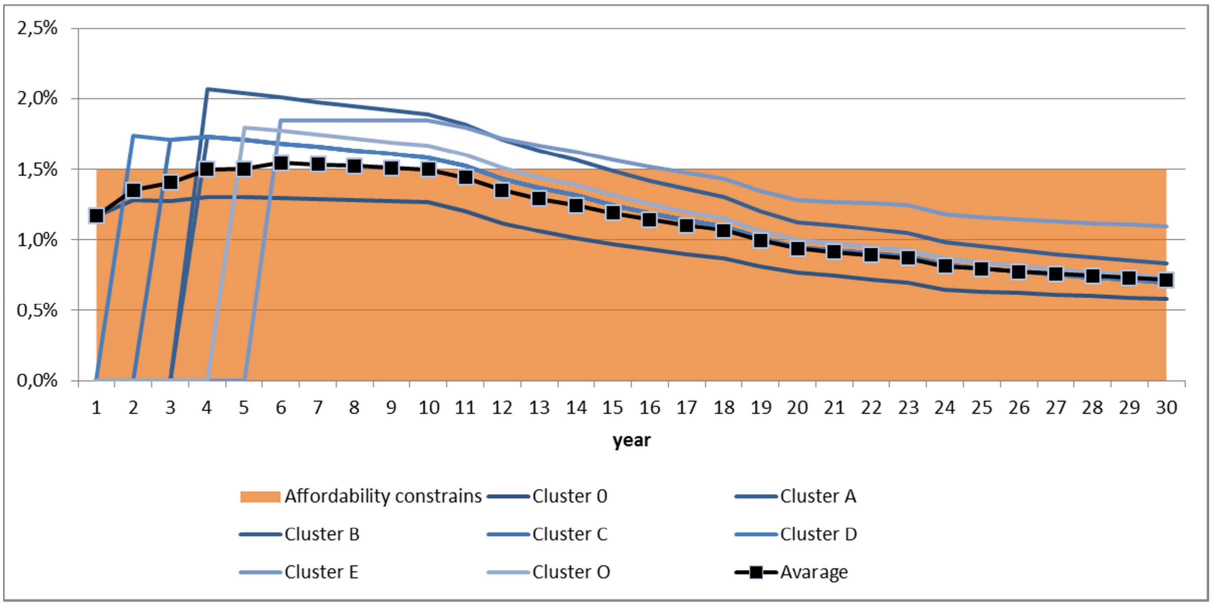


0.7 Tariff affordability

The following chart presents the tariff calculation for water for households and its relation to the affordability threshold: **1.5%**. The tariff should cover at least operating and maintenance costs and shall not exceed a level covering O&M and capital costs (depreciation). The most problematic is the time period during and just after project implementation. Thereafter, the expansion of the service area, increase in household income, and higher water consumption will lead to lower unit costs and the impact of the affordability constraint will lessen. For the first years of the project implementation, it is proposed that tariff does not contain the component of capital costs (depreciation), otherwise the proposed tariff would be too high and the affordability constraint would lead to a further decrease of water consumption. The average bill in these years slightly exceeds 1.5% of average disposable household income.

The proposed bill for water as a percentage of disposable household income is presented by chart below.

Figure 0-6: Proposed tariff and tariff affordability [%]



0.8 Financial performance of the project - NPV and IRR calculation

The calculated NPV at a 5% discount rate for a 30-year operating period is negative. This attests to the fact that the project does not generate a return and is financially unprofitable.

This is a typical result for a project in which costs are incurred (capital and operating) but revenues do not significantly increase. Other investments in the water sector obtain similar results.

Negative financial indicators (rate of return) for a project cannot serve as the sole basis for determining whether a project should be pursued. These results, however, serve as the basis for estimating the social benefits associated with the project.

FNPV (C)=	-376.83	Million MDL
FRR (C)=	-1%	

The financial analysis on profitability of the own capital contribution was also conducted. The analysis is similar to that presented above, but takes into account the capital contribution to the project only and does not count grant (donor) contribution to the project.

The results are positive but close to 0, what is according to the assumption that external co-financing shall do not lead to the profitability of the own funds.

FNPV (K) =	0.0	Million MDL
FRR (K) =	5%	

0.9 Economic rate of return (ERR) and economic net present value (ENPV)

To calculate the economic rate of return (ERR), net cash flow balance was corrected for the social costs and benefits:

Fiscal corrections:

- VAT

Price distortions:

- Engaging unemployed persons during construction
- Price distortions for electricity prices

External effects:

- Shadow prices related to business development
- Benefits of avoided water-related diseases

After making the above corrections, the surplus after corrections was calculated; this in turn was the basis for calculating the economic rate of return (ERR) and the economic net present value (ENPV).

The calculated ERR is 14% while the ENPV is 211.23 million MDL at a discount rate of 5% what means that project is worth for financing.

0.10 Affordability of centralized sewage collection and wastewater treatment

The cost assessments are based on the units and unit prices as well as on the population figures outlined in section 6.1. The assessment is done on a local level, but aggregated here for the clusters. For the city of Cahul, a new WWTP is calculated and a sewer system for the extension of the existing system to cover the forecasted increase of population until the year 30 is also included in the calculations. According the clusters on which this study is based on, it is preliminary planned to connect in future all localities from the clusters 0, C, and E to the WWTP in Cahul. The investment costs for the WWTP Cahul are calculated accordingly.

The total investment costs for established and centralized wastewater management systems are assessed at EUR 146,76 million, whereof EUR 27,69 million amount for the wastewater treatment and EUR 119,07 million the wastewater collection (sewer system and house connections).

Table 0-5: Investment costs assessed for the waste water management systems in the district of Cahul, aggregated for clusters

Area	Investment costs					
	Waste water treatment [mEUR]	sewer system [mEUR]	house connections [mEUR]	pressure pipes [mEUR]	pumping stations [mEUR]	Total [mEUR]
Cluster 0	9,87	8,35	3,04	0,18	0,11	21,55
Cluster A	1,68	5,06	0,67	0,76	0,11	8,28
Cluster B	2,71	10,12	1,22	1,86	0,18	16,08
Cluster C	2,09	19,09	1,89	2,70	0,28	26,05
Cluster D	3,14	13,80	1,41	1,93	0,25	20,53
Cluster E	7,05	32,25	6,92	2,81	0,28	49,31
Cluster FCB Frumusica, Chioselia, Borceag	1,14	2,81	0,40	0,54	0,07	4,96
Total	**27,69**	**91,49**	**15,55**	**10,77**	**1,26**	**146,76**

It is assumed that the implementation of all the facilities is realistic only for a period of about 15 years.

The assessed O&M based on the units and unit prices as well as on the population figures.

Table 0-6: O&M costs assessed for the waste water management systems in the district of Cahul; aggregated for clusters

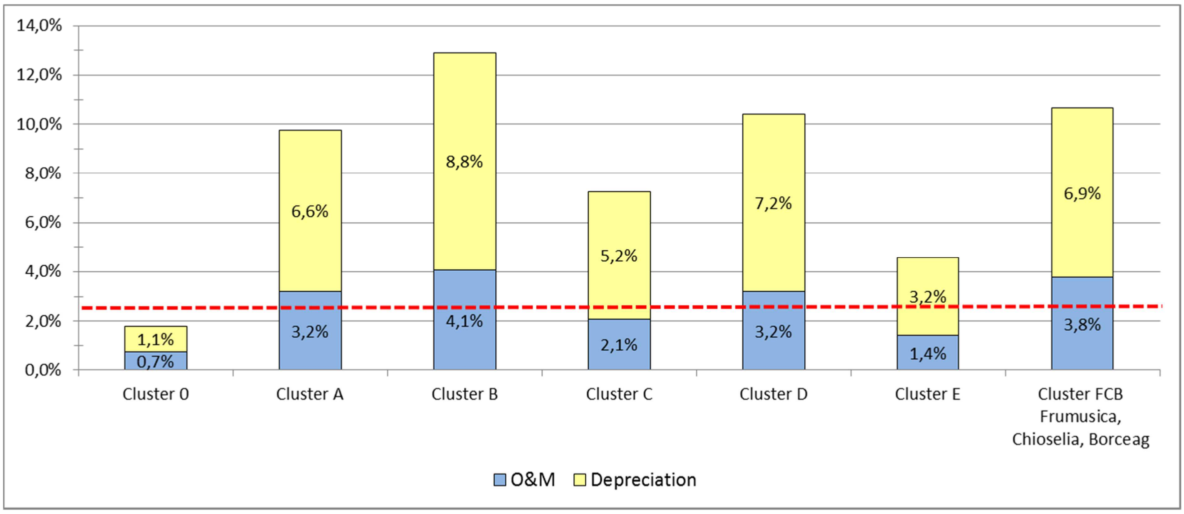
Area	O&M costs/depreciation						
	O&M WWTP [mEUR/y]	O&M Sewer system & PS [mEUR/y]	Total O&M per year [mEUR/y]	O&M costs per capita and year [EUR/c*y]	Depreciation per year [mEUR/y]	O&M incl. depreciation per year [mEUR/y]	O&M incl. depreciation per capita and year [EUR/c*y]
Cluster 0	0,41	0,14	0,55	9,49	0,80	1,36	23,35
Cluster A	0,06	0,04	0,10	24,50	0,20	0,30	74,74
Cluster B	0,10	0,08	0,18	24,00	0,38	0,56	75,78
Cluster C	0,09	0,14	0,23	18,48	0,57	0,80	64,67
Cluster D	0,11	0,10	0,21	25,01	0,48	0,69	81,39
Cluster E	0,29	0,22	0,51	12,19	1,13	1,64	39,49
Cluster FCB Frumusica, Chioselia, Borceag	0,05	0,02	0,07	28,58	0,12	0,19	80,57
Total	**1,09**	**2,58**	**1,84**		**3,69**	**5,53**	

The level of optimal tariffs for water and sewage is about 3 - 4% of a household income, whereas the tariffs for water are only about 1.5% - 2%; consequently 2% – 2.5% remain for sanitation expenses. The tariff should cover at least operating and maintenance costs and should not exceed a level covering O&M and capital costs (depreciation).

The assessment of the affordability is based on the assessed O&M costs outlined above and on the disposable household income identified and forecasted for the district.

The chart below presents the O&M as a percentage of disposable household income. It can be seen that the O&M costs already for 4 out of the 7 clusters exceeds the threshold of 2.5% and that the depreciation exceeds the threshold by far.

Figure 0-7: O&M costs as a percentage of disposable household income



Depreciation for centralized wastewater management cannot be covered in any of the localities out of Cluster 0 (agglomeration of the city of Cahul), neither at present nor in the next decades.

1 Introduction

Acting upon the request of Rayonal Council of Cahul, the GIZ project “Modernization of Modernization of Local Public Services in the Republic of Moldova” commissioned a team of experts to conduct a Feasibility Study to investigate and assess the proposed project on aggregating water supply services for Rayon of Cahul with options for wastewater services.

This would enable domestic and international donors to consider providing grant financing for the project.

This Feasibility Study is based on the data provided by Rayonal Socio-Economic Development Strategy (SEDS) and data collected from the Rayon administration and communes (LPA1) from the territory of Rayon of Cahul.

The assumptions used for the preparation of the Feasibility Study and the conditions for the implementation of the project have been identified by the Rayon of Cahul and its communes. In preparing the study, the expert team based its work on information received from the Rayon of Cahul and communes, in particular, shared studies and documents in their possession and through providing data via questionnaires. The study is also based on the “Willingness-to-Pay and Affordability” study commissioned by GIZ and performed by NGO “Contact-Cahul”.

All above mentioned sources of information were verified when possible, however, not all information was provided. Nevertheless, the estimates used by the team of experts were deemed sufficient at this stage of project development.

Documents that were used for the preparation of the Feasibility Study are identified in the text of the study.

Some figures in this Feasibility Study, in particular, the sum of intermediate and final calculations included in the tables have been rounded. Therefore, the numbers given as the sum or the intermediate sums in the tables and in the text may not correspond to the arithmetical sum.

1.1 Background and scope of the feasibility study

In 2011, the Rayon of Cahul, together with RDA South and with support from GIZ project “Modernization of Modernization of Local Public Services in the Republic of Moldova” (MLPS), began work on updating the chapter of Water and Sanitation Services (WSS) of the Socio-Economic Development Strategy. The updated chapter on WSS takes into account different options of the water supply, such as underground water sources (artesian wells) and surface water, and provides recommendations on how to organize drinking water supply services. This feasibility study is a step towards implementation of the strategy in the Cahul Rayon.

1.2 Project objective

The objective of the project is to provide the population of the Cahul Rayon with safe drinking water through aggregated water supply as defined by the updated chapter on Water and Sanitation Services of the Socio-Economic Development Strategy.

2 Description of the cluster/agglomeration

2.1 Project area

The project area comprises of the territory of Rayon of Cahul, however in option analysis it goes beyond the territory of the Rayon. The Rayon of Cahul is located on the south of the Republic of Moldova and has one exclave, locality Alexandru Ion Cuza.

The entire project area has been divided into clusters, as defined in the Socio-Economic Development Strategy. Clusters were defined by optimising localities for their proximity to one another, their similarities in terms of network density, topography, etc., and for design of future service provision. The following table presents the localities in the rayon according to cluster. Four remote villages (Borceag Frumusica, Chioselia, Alexandru Ion Cuza) are not included in the main clusters.

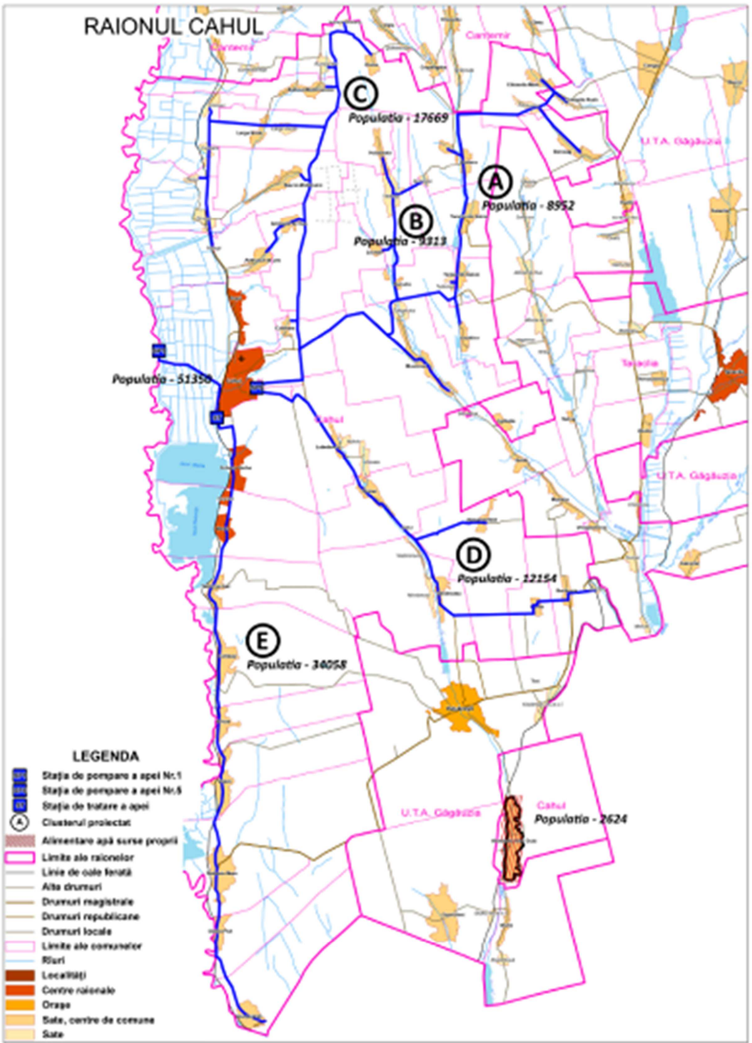
The following map provides overview of the project area and clusters definition, while table provides information on localities in each cluster,

Table 2-1: Definition of clusters

	Cluster 0
1	Cahul
2	Manta
3	Rosu
4	Crihana Veche
5	Pascani
	Cluster A
6	Burlacu
7	Taraclia de Salcie
8	Tudoresti
9	Tartaul de Salcie
10	Lopatica
	Cluster B
11	Moscovei
12	Bucuria
13	Lucesti
14	Trefestii Noi
15	Spicoasa
16	Huluboaia
17	Tatarasti
	Cluster C
18	Cotihana
19	Andrusul de Jos
20	Andrusul de Sus
21	Tretesti
22	Baurci Moldoveni
23	Larga Noua
24	Larga Veche
25	Badicul Moldovenesc
26	Rumeantev
27	Iasnaia Poleana
28	Doina
29	Paicu
30	Cucoara
31	Chircani
32	Zirnesti
	Cluster D
33	Lebedenco
34	Hutulu
35	Ursoaia
36	Peliniei
37	Satuc
38	Vladimirovca
39	Nicolaevca
40	Gavanoasa
41	Alexanderfeld
42	Iujnoie
43	Burlaceni
44	Greceni
	Cluster E

45	Vadul lui Isac
46	Colibasi
47	Brinza
48	Valeni
49	Slobozia Mare
50	Cislita Prut
51	Ghiurghiulesti
Localities out of clusters	
	Borceag Frumusica, Chioselia
52	Borceag
53	Frumusica
54	Chioselia
	Alexandru Ioan Cuza
55	Alexandru Ioan Cuza

Figure 2-1: Map of the project area and clusters definition



2.2 Natural features

The whole territory that is located southward of the Colina Moldovei (*Moldovan Valley*) is called South Moldova. It represents 20% of the Moldovan territory. The South of Moldova is less populated. Only 465 thousand people live here, which constitutes about 14% of the country's population and the population density is 68 people per km^2. The majority population consists of Moldovans, but there are several regions where the Gagauz and Bulgarians are predominant. There are also Ukrainian villages. This can be seen in the names of communities - Slobozia Mare, Leova, Slave origin − Ferapontevka, Mikhailovka and Turkish origin − Beş-Alma, Beş-Gioz and others.

Southward of the Codri in the direction of Danube and the Black Sea the heights decrease, the surface is flatter, there are no forests and the influence of the Mediterranean climate can be felt – it is warmer, more arid, the winter is milder. The average annual temperature is 9-10°; in July the temperature is about 22° and the sum of active temperatures is over 3100°. The precipitations amount to 400-480 mm, the largest part of them in the warm season in the form of torrential rains. In the summer of almost every year there is a deficit of humidity and the droughts are not rare.

On the once large areas in the South of Moldova the Gramineae and straw steppe was predominant with a mixture of plants typical of the regions coterminous with the Mediterranean Sea and the Middle Danube (Pannonia). The fauna suffered a transition as well. The specific combination of the elements from Eastern Europe and the Balkans has maintained in the soil coating: ordinary Chernozem soils, Chernozem soils similar to those from the steppes of Ukraine and Northern Caucasus, as well as compact black soils in the neighboring areas – such as the black clay soils of Bulgaria and Yugoslavia and brown soils with dry forests, such as those located close to the Mediterranean Sea. This interaction between western and eastern influences has not been identical in different parts of Southern Moldova. Representatives of the woody plants came from the upper northern and southern parts of the Codrii and of Colina Tigheci and from Dobrogea. As a result, a pile steppe was formed. It is dominated by steppe areas that are cut across by groves of downy oak, hornbeam and sumac. Southward, on lower areas the true steppe lies. It has had the same name since the nomad Tatars − Bugeac. It is referred to as straw steppe on the modern botanical-geographic maps.

The lack of ores and fuels, the limited hydro-energy resources, on the one hand and the exuberance of heat and increased soil fertility – on the other hand have led to the fact that agriculture is more developed than industry in the South of Moldova. The number of farmed land plots is very large — over 80%: 58% are the pastures (403 thousand ha) and 10% − orchards and vineyards (69 thousand ha).

2.3 Infrastructure

The existing water supply infrastructure in the Rayon of Cahul can be characterized as follows:

1. The water supply system with the surface source from Prut River covers the city of Cahul and recently also is expanding to neighbour localities. This system comprises the following:
    a. Treatment station with a capacity of 17.4 thousand m^3/day;
    b. Reservoirs for storage - 5500 m^3;
    c. Pumping stations – 8 units;
    d. Adduction networks – 11.5km;
    e. Distribution networks – 158.6km;

2. Localities out of the city of Cahul either have no centralized water supply system, or the system is based on the water source from artesian wells and usually covers only a part of the population.

2.3.1 The water supply system with the surface source from Prut River

The agglomeration of the city of Cahul (Cluster 0) covers 51 thousand inhabitants and over 17 thousand households. 13998 households are connected to the water supply services, which represents 80.1%. The length of street water supply pipelines is 150.6 km, which represents 86.4% of the street length. The system is managed by the Municipal Company Apă Canal Cahul.

Table 2-2: Water supply system from surface sources (cluster “0”)

Number of the households	Number of the residents	Number of the households connected to water services	Number of water consumers	Length of the streets, km	Length of the water pipelines, km	Households/1km of the network
17.466	51 591	13.998	31.908	174,3	158.6	86

2.3.2 Water supply system out of the city of Cahul

The water supply systems in many communities out of Cluster 0, consists of artesian wells, water storage reservoirs, water main and water distribution networks. These systems are operated by the municipal enterprises established by the LPA or managed directly by department within the Mayor’s office. These services are provided to over 45 thousand inhabitants and have coverage of 61.5%.

Table 2-3: Water supply systems from depth sources

No. of households	No. of residents	No. of households connected to water supply services	Length of the streets, km	Length of water pipelines, km	Coverage of water supply
14385	45946	6304	320.16	196.74	61.5%

2.3.3 Current sewerage and wastewater treatment infrastructure

The sewerage and wastewater treatment infrastructure is only operational in the city of Cahul. There are several treatment stations in the Rayon that belong to businesses, but there is no data available on their operation.

The sewerage system of the city of Cahul was constructed in 1970. It comprises 51.3 km of sewerage networks, a main pumping station, 2 smaller sewerage pumping stations and the treatment station with a capacity of 13.7 thousand m^3/day and the discharge pipeline. The average volume of wastewater is only 2500-3000m^3/24h. Several sewage pumps were replaced since 2006 and 6.5 km of the sewerage collector with the diameter of 400 mm was renovated in 2007.

2.4 Socio-economic situation

The Rayon of Cahul has a strong Rayon centre. The city of Cahul with population of almost 40 thousand citizens, serves as economical, educational and social centre of the Rayon. The railway station serves the city and is operated by Moldovan Railways. It provides direct rail connections to Chişinău. The railway connects also other localities south from the city of Cahul up to Giurgiuleşti. Giurgiuleşti is in the southernmost point of Moldova, at the confluence of the Prut

River with the Danube, on the border with Romania and Ukraine. Moldova has access to the Danube for only about 480 metres and the port is located there. The building of an oil terminal started there in 1996, and was finished in 2006. Rayon of Cahul is connected by national roads with Chişinău, Oancea (Romania) and Reni (Ukraine). Cahul is also a border checkpoint to Romania.The city is served by the Cahul International Airport located 8 km south-east of the city centre. Currently, the airport has no scheduled flights.

2.5 Population living in the cluster/agglomeration

The following table summarize the population living in the service area.

Table 2-4: Population living in the service area.

	Commune	Localities	Population
0	City of Cahul	Cahul	39800
	City of Cahul	Cotihana	1314
1	Alexandru Ioan Cuza	Alexandru Ioan Cuza	2624
2	Alexanderfeld	Alexanderfeld	1486
3	Andrusul de Jos	Andrusul de Jos	2287
4	Andrusul de Sus	Andrusul de Sus	1714
5	Badicul Moldovenesc	Badicul Moldovenesc	1342
6	Baurci-Moldoveni	Baurci-Moldoveni	2205
7	Borceag	Borceag	1600
8	Bucuria	Bucuria	822
9	Burlacu	Burlacu	2366
10		Spicoasa	276
11	Burlaceni	Burlaceni	2241
12		Greceni	103
13	Brinza	Brinza	2660
14	Chioselia Mare	Chioselia Mare	766
15		Frumusica	841
16	Colibasi	Colibasi	6030
17	Crihana Veche	Crihana Veche	4420
18	Cucoara	Cucoara	1207
19		Chircani	760
20	Cislita-Prut	Cislita-Prut	1300
21	Doina	Doina	1272
22		Iasnaia Poleana	123
23		Rumeantev	428
24	Gavanoasa	Gavanoasa	1336
25		Nicolaevca	723
26		Vladimirovca	346
27	Giurgiulesti	Giurgiulesti	3200
28	Huluboaia	Huluboaia	1012

29	Iujnoe	Iujnoe	755
30	Larga Noua	Larga Noua	1123
31		Larga Veche	423
32	Lebedenco	Lebedenco	723
33		Hutulu	641
34		Ursoaia	1300
35	Lopatica	Lopatica	745
36	Lucesti	Lucesti	650
37	Manta	Manta	3000
38		Pascani	1095
39	Moscovei	Moscovei	3434
40		Trifestii Noi	432
41	Pelinei	Pelinei	1738
42		Satuc	74
43	Rosu	Rosu	3276
44	Slobozia Mare	Slobozia Mare	6040
45	Taraclia de Salcie	Taraclia de Salcie	1887
46	Tartaul de Salcie	Tartaul de Salcie	1016
47		Tudoresti	106
48	Tataresti	Tataresti	2160
49	Vadul lui Isac	Vadul lui Isac	3225
50	Valeni	Valeni	3100
51	Zirnesti	Zirnesti	2072
52		Paicu	577
53		Tretesti	66
	Total rural population		86 462
	Total population		126 262

2.6 Industry, business and public institutions in the project area

In terms of economic development, Rayon of Cahul is characterized by the development of industries based primarily on various raw materials. There are 11 private wineries and 8 bakeries. The is limited cheese industry, enterprises collecting cereal and processing vegetables and fruits. Light industry is present in two garment factories (SA Tricon and Laboratorio Tessala Mol SRL). Also building materials are produced however agriculture is a main economy of the district. Of the total 154,600 ha, 64% is agricultural land. A port and free economic zone is located in Giurgiulesti, which represents a big economic potential.

Cahul is a city home to the State University of Cahul, opened in 1999. The university has 3 faculties (Philology – History, Law – Public Administration and Business – Computer Science – Mathematics) with around 2,150 students.

3 Legal and regulatory framework

3.1 Regulatory framework

The regulatory framework relevant for aggregating water supply services can be conventionally divided in three categories presented below:

1) Regulatory framework on LPA organization and operation

- Law No.397-XV of 16.10.2003 on Local Public Finances
- Law No.435 of 28.12.2006 on Administrative Decentralization
- Law No.436 of 28.12.2006 on Local Public Administration
- Law No.438 of 28.12.2006 on Regional Development in the Republic of Moldova
- Law No.121 of 04.05.2007 on Administration and Denationalization of Public Property.

2) Regulatory framework on construction of water supply systems, distribution of drinking water, construction and maintenance of sanitation and sewage and rainwater treatment systems

- Law No.1515-XII of 16.06.1993 on Environmental Protection
- Health Care Law No.411-XII of 28.03.1995
- Public Utilities Law No.1402-XV of 24.10.2002
- Law No.163 of 09.07.2010 on Authorization of Construction Works
- Law No. 721-XIII of 02.02.96 on Quality in Constructions
- Law No. 272-XIV of 10.02.1999 on Potable Water
- Law No. 10-XVI of 03.02.2009 on State Supervision of Public Health
- Government's Decision No.656 of 27.05.2002 on approval of the Framework Regulations on the Use of Municipal Water Supply and Sanitation Systems
- Government's Decision No.1406 of 30.12.2005 on approval of the Water Supply and Sanitation Program for the localities of the Republic of Moldova until 2015
- Decision of the Government of the Republic of Moldova No.1141 of 10.10.2008 on approval of the Regulations on Conditions for Urban Sewage Evacuation to Natural Recipients
- Decision of the Ministry of Environment No.7/1 of 14.05.99 of the Ministry's Board on approval of the Strategy for Modernization and Development of Municipal Water Supply and Sanitation Systems
- Order of the Ministry of Environment No.163 of 27.10.99 on approval of the methodology for development of technological water consumption standards at companies providing water supply and sanitation services in the Republic of Moldova.

3) Regulatory framework on possible legal organization forms of inter-community cooperation (ICC)

- Law No.845-XII of 03.01.1992 on Entrepreneurship and Enterprises
- Law No.534-XIII of 13.07.95 on Concessions
- Law No.1134-XIII of 02.04.97 on Joint Stock Companies
- Civil Code No.1107-XV of 06.06.2002
- Law No.179- XVI of 10.07.2008 on Public-Private Partnership
- Decision of the Government of the Republic of Moldova No.387 of 06.06.1994 on approval of the Model Regulations of Municipal Company
- Government's Decision No.1006 of 13.09.2004 on approval of the Regulations on Concession of Public Utilities.

3.2 Institutional set-up

Art. 4 of the Law on Administrative Decentralization No.435 of 2006 mentions that provision of water supply and sanitation services comes under the activities of level-one public authorities (LPA1). Nevertheless, central public authorities, decentralized public services, and district administration also have different roles and competences in water supply and sanitation.

The following is a brief summary of the institutional framework describing the role of various public authorities in provision of water supply and sanitation services:

1. The Parliament of the Republic of Moldova adopts laws on public utilities in general, as well as public water supply and sanitation service in particular, regulates competences of different relevant authorities, establishes general rules of conduct for the stakeholders (operator, user, public authority, etc.). A number of important WSS laws are listed under section 3.1 of this study. Also, at the moment, the draft law No.258 of 14 June 2013 on public water supply and sanitation service is under examination to be passed by the Parliament of the Republic of Moldova.

2. The Government of the Republic of Moldova is in charge of developing the WSS strategic and policy framework, develops and approves regulations, prepares draft laws and presents them to the Parliament for adoption.

According to the Law on the Government No.64 of 31.05.90, the Government's main authorities in relation to WSS are to:

1) coordinate and exercise control over the activities of local public administration bodies of the Republic of Moldova

2) promote a single state policy to ensure a living standard for the population of the republic that would not be lower than the officially established minimal living standards and that would correspond to the level of economic development of the Republic of Moldova

3) develop strategic urban development, **public utilities** and housing policies.

According to article 13 of the Public Utilities Law 1402/24.10.2002[1], the Government ensures implementation of the state general public utilities policy in compliance with the government program and the objectives of the social and economic development strategy of the country by:

a) Initiating and presenting for adoption a number of draft laws on regulation of relevant activities

b) Adopting public utilities regulations and standards where central regulation is required

c) Supporting local public administration in institution, development and improving of public utilities, as well as development of relevant infrastructure.

The Government regularly examines the condition of public utilities and, based on specific strategies, establishes measures for sustainable development and raising the quality of delivered/provided services in compliance with users' requirements and needs of localities.

The same article 13 of the Public Utilities Law stipulates that the Government shall support local public administrations in the institution and organization of public utilities upon their request with a view to efficient administration of the corresponding delivered/provided services. The support shall be granted by competent central public administration authorities under the form of technical or financial assistance.

The role of the Government in WSS is also fulfilled through subordinated institutions and bodies that are part of the government structure, such as the Ministry of Environment, the Ministry of

[1] Official Monitor 14-17/49, 07.02.2003

Regional Development and Constructions, the State Chancellery, decentralized structures of the government in districts (State Environmental Inspection, Territorial Offices of the State Chancellery, etc.), Regional Development Agencies, etc.

An especially important role of the Government in developing WSS systems is financing, e.g. through the National Regional Development Fund, the Environmental Fund, MSIF, etc.

3. The Ministry of Environment. In compliance with GD No.847/18.12.2009, the Ministry of Environment develops and promotes the national policy on environmental protection, natural resources, biodiversity conservation, geological studies, soil use, **water resource management, water supply and sanitation,** control over the environmental condition, hydrometeorology and environment quality management. The National Environmental Fund is managed by the Ministry of Environment and used for environmental projects, including for the WSS sector.

4. The Ministry of Regional Development and Construction develops and promotes state policy on regional development, spatial arrangement and planning, architecture, urban development, constructions, production of construction materials, housing construction. The MRDC approves general and regional urban development plans, including WSS infrastructure. The Ministry also administers the Regional Development Fund through RDAs (1% of the national budget plus additional resources from other sources).

5. The National Public Health Center subordinated to the Ministry of Health exercises functions related to the WSS sector at the national and local level by means of its territorial structures. NPHC has data on the quality of potable water offered by territorial PHCs. NPHC has 38 laboratories, which are well-equipped to carry out potable water quality monitoring program.

6. The Ministry of Finance develops and promotes state budget policy, including activities related to WSS sector financing.

7. The State Chancellery offers methodological and organizations support in planning, development and implementation of public policies by governmental authorities; coordinates the process of development and implementation of decentralization policies. Through its territorial offices verifies the legality of decisions made by local councils, including on WSS (e.g. decisions on concession, on operator institution, etc.).

8. **Agency *Apele Moldovei***, subordinated to the Ministry of Environment, is in charge of implementing state policies on water resource management, hydro-forming, water supply and sanitation.

9. The Agency for Geology and Mineral Resources subordinated to the Ministry of Environment is in charge of implementing state policies on geological studies, soil use and protection. The Hydro-geological Expedition *EHGeoM* renders services related to water well drilling.

10. **State Environmental Inspection.** The main role of SEI for WSS sector is to issue permits for water use, water evacuation, and environmental expert examination. The Inspection is subordinated to the Ministry of Environment.

11. **The National Agency for Energy Regulation (ANRE)** at the moment is in charge of developing and approving the methodology for determination, approval and application of tariffs for public water supply and sanitation, as well as for sewage treatment services. Also, the Public Utilities Law stipulates that ANRE monitors compliance by the operators with the tariff calculation methodology, within the limits of its competence participates in exercising control over activities of participants on the public utilities market, and ensures transparency of tariffs for public utilities. According to the draft law on public water supply and sanitation service registered in the Parliament under No.258 dated 14 June 2013, ANRE would approve tariffs for public water supply, sanitation and sewage treatment services at the level of municipality, town, district or region directly. The corresponding initiative has been largely debated and encountered resistance on the part of the majority of local authorities who consider it a violation of local autonomy principles and a centralization attempt.

12. Local Public Authorities of Level 1: According to the current local public administration system, at the level of villages, communes and towns (LPA 1) there are only two types of local authorities: the mayor as executive authority and the local council as deliberative authority ("legislative" power at the local level). In fact, local authorities represent key actors in water supply and sanitation. According to art.4 of the Law on Administrative Decentralization No.435 of 2006, distribution of potable water, construction and maintenance of sanitation and sewage and rainwater treatment systems comes under the activities of level-one local public authorities.
According to the law on public utilities, local public administration authorities have exclusive competence to institute, organize, coordinate, monitor and control the operation of public utilities, as well as to create, administer and exploit public property assets in the municipal structure of the corresponding administrative-territorial unit. In exercising these competences, local public administration authorities can adopt decisions related to:

a) Development of existing endowment rehabilitation, extension and modernization programs, as well as programs to institute new public utilities systems, under the conditions provided for by the law

b) Coordination of design and delivery of municipal works with a view to their realization within a single concept and in correlation with social and economic development programs of localities, general urban development plans and environmental programs

c) Association of public utilities with a view to making common-interest investments in municipal infrastructure

d) Initiation of public-private partnership for management of public utilities, privatization of these services, as well as public property assets from municipal infrastructure of administrative-territorial units

e) Their participation with shareholders' equity or assets in capital or assets of economic agents for performance of works and delivery/provision of public utilities at the local or district level, as appropriate, based on conventions also stipulating financial resources made of contributions of local public administration authorities. Conventions are drawn by the key crediting authorities based on mandates approved by each local or district council

f) Contracting or granting, under the conditions provided for by the law, loans to finance investment programs for development of municipal infrastructure of localities – carrying out new works, extensions, capacity building, including rehabilitation, modernization and re-equipment of the existing systems

g) Guaranteeing, under the conditions provided for by the law, loans contracted to form stocks of liquid and solid fuel sufficient for the heating season

h) Development and approval of local standards and regulations for operators' functioning in order to regulate activities of public utilities based on framework regulations developed by a specialized central public authority.

Local public administration authorities approve, in compliance with the methodology approved by NAER, fees and tariffs for public water supply, sanitation and sewage treatment services, except for technological water supply services.

More details on the role and responsibilities of LPA1 authorities shall be given under section 8.2.1 of this study.
13. Rayon authorities. Do not have direct duties related to WSS, which comes exclusively under the authority of local public administration. Nevertheless, they may play an important role in investment co-financing, as well as in coordination of inter-community cooperation initiatives of level-one administrative territorial units at the district level. They may participate together with LPA 1 in accumulation of the shareholders' equity of public-capital regional operators.

3.3 Regulatory framework of sludge management

Sludge management and conditions for wastewater discharge in natural recipients are regulated by the following acts:

- Decision of the Government of the Republic of Moldova No.1141 of 10.10.2008 on approval of the Regulations on the conditions for urban sewage evacuation to natural recipients.
- Order of the Ministry of Regional Development and Constructions No.40 of 18.02.2005 on approval of the Framework Regulations on receipt of sewage, issue of technical specifications and authorizations for discharging sewage created within the sanitation system of localities;
- Government's Decision No.282 of 09.09.88 on differentiated tariffs and economic sanctions for non-compliance with conditions for accumulation of sewage in the municipal sanitation system;
- Order of the Ministry of Regional Development and Constructions No.5 of 23.01.2013 on approval of the regulatory document CP D.01.06-2012 "Determination of admitted limits of harmful substances in ground debits for the conditions of the Republic of Moldova".

Also, in the context of developing draft laws on the public water supply and sanitation service, the Ministry of Environment has developed a new draft Regulation on the conditions for sewage discharge in water bodies[2], as well as draft Regulation on requirements for sewage treatment in urban and rural localities[3]. Both documents are undergoing public consultations at the time of preparation of this study and probably will be approved by the government only after the Parliament passes the new law on public water supply and sanitation service (the draft registered in the Parliament under No.258 on 14 June 2013).

[2] http://particip.gov.md/proiectview.php?l=ro&idd=975

[3] http://particip.gov.md/proiectview.php?l=ro&idd=976

4 Current WSS situation

4.1 Water resources

Moldova's water resources consist of surface waters and groundwater. With regard to surface waters, there are two major river basins in the Republic of Moldova: the Dniester and the Prut. The natural water regime of the rivers in these basins has been changed by the construction of dams and reservoirs, designed to prevent floods, trap sediment, and provide water for agricultural, industrial and household consumption as well as for fish farming. Groundwater for centralized household and industrial use is drawn from ten aquifer systems.[4]

The groundwater grid includes around 112,000 springs and wells (public and private) and more than 3,000 functional artesian wells. Ground waters are the main source of potable water supply in the Republic of Moldova, for 100% of the rural population and 30% of the urban population, or 65% of the total population of the country. The remaining 35% of the population use surface water as a source of potable water.[5]

The study area, the Rayon of Cahul, is located in the river basin of the Prut River and the City of Cahul with a population of about 40,000 is supplied with this water source. In the other localities in mostly rural areas groundwater is used as source for water supply.

4.1.1 **Surface water**

According to the NHDR (2009), as a result of the economic decline, there has been a decrease in heavy industry and falling water use in industry and agriculture since 1990, which has led to an improvement in the quality of surface water resources, improving the water quality of major river basins. For example, the water of the Prut river is considered clean to moderately polluted in more charged river sections.[6]

The Prut River, which flows from Wooded Carpathians in Ukraine, has a length of 953 km. It flows into the Danube near the Giurgiulesti village in the Rayon of Cahul. The Prut forms the border between Romania and the Republic of Moldova. In the interwar period, the river was navigable up to Ungheni, but henceforth navigation on the river was gradually abandoned and the course has no longer being maintained. The largest cities located on the river are Cernivtsi and Kalush in Ukraine, Saveni, Iaşi and Huşi in Romania and Ungheni, Leova and Cahul in the Republic of Moldova. The boundary between Romania and the Republic of Moldova contains a river segment of 681.3 km in length, of which 73.9 km is the Costeşti-Stinca Lake.

In its upper course, the Prut is a typical mountain river: its valley is narrow, with steep and high slopes and it is fast flowing with frequent rapids. In the middle course, the river forms meanders and its speed lowers to 1.5 m/s. On a small area where a number of reefs intersect and the valley narrows to a few hundred meters, forming key shapes.

Further south, the river valley widens to 5-6 km, the flow slows further, and the banks are low, assuming symmetrical shapes. There are well-marked terraces on the slopes. In its lower course, coinciding with the current study area, the Prut Valley widens considerably up to 7-10 km, the river forms meanders, forms branches, and the slopes become flatter, sometimes fragmented by ravines. The riverbed width varies from between 50 and 180 m, its maximum depth is 6-7 m, and its speed decreases to 0.7 m/sec.

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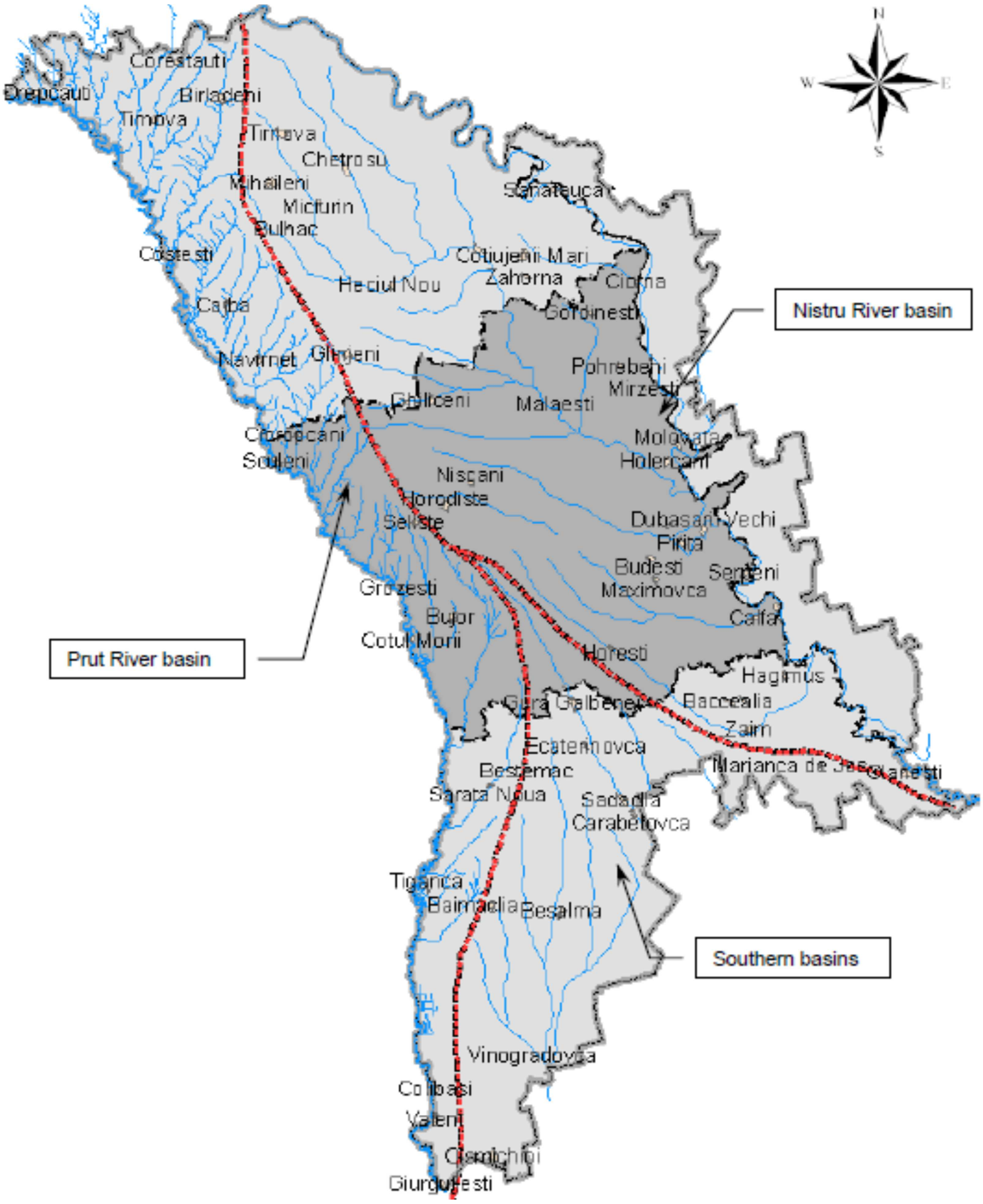
[4] UNDP 2009/2010 and National Adaptation Strategy for the Republic of Moldova June, 2011

[5] Second National Communication, 2009.

[6] http://meteo.md/mold/valori/apa.html

Figure 4-1: Hydrographic basins of the rivers of the Republic of Moldova



The main environmental problems in the Prut River Basin are due to anthropogenic impact on the environment. Public utility enterprises are the main sources of pollution. More than a half of the existing sewage treatment plants in the Ukrainian part of the Prut River Basin operate inefficiently and ineffectively. The operation of wastewater treatment plants in the cities Novoselytsya, Glubokaya, Vyzhnytsia, Vashkivtsi and Hertsa is of major concern. Most of the wastewater flows into the water bodies in the Prut River Basin without any treatment. At the same time, wastewater from Chernivtsi is a primary source of pollution to the Prut River. In 2011, the Chernivtsi wastewater system discharged 18.4 million m^3 of wastewater into the Prut.[7]

[7] ***"River Basin Management Plan for Prut Pilot Basin in the territories of Ukraine and Moldova". Report of Environmental Protection of International River Basins Project.***

On the whole, the quality of surface waters in the Prut basin in Ukraine is “clean” and “moderately polluted” in the Carpathians. Waters are also “clean” as they enter Chernivtsi Region – but turn “moderately polluted” as they exit the region.

In Moldova, organic chemicals are serious pollutants of the water in the Prut River. These originate from insufficiently treated and untreated wastewater discharges in rural localities, as well as runoff from unauthorized landfills and transportation, etc. The most polluted part of the Prut River is the section downstream of the Jijia River (Romania) inflow near Valea Mare (Ungheni District).

The significant increase in the level of surface water pollution at low river flow rates is also a major concern.

Water quality monitoring of the Prut is carried out through surveillance monitoring (monthly and quarterly campaigns) and routine analysis (daily and weekly campaigns) of physical, chemical, biological and bacteriological indicators.

Surface water quality in the Prut Basin is tracked for five groups of indicators – oxygen regimen, nutrients, mineralization, metals and organic toxic substances. The quality degrees are indicated in the following table according to monitoring section.

Table 4-1: Water quality of the Prut River, by monitoring section and quality indicator

Monitoring Section	Degree of Quality					
	Oxygen Regimen	Nutrients	Mineralization	Metals	Toxic Substances	General Degree
Oriftiana	2	1	1	-	1	1
Ungheni	2	1	1	-	1	1
Prisecani	2	1	2	-	2	2
Drănceni	2	1	1	-	-	-
Şiviţa	2	1	2	-	1	1
Giugiuleşti	2	1	2	-	1	1

Source: http://ru.scribd.com/doc/24903745/I-Calitatea-Apelor-raului-Prut--ROMANIA

1 – First class of quality, very good ecological condition;

2 – Second class of quality, good ecological condition;

3 – Third class of quality, moderate ecological condition;

4 – Fourth class of quality, poor ecological condition;

5 – Fifth class of quality, bad ecological condition.

The river water quality in the Leova and Cahul section is shown in the table below, which is compiled based on data from the State Hydrometeorologic Service.

Table 4-2: Quality of Prut River

Section	Date of the sample	Suspended solids [mg/dmc]	pH	O2 [mgO2/dmc]	BOD 5 [mgO2/dmc]	Nitrogen, mg/dmc			Phosphorus, mg/dmc	
						N-NH4	N-NO2	N-NO3	mineral	Total
Prut River - Leova city	25.02	85.0	8.69	12.38	2.33	0.10	0.015	1.73	0.046	0.052
Prut River –	24.02	35.0	8.72	12.80	2.32	0.17	0.012	1.83	0.076	0.106

Cahul city										
Prut River - Leova city	24.03	90	7.98	9.84	1.07	0.03	0.019	1.88	0.045	0.06
Prut River – Cahul city	24.03	90	7.9	8.84	2.64	0.2	0.027	1.63	0.029	0.074
Prut River - Leova city	28.04	120	7.93	7.98	2.12	0.07	0.007	1.3	0.036	0.047
Prut River – Cahul city	28.04	300	7.88	7.49	2.64	0.07	0.007	1.4	0.07	0.072
Prut River - Leova city	18.05	140	8.48	8.75	2.32	0	0.009	0.9	0.03	0.044
Prut River – Cahul city	18.05	850	8.24	7.55	1.67	0	0.014	0.8	0.046	0.072
Prut River - Leova city	27.06.	100	8.37	8.3	2.11	0	0.036	0.85	0.034	0.039
Prut River – Cahul city	28.06.	60	8.4	7.94	2.66	0	0.01	0.9	0.036	0.046
Prut River - Leova city	27.7	40	8.46	6.84	2.3	0.33	0.007	0.65	0.044	0.07
Prut River – Cahul city	28.7	140	8.33	7.41	2.48	0.17	0.012	0.25	0.019	0.048
Prut River - Leova city	18.08	80	8.45	7.35	2	0	0.005	0.6	0.025	0.086
Prut River – Cahul city	18.08	60	8.39	7.08	1.67	0	0.007	0.8	0.031	0.068
Prut River - Leova city	29.09	90	8.48	7.5	1.98	0	0.009	1.08	0.064	0.088
Prut River – Cahul city	29.09	140	8.45	6.75	2.32	0.07	0	0.65	0.063	0.096
Prut River - Leova city	27.10	80	8.68	8.92	2.32	0	0.01	0.73	0.034	0.048
Prut River – Cahul city	27.10	40	8.73	9.12	2.67	0	0.007	0.8	0.053	0.07
Prut River - Leova city	24.11	0	8.55	12.7	1.86	0	0.012	0.93	0.05	0.08
Prut River – Cahul city	24.11	0	8.59	12.86	2.18	0	0.012	0.98	0.053	0.13
Prut River - Leova city	22.12	70	8.32	12.05	2.65	0.1	0.017	1.15	0.049	0.07
Prut River – Cahul city	22.12	40	8.36	11.88	2.5	0.1	0.012	1	0.031	0.05

Source: Consultant compilation based on data from the State Hydrometeorologic Service

Another source of the information on the water quality of the Prut is the “Romanian Waters” National Administration, the Prut-Barlad branch, which monitors the Prut.

The section downstream of the Jijia River is biologically moderately polluted, whilst general conditions physical-chemical indicators are moderate and overall chemical indicators are good.

BH	Cursul de apa	Denumire corp de apa	Codul corpului de apa	Cod tipologie	Elemente biologice					Conditii fizico-chimice generale						Poluanti specifici		Corp de apa artificial si puternic modificat			Stare chimica
					Pesti	Nevertebrate bentice (macronevertebrate)	Fitobentos si Macrofite	Fitoplancton	Evaluare elemente biologice	Conditii temice (temperatura)	Conditii de oxigenare (oxigen dizolvat)	Salinitate (conductivitate)	Starea acidifierii (pH)	Nutrienti (N-NO3, N-NO2, N-NH4, P-PO4, Ptotal)	Evaluare elemente fizico-chimice generale	Poluanti specifici (pentru starea/potential ecologic)	Stare ecologica	CA Artificial (Da/Nu)	Corp de apa puternic modificat (Da/Nu)	Potential ecologic	Stare chimica (substante prioritare)
PRUT	Prut	Prut - sector am. ac. Stanca	RORW13.1_B1	RO10	Z	FB	-	M	M	FB	M	B	FB	B	M	B	M	NU	NU	-	B
PRUT	Prut	Prut - sector av. ac. Stanca - conf. Solonet	RORW13.1_B3	RO10	Z	FB	-	B	B	FB	B	B	FB	FB	B	B	B	NU	NU	-	B
PRUT	Prut	Prut - sector conf. Solonet - confl. Jijia	RORW13.1_B4	RO11	Z	Max	-	M	M	Max	M	B	M	Max	M	B	-	NU	DA	PEMo	B
PRUT	Prut	Prut - sector confl. Jijia - confl. Dunarea	RORW13.1_B5	RO11	Z	B	-	M	M	Max	M	B	Maxim	B	M	B	-	NU	DA	PEMo	B

Source: Romanian Waters, Prut-Barlad branch

Legend:

Ecological status (Stare ecologica): very good (FB), good (B), moderate (M), week (S), poor (P)

Ecological potential (Potential ecologic): maxim (PEM), good (PEB), moderate (PEMo)

Chemical status (Stare chimica): good (B), poor (P)

Downstream of the Huşi River inflow, "Romanian Waters" advises that a drinking water treated station is equipped with a mixing chamber, coagulation - flocculation, decantation, filtration, and disinfection with ozone[8].

Nr. crt.	BH	Nume sectiune de prelevare / priza	Sursa de apa	Tipul statiei de tratare		Tipul captarii conform HG 100/2001 (categoria apei brute)	Indicatori depăşiţi: - faţă de tipul statiei de tratare; - faţă de categoria apei brute
				descriere	tip		
0	1	2	3	4	5	6	7
9	Prut	Priza Husi	r.Prut	camera de amestec, coagulare – floculare, decantare, filtrare, dezinfectie cu ozon	A2	A2	Exceptie : suspensii

The Cahul Rayon is also crossed by a number of rivers and rivulets, like the Cahul, Cotihana, Salcia mare, Salcia mica, Tiheci and Larguta. These rivulets, as well as the Manta and Beleu Lakes, are not examined as alternative sources of water supply.

Other projects implemented or in process (e.g., in the Cities of Cantemir and Nisporeni) in the Prut River Basin provide very helpful information on the water quality of the Prut River and its suitability for use as drinking water.

All analysis of the surface water for Cantemir (project implemented in 2006-2009) and Nisporeni (in process) yielded a quite favourable composition of the water for drinking water purposes after treatment. A conventional water treatment facility comprising sedimentation, precipitation according to the turbidity after sedimentation, filtration and disinfection should easily lead to a sufficient water quality for drinking water purposes.

Water flow of the Prut River

As mentioned above, the surface water from the Prut River is used as a source of drinking water in many localities in Moldova, among others also in Cahul city.
In order roughly to estimate the availability of surface water from the Prut for water supply purposes in the entire Rayon of Cahul, the water demand and the river runoff need to be compared.

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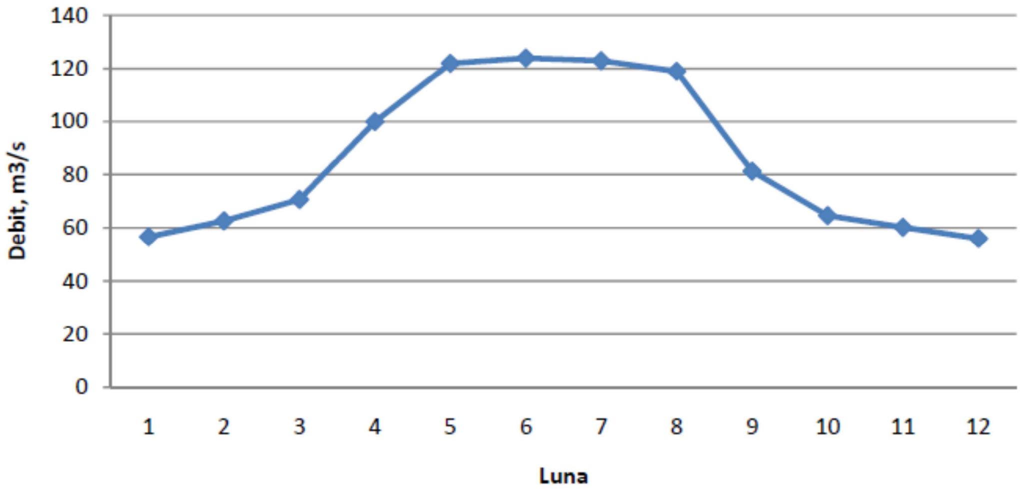
[8] Source: BULLETIN DE CALITATE A APELOR, Bazinele hidrografice Prut şi Bârlad, Ianuarie - iunie 2012

The runoff in the relevant lower and central Moldovan river section is illustrated in the figure below and is based on data from the hydrometric station at Ungheni. The runoff is indicated as average annual monthly water flow in m³/s.

Figure 4-2: Average Multiannual Monthly Water Outputs. Prut River, Ungheni hydrometric station.



It can be assumed that the availability of water will change in the future due to different factors. Climate change is one of several drivers impacting in this regard and is in many aspects as an exacerbating factor for other drivers.

One of the main aspects in terms of climate change and the impact on water sources is precipitation. Future projections indicate the continuous increase of annual average temperature. Regarding precipitation, the models do not concur on the change in the annual amount of precipitation. Some models project an increase in precipitation, whilst others – a decrease. All the models conclude, however, that the annual discharge will most likely decrease in the future. The indicated range is between 13% (2030-2049)[9] and 50-60%[10] according other models.

It is worth mentioning that, projected changes in the annual discharge are very difficult to model and tend to be very uncertain.
The expected average demand for drinking water for the Cahul Rayon is 0.3 m³/s (provided a total daily consumption of 25,000m³), which is about 0.5% of the present lowest average annual monthly water discharge (55-60m³/s).

In terms of quantity, the Prut should have sufficient capacities to serve as a drinking water source for the Rayon of Cahul.

Even if the worst case scenario of a decrease in the discharge of about 50% or more came to pass, the Prut River can be seen as a reliable water source. However, it has to be ensured that integrated water resource management (IWRM) on a river basin basis is established in the future in order to coordinate all types of water demand (domestic, industry, agriculture etc.)

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[9] ENVSEC Initiative Report: Minimizing vulnerability to extreme floods and climate change in Nistru river catchment (Nistru-III: floods and climate). Baseline study on Republic of Moldova.

J. Pollner, 2010

[10] http://www.meteo.md/metodof_karti.htm

Conclusions:

The following predictions can be made based on the information analysed for this sector of the Prut River:

- All data from public institutions, such as the State Hydrometeorologic Service and Romanian Waters, as well as analyses done for projects implemented or in process (e.g. Cantemir and Nisporeni), yielded a quite favourable composition of the water for drinking water purposes.

- The Prut River water is absolutely suitable to be used for the future drinking water supply of Rayon of Cahul after standard treatment (precipitation with aluminium sulphate, filtration, and disinfection).

- The discharge of the Prut River should be sufficient to serve as source for drinking water supply for the Rayon of Cahul in the long term.

- According to climate projections, the river discharge will most likely decrease in the future. In order to establish sustainable water supply systems, integrated water resource management (IWRM) on a river basin basis needs to be established. This would allow the coordination of all types of water demand (domestic, industry, agriculture etc.), both in the entire Cahul Rayon and the river basin.

4.1.2 Groundwater

When talking about ground water in Moldova, we have to distinguish between the groundwater from the shallow wells (depth of 2-40m) and groundwater from the deep wells (depth 100-300 m).

In most of the rural areas in Moldova general and also in the Cahul Rayon in many localities, shallow groundwater is used as a source of water.

For shallow ground water the major problem is the concentration of nitrates and microbiological contamination which is most likely caused by infiltration of untreated waste water from pit latrines, poor sewer systems and from livestock farming. The majority of shallow wells do not provide drinking water quality, further the water output varies during the seasons and some of them even dry up during dry periods.

For the deep wells the water-bearing strata in the southern part of the Republic of Moldova, where the Cahul Rayon is located, are characterized by depths of over 250 meters and fine sand content. Analysis of over 120 wells drilled in the Cahul Rayon has showed that water output relatively is low, ranging between 2 and 10 cubic meter per hour.

Table 4-3: Hydrological characteristics of water-bearing strata in southern Moldova

	Unit	Period	Width, (m)	Average depth of wells, (m)	Available water output rate (m3/h)	The main contaminants	Lithology / Comments
(ii) N_1S_1	Baden Sarmaţian Tîrziu	Neogene	30-50	SM=200 – 260m	2÷5	NO3; SO4, F, TDS, hardness	Limestone with traces of sand. The main water-bearing basin, it contains 70% of groundwater resources.
(v) N_1P_2	Sarmaţian Timpuriu	Neogene	10	General 100, in flood basin of the Prut River	3 ÷10	Fine sand	Clay with layers of sand. Local water-bearing basin in

				>250m			Southern Moldova.
(vi) N_2P_2	Pont	Neogene	10	General 100, in flood basin of the Prut River >250m	5 ÷10	Fine sand	Clay with traces of limestone. Local water-bearing basin in Southern Moldova.

Source: Adapted from: the National Strategy for Water Resources Management, Tahal, 1997.

Legend: SM – Southern Moldova

From the chemical composition the groundwater from the deep wells exceeds several parameters regarding the drinking water standard. This concerned mainly the Sodium (Na) and Flouride (F), but additionally also the Sulphate (SO4) and Iron (Fe) and Ammonium (NH4) concentrations.

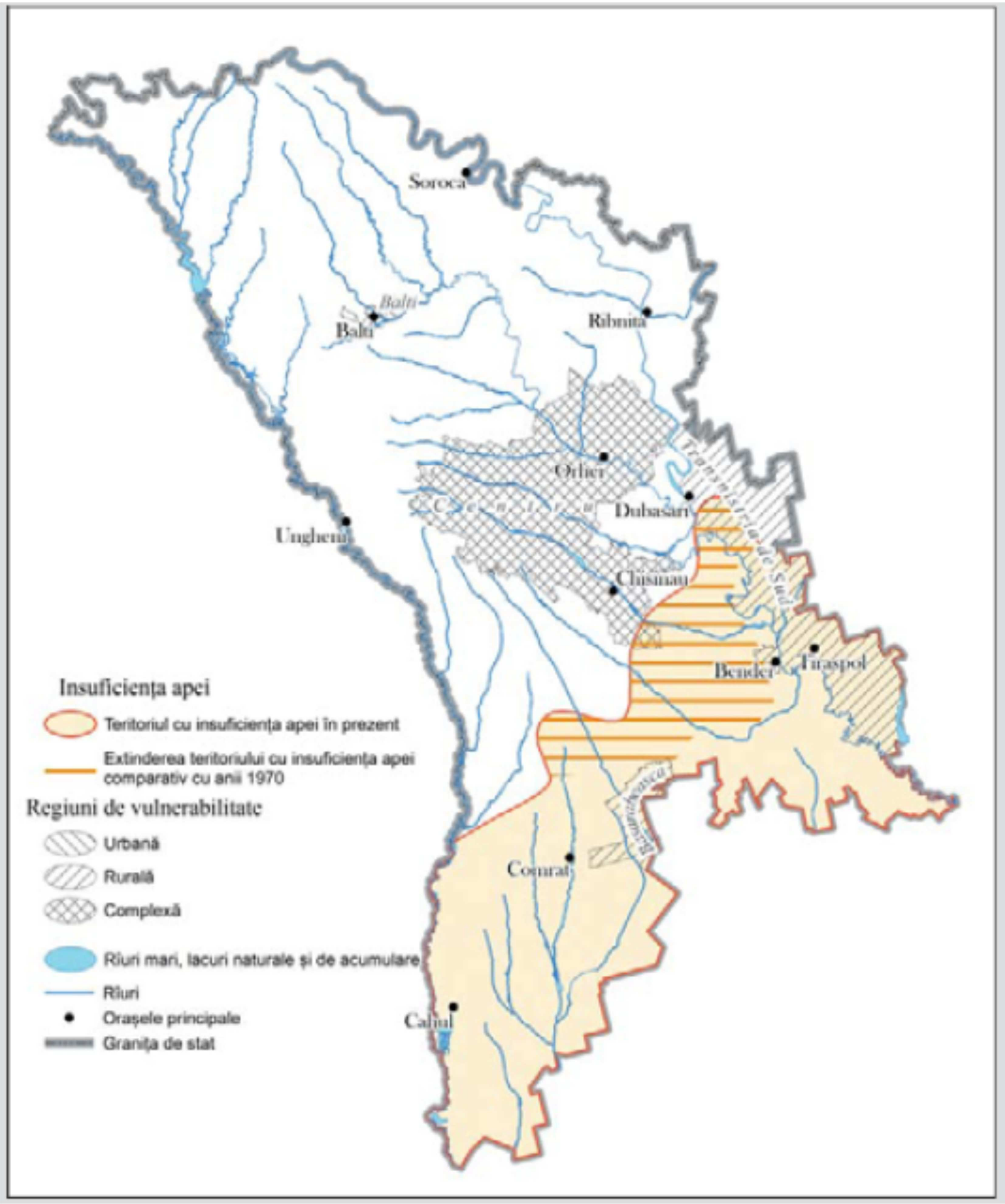
Considering a treatment for conversion to drinking water, the high fluoride, but also the sodium and iron content require a quite sophisticated treatment using of reverse osmosis for desalination. The desalinated water has likely to be conditioned afterwards to get a drinking water quality. This treatment would lead to relatively high treatment costs and complex operation. Further, the capacities of existing deep wells would not be sufficient to be a significant water source for the Cahul Rayon. A significant number of new wells with all the necessary equipment would be needed.

Conclusions:

The following predictions can be made based on the information analysed for the groundwater in the Cahul Rayon:

- Shallow wells are not suitable for the main water supply of the Cahul Rayon. Shallow wells are not well protected against surface influence (pollution) and the capacities are very limited.
- All the available quality data on groundwater from the deep wells provided in the annual report for 2010 of AgeoM leads to the conclusion that almost all groundwater needs treatment.
- A high sophisticated technology needs to be applied to treat the deep groundwater to drinking water quality
- The operation costs are be quite high due to the need of sophisticated technology
- Trained and educated staff is needed for the complex operation of the water treatment plants.
- The capital investments for additional deep wells need to be taken into consideration.
- A reliable up-to-date inventory on available of groundwater resources as planning basis does not exist in Moldova
- After consideration of all the mentioned aspects the deep ground water is not considered for the future water supply for the Cahul Rayon.

Figure 4-3: Identification of the vulnerable areas in terms of water scarcity in the Republic of Moldova



Source: Sirodoev I.G. Knight C.G., 2007 Vulnerability to Water Scarcity in Moldova: Identification of the Regions (Vulnerabilitatea la deficitul de apă din Moldova. Identificarea regiunilor). Bulletin of the Academy of Sciences of the Republic of Moldova. Life sciences 3 (303): p.159-166 with amendments.

The map presented in the figure above shows that the area under consideration in this feasibility study is fully located in region classified by the authors of the cited scientific study as vulnerable.

In conclusion, after analysing the options of using water sources, the further development of the Prut River surface water option by treating raw water at the treatment plant in the city of Cahul is proposed.

4.2 Level and quality of water supply service

To determine the investment needs in the water supply system, the current situation of WSS in rural areas of Rayon of Cahul was investigated by collecting a data through a questionnaire. The questionnaires were filled out by 51 of 53 rural localities. Two localities, Trifeştii Noi and Tudoreşti, did provide information, but most of the data were included in the questionnaire used in the affordability and willingness-to-pay study (see section 10.4). Out of 51 localities, 30 localities have centralized water supply systems and 21 do not have a water supply system.

According to the Strategy on Water Supply and Sanitation of Localities in the Republic of Moldova, approved by Government Decision No. 662 of 13 July, 2007, Annex 1 the list of priority localities for water supply and sanitation in the of the years 2008-2012 includes 10 rural localities in the Cahul Rayon, which constitutes 19% of all rural localities in the rayon. Localities included in the Strategy are Brînza, Colibaşi, Slobozia Mare, Cîşliţa-Prut, Alexandru Ion Cuza, Văleni, Frumuşica, Giurgiuleşti, Chioselia Mare and Moscovei. Eight of these localities, or 80% of those incorporated in the plan at the moment of survey, have water supply systems and two localities (Moscovei and Chioselia Mare), or 20% of the planned ones, have no water supply system.

According to the Program for Water Supply and Sanitation of Localities of the Republic of Moldova up to 2015, approved by Government Decision No. 1406 of 30.12.2005, in Annex 3 all 53 localities in the Cahul Rayon, or 100%, of the rural localities that shall be provided with water supply and sanitation. Twenty-two localities, or 41.5%, do not have water supply systems, whilst 31 localities, or 58.5%, have water supply systems.

Water supply is abstracted from groundwater sources from artesian wells. Overall, there are 117 artesian wells in rural localities, 92 of which, or 78.7%, are in the public ownership, 11 or 9.4% are in private ownership (by legal persons), 4 or 3.4% are privately owned by individual persons and 10 or 8.5% have been abandoned.

7,569 households or 42.6% of the total number of 17,747 households are connected to a centralized water supply system, 287 or 1.6% of households are connected to a sewage system with wastewater treatment.

There were 26 companies for water supply and sanitation (“Apa-Canal”) reported to be present in rural communes. The vast majority (93.4%) of the water supply system customers are equipped with meters.

The total length of roads in these 30 localities is 400.7 km and only 279 km of water supply networks, in other words, 69.6% of the streets have water supply networks. This shows the expansion needs for the water supply network.

4.3 Level and quality of wastewater service

Sewage systems in rural areas are not developed. Six of the 30 localities with water supply systems have a short section of sewage networks, which in most cases collect wastewater from public institutions such as kindergartens and schools. In four of the locations, some households are connected to the sewage system as well. The connection rate of households to the sewage system in these areas is small: 0.1%, 0.3%, 28% and 58%.

4.4 Existing infrastructure, assessment of existing assets

This section contains a description of the water supply and sewerage system of the city of Cahul

4.4.1 Water supply system of the city of Cahul

Drinking water supply in the city of Cahul is carried out through the centralized system built in the 1970s. The system comprises an raw water abstraction at the Prut River bank located 5 km from the city including a pumping station (2 pumps x480 m3/h), a transmission line with a length of 8.2 km to the water treatment plant (capacity of 17,400 m^3/d), 11 water storage tanks with total storage capacity of 11,750 m3, six water pumping stations and water distribution networks with a total length of 79.9 km, with a diameter ranging from 100 mm to 700 mm.

The water treatment plant has a capacity of 17,400 m3 per day, and it comprises coagulation part (using Aluminium sulphate), contact chambers – 4 units; Decanters – 4 units; Fast Filters – 8 units, 6 of which are operational, and a Chlorination station for final processing.

At this stage, there are three concrete tanks for drinking water storage with a volume of 2,000 cubic meters. Total storage volume is 6,000 cubic meters. There is a sanitary and bacteriological laboratory at this facility to monitor the quality of drinking water.

There are 5 drinking water pumping stations in the city of Cahul.

Table 4-4: Technical characteristics of water pumping stations in the city of Cahul

Pumping station	Capacity	Head of pumping [m]	Number of pumps	Capacity per pump, [m3/hour]	Total capacity, [m3/h]	Storage tanks	Date of renovation
PS2	23,000 m3/day	60	3	320	960		2006
PS3	336 m3/h	72/ 35	3	112	336	2 units 2,000m3	2005
PS4	97.5 m3/h	50	3	32.5	97.5	2 units 500m3	2005
PS5	32 m3/h	25	2	6	12		2004
			3	5	15	2 units 3,000m3	

The total length of distribution networks is 80 km. The construction material of these networks varies and includes polyethylene, steel, iron and reinforced concrete.

Table 4-5: Technical data of water supply (distribution) networks in the city of Cahul

Age	< 10 years	< 20 years	< 30 years	Total, km	% according to the material
Polyethylene, km	20			20	25,0%
Reinforced concrete, km		7		7	8,7%
Cast iron			22	22	27,5%
Steel			31	31	38,8%
Total	20	7	53	80	100,0%
% according to age	25%	8.7%	66.3%	100%	

A number of system renovation works was carried out as a part of the Pilot Project of Water Supply and Sewerage. During the 2006-2007 period, 19.6 kilometres of the water supply networks were renovated.

The existing pumps at the level I, II, III, and IV water pumping stations have been replaced with pumps that are efficient with respect to operational use and energy consumption. Six pumps have been replaced at Water Pumping Station Nr.3, three pumps at Water Pumping Station Nr.4, two pumps at Water Pumping Station Nr.3, and two pumps at Water Pumping Station Nr.2.

The drinking water supply system is operated by 57 qualified personnel, of which eight have a university education, seventeen have a specialized secondary education (paraprofessionals), and thirty-two have a high-school education.

4.4.2 Sewerage and Waste Water Treatment System of the city of Cahul.

The sewerage system was put into operation in 1970 and it comprises 51.3 km of sewerage networks, main wastewater pumping stations, two regional wastewater pumping stations, a treatment plant with a capacity of 13.7 thousand m3/day, and a discharge pipeline. The average volume of treated wastewater is 2,500 – 3,000 m3/day.

As a part of a pilot project, two new pumps FA- 15.77Z with capacity of 65 kWt with greater efficiency were in installed in May 2006 and in October 2007 two pumps FG160/50 with capacity of 30 kWt were replaced.

Two pumps with capacity of 55 kWt were replaced with pumps with capacity of 11 kWt and 22 kWt, respectively, at the wastewater pumping station Nr.1.

Two pumping aggregates CD 50/12 with electric engines and a capacity of 7.5 kWt are installed at the regional wastewater pumping station Nr.2.

In 2007, 6.5 of 9 km of the pressurized sewerage collectors with diameter of 400 mm was renovated. The renovated pipeline is made of polyethylene.

Facilities for additional treatment are needed in order to achieve, at the outflow into the Prut River, effluent quality levels that comply with regulations in force.

The total length of sewerage networks is 51.3 km, of which 34.9 km or 68% are gravitational networks and 32 % are pressurized sewerage networks.

The main wastewater ewerage pumping station was built in 1970 and it collects wastewater from the central part of the city. As a part of a pilot project, the station was renovated in 2006, involving installation of two pumps of type FA-15.77Z with capacity 65 kWt and two pumps FG160/50 with capacity 30 kWt.

The wastewater pumping station Nr.1 was built in 1980, and it collects wastewater from the northern-eastern part of the city. The station was renovated as part of a pilot project, during which old pumps with capacity of 55 kWt were replaced with new pumps with capacities of 11 kWt and 22 kWt respectively.

The wastewater pumping station Nr.2 was also built in 1970, and it collects wastewater from the southern part of the city. The station was renovated as part of a pilot project, involving the installation of two pumps CD 50/12 with electric engines with the capacity of 7.5 kWt.

The breakdown of the sewerage networks by age and construction material is provided in the following table.

Table 4-6: Technical data of the sewerage networks of the city of Cahul.

Age of network	< 10 years	10- 20 years	20- 30 years	>30 years	Total, km	% according to the material
Steel, km				7,0	7,0	13,6%
Asbestos-cement, km			4,3	9,3	13,6	26,5%
PVC, km			9,6	4,7	14,3	27,9%
Polyethylene, km	16,4				16,4	32,0%
Total	16,4		13,9	21,0	51,3	100%
% according to age of network	32%		27%	41%	100%	

A wastewater treatment plant is located in Crihana Veche. The plant was brought into operation in 1970 and its capacity is 13,700 m^3 per day. The average volume of treated wastewater per day is 2,500-3,000 m^3, in other words the treatment station is operated at 18-22% of its capacity. The treatment plant comprises the following components: decanters (eight units), biological filters (three units), of which only one is in operation, secondary decanters (three units), sludge dewatering platforms, sludge pumping station, chlorination station, laboratory (which monitors the quality of wastewater and treated wastewater), and 5 km-long spillway with a nominal diameter of 500 mm.

The wastewater transmission and treatment system is operated by 47 persons, including two persons with a university education, 13 persons with a specialized secondary education and 32 people with a high-school education.

The wastewater collection network is operated by 31 persons, including 4 persons with specialized secondary education and 27 persons with high-school education.

4.4.3 Summary information on existing infrastructure by cluster

The following tables present the summary information on existing water supply infrastructure by cluster. For clusters A-E, Cluster 0 is included for comparison.

Table 4-7: Data on Infrastructure of the Cluster 0.

Denomination	Data on water infrastructure of the Cluster “0”							
	Number of households	**Number of residents**	**Number of households connected to water services**	**Number of water consumers**	**Length of streets, km**	**Length of water pipelines, km**	**Density of branch pipelines, households/1km**	**Water pipelines required, km**
Cahul	13 500	39 800	12 590	27 379	119	80.2	113	38.8
Crihana Veche	1 380	4 420	400	1 281	32	32	43	0
Manta	1 236	3 000	300	948	21	21	59	0
Pascani	350	1 095	104	325	8.2	8.2	43	0
Rosu	1 000	3 276	604	1 975	22.1	17.2	58	4.9
Total	17 466	51 591	13 998	31 908	202.3	158.6	86	43.7

Table 4-8: Data on Infrastructure of the Cluster “A”.

Localities	**Data on water infrastructure of the Cluster “A”**							
	Number of households	**Number of residents**	**Number of households connected to water services**	**Number of water consumers**	**Length of streets, km**	**Length of water pipelines, km**	**Density of branch pipelines, households/1km**	**Water pipelines required, km**
Lopatica	288	745	0	0	5.2	0	55.4	5.2
Tartarul de Salcie	612	1 016	0	0	6.7	0	91.3	6.7
Tudoresti	30	106	0	0	0.72	0		0.72
Taraclia de Salcie	305	1 887	102	339	10.3	4.5	29.6	5.8
Burlacu	640	2 366	450	1663	14	14	45.7	0
Subtotal	1 875	*6 120*	552	2002	36.92	18.5	51	18.42

TOTAL including Cluster 0	19 341	57 711	14 550	33 910	239	177	81	62

Table 4-9: Data on Infrastructure of the Cluster "B" taking into account data on the Cluster "0".

Localities	Localities							
	Number of households	Number of residents	Number of households connected to water services	Number of water consumers	Length of streets, km	Length of water pipelines, km	Density of branch pipelines, households/1km	Water pipelines required, km
Moscovei	1 272	3 434	0	0	22.6	0	56	22.6
Bucuria	264	822	203	632	6.28	1.3	42	4.98
Lucesti	228	650	150	428	7.2	4	32	3.2
Trefestii Noi	138	432	127	398	2.6	2.6	53	0
Spicoasa	75	276	20	74	2.9	1	26	1.9
Huliboia	365	1 012	0	0	7.5	6.5	49	1
Tataresti	608	2 160	0	0	15.4	2.8	39	12.6
Subtotal	2 950	8 786	500	1 531	64	18	46	46
TOTAL including Cluster 0	20 416	60 377	14 498	42 588	267	177	77	90

Table 4-10: Data on Infrastructure of the Cluster "C" taking into account data on the Cluster "0".

Localities	Data on water infrastructure of the Cluster "C"							
	Number of households	Number of residents	Number of households connected to water services	Number of water consumers	Length of streets, km	Length of water pipelines, km	Density of branch pipelines, households/1km	Water pipelines required, km
Cotihana	454	1 314	0	0	8.5	0	53	8.5
Andrusul de Jos	648	2 287	409	1 079	16.3	14.8	39	1.5
Andrusul de Sus	591	1 714	97	251	14.7	2	40	12.7
Tretesti	20	66	0	0	1	0	20	1
Baurci Moldoveni	709	2 205	0	0	20.5	0.4	34	20.1
Larga Noua	450	1 123	186	549	10.5	6.9	43	3.6
Larga Veche	126	423	0	0	3.4	0	37	3.4
Badicul Moldovenesc	428	1 342	0	0	14.5	8.9	29	5.6
Rumeantev	165	428	0	0	6.7	3.5	25	3.2
Iasnaia Poleana	45	123	0	0	0.9	0	50	0.9
Doina	425	1272	0	0	8	0	53	8
Paicu	160	577	122	0	4	4	40	0
Cucoara	336	1 207	284	1 700	8	8	42	0
Chircani	213	760	170	0	10	8.8	21	1.2

Zirnesti	604	2 072	580	0	11	11	55	0
Subtotal	5 374	*16 913*	1 848	3 579	138	68.3	38.9	69.7
TOTAL including Cluster 0	22 415	68 504	15 846	35 487	340	226	65.9	113.7

Table 4-11: Data on Infrastructure of the Cluster "D" taking into account data on the Cluster "0"

Localities	**Data on water infrastructure of the Cluster "D"**							
	Number of house-holds	**Number of residents**	**Number of house-holds connected to water services**	**Number of water consumers**	**Length of streets, km**	**Length of water pipe-lines, km**	**Density of branch pipelines, house-holds/1km**	**Water pipelines re-quired, km**
Lebedenco	241	723	93	279	6.8	6.2	35	0.6
Hutulu	232	641	47	130	4.4	3.4	53	1
Ursoaia	433	1 300	47	141	8.8	1.8	49	7
Peliniei	731	1 738	0	0	18.5	0	40	18.5
Satuc	35	74	27	57	2.1	1.7	17	0.4
Vladimirovca	114	346	0	0	5	0	23	5
Nicolaevca	249	723	0	0	6.6	0	38	6.6
Gavanoasa	437	1 336	0	0	13.1	0	33	13.1
Alexanderfeld	463	1 486	260	834	8.3	12.5	56	0
Iujnoe	252	755	203	608	8.2	6.2	31	2
Burlaceni	672	2 241	0	0	12	1	56	11
Greceni	32	103	0	0	1.6	0	20	1.6
Subtotal	3 891	11 466	677	2 050	95	33	41	67
TOTAL including Cluster 0	21 357	63 057	14 675	43 107	297	191	72	111

Table 4-12: Data on Infrastructure of the Cluster "E" taking into account data on the Cluster "0".

Localities	Data on water infrastructure of the Cluster "E"							
	Number of households	**Number of residents**	**Number of households connected to water ser-vices**	**Number of water con-sumers**	**Length of streets, km**	**Length of water pipe-lines, km**	**Density of branch pipe-lines, households/1km**	**Water pipelines re-quired, km**
Vadul lui Isac	1 037	3 225	384	1 194	19	3	55	16.4
Colibasi	1 694	6 030	480	1 790	29	20	58	9.2
Brinza	820	2 660	560	1 817	17	0	47	17.3
Valeni	987	3 100	280	879	23	13	43	9.5
Slobozia Mare	2 036	6 040	1 158	3 435	39	16	53	23

Cislita Prut	460	1 300			11	6	43	5.1
Giurgiulesti	912	3 200	844	2 961	26	26	35	0
Subtotal	7 946	25 555	3 706	12 077	164	83	49	81
TOTAL including Cluster 0	25 412	77 146	17 704	53 135	366	242	69	124

4.5 Existing water treatment plant

The Prut River is the water source for the city of Cahul. The water abstraction station is situated in Cotihana locality at the distance of about 5km from the city.

The capacity of the treatment plant is 17,400 m3/day however about 1/3 of that capacity is currently used, due to low demand. The details of the treatment process were presented in the section 2.3.1.

Table 4-13: The volume of the water treated by the Water Treatment Plant in the city of Cahul.

	2008	2009	2010	2011	2012
Treatment plant capacity, thousand m3/year	6 351	6 351	6 351	6 351	6 351
Treated water, thousand m3/year	2 049	2 135	1 898	2 038	2 171

4.6 Connections

4.6.1 Population connected to WSS services

The total rural population of the Rayon of Cahul is 85,100, of which 57,100 or 67% live in localities that are connected to the water supply systems.

The average population of the localities connected to the water supply system is 1904 persons. The average share of households connected to the water supply system is 42.6%. The maximum share of connected households is in Giurgiulesti at 98.7 %, and the minimum share of connected households is in Alexandru Ioan Cuza at 3.4%. The remaining 57.4 % of households use water from shallow wells and springs.

4.6.2 Industry, agriculture and business connected to WSS services

The use of water supply and sewerage services by the industry, agriculture and business can be described as follows – after 1993, the industrial consumption decreased and represents an insignificant part of the sales plan of service operators. 11 wine factories in the Rayon of Cahul have an autonomous source of water (depth sources) and treatment stations. The water supply services in rural areas are mainly used by small economic entities, such as bars, shops, small mills.

In contradiction, the city of Cahul has a strong economic base. 43 industrial companies operate on the territory of the city. The largest of them are shown in the table below.

Table 4-14: Classification of industrial companies by the type of activity

Industry	Description of the business	Name of the company
Food industry	Beer and non-alcoholic drinks factory	SA “Bere – Unitanc”
	Wine factory	SA “Podgoria Dunării”;
	Butter and cheeses factory	SA “Fabrica de brînzeturi”
	Bread factory	SA “Combinatul de panificaţie
	Combined forage factory	SA “Cereale”
Light industry	Knitted items factory	SA “Tricon”
Printing industry	Printing Company	SA “Raza de Sud”

Construction materials industry	Reinforced concrete piles plant	SA “USBA”

There are also 37 construction businesses and 4 transport companies in the city. Data on the largest consumers of water supply and sewerage services is shown in table below.

Table 4-15: Industrial water and sewerage services consumption (the largest consumers)

	Classification of economic entities by industries	Water		Sewerage, m^3/year
		from the own sources, m^3/year	From the central pipeline, m^3/year	
1	Textile industry:	5392	14566	19704
1.1	Tricon SA	4695	7881	12322
1.2	Laboratorio Tessile Mol SRL		5568	5568
1.3	Tricou Fantasy SRL	697	1117	1814
2	Bakery industry:	16465	2402	12854
2.1	CahulPan	16465	2008	12508
2.2	Savit-Sim SRL		233	233
2.3	Pîine și Tehnologii SRL		161	113
3	Food industry	4336	17708	18944
3.1	Fabrica de brînzeturi SA		4509	3801
3.2	Bere Unitank SA	4336	13199	15143
4	Construction materials industry		119	119
4.1	Trans-montaj SRL (brick plant)		119	119
5	Balneary tourism	99901	955	99901
5.1	sanatorium Nufarul Alb	99901	955	99901

4.6.3 Public institutions connected to WSS services

The following institutions in rural areas of Rayon of Cahul are connected to the water supply system:

- 9 schools, with the projected capacity of 6,606 pupils. Actual attendance is 3961 pupils, or 60% of projected capacity
- 18 schools, with projected capacity of 6430 pupils, actually attendance is 3050 pupils, or 47% of projected capacity
- 27 kindergartens with the capacity of 3765 children, actually attendance is 2573 children, or 68% of projected capacity.

At the same, it is necessary to mention that in the localities without centralized water supply systems, public institutions provide water supply for pupils from decentralized sources. These sources are the abstractions from shallow wells, which in most cases are at risk of contamination.

Table 4-16: Consumption and characteristics of budgetary customers

Consumption and characteristics of budgetary customers			%	Notes
Design number of users in high schools according to the technical design	students	6606	100%	Nine units
Actual attendance in high schools	students	3961	60,0%	

Monthly volume of billed water for high schools	m3/month	250,5		3 lcd
Number of seats in secondary schools according the technical design	students	6430	100%	Eighteen units
Actual number of students in secondary school	students	3050	47,4%	
Monthly volume of water billed to secondary schools	m3/month	411,5		7 lcd
Number of seats in kindergartens according to the project	children	3765	100%	Twenty-seven units
Actual number of children in kindergartens	children	2573	68,34%	
Monthly volume of water billed to kindergartens	m3/y	767	15l/per/day	
Monthly volume of water billed to City Hall	m3/y	52,5	1,6l/per/day	Fifteen units

In terms of efficiency of use of the public institutions, decreases in the number of students in institutions of education and children in kindergartens have been observed. This phenomenon correlates with the demographic conditions of the population in the country.

4.7 Operation and maintenance

There is a need for the following improvements in the WSS operation in the city of Cahul:

- Rehabilitation and upgrade of the water main network between the pumping station water treatment station;
- Reconstruction and modernization of the water treatment plant;
- Replacement of the distribution networks made of steel and asbestos cement;
- Installation of water meters in the consumption areas.
- Implementation of the SCADA system;
- Rehabilitation and modernization of the wastewater treatment station;
- Rehabilitation of the discharge channel of treated water in Prut river with a length of 5km;

Water losses represent 1231.1 thousand m^3/year, which exceeds by 1.31 times the amount of billed water. In addition, there is a latent growth of the specific consumption of electric energy.

Table 4-17: Evolution of indicators: water losses and specific consumption of electric energy

	Unit	2010	2011	2012
Water losses	M^3/km/24 h	24.87	27.9	32.1
Specific coefficient	kWt/1m^3	0.88	0.92	0.92

The water utility has the necessary mechanisms and equipment to organize operation and maintenance services even to the expanded service area.

4.8 Financing of WSS services, tariff policy

WSS services in the Rayon of Cahul are financed from tariffs, local contributions, local budgets and other sources. Tariffs in general cover operating costs, while the maintenance costs outside the city of Cahul, are incurred on an ad-hoc base. This means that maintenance is typically only organized in cases of system failure (leaking pipe, pump failure or similar) and is covered either from extra funds collected from population or from local budget of a commune. A similar situation occurs with regards to capital costs, which are covered by transfers from various domestic sources (including the National Environmental Fund), local contributions and local budgets.

In the city of Cahul, tariffs cover operating and maintenance costs. Maintenance, however, is not performed on an adequate level. In addition, depreciation is not fully accumulated for further re-investment (utility generates losses, but has a positive cash flow).

4.8.1 City of Cahul

The current tariffs in the city of Cahul are presented in the table below. The tariff has not been changed since 1 April 2010

Table 4-18: Current tariffs applied at Apa Canal Cahul – without VAT [MDL/m3]

	Water			Wastewater		
	Households	**Budgetary institutions**	**Business**	**Households**	**Budgetary institutions**	**Business**
Basic tariff	6.00	21.00	27.97	3.00	4.00	6.00
Tariff for consumption higher than $5m^3$	12.00			5.50		

The tariff for households is higher for consumption exceeding 5m3. In addition, the tariffs for households are not unified and various discounted categories exist. The weighted average tariff is 9.09 MDL/m3 for water supply and 4.1 MDL/m3 for sewerage, while Apa-Canal Cahul estimates that average full cost recovery tariff should be 15.14 MDL/m3 for water and 11.28 MDL/m3 for sewage.

Because the difference between tariffs for households and industry is not justified by the costs difference, the Apa Canal Cahul is cross-subsidizing domestic users. Yet, as of the preparation of the current study, the City of Cahul had begun discussions on tariff increases and the introduction of a unified tariff system (no cross-subsidization among domestic users).

4.8.2 Rural communities

Of 26 Apa-Canals in rural communes, only 25 have declared a tariff. In 2010 it ranged from 2.5 MDL/m3 in Cislita Prut to 16.5 MDL/m3 in Bucuria. Tariff for water is higher and equal to 10 MDL/m3 in 4 localities, and is less than 10 MDL/m3 in 22 localities out of the 30 surveyed.

5 Option analysis for centralized water supply

Three options have been analysed before a detailed study was conducted of the preferred option. These options were analysed from technical, environmental, financial, and organizational perspectives. The institutional analysis of options for inter-communal cooperation was performed separately from technical options. Option 1 takes into account the supply of the entire Rayon from one source at the city of Cahul. While this is the most natural option for aggregated water supply, the disadvantage of this option is that some localities are remotely located and does not take into account local sources of underground water to supply such localities. Another disadvantage of this option is that the water main has to pass beyond the border of Rayon of Cahul in order to supply the Alexandru Ioan Cuza Commune.

Option 2 takes addresses the major shortcoming of Option 1 and proposes that the Alexandru Ioan Cuza Commune is supplied from a local source. Option 3 proposes also to supply three other localities (Borceag Frumusica, Chioselia) from local sources. Options 2 and 3 require that local wells and local water treatment plants are analysed.

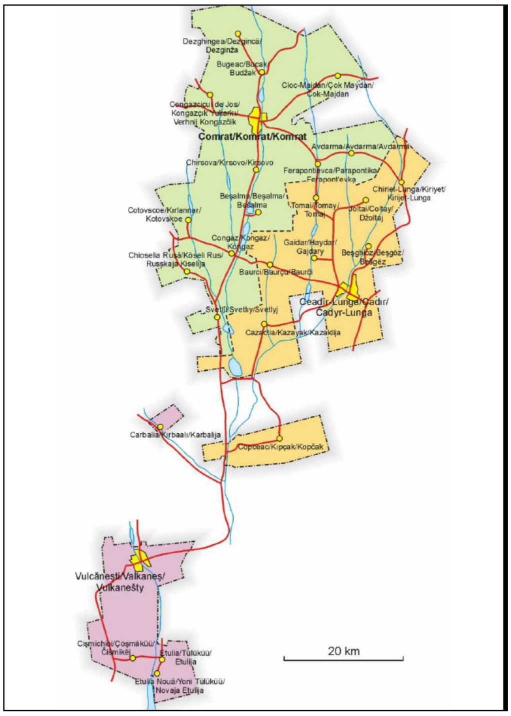
5.1 Option 1

This option provides water supply not only to the entire territory of Rayon of Cahul but also part of Gagauzia, thus requires additional introduction.

5.1.1 Introduction

Gagauzia represents a territorial-administrative structure within the Republic of Moldova with special legal status, which provides for the right to self-determination of the Gagauz people, operating in accordance with the provisions of the Constitution of the Republic of Moldova, according to the Law of the Republic of Moldova 'on special legal status of Gagauzia (Gazauz-Eri)' and the Regulation of Gagauzia. The Law on special legal status of Gagauzia (Gagauz-Yeri) was adopted by the Parliament of the Republic of Moldova on 23 December 1994. The Regulation of Gagauzia, which is the basic legal act and has legal force throughout in Gagauzia, was adopted by the Members of the People's Assembly of Gagauzia on 14 May 1998. The Regulation entered into force since 5 June 1998.

Figure 4. Autonomous Territorial Unit Gagauzia



The territory of Gagauzia covers 1848 square kilometres, or 5.5% of the total of the Republic of Moldova's territory.

In accordance with the Law 'on special legal status of Gagauzia' and on 'territorial- administrative division of Gagauzia', the autonomy's territory is divided into rayons, cities and villages.

The autonomy has 3 rayons (Comrat, Ceadar-Lunga and Vulcanesti). Gagauz Autonomy includes a municipality, two cities, twenty villages and three communes. The administrative centre of the autonomy is Comrat municipality.

The administrative centre of Gagauzia is municipality Comrat.

5.1.2 Population of Gagauzia

The population of Gagauzia is presented in the table bvelow.

Table 19. Population of Gagauzia

	Name of locality	Number of population
1	Comrat municipality	23327
2	Ciadar-Lunga city	19340
3	Vulcanesti city	15729
4	Congaz v.	12850
5	Copcac v.	9554
6	Baurci v.	9150
7	Cazaclia v.	7043
8	Chirsovo v.	7036
9	Tomai v.	5300
10	Dezghinja v.	5252
11	Cismichioi v.	5210
12	Besalma v	4750
13	Gaidar v.	4600
14	Cioc-Maidan v.	3926
15	Avdarma v.	3758

16	Etulia com.	3564
17	s.Besghioz	3391
18	Chiriet – Lunga v.	2498
19	Djoltai v.	2278
20	Svetlii com.	2271
21	Congazcic com.	2079
22	Budjac v.	1763
23	Ferapontovca v.	1008
24	Cotovscoe v.	989
25	Cioselia Rusa v.	735
26	Carbolsia v.	563

5.1.3 Extended project area for option 1

Extended project area for option 1 covers territory of Rayon of Caul and in addition:

1. City of Vulcanesti;
2. Village of Cismichioi;
3. Commune of Etulia.

Vulcnesti is located in the south of the country at a distance of 200 km from Chisinau, 7 km from the border with Ukraine and 35 km from the border with Romania.

5.1.4 Climate, topography and soil

ATU Gagauzia is located in the steppes of Budjac, which is part of the Moldavian south plain. The area is intersected by ravines and valleys. The landscape is mostly steppe hills. The territory of the autonomy is crossed by little rivers such as Ialpug, Ialpujel, Lunga and Lunguta. The region is attributed to Carpathian seismic zone.

The region’s climate is warm, the temperature of +10˚C and more are kept for a period of 179-187 days during the year.

The water resources of ATU Gagauzia are deep with a volume of 8-10mil.m3. Surface water sources are almost not existing. There are two water reservoirs located in the territory of ATU Gagauzia: one in Comrat with a surface of 1.7 km2 and on in Congaz with a surface of 4.9 km2.

5.1.5 Natural resources

The landed fund of the village is 15.260 ha, of which the majority – 12.645 ha or 82.9% is land for agricultural purpose. Vulcanesti cardinally differs from other urban areas in the country by its surface and large farmland share. Agricultural lands are distributed as follows: arable land – 9.820 ha, vineyards – 1.336 ha, orchards - 299 ha. The city has three parks with a total area of 3.8 ha. The surface of protective strips around the city is 275.4 ha. The forestry real estate is 800 ha.

5.1.6 Infrastructure

Gagauzia has 26 localities, provided with water supply systems. The total length of water supply network is 605 km., 51 6% of the total number of households are connected to centralised water supply facilities and about 38.5% of households are connected to the centralised sewerage systems. The population is also supplied with water from depth wells. The status of water quality in the south, where Vulcanesti is located, is rather difficult, while the situation in other parts of Gagauzia is slightly better (only 22.3% of the wells have water that does not meet quality standards).

The total length of roads in the city of Vulcanesti is 64 km, of which 35.8 km are roads with rigid cover. In the city there are 4.675 houses and apartments, of which 955 are connected to the centralised water supply network and sewerage system. Some houses are supplied from 73 public wells. Vulcanesti city is gasified in proportion to 95%. Of the total number of houses and apartments 3.549 or 76% have access to telephone line. The city is connected to other localities by railroad and road, which passes through the city.

Municipal Enterprise Apa Canal Vulcanesti manages a water supply and sanitation system, which on 1 April 2013 had a value of assets MDL 23.567.772[11].

Value of fixed assets shall be distributed as follows:

1. Water supply infrastructure - MDL 13.953.12;
2. Sewer infrastructure - MDL 8.437.660;
3. Auxiliary output - MDL 669.900;
4. Administrative building - MDL 507.100.

5.1.7 Water supply system

The water supply system comprises of two water intakes, of which intake No.1 has 8 artesian wells. Water intake No.2 has 5 abstractions of wells of small depth type.

For intake No.1 of 8 wells, only two are functional: well No.6 and No.7. A serious problem of the water intake is the lack of flow in wells No. 2, 3 and 8. Wells No. 4 and 5 are preserved.

Figure 5. General Plan for water supply and sanitation systems development

Out of 5 abstraction wells which are on balance of intake No.2, only 4 are functional: No. 1, 2, 3 and 5. Abstraction No.4 requires repair.

Table 20. Stage II pumping station is equipped with pumps type "K"

Pump type	Physical condition	Actions
K – 100 – 65 – 200	satisfactory	Functional
K – 100 – 65 – 200	satisfactory	Overhaul
K – 90 / 45	unsatisfactory	Replacement

[11] Report on assets of ME Apa Canal Vulcanesti

Figure 6. Part of the water supply installation

Figure 7. Pumping station

The length of water supply pipes is 44.2 km, 98% wear degree. Water supply pipes' material is distributed as follows:

Table 21. Pipes by construction material

Pipes' material	Pipes' length, m
PEID	0
Steel	27 800
Cast iron	11 600
Asbestos - cement	4 800

5.1.8 Sewerage and waste water treatment system

The sewerage networks have a length of 17.6 km; including main collectors that have a length of 1.6 km. The system is divided in 3 channelled zones and 3 waste water pumping stations. WWTP capacity is 3800 m^3 /day.

Out of 3 pumps of the main pumping station, only one is functional. 2 pumps were replaced during the overhaul of the pumping station. All pipes and fittings from inside the station have been also replaced. The equipment and rayon pumping stations require overhaul.

5.1.1 Technical option

The surface water of the Prut River will be the main source of water supply for all localities. The existing water intake and water treatment plant will be used to supply water. The existing water treatment plant has sufficient capacity to meet the future demand of water from all localities[12].

The water from the water treatment plant in Cahul and from the existing water system of the city of Cahul, will be distributed through three water mains. The south water main will supply Cluster E, the south-eastern water main will supply cluster D and the Alexandru Ion Cuza Commune. The north-eastern water main will further divide and will supply Cluster A, B and C and in addition localities Borceag Frumusica, Chioselia. In addition to supplying the entire Rayon of Cahul, the water main from the Cluster D to Alexandru Ion Cuza, must pass through the city of Vulcanesti, which is located in Gagauzia. This means an additional population will be supplied and water supply network through the cluster D will be extended to the parameters of additional water demand.

5.1.2 Extended cluster D

Number of localities connected - 18

Population served – 29,246 inhabitants

Maximum daily flow - 5750.59 m3 /day

Table 22. Flow calculation for each locality

Locality	no. house holds	inhab. 2013	inhab. 2025	q sp.	$Q_{day\ av}$, m^3/day	K_{day}	$Q_{day\ max}$, m^3/day	K_p	K_s	$Q_{day\ calc}$, m^3/day	Q, mc/h	Q, l/s

[12] Currently, the water output of water supplied in the city is 3,000 cubic meters per day; while the station's pumping capacity is approximately 23,000 cubic meters per day (when all three (3) pumps are in operation. The water treatment station was designed for a capacity of 27,500 cubic meters per day, whilst the current use is 8,000 cubic meters per day.

Lebedenco	241	723	766	125	95,80	1,3	124,54	1,1	1,1	150,69	6,28	1,74
Hutulu	232	641	679	125	84,93	1,3	110,41	1,1	1,1	133,60	5,57	1,55
Ursoaia	433	1300	1378	125	172,25	1,3	223,93	1,1	1,1	270,95	11,29	3,14
Pelinei	731	1738	1842	125	230,29	1,3	299,37	1,1	1,1	362,24	15,09	4,19
Satuc	35	74	78	125	9,81	1,3	12,75	1,1	1,1	15,42	0,64	0,18
Vladimirovca	114	346	367	125	45,85	1,3	59,60	1,1	1,1	72,11	3,00	0,83
Alexanderfeld	463	1486	1575	125	196,90	1,3	255,96	1,1	1,1	309,72	12,90	3,58
Nicolaevca	249	723	766	125	95,80	1,3	124,54	1,1	1,1	150,69	6,28	1,74
Gavanoasa	437	1336	1416	125	177,02	1,3	230,13	1,1	1,1	278,45	11,60	3,22
Iujnoe	252	755	800	125	100,04	1,3	130,05	1,1	1,1	157,36	6,56	1,82
Burlaceni	672	2241	2375	125	296,93	1,3	386,01	1,1	1,1	467,07	19,46	5,41
Greceni	32	103	109	125	13,65	1,3	17,74	1,1	1,1	21,47	0,89	0,25
Al. Ioan Cuza		2653	2812	125	351,52	1,3	456,98	1,1	1,10	552,94	23,04	6,40
Etulia	1115	2714	2877	125	359,61	1,3	467,49	1,1	1,10	565,66	23,57	6,55
Etulia Noua		740	784	125	98,05	1,3	127,47	1,1	1,10	154,23	6,43	1,79
Cismichioi	1558	5032	5334	125	666,74	1,3	866,76	1,1	1,10	1048,78	43,70	12,14
Vulcanesti city	4254	16125	17093	125	2136,56	1,3	2777,53	1,1	1,10	3360,81	140,03	38,90
Vulcanesti cf	121	222	235	125	29,42	1,3	38,24	1,1	1,10	46,27	1,93	0,54
TOTAL		27591	29246		3655,81		4752,55			5750,59	239,61	66,56

It was considered the prospect of building a centralised water supply system for 18 localities with a total number of 29246 inhabitants.

This water supply system is connected to the pumping station PS5 and to the two tanks of 1500 m3 each, which are currently not used.

The water supply system must ensure the continuous supply of the flow Qday max = 5750.59 m3/day, Qo = 66.56 l/s and a minimum working pressure of water storage local building supply.

To route 'D' the following locations are to be connected: Lebedenco, Hutulu, Ursoaia, Pelinei, Satuc, Vladimirovca, Alexanderfeld, Nicolaevca, Gavanoasa, Iujnoe, Burlaceni, Greceni, Vulcanesti city, Alexandru Ioan Cuza, Etulia, Etulia Noua, Cismichioi, Vulcanesti locality and railway station.

The water is pumped through PS5, equipped with 3+1 pumps, type NL80/250-45-2-12-50Hz up to 185 m of the ground level, where two tanks of 1000 m3 each are placed, by means of a pipe with a diameter DN 400, where adduction operates gravitationally, from 185 to 45m land share in Gavanosa v. In order to reduce the pressure, in upstream of the branch to Lebedenco v., it was provided a pressure reducer with Δp = 15.0 m col. H2O.

On exit of Gavanoasa village, there have been provided two water storage tanks of 500 m3 each, from which water is pumped through pumping station PS1, equipped with 2+1 pumps, type NL 80/250-37-2-12-50Hz, to Vulcanesti city land share 90 and to water tank in Alexandru Ioan Cuza v. land share 94, pressure col. 5.21m H2O and respectively to Iujnoe v. land share 110, pressure 24.99 m col H2O.

The main route for water supply of Vulcanesti v. was foreseen with DN 315.

For water supply of Cismichioi v., after Etulia v. at land share of 60 m, it as foreseen a water re-pumping station, PS4, equipped with 1+1 pumps, type MVI 5204/PN16 3 ~ , which supplies water towers. Due to accidental configuration of the land in Cismochioi v., having land elevation difference of approximately 75 m, water supply was provided from two opposite directions.

Water supply of the tower in Etulia Noua v. will be provided using water re-pumping station PS6, located on exit of Etulia v., land share 50 m, equipped with 1+1 pumps, type MVI 806/PN16 3~.

Vulcanesti, part loated close to the railway station is supplied through a pipe with DN50, which goes up to 106 m of the ground level, pressure col. 9.02 m H2O, after which operates gravitationally.

Secondary route that supplies such localities as Iujnoe, Burlaceni and Greceni was foreseen to DN 160 mm. In order to supply water towers from Iujnoe and Burlaceni v. there have been provided two pumping stations.

On exit of Iujnoe v., a water re-pumping station PS2, equipped with 1+1 pumps, type MVI 3203/PN16 3~, that pumps water up the Burlaceni v., land share 142, pressure col. 18.58 m H2O.

To Greceni v. the adduction pipe operates gravitationally.

For supplying Alexanderfeld v. located at the land share of 155 m, on the branch having the point of connection to the main pipe in front of Vladimirovca v., land share 50 m, there must be placed a re-pumping station PS3, land share 101 m, equipped with 1+1 pumps, type MVI 1607-6/PN16 3~.

Length of adduction pipes on the main route carrying drinking water is 79333 m, and the local ones is 12461 m, their distribution by diameters and lengths is shown in Table 2 and 3.

Table 23. Length and material of the designed networks of the main route

Diameter	Length, m
Main route	
PEID DN400	7585
PEID DN355	9308
PEID DN315	15450
PEID DN250	9730
PEID DN200	5870
PEID DN160	12200
PEID DN125	2110
PEID DN110	5890
PEID DN75	4220
PEID DN50	6870
TOTAL	**79333**

Table 24. Length and material of the designed networks of the secondary route

Diameter	Length, m
Local route	
PEID DN225	30
PEID DN125	4430
PEID DN110	1551
PEID DN90	2750
PEID DN75	540
PEID DN63	1950
PEID DN50	1210
TOTAL	**12461**

The total length of the water supply pipes is 91794 m.

Depending on the configuration of the field of served settlements, there was established the type of water storage facilities and their capacity.

In order to ensure free pressure in the distribution network and storage of compensation, fire volumes, there were foreseen tanks or water towers.

The data regarding the type of storage constructions, their capacity and numbers are presented in the table below.

Table 25. Technical characteristics of storage tanks

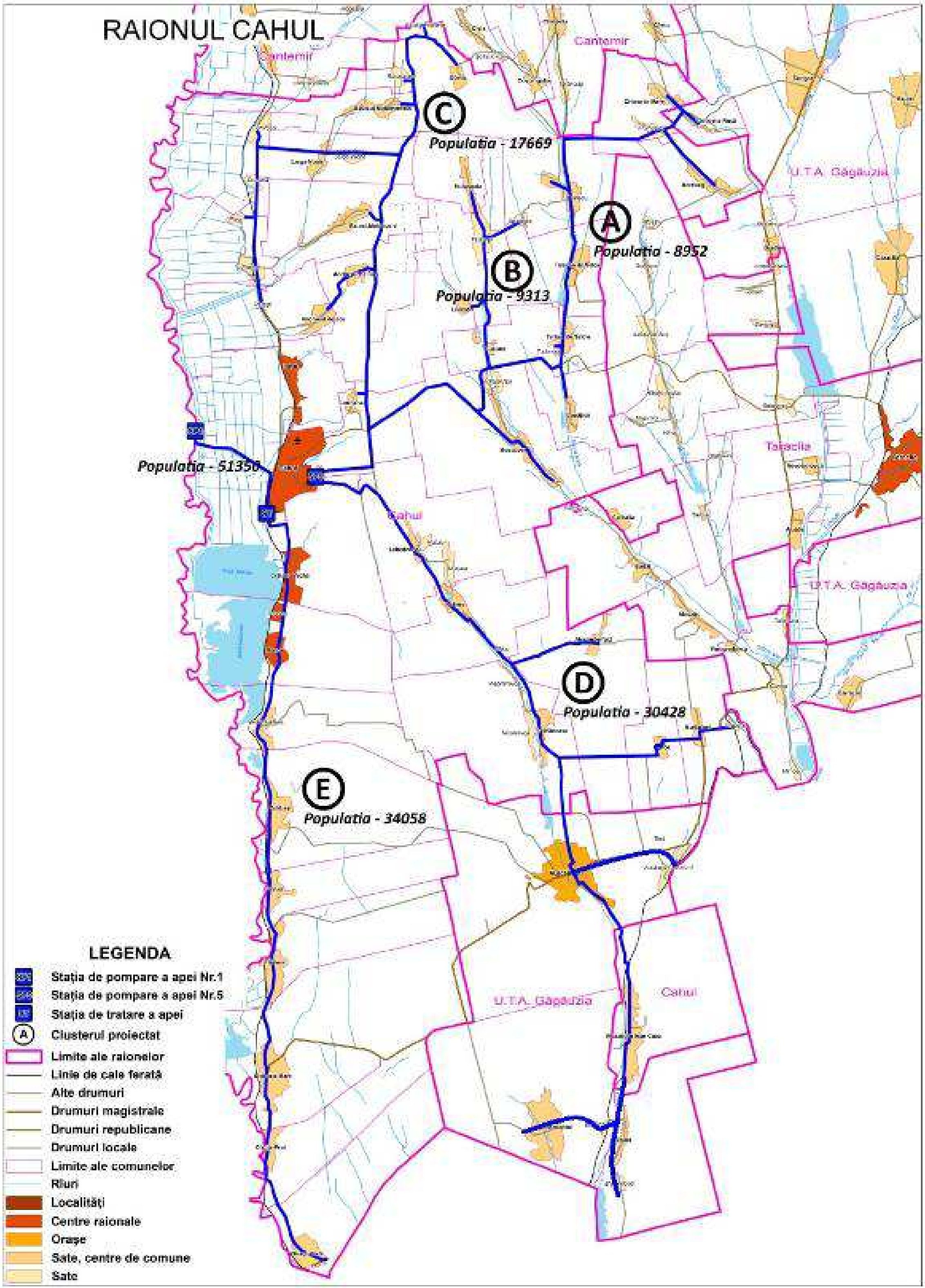
Locality	**Land share, m**	**capacity, m^3**	**number**
water tank			
Vulcanesti city	90	500	2
Alexandru Ioan Cuza	94	150	1
Etulia	75	150	1
Water tank			
Lebedenco	110	50	2
Hutulu	125	50	1
Ursoaia	125	50	3
Pelinei	100	50	3
Satuc	68	25	1
Vladimirovca	75	50	1
Alexanderfeld	155	50	3
Nicolaevca	65	50	2
Gavanoasa	75	50	3
Iujnoe	115	50	2
Burlaceni	142	50	3
Greceni	102	25	1
Etulia Nouă	95	50	1
Cişmichioi	92/85	50	2/2
Vulcanesti loc. st. CF	90	25	1

On the route of regional adduction pipe, there have been provided water tanks, which location and capacity are presented in the table below.

Table 26. Characteristics of pumping stations

Water tank	**Land share, m**	**capacity, m^3**	**number**
RAP 1 (route)	185	1000	2
RAP 2 (PS1)	90	500	2

The map below provides an overview of the proposed infrastructure.


RAIONUL CAHUL
Cantemir
U.T.A. Găgăuzia
Taraclia
Cahul
Populatia - 17669
Populatia - 8952
Populatia - 9313
Populatia - 51350
Populatia - 30428
Populatia - 34058
LEGENDA
Stația de pompare a apei Nr.1
Stația de pompare a apei Nr.5
Stația de tratare a apei
Clusterul proiectat
Limite ale raioanelor
Linie de cale ferată
Alte drumuri
Drumuri magistrale
Drumuri republicane
Drumuri locale
Limite ale comunelor
Râuri
Localități
Centre raionale
Orașe
Sate, centre de comune
Sate

5.1.3 Institutional requirements and arrangements

The proposed option requires the most complicated institutional arrangements given that the water network crosses the border of the Rayon of Cahul. At the current stage, arrangements for inter-communal co-operation, based on one utility, proposed in section 8.2, will be difficult to be applied for the city of Vulcanesti.

5.1.3.1 Background

One of the purposes and benefits of inter-municipal cooperation is benefiting from the effects of economies of scale, which, in the context of the administrative-territorial structure of the Republic of Moldova, can hardly be achieved within the territorial limits of single rayon. In addition to reasons of economic efficiency and environmental and strategic importance (settlements from Vulcanesti rayon making use of water from surface waters vs. water from wells), the interconnecting of the water supply system of Vulcanesti rayon to the future system of Cahul rayon (Cluster D) would allow the integration of the town of Alexandru Ioan Cuza into the centralized system of this cluster, whereas currently, due to its geographical location, the town is isolated and the option of supplying water from its own/ground sources is being examined.

In these circumstances, depending on the interest and the choice made by the local authorities of Vulcanesti rayon, several institutional integration options, more or less advanced, are possible.

Therefore, four basic options are proposed by experts for the integration of settlements in Vulcanesti rayon:

Option 1: Full integration into the institutional architecture of Cahul rayon (settlements from Vulcanesti rayon become shareholders of Cahul rayon operator).

Option 2. Partial integration, according to which both Cahul and Vulcanesti operators remain independent entities, but create together a holding (union).

Option 3. Contractual relationships. In this case, it is not an institutional integration, but rather contractual relationships, the object of which is the bulk purchase of water at the administrative border of the concerned administrative entities.

Option 4. The lease of the service (outsourcing). In this case, the authorities of Vulcanesti rayon lease the supply of the service to Cahul operator, without taking part in its creation. The public authorities from Vulcanesti retain some monitoring, coordination functions, however Cahul operator is responsible for supplying the service (direct interactions with consumers).

It has to be noted that, within this study, these options for the institutional integration of settlements in Vulcanesti rayon will be analysed in a summary manner, and, subsequently, based on the interest of the partners (LPAs) from these settlements, the chosen option will be developed in detail.

5.1.3.2 Description and analysis of options

1) Total integration option.

This option entails that settlements from Vulcanesti rayon participate as equals alongside settlements from Cahul rayon in establishing a joint operator (for example, a Joint Stock Company). In this case, the institutional integration of these settlements does not require any specific document drafts, all documents prepared for the settlements from Cahul rayon are applicable to the ones from Vulcanesti.

The following steps must be made and documents must be drawn up for the implementation of this institutional integration option:

I. The reorganization of existing operators (the merger of existing operators and their transformation from ME to JSC), with all the resulting requirements (notifications to creditors, publications in the official gazette), a possible increase of capital and the subscription of new shareholders to the newly issued shares, which requires the following documents:

1. The Charter of the commercial company

2. Articles of association

II. Likewise, apart from participating in the establishment of the operator, it will be necessary to conclude a contract delegating management of the public water supply service to the joint regional operator.

Advantages of the option:

1. Simplicity and homogeneity of the system

2. Possibility of employing a single tariff policy and applying the principle of cohesion between settlements/rayons

3. The advantages of economies of scale may be more significant than is the case with other options

4. Duplication of administrative structures is avoided (one operator instead of two – reduced operating costs, from an administrative point of view)

Disadvantages/possible risks:

1. A stronger will to cooperate is necessary on the part of the LPA concerned (especially those in the Vulcanesti rayon), which may be difficult to achieve

2. If contributions in kind are accepted in the creation of the share capital, resources will be required for valuation of assets

4. Some decisions within the governing bodies of the future commercial company may be passed with more effort.

5. The ratio of contribution and power existing at the moment within Cahul rayon would change.

2) Partial Integration Option.

This option entails the existence of distinct operators and therefore institutional and legal structures within each of the two rayons (which, in turn, may include settlements in each rayon), however the two operators may together form a joint institutional structure, for purposes of coordination and integration (conglomerate, holding, union).

Advantages: This option would allow a certain degree of coordination and integration between the two rayons, less intense than that provided by option 1, but increased in comparison to the contractual option.

Disadvantages:

1. It is a less known and practised form in Moldova, which may create difficulties in further phases;

2. However, this entails doubling some administrative structures (an institutional structure within each rayon) plus the effort required to administer the union.

3) Contractual Option.

This option does not entail any integration from an institutional point of view, but rather it concerns contractual relationships the purpose of which is the bulk purchase of water at the administrative border and finally benefiting from the surface water source of the Prut river.

Since, as it can be seen on the schematic figure provided in Annex 1, the town of Alexandru Ioan Cuza is an enclave in Vulcanesti rayon, and the network would initially pass through the city of Vulcanesti and then through Alexandru Ioan Cuza and would further continue in other settlements from Vulcanesti rayon, certain technical and engineering challenges regarding the metering of the quantity of water may arise. In this case, it will be required to install some devices to measure the quantity of water at the following locations: (1) at the border (entry) into the city of Vulcanesti and the exit therefrom (the difference will represent the amount of water to be billed), at the entry (2) into Alexandru Ioan Cuza (optional, since this will be integrated into the institutional structure of Cahul operator and contractual relationships will exist with every water user, which will entail the metering of individual consumption), (3) at the exit from Alexandru Ioan Cuza (provided the other settlements from Vulcanesti rayon will be integrated into the operator from the town of Vulcanesti) or at the entry into each of the settlements from Vulcanesti rayon, provided such integration will not take place.

Is a tender required for the conclusion of such a contract or not? Answer: The public procurement procedure is not required for the conclusion of the contract on bulk purchase of water by the Vulcanesti operator. This conclusion is based upon several reasons:

1) The law on public procurement no. 96 dated 13.04.2007 provides the possibility of acquiring from a single source or of moving on to negotiated procedures if, for some reasons, a certain good or service may be furnished only by one or by a specific commercial entity.

2) The new law on the water supply and sanitation public service no. 303 dated 13.12.2013 provides, in an indirect manner, such an argument in art. 13, paragraph (12).

3) In the context of the approximation of Moldovan legislation to European Union rules, the supply of drinking water and sanitation are part of the so-called Services of General Economic Interest, which are subject to special regulations, which essentially remove the obligation to comply with competition rules and permit state aid, under certain conditions (not the general kind, rather state aid targeted for specific services, on the basis of transparency regarding the volume of services rendered and established cost, with the allowance of a certain profit).

The elements of such a contract. A prospective contract on bulk purchase of water should contain the following basic elements:

1. Information regarding the parties, which will be referred to as the buyer and the seller respectively, as well as the authorisation on the part of the founders (resolutions of governing bodies)
2. Definitions
3. Subject of the contract (supply / purchase of water in bulk)
4. Rights and obligations of parties
5. The term for which it is to be concluded
6. The method by which the volume of water is measured, placement of measuring equipment
7. Price and method (term) of payment
8. The estimated volume of water to be supplied, quality, pressure, etc.

9. Penalties and liability of parties
10. Disputes and resolution
11. Force majeure and supply in exceptional situations
12. Provisions regarding the continuation of the network and the flux of water towards Alexandru Ioan Cuza
13. Amendment, termination and extension of the contract
14. others.

Advantages:

1. Certain effects of economies of scale may be felt (volume of sold water will increase)

2. More secure water for users in Vulcanesti

3. Alexandru Ioan Cuza may be integrated into the centralized system and will benefit from more secure water

Disadvantages/risks:

1. Vulcanesti may withdraw from the scheme, thus affecting the rest of the system

2. The price of water will start at the cost of production and pumping until the point of demarcation, the possibilities of balancing the price over the entire area of supply will be more limited

3. Administration efforts remain not optimized (distinct operators will continue to exist in each rayon).

<u>4) Lease of the Service (outsourcing).</u>

It is the option under which authorities from Vulcanesti rayon apply one of the possibilities to delegate management of the service: lease of the service to an operator independent from them, which may be a public or private operator. Since new norms have been recently adopted and circumstances justifying direct delegation of the water supply and sanitation service to operators with public capital have arisen, Vulcanesti authorities may directly concede the service to Cahul operator, without having to organize a tender in this regard (please see arguments regarding point / option 3).

In this case, it is not about the bulk sale of drinking water, but about direct relationships between the operator Apa-canal Cahul and consumers from the Vulcanesti rayon.

Despite the fact that the law on leases (concessions) is fairly outdated and contradicts the law on public-private partnerships, however the elements and the specifics of lease relationships are very well known and applied by the local authorities in Moldova, and for this reason it is not required to insist upon the details.

Advantages:

1. It is a more advanced form of integration compared to the option of bulk supply of water. It offers more possibilities to plan and manoeuvre to the operator (Apa-canal Cahul). A single centre for coordination and command exists.

2. The potential of the effect of economies of scale is retained.

3. Fairly clear and simple relationships. It is a known contractual form.

Disadvantages/Risks

1. The Vulcanesti operator must be closed (the possibility of losing jobs, although a significant portion may be rehired by Apa-canal Cahul)

2. The obligation to and source of maintaining and investing into the infrastructure, as well as the fee, should be very clearly stated

3. The term is limited to 49 years.

4. The option to terminate exists, therefore the conditions of termination of the contract should be clearly set out.

5.1.4 Environmental implications

The main criteria for selecting the most environmentally friendly water supply option are:

- Priority should be given to the route that contains fewer water reservoirs, since each water reservoir represents a risk of toxic substance leakage.
- Priority should be given to routes that are planned on less fragmented topography, with less ravines and unstable soils, and which intersect less tributary valleys. (The unstable topography exposed to erosion leads to a higher risk for water pipes breakage). In order to intersect the lower part of the abrupt slopes, special measures to avoid landslides and pipe breakage would need to be developed.
- Priority should be given to the option that does not intersect contaminated lands. These include: human and animal cemeteries, former pesticide deposits, landfills, manure storage and other sources of contamination.
- Priority should be given to routes that will consume less energy during operations (that is, fewer pumping and water treatment stations).
- Priority should be given to routes that have a higher coverage with sewerage system.
- Water reservoirs and pumping stations preferably should be located on public land, taking into account the establishment of sanitary zones, and with an aim to avoid illegal connection to the network and risk of spillages.
- Priority should be given to routes that cross less the roads and other transmission infrastructure.

Taking into account the above mentioned criteria for route selection, the most environmentally friendly route is the one proposed by clusters D, B, A (in order of priority). Including additional demand from the city of Vulcanesti to the cluster D. This makes Option 1 the most environmentally friendly option.

Taking into consideration that according to Moldavian legislation the ecological expertise is compulsory for new projects on water supply, and that the routes of water supply system proposed in option 1 are crossing a series of state natural protected areas[13], *the need to conduct a detailed environmental impact assessment has to be determined by the State Ecological Inspectorate*.

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[13]State protected areas crossed by the water supply routes proposed in option 1:
Cluster A: Natural reserve “Bolgrad Lyceum”,
Cluster C: (1) Natural reserve “Baurci”, and (2) Resource reservation Baurci Moldoveni-Larga
Cluster D: Natural geological and paleontological monument “Fossil site near the village Pelinei”
Cluster E: Ramsar humid zone nr. 1029 “Lower Prut Lakes”.

In case of selection of proposed water supply routes, the following potential impacts should be considered:

- **Improvement of public health:** The project increases the reliability of water supply service provision to domestic customers and will noticeably improve the quality of drinking water supplied to the population (particularly in physical and microbiological indicators), which lead to reduction of illness rates related to water and will improve public health.
- **Security of disinfection process:** chlorinated reagents that will be used for water storage of more than 6 hours can pose a public health risk. The reagents used for water disinfection need to be subjected to standard measures for protection and control of its content in the water.
- **Pollution with construction waste:** This waste may pose a temporary and insignificant negative impact on groundwater quality. Construction works will be conducted in the short term. Additional measures will be implemented and local standards for protection of the groundwater from pollution will be taken into account.
- **Temporary nuisance during the construction phase**. The negative impact includes: dust from construction works, noise during excavation, possible effects of vibration on old houses, and transportation of the constructed elements.
- **Removal of construction waste:** Waste will be generated during the construction of facilities. These impacts will be localized and minimized through the corresponding procedures of removal and disposal of construction waste, by contracting a company authorized for waste management.
- **Damage to existing communal sites**: old water pipeline networks, transmission equipment and telephone lines can be damaged during installation and repair works.
- **Labour security at the construction works**. Appropriate construction skills and worker safety should be applied, in accordance with the existing construction norms, rules and regulations.
- **Leakage of fuel and lubricants from machines during construction**. Since, the usage of fuel and lubricants is expected to be minimal, the potential negative effect is insignificant. However, proper construction skills and practices shall be ensured to avoid water pollution.
- **Damage to trees and plants:** Effect on green plantations will be short, local and related to the construction. The activity may possibly result in removal or relocation of trees and vegetation.
- **Damage to cultural sites:** Since the project sites do not interfere with any cultural sites, no damage will be made to any archaeological and other cultural values during the project implementation.

5.1.5 Investment costs and proposed phasing

The total investment costs of Option 1 are 727.6 million MDL. The proposed phasing of the investment is presented in the table below.

Table 5-27: Proposed project implementation schedule for Option 1

	2014	2015	2016	2017	2018	Total
Pipelines	217,6	80,4	72,1	40,6	75,3	485,9
Water towers	22,6	5,4	3,0	0,3	0,6	31,8
Reservoirs	0,0	18,4	18,5	5,3	9,8	52,0
Pumping stations	7,2	7,6	12,3	3,0	5,5	35,4

Artesian wells	0,0	0,0	0,0	0,0	0,0	0,0
Water treatment plant	0,0	0,0	0,0	0,0	0,0	0,0
Land acquisition	3,8	2,0	4,0	0,6	1,0	11,4
Technical assistance	20,1	9,1	8,8	4,0	7,4	49,3
Contingencies	25,1	11,4	11,0	5,0	9,2	61,7
Total	296,3	134,2	129,6	58,6	108,8	727,6

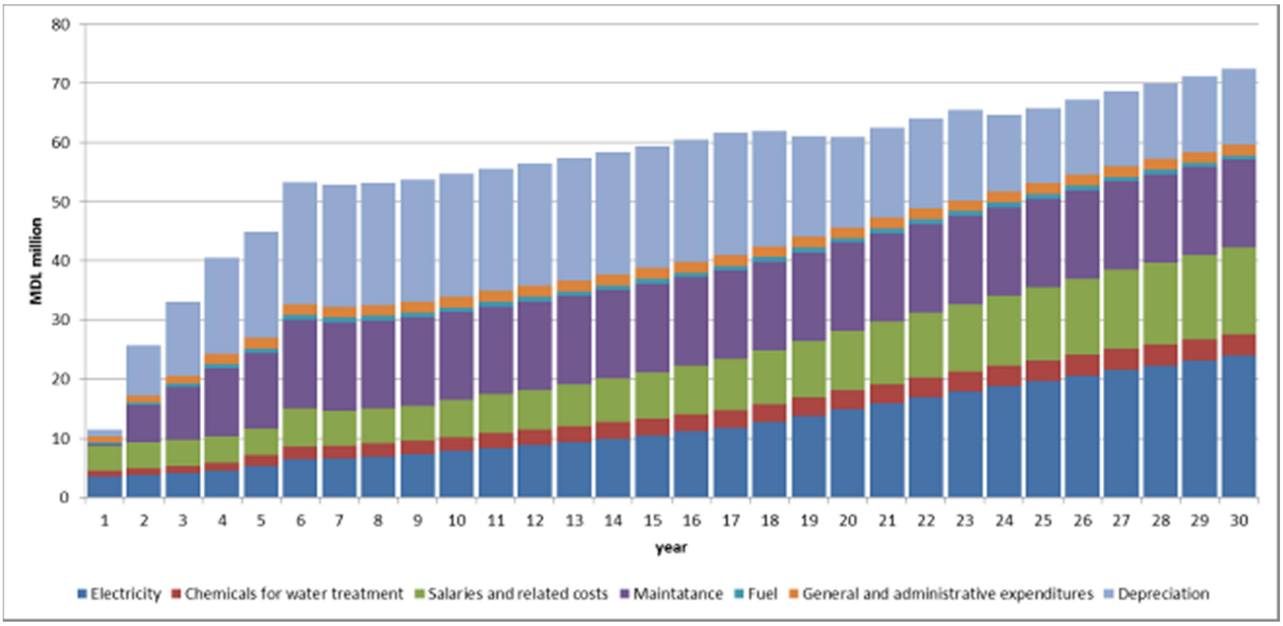
This option will also require additional costs for replacement of the water main from water intake to the water treatment plant (higher diameter or a second pipe). Additional costs are not considered in the table above because increased demand will be required in about 15 years from now and surplus in cash flow of the regional operator gloves a possibility for such investment.

5.1.6 Operation and maintenance costs

The summary of the variable and fixed costs forecast for Option 1 is provided in the figure below. The detailed description of the costs calculation is in section 10.2.3 describing financial analysis of the selected option. The difference is in variable costs (pumping additional water for a water demand from Vulcanesti and Alexandru Ion Cuza) minus the costs of water treatment and pumping for Alexandru Ion Cuza only.

The following figure illustrates the operating costs forecast.

Figure 5-8: Operating costs forecast [MDL M]



5.1.7 Revenues

Revenues are calculated based on the proposed tariff that covers O&M and capital costs. Option 1 has a higher level of revenues due to a higher number of customers.

For each option, the dynamic generation cost (DGC) indicator (which constitutes a simplified cost benefit analysis or cost-effectiveness analysis) was calculated. Most of development banks use DGC (for example, “Handbook for the Economic Analysis of Water Supply Projects”, ADB, 1999, Manila). Each institution, however, uses a different term to describe it.

The lower the DGC, the more cost-effective the option; thus, this method reveal which option is the best at delivering the defined level of services. If two options generate a similar DGC, however, decision-makers need to consider the simplified approach taken in this study and make a political decision on which option should be selected.

The DGC for Option 1 is 7.80 MDL/m3.

5.2 Option 2

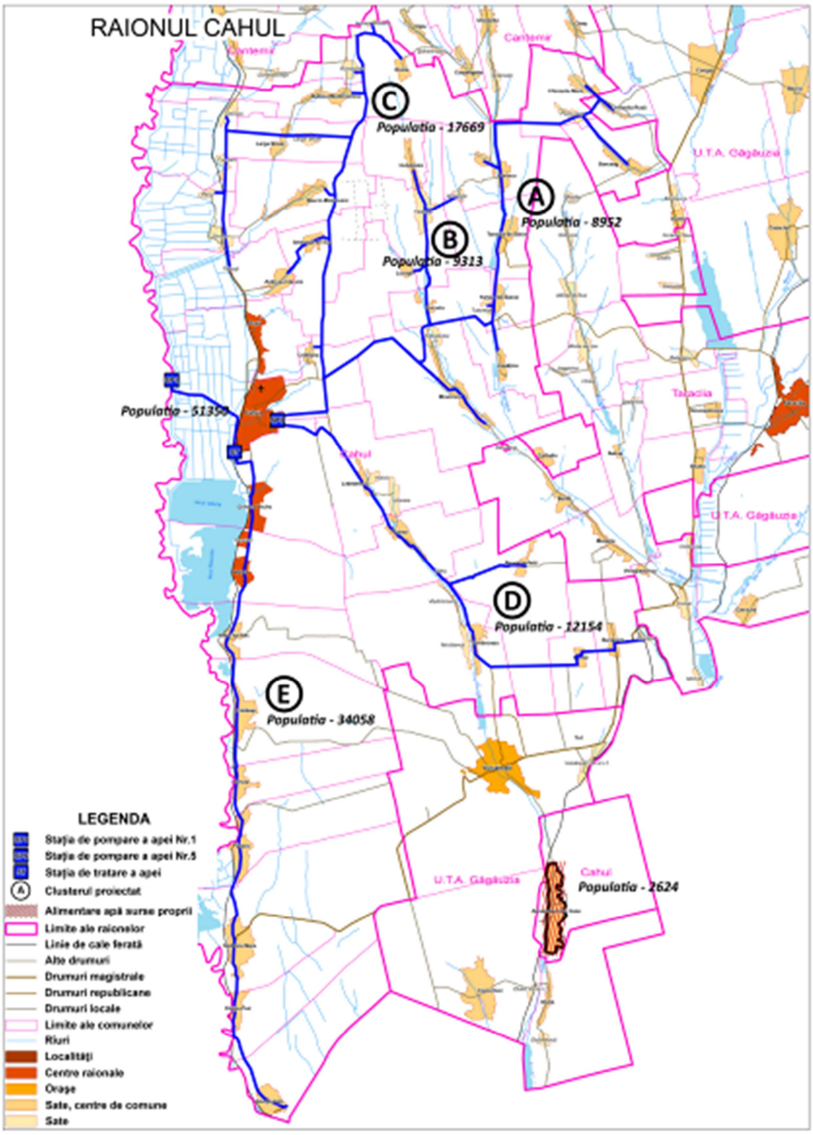
5.2.1 Technical option

The surface water of the Prut River will be the main source of water supply for all localities except Alexandru Ion Cuza. The existing water intake and water treatment plant will be used to supply water. The existing water treatment plant has sufficient capacity to meet the future demand for water from all localities.

The water from the water treatment plant in Cahul and from the existing water system of the city of Cahul will be distributed through three water mains. The south water main will supply Cluster E and the south-eastern water main will supply cluster D. The north-eastern water main will further divide and will supply Cluster A, B and C and in addition to the localities Borceag Frumusica and Chioselia. The centralized supply system will cover localities from Rayon of Cahul only.

The exclave of Alexandru Ion Cuza in Option 2 will be supplied from a local source. These means it will be necessary to drill three artesian wells and construct a water treatment plant with a capacity of 15 m3/h. The lengths of water mains and distribution network in Option 2 for Alexandru Ion Cuza ale similar to those in Option 1; the total length of the water mains and distribution network, however, is smaller due to exclusion of Vulcanesti. Also, the demand for water and population supplied is lower.

The map below provides an overview of the proposed infrastructure.



5.2.2 Institutional requirements and arrangements

The option requires simpler institutional arrangements than Option 1, as the water network does not cross the border of the Rayon of Cahul. Arrangements for inter-communal co-operation, based on one utility proposed in section 8.2 can be applied.

5.2.3 Environmental implications

The environmental implications for option 2 are similar to those described for option 1. Taking into account the need to use the underground sources of water, option 2 will involve activities that may cause more impact on the environment, such as: drilling of artesian wells and construction of a water treatment plant. Construction of water treatment plant requires: land clearance by bulldozers, pile driving, drilling, general construction activities such as cement works, brick laying, steel erection, and water treatment plant testing. Additionally option 2 cause lower efficiency of the network.

5.2.4 Investment costs and proposed phasing

The total investment costs of Option 2 are 579 million MDL. The proposed phasing of the investment is presented in the table below.

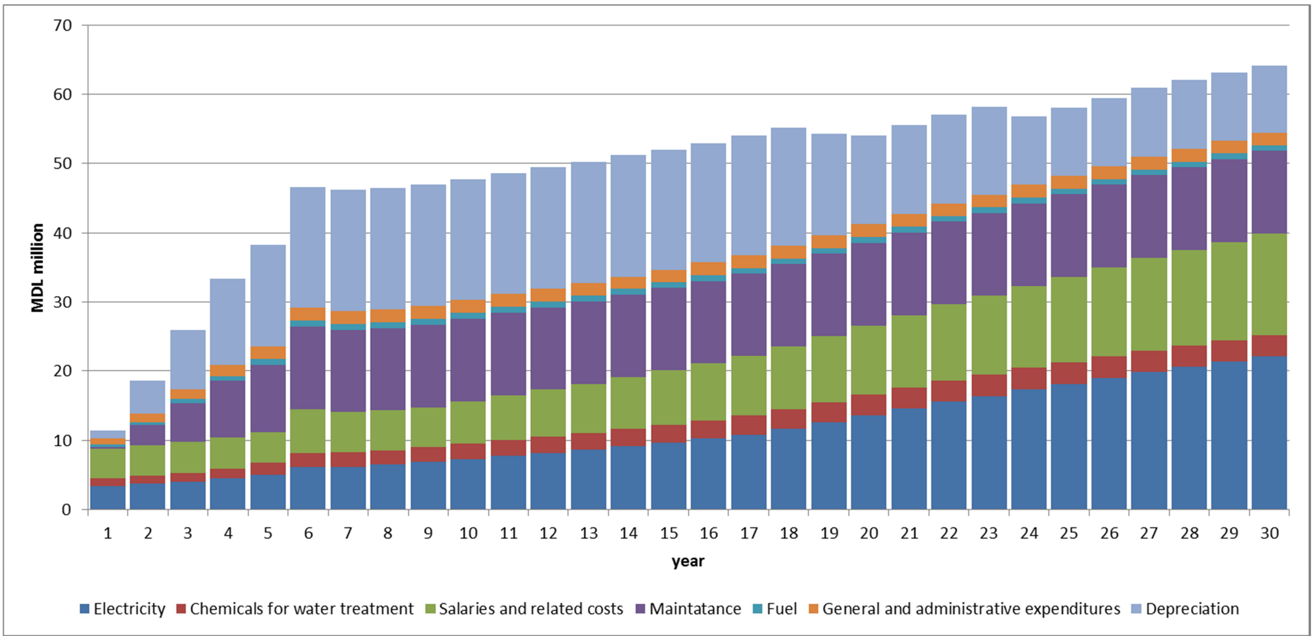
Table 5-28: Proposed project implementation schedule for Option 2

	2014	2015	2016	2017	2018	Total
Pipelines	87,8	80,4	72,1	46,8	75,3	362,4
Water towers	8,6	5,4	3,0	0,3	0,6	17,9
Reservoirs	6,6	18,4	18,5	6,9	9,8	60,2
Pumping stations	5,6	7,6	12,3	3,0	5,5	33,8
Artesian wells	0,0	0,0	0,0	3,2	0,0	3,2
Water treatment plant	0,0	0,0	0,0	2,3	0,0	2,3
Land acquisition	3,1	2,0	4,0	0,6	1,0	10,7
Technical assistance	8,9	9,1	8,8	5,1	7,4	39,3
Contingencies	11,2	11,4	11,0	6,3	9,2	49,1
Total	131,7	134,2	129,6	74,5	108,8	579,0

5.2.5 Operation and maintenance costs

The summary of the variable and fixed costs forecast for Option 2 is provided in the figure below. The detailed description of the costs calculation is contained in section 10.2.3 of the selected option.

Figure 5-9: Operating costs forecast for Option 2 [MDL M]



5.2.6 Revenues

The calculation of revenues is based on the proposed tariff that covers O&M and capital costs. Optino 2 has a lower level of revenues due to the lower number of customers.

The DGC for Option 2 is 8.32 MDL/m3.

5.3 Option 3

5.3.1 Technical option

The surface water of the Prut River will be the main source of water supply for all localities except for remote localities: Borceag Frumusica, Chioselia, Alexandru Ion Cuza.

The existing water intake and water treatment plant will be used to supply water. The existing water treatment plant has sufficient capacity to meet the future demand for water from all localities.

The water from the water treatment plant in Cahul and from the existing water system of the city of Cahul will be distributed through three water mains. The south water main will supply Cluster E and the south-eastern water main will supply cluster D. The north-eastern water main will further divide and will supply Cluster A, B and C. The centralized supply system will cover the localities from Rayon of Cahul only.

The exclave of Alexandru Ion Cuza in Option 3 will be supplied from the local source as in Option 2. For Borceag Frumusica and Chioselia a water supply system for 3206 residents will be provided.

The water supply system has to provide continuous distribution of the water output Qdailly max = 395.94 m3/day, Qo = 4.58 l / s and minimum operative pressure of 10 meters of head for all consumers from the localities. The new water treatment plant will need a capacity of 20 m3/h.

Along the route of the supply system, the maximum elevation is 225 meters (branch towards the Frumusica village) and the minimum elevation is 50 meters (at the border of the Borceag village). The difference between the two elevations is 175 meters. The maximum pressure in the system reaches 110.6 meters of head and the minimum pressure in the system is 1.76 meters of head. Because of that, it is necessary to equip the pipeline with one pressure reducing regulator.

Proposed underground water capture is located upstream of the village Frumusica. Next, the water is pumped up to supply the branch to the Frumusica village (elevation 225 meters).

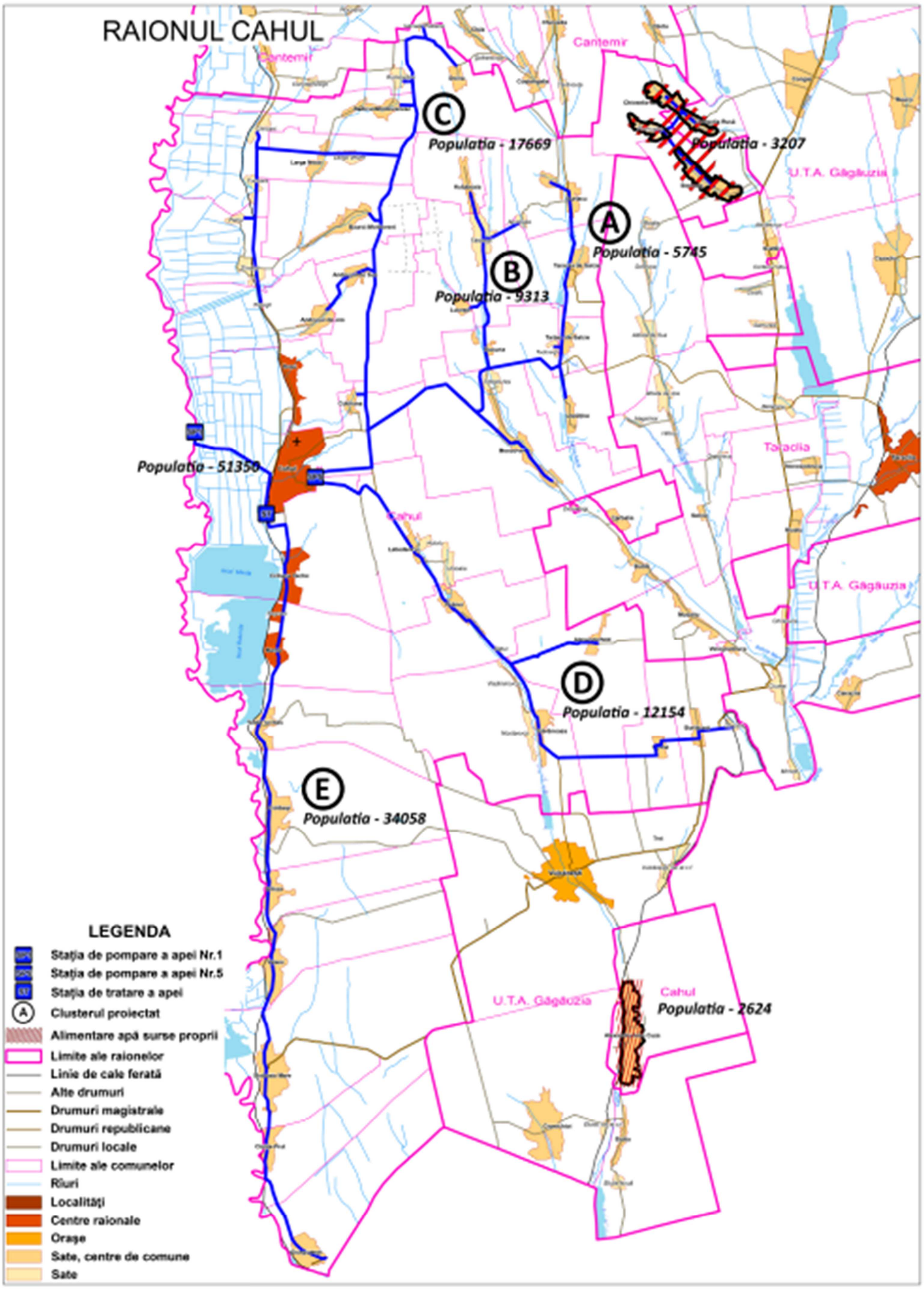
The branch pipeline to Frumusica village works gravitationally and due to the difference in elevation, which is 25 meters, it can supply the water tower (elevation of 200 meters, pressure 12 meters of head), which serves as a water storage facility and output regulator for the village. In Frumusica village, the difference between the elevations is 100 meters. Two pressure reducing regulators to maintain the pressure lower than 60 meters of head will be provided within the village limits.

Due to the difference in elevation of 175 meters, the branch pipeline carrying water to Borceag village and Chioselia Mare village will operate gravitationally.

Downstream of the branch towards Frumusica village (which is at an elevation of 225 meters), the supply pipeline is equipped with a pressure reducing regulator at an elevation of 150 meters.

Two water towers would be necessary at the entrance to the Borceag village (elevation 100 meters). The pressure of the towers is 12 meters of head. As to the Cioselia Mare village – elevation 100 metres), there is one water tower with the pressure of 12 meters of head.

The map below provides an overview of the proposed infrastructure.



5.3.2 Institutional requirements and arrangements

The option requires simpler institutional arrangements than Option 1 as the water network does not cross the border of the Cahul Rayon. Arrangements for inter-communal co-operation, based on one utility proposed in section 8.2 can be applied.

5.3.3 Environmental implications

The environmental implications for option 3 are similar to those described for option 1. Taking into account the need to use the underground sources of water, option 3 will involve activities that may cause more impact on the environment, such as: drilling of artesian wells and construction of a water treatment plant. Construction of water treatment plant requires: land clearance by bulldozers, pile driving, drilling, general construction activities such as cement works, brick laying, steel erection, and water treatment plant testing.

5.3.4 Investment costs and proposed phasing

The total investment costs of Option 3 are 584,5 million MDL. The proposed phasing of the investment is presented in the table below.

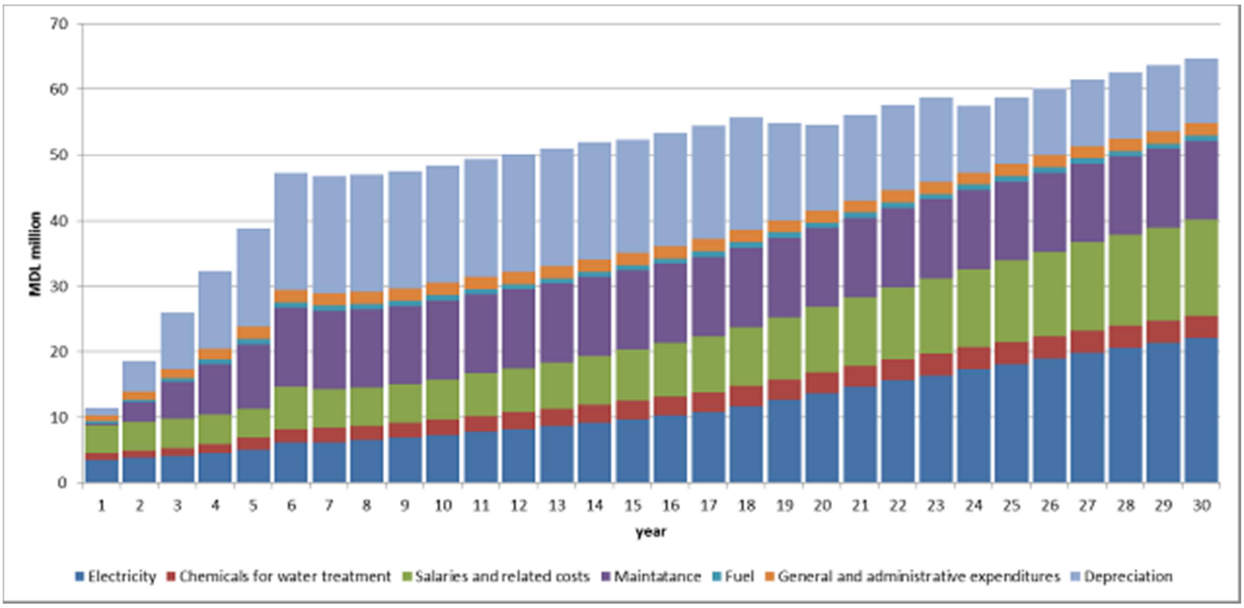
Table 5-29: Proposed project implementation schedule for Option 3

	2014	2015	2016	2017	2018	Total
Pipelines	87,8	80,4	59,4	60,2	75,3	363,0
Water towers	8,6	5,4	1,2	1,7	0,6	17,5
Reservoirs	6,6	18,4	16,8	6,9	9,8	58,5
Pumping stations	5,6	7,6	9,6	4,4	5,5	32,6
Artesian wells	0,0	0,0	0,0	7,6	0,0	7,6
Water treatment plant	0,0	0,0	0,0	5,4	0,0	5,4
Land acquisition	3,1	2,0	4,0	0,6	1,0	10,7
Technical assistance	8,9	9,1	7,3	6,9	7,4	39,6
Contingency	11,2	11,4	9,1	8,7	9,2	49,5
Total	131,7	134,2	107,4	102,4	108,8	584,5

5.3.5 Operation and maintenance costs

The summary of the variable and fixed costs forecast for Option 3 is provided in the figure below. The detailed description of the costs calculation is provided in section 10.2.3 of the selected option.

Figure 5-10: Operating costs forecast for Option 3 [MDL M]



5.3.6 Revenues

The revenues are calculated based on the proposed tariff that covers O&M and capital costs. Option 3 has a lower level of revenues due to the lower number of customers.

The DGC for Option 3 is 8.37 MDL/m3.

5.4 Institutional Option 1 – Municipal Company (MC)

Although as a legal organizational the municipal company presupposes the existence of just one founder, this was still viewed as a possible form of association of several local public authorities because there is a legal possibility for the Statute of an MC to stipulate such an organization of management and control bodies of MC that would allow for association of other LPAs (competencies of the founder and other LPAs being balanced).

Regulated by: art.179 of the Civil Code, art.20 of the Law on Entrepreneurship and Enterprises, Decision of the Government of the Republic of Moldova No.387 of 06.06.1994 on approval of the Model Regulations of Municipal Company

Definition: A municipal company is an economic agent with legal entity established exclusively on the basis of municipal property, which, by its judicious use, produces certain types of goods (production), delivers works and provides services necessary for satisfaction of the founder's (of the founding administrative-territorial unit's) requirements and for realization of social and economic interests of staff.

Characteristics: MC is liable for its obligations with its entire assets. The founder is not liable for the MC's obligations, while the MC is not liable for the obligations of the founder. The municipal assets that the founder transmits to the MC belong to the latter only within the limits of entitlement to their management for economic purposes.

Advantages of Municipal Company:

- Since, as a rule, MC is formed based on certain services, LPA subdivisions, there is work experience to deliver corresponding works or services;
- Integral or partial staffing with qualified personnel

- Probability of LPA being able to influence the company's management
- Probability of LPA being able to influence the cost of services delivered by MC.

Disadvantages of Municipal Company:

- High costs of services due to a small number of beneficiaries and/or lack of investment that would improve the MC's performance
- High costs of services due to inefficient management costs
- High probability of dependency on the budget
- Probability of inefficient MC management due to moral dependence of the administration on the founder
- High probability of economic ceilings – lack of desire to identify solutions for making the MC's activity more efficient, because there is no market for alternative services (no competition, while costs are known).

Conclusion/expert recommendation:

Although it is a rather simple and well-known form of organization that is preferred by the majority of local public authorities, the municipal company is not the most appropriate form of organization for a truly regional operator. This conclusion is based on the following arguments:

- It is quite vaguely regulated at the legislative level (except for model regulations approved by a government's decision);

- An analysis of the regulatory framework reveals that several administrative-territorial units cannot participate in the creation of a municipal company. A solution would be for each LPA to establish its own municipal company entitled (based on the founder's decision) to enter into consortia (to create associations of municipal companies), but this would lead to a more complicated functioning mechanism and increased number of administrative staff.

- Lack of a clear mechanism to engage all the local authorities willing to cooperate in the process of decision-making.

- Is a legal organization form that it is not viewed favourably by certain international donors as they consider it to be inefficient and outdated. Many donors insist upon reorganization of MC in other forms (e.g. in JSC) before offering financial or technical assistance.

5.5 Institutional Option 2 – Limited Liability Company

Regulated by: art.145-155 of the Civil Code, Law No.135-XVI of 14.06.2007 on Limited Liability Companies

Definition: A Limited Liability Company is a trade company with legal entity, of which shareholders' equity (social capital) is divided in social parts according to the constituent act, and which obligations are guaranteed by the company's property.

Founders: individuals and/or legal entities, including the state and administrative-territorial units.

Shareholders' equity of LLC cannot be less than MDL 5,400. Contribution to the shareholders' equity can be made in assets, including property rights, and in cash. Any asset in civil circuit could be subject to in-kind contribution. The asset making up in-kind contribution shall be indicated in the constituent act. Single-use assets cannot make up a contribution to the equity. In-kind contributions are estimated in money equivalent by an independent evaluator and are approved at the General Shareholders' Meeting.. Until the date of state registration of the company, each founder shall transfer to the company's account at least 40% of their subscribed contribution in cash, unless the law or the constituent act stipulates a greater proportion. Each associate shall transfer the entire subscribed contribution within at most six months from the date of the company's registration. The shareholders' equity is divided in social parts, of which amount is established depending on the amount of the contribution and includes all the rights and obligations of the associate. A social part is indivisible, unless the constituent act stipulates otherwise. An associate can hold a social part that is not less than one leu. Social parts can be of different size. A social part has to divide without remainder by a unit expressed in lei. Each leu from the shareholders' equity entitles to one vote. The company issues a certificate to the associate who has transferred their entire contribution attesting they hold a social part and the amount of the latter.

LLC bodies are represented by: General Meeting of Associates, Company's Board, Company's Administrator and Auditor.

Registration: LLC is subject to state registration at the State Registration Chamber.

Characteristics:

- Associates are not liable for LLC's obligations, but bear the risk of its activity within the limits of the value of their participation in the shareholders' equity; an associate who has not timely transferred the subscribed contribution is subsidiary liable for LLC's obligations within the limits of non-transferred part
- LLC has a minimum shareholders' equity stipulated by law (MDL 5,400)
- The number of associates cannot be greater than 50. A company with over 50 associates is obliged to reorganize, to liquidate itself or to reduce the number of associates within a period of 6 months

Advantages of **LLC**

- Limited liability of associates
- Minimum shareholders' equity of MDL 5,400
- Control over the management
- Can have one single associate.

Disadvantages of **LLC**

- Limited number of associates (up to 50)
- Decision on the activity of LLC (by the General Meeting of Associates) in many cases is made jointly by all the associates (unanimous vote) or by 2/3, which could be difficult to achieve if there is a larger number of founders
- More limited possibilities of accessing credit.

Conclusion/expert recommendation:

It is recommended only for small operators with a relatively small shareholders' equity and a small number of participants (founders). The maximum number of associates stipulated by the law is 50. Should the area covered by water supply service be larger, when the number of localities exceeds 50, there will be a need to reorganize LLC in another legal organization form, where the number of associates is not limited (e.g. in JSC).

5.6 Institutional Option 3 – Joint Stock Company

Regulated by: art.156-170 of the Civil Code, Law No.1134-XIII of 02.04.97 on Joint Stock Companies

Definition: Joint Stock Company (JSC) is a trade company, of which shareholders' equity is divided in shares and which obligations are guaranteed by the company's assets.

Characteristics:

- The duration of JSC is unlimited, unless the Articles of Association stipulate otherwise.
- JSC can obtain and exercise on its behalf personal property and non-property rights, to have obligations, to act as claimant and defendant in court.
- The company has the right to carry out any activity that is not prohibited by legislation. Certain activities, the list of which is established by the legislation, can be carried out by the company only based on the corresponding license.
- A company, the securities of which are registered at the value of their stock exchange listing, has to publish information about holding general meetings of shareholders, decisions made, closed issues and public offers of shares placed by the company on the primary and secondary security market, etc. on their corporate webpage.
- The JSC property is made up based on share placement, business activity and other grounds provided for by the legislation. JSC has the right to grant and take loans. JSC is not liable for the obligations of its shareholders. The company is not entitled to grant loans nor offer guarantees to procure its own securities.
- A share is a document (under the form of a printed certificate; and/or entry in the personal account opened in the name of their owner or nominal holder in the register of the company's security holders) attesting the right of its owner (shareholder) to participate in company's management, to receive dividends, as well as a part of the company's assets in case of its liquidation. The company's shares can have a nominal value that has to be divisible by one MDL;
- A bond is a financial loan title attesting the right of the bond holder to receive the nominal value or the nominal value and corresponding interest from the issuer in the amount and within the terms established by the decision on bond issuing. The nominal value of the company's bond has to divide by 100 lei. The bond circulation term shall be of at least one year. Bond holders act as the company's creditors. Bonds are repaid only in cash and cannot be placed to constitute, to fill or increase the shareholders' equity of the company. The nominal value of all the bonds placed by the company cannot exceed the amount of its shareholders' equity.
- JSC has to keep registers of security holders.

Founders: individuals, legal entities, administrative-territorial units, state and municipal companies. The number of founders of a joint stock company is not limited.

Shareholders' equity of JSC cannot be less than 20,000 lei. The shareholders' equity is made up of the values of contributions received as payment for shares and shall be equal to the amount of the nominal (fixed) value of placed shares, if established. The size of the shareholders' equity is indicated in the Articles of Association, on the balance sheet, in the shareholders' register and on the company's letter-head.

Contributions to the s shareholders' equity could take the form of: money, entirely paid securities; other assets, including property rights or other rights that can be evaluated in money; obligations (liabilities) of the company before the creditors. Public property facilities that are not subject to privatization can be transmitted to the company as contribution to the shareholders' equity only with the right of use.

The following cannot make up contributions to the shareholders' equity: evaluation in money equivalent of the activity of founders to establish the company, as well as the work of shareholders for the company; obligations (liabilities) of the company's founders, shareholders and other people; non-registered securities and real estate, including intellectual products subject to registration in compliance with the legislation; assets belonging to the purchaser of shares with the right of business administration or operational management without the consent of the owner of these assets;

assets intended for current consumption of the civil population, assets, the circulation of which is prohibited or limited by legislative acts.

Operation: JSC is one of the most complex legal organization forms. Corporate administration takes place through internal bodies with strictly delimited competencies.

The management bodies of the company are as follows: general meeting of shareholders; company's board; executive body; auditor's committee. In a company, where the number of shareholders is less than 50, the duties of the company's board can be exercises by the general meeting of shareholders. The structure, duties, the procedure for establishment and functioning of management bodies of the company are set by the Law on Joint Stock Companies, the Articles of Association and the company's regulations.

Registration: JSC is subject to state registration at the State Registration Chamber.

Advantages of **JSC**:

- Limited liability of shareholders
- Possibility to attract large investments and funding
- Longer potential life cycle
- Transferability of property (shares)

Disadvantages of **JSC**:

- Many formalities in business activity
- Raised ceiling of the shareholders' equity.

Conclusion/expert recommendation:

JSC is one of the most complex legal organization forms. It can be founded by several administrative-territorial units who can participate in accumulation of the shareholders' equity and can hold a number of shares. The decision-making mechanism is complex and can meet the needs of inter-community cooperation: at the general meeting, the decisions are made according to the held shares (one voting share – one vote), while the administrative board applies another principle: one member – one vote. In Romania, for instance, almost all regional operators founded by the LPAs take the legal organization form of a joint stock company (the law expressly stipulates that the regional operator should be organized as a joint stock company). The only "disadvantage" is that in order to reorganize the existing municipal companies and jointly participate in increasing the capital of the new joint stock company, LPAs need a strong will and a high level of trust, parties will have to evaluate and negotiate the participation of each administrative-territorial unit in accumulation of the shareholders' equity. District authority can also participate in accumulation of the shareholders' equity and can hold shares in the new regional operator.

Annex A to this report provides a "Model Decision of Local Council on approval in principle of participation in establishment of a joint stock company" and Annex B a "Model Decision of Local Council on participation in establishment of a regional operator in the form of a joint-stock company".

5.7 Justification of the proposed option

5.7.1 Justification of the proposed technical option

The DGC indicator is a good decision making tool to select the most cost-effective option.

The following table summarizes DGC of the three technical options. It also takes into account the environmental and institutional arrangements. All criteria were provided in the form of points, where 3 means the best solution and 1 means the worst (or the most complicated) solution. Various factors – economic, environmental, institutional were given equal weights.

Table 5-30: Justification of the proposed technical option

Option	DGC [MDL/m3]	DGC	Environmental	Institutional	Sum of points
Option 1	7.80	3	3	1	7
Option 2	8.32	2	2	3	7
Option 3	8.37	1	1	3	5

From the economic and environmental perspectives, Option 1 is the best. On the other hand, Option 1 is the most institutionally complicated approach. In total, Options 1 and 2 received the same number of points. Option 2 was selected for further analysis due to easier institutional arrangements, however is recommended to conduct more detailed studies on Option 1.

5.7.2 Justification of the proposed institutional option

All three options of inter-communal co-operation were presented to the working group and discussed. Option 3 was the preferred option: creating a joint stock company.

6 Technical analysis of the selected option for centralized water supply.

This section provides detailed technical information of the selected option for centralized water supply in the Rayon of Cahul. Annex C of this report provides "Concept drawings of the selected option", Annex D provides estimation of investment needs and Annex E technical calculations described later in this section.

6.1 Water demand projection

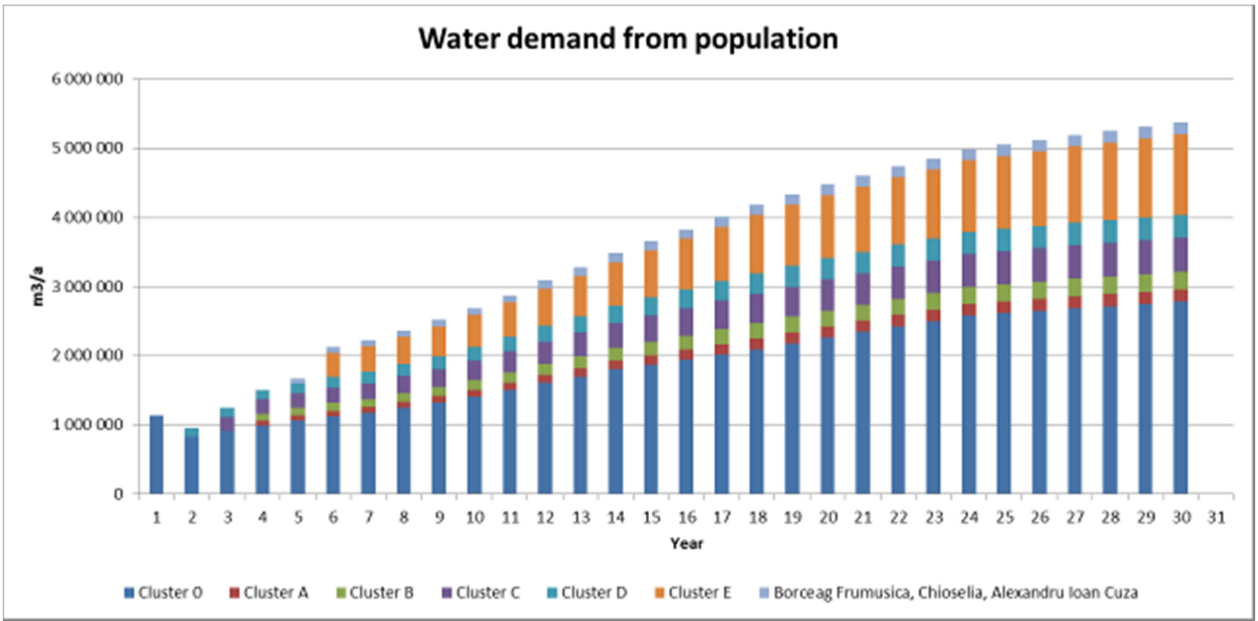
6.1.1 Demand from population.

The forecast of water demand from the population is based on:

- Current water consumption, which is about 60 lcd in the city of Caul and about 50 lcd in other villages where water services exist;
- Demographic information (number of households and population) on each village;
- Demographic forecast is based on two assumptions:
  - o Population in cluster 0, which represents the city of Cahul and surrounding villages will increase by 1% annually;
  - o Population in cluster E, which represents the villages located along the Prut River will increase by 0.5% annually;
  - o Population in other clusters will decrease by 1% annually;
- Number of households in cluster 0 is proportional to the population while in other clusters it is stable, which means that when the population decreases, the size of households will also decrease;
- Calculation of demand for water from the population is based on unit consumption in lcd, which changes in accordance with demand elasticity in response to changes in the tariff and in disposable household income;
- Current connection level in cluster 0 and construction schedule of the new network.

The forecast of water demand from the population is presented in Annex F, Table 3. The figure below illustrates that forecast.

Figure 6-1: Water demand from population



6.1.2 Demand from industry, agriculture and business.

The estimation of water demand from industry, agriculture and business was based on current consumption. The table below summarizes the expected annual demand after project completion (year 6) from industry, agriculture and business. The forecast is based on an increase in demand proportional to the real GDP increase. Initial demand from business is presented in the table below, while the forecast is presented in Annex F, Table 4.

Table 6-1: Demand from business [m3/year]

Cluster	Demand from business [m3/year]
Cluster 0	124 970
Cluster A	680
Cluster B	1 332
Cluster C	3 472
Cluster D	2 125
Cluster E	4 165
Free economic zone in Gurgiulesti	100 000
Borceag Frumusica, Chioselia, Alexandru Ioan Cuza	507
Total	237 249

6.1.3 Demand from public institutions.

The estimation of water demand from public institutions was based on current consumption and information on existing public institutions in localities where public institutions are not connected to the network. The table below summarizes the expected annual demand from public institutions. The forecast is based on an increase in demand proportional to the real GDP increase. Initial demand from public institutions is presented in the table below, while the forecast is contained in Annex F, Table 5.

Table 6-2: Demand from public institutions [m3/year]

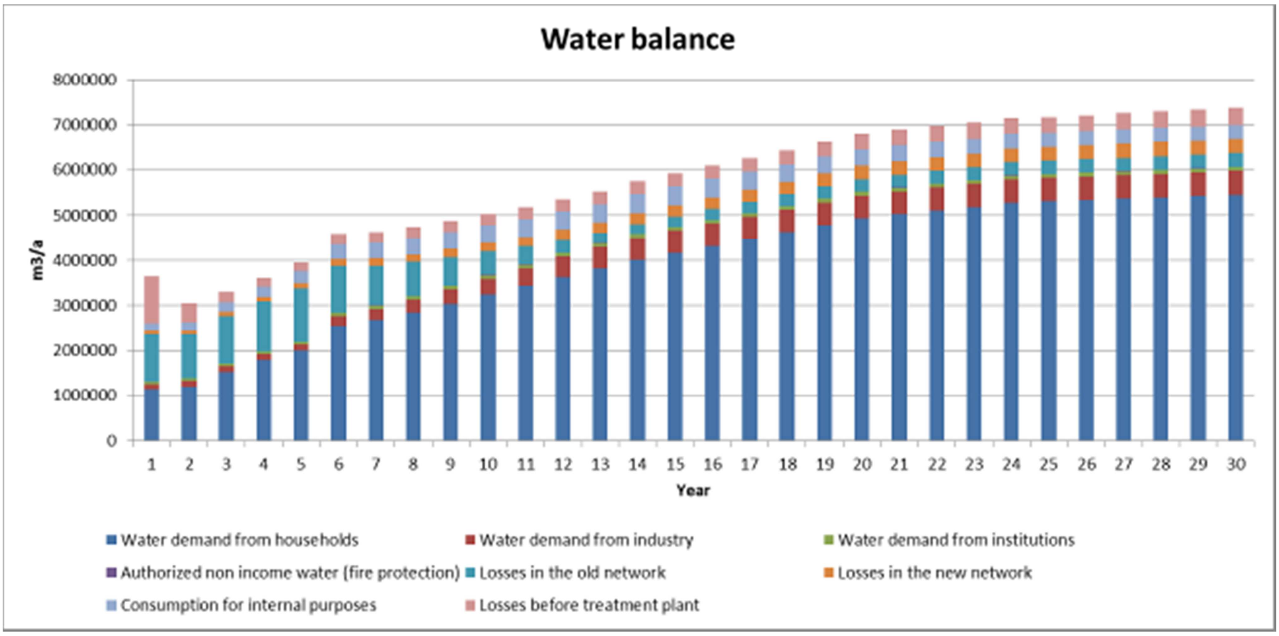
Cluster	Demand from public institutions [m3/year]
Cluster 0	57 368
Cluster A	1 655
Cluster B	1 834
Cluster C	4 216
Cluster D	3 016
Cluster E	6 386
Borceag Frumusica, Chioselia, Alexandru Ioan Cuza	500
Total	74 975

6.1.4 Water balance projection.

The water balance projection takes into account the demand from households, industry and institutions, as well as authorized, non-revenue water consumption (fire protection), losses in the old network in the city of Cahul, expected losses in the new network, consumption for internal purposes, and losses before treatment plant (transmission between water intake and water treatment plant).

The water balance projection is presented in Annex F, Table 7, while the figure below summarizes the components of water demand.

Figure 6-2: Water balance projection



6.2 Scope of the selected option

The surface water of the Prut River will be the main source of water supply of localities, for most of the localities through the common aqueducts for the groups of communities.

The water supply system of the city of Cahul is based on surface water that is abstracted from the Prut River. The current water abstraction station is situated approximately 4 km to the west of the city centre. Raw water is pumped through an eight kilometre-long pipe from the abstraction station to the treatment station, which is situated approximately 4 km to the south of the city centre. The treatment station includes the following installations: vertical mixer for coagulant solution introduction (aluminium sulphate); reaction chambers; suspension decanters; opened high-rate filters; chlorination station for the final treatment.

The treated water is stored in three underground reservoirs with capacity of 2,000 cubic meters each, and distributed from the pumping station (PS) located at the treatment station (TS).

Currently, the output of water supplied in the city is 3,000 cubic meters per day, while the station's pumping capacity (PS) is approximately 23,000 cubic meters per day (when all three pumps are in operation).

The water treatment station was designed for a capacity of 24,000 cubic meters per day (while about 30% of this capacity is used currently).

The calculations of the water output required for each locality were performed using the target water output of 125 lcd. This specific water output includes water outputs required for the following consumption:

- Water for domestic needs of the population
- Water for local economic entities
- Water for domestic animals
- Water for social and cultural institutions.

Currently, the number of people to be supplied with drinking water through the proposed system is 78,939 (out of existing water supply system in the Cluster 0). As discussed in the previous section, the target population is different in each cluster.

Average daily total water consumption for each locality was determined using the following equation:

$$Q_{zi\ med} = \frac{qN}{1000}, \qquad m^3/d$$

where:

q - Specific water consumption in lcd (includes household and public institution demand)

N – Target population in the service area.

Water outputs during the days of the maximum water consumption were calculated using the following equation:

$$Q_{zi\ max} = K_{zi\ max} \cdot Q_{zi\ med}, \qquad m^3/d$$

Daily non-uniformity coefficient of water consumption, K_{daily}, which reflects the lifestyle of the population, the working pattern of enterprises and social and cultural institutions, level of the plumbing infrastructure of the residential buildings, changes of the water consumption depending on the seasons and days of the week are equal to:

$K_{zi,\ max} = 1,1 \div 1,3$

The water outputs of the water supply system have to include inevitable losses too. The coefficient K_p = 1.10 was adopted for these losses.

The coefficient of the water output Ks = 1.10 was used to calculate the consumption of the business.

The water supply system (capacity of the water treatment plans, pumping stations, diameters of pipes, capacity of water towers and reservoirs) was designed according to the maximum daily water output, which was determined by the following equation:

$Q_{zi\ max\ calc.} = Q_{zi\ max} \cdot K_p \cdot K_s$

Based on the presented formulas, the water supply system has to provide continuous distribution of water output $Q_{dailly\ max}$ = 13,747.80 m3/day; Qo = 572.82 m3 / h; Q = 159.10 l / s.

6.2.1 Clusters A, B, C

For clusters A, B and C, the construction of a centralized water supply system for twenty-seven localities with the total number 32,727 of residents was considered.

This water supply system is connected to the pumping station PS5 and two reservoirs of 1,500 m3 each, which are currently not used.

The water supply system was divided into three subsystems that can function together and separately.

The water supply subsystem for Cluster A has to supply the following localities: Burlacu, Taraclia de Salcie, Tudoresti, Lopatica, Tartarul de Salcie, with a total of 5745 residents.

The water supply system has to provide continuous distribution of water output $Q_{dailly\ max}$ = 1129.65 m3/day, Qo = 13.07 l / s and a minimum operative pressure for the supply of the local water storage constructions.

The water supply subsystem for Cluster B has to supply the following localities: Huluboaia, Tataresti, Lucesti, Bucuria, Trifestii Noi, Moscovei, Spicoasa, with a total of 9313 residents.

The water supply system has to provide continuous distribution of water output Qdailly max = 1831.20 m3/day, Qo = 21.19 l / s and a minimum operative pressure for the supply of the local water storage constructions.

The water supply subsystem for Cluster C has to supply the following localities: Cotihana, Andrusul de Sus, Andrusul de Jos, Baurci Moldoveni, Larga, Badicul Moldovenesc, Rumeantev, Iasnaia Poleana, Doina, Tretesti, Zirnesti, Paciu, Cucoara and Chircani, with a total of 17669 residents.

The water supply system has to provide continuous distribution of the water output Qdailly max = 3200.33 m3/day, Qo = 37.04 l / s and a minimum operative pressure for the supply of the local water storage facilities.

Pumping station PS5 is situated in the city of Cahul, on the east border of the city at an elevation of 113 meters. Pumping station PS5 is equipped with 4+1 pumps: three pumps have to serve the route “A-B-C" and one pump has to serve the route "D". The water is pumped to an elevation of 189 meters through the pipeline with the nominal diameter 400 and then the water is transported by gravity. At the distance of 6.1 km from the pumping station PS5, the water supply pipeline splits into two branches: the route "C" and common path "AB" respectively.

After the split, the pipe diameter for route "AB " is DN280. The pipeline operates by gravity down to an elevation of 180 meters, with a pressure of 5.98 meters of head. Thereafter, the water is pumped through the re-pumping Station PS1 – which is equipped with 2+1 pumps into two reservoirs of 500 m3 each.

Their location was chosen because of the high elevation (210 meters). The length of period of circulation of the water in pipelines from the pumping station PS5 up to this location, which is approximately five hours, was also taken into account.

The water detention period, which is six hours, is taken into account for determination of the capacity of the reservoirs. It is recommended to perform water disinfection procedures in these reservoirs to maintain the quality of the drinking water.

The pipeline works gravitationally from these two reservoirs to the branch point to the route "B". The difference between the elevation of the reservoir and the elevation of the branch is 135 meters; therefore, the pipeline route is equipped with a pressure reducing regulator PRR1, with $\Delta p = 36$ meters of head. The pressure at the branch point is 74.84 meters of head.

The length of the supply pipelines of the main route carrying drinking water is 17,341 meters; a breakdown of the pipes by diameter and length is presented in Annex D, Table 1 and 2.

At the distance of 0.8 kilometres from the branch point, at an elevation of 143m, the water is pumped through the re-pumping Station PS6, equipped with 2+1 pumps, to two reservoirs of 150 m3 each, and located at an elevation of 180 meters. The lowest elevation on route "A" is 50 meters. The difference in elevations is 130 meters; therefore, the pipeline route is equipped with a pressure reducing regulator RP3 , with $\Delta p = 54$ meters of head.

Tudoresti village is located at an elevation of 60 meters. The elevation of Taraclia de Salcie is 135 meters and the elevation of Burlacu village is 150 meters. There is local re-pumping station PS7 provided to supply the reservoir of Taraclia de Salcie village, equipped with 1+1 pumps. There is local re-pumping station PS8 provided to supply reservoir of Burlacu village, equipped with 1+1 pumps.

The length of the supply pipelines carrying drinking water from the main route is 17,350 meters and the length of the local pipelines is 6,265 meters. The breakdown of these pipelines by diameter and length is presented in Annex D, Tables 3 and 4.

The overall length of the supply pipeline composing the water supply system is 23,615 meters.

The elevations of Route "B" vary between 75 meters and 160 meters. A local re-pumping station PS4 is provided to supply the reservoir in the village Huliboaia at an elevation of 160 m, equipped with 1+1 pumps. In the case of Spicoasa village it is necessary to install two re-pumping stations: the first station PS3, equipped with 1+1 pumps, also provides supply of the reservoir of Tataresti village, located at an elevation of 160 m, and the station PS12, equipped PS12 with 1+1 pumps, pumps water up to an elevation of 212 m, after which the pipeline operates by gravity to the Spicoasa village.

The length of supply pipelines carrying drinking water from the main route is 12,005 meters and the length of the local pipelines is 7,320 meters. The breakdown of these pipelines by diameter and length is presented in Annex D, Tables 5 and 6.

The overall length of the supply pipelines forming the water supply system is 19,325 meters.

Two different options for the route of the water main for cluster C supplying Tretesti, Zirnesti, Paciu, Cucoara and Chircani (which are located on the banks of the Prut River) were analysed.

The village of Rosu is currently supplied with water through a pipeline with diameter DN160, branching from the distribution network of the city of Cahul. The diameter of this pipeline does not provide for adequate supply other villages (of total population 4704), which require a water output Qdaily max= 924.98 m3/day, Qo = 10.71 litres/second. Thus, a gravitational network through the Larga Veche village and Larga Noua village is proposed as the route C1 supplying Tretesti, Zirnesti, Paciu, Cucoara and Chircani villages.

The routes through Andrusul de Sus and Andrusul de Jos, and respectively Baurci Moldoveni, were not taken into account, because it was necessary to install pumping stations to supply the Chircani village, located at an elevation of 70 meters. The lowest elevation level of this branch is 15 meters; the difference in elevations is 55 meters.

Another option analysed (route C2) proposes the gravitational supply of this branch through the Rumeantev, Badicul Moldovenesc and Larga Noua villages.

In addition, the type of water storage facilities and their capacity, depending on the topographical form of the supplied localities, were defined.

Further, the water reservoirs or water-towers to ensure available pressure in the distribution network and storage of the compensation volumes and water for fire-fighting.

The total value is determined by the following equation:

W = Wc + Wi m3 .

Where:

Wc – necessary volume for compensation of water outputs

Wi - necessary volume for the fire-fighting.

The volume of water that has to be stored in reservoir for fire-fighting, is reserved to extinguish all outdoor fires that may simultaneously occur in the village. Exterior hydrants have to function for three hours, along with the maximum water consumption in the village, with the following relation:

Wi = tinc Qi m3 .

Where:

tinc - duration of functioning of the exterior hydrants, tinc = 3 h

Qi – necessary water output for extinguishing all outdoor fires.

In accordance with STAS 2.04 02 84 tab.5, the water output designated for extinguishing outdoor fires, the number of possible simultaneous fires in the village, and the time necessary for extinguishing one fire were established depending on the number of the residents.

For Cluster C, the construction of a centralized water supply system for twelve localities with a total of 12,154 residents was considered.

This water supply system is connected to the pumping station PS5 and two reservoirs of 1500 m3 each, which are currently not used.

The water supply system has to provide continuous distribution of the water output Qdailly max = 2389.77 m3/day, Qo = 27.66 l / s and a minimum operative pressure to supply the local water storage facilities.

6.2.2 Cluster D

For Cluster D, the following localities will be supplied: Lebedenco, Hutulu, Ursoaia, Pelinei, Satuc, Vladimirovca, Alexanderfeld, Nicolaevca, Gavanoasa, Iujnoe, Burlaceni and Greceni.

Water is pumped through pumping station PS5 up to an elevation of 185 meters, where two reservoirs of 500 m3 each are located, through the pipeline with the diameter of DN 250, after which the pipeline operates by gravity from an elevation of 185 meters down to an elevation of 45 meters in Gavanoasa village. To reduce the pressure, a pressure reducing regulator would be installed upstream of Lebedenco branch with Δp = 13.5 meters of head.

After Gavanoasa village (elevation 45 meters), the transmission pipeline route climbs up to 142 meters in the Burlaceni village. Two pumping stations to supply water-towers from Iujnoe village and Burlaceni village will be necessary.

Two water storage reservoirs of 100 m3 each are foreseen at the border of the Gavanoasa village, after which the water is pumped through the pumping station PS1, equipped with 1+1 pumps to Iujnoe village at an elevation of 110 meters, with the pressure of 24.99 meters of head.

Water pumping station PS2 is foreseen at the border of Iujnoe village, equipped with 1+1 pumps, which pumps water to Burlaceni village, at an elevation of 142 meters, with the pressure of 18.58 meters of the water column.

The supply pipeline through Greceni village operates by gravity.

The supply of Alexanderfeld village, located at an elevation of 155 meters, the branch that has the point of connection to the main supply pipeline towards Vladimirovca village at an elevation of 50 meters, should be provided with re-pumping station PS3 (elevation 101 metres), equipped with one 1+1 pumps.

The length of supply pipelines carrying drinking water from the main route is 43,023 meters and the length of the local pipelines is 7,981 meters. The breakdown of these pipelines by diameter and length is presented in Annex D, Tables 11 and 12.

6.2.3 Cluster E

For Cluster E, the construction of a centralized water supply system for ten localities with a total population of 34,058 was considered. Cluster "E" has to supply the following locations: Crihana Veche, Pascani, Manta, Vadul lui Isac, Colibasi, Brinza, Valeni, Slobozia Mare, Cislita Prut and Giurgiulesti however localities Crihana Veche, Pascani, Manta are already connected to the centralized water supply system from Cahul, thus further description focus on remaining localities, where 27,088 citizens lives.

The flow calculation for each locality is provided in table below.

Table 3. The flow calculation for each locality in cluster E.

Locality	no. house-holds	inh. 2013	inh. 2025	q sp.	$Q_{day\ av}$, m^3/day	K_{day}	$Q_{day\ max}$, m^3/day	K_p	K_s	$Q_{day\ calc}$, m^3/day	Q, mc/h	Q, l/s
Vadul lui Isac	1,037	3,225	3,419	125	427.31	1.3	555.51	1.1	1.1	672.16	28.01	7.78
Colibasi	1,694	6,030	6,392	125	798.98	1.3	1,038.67	1.1	1.1	1,256.79	52.37	14.55
Brinza	820	2,660	2,820	125	352.45	1.3	458.19	1.1	1.1	554.40	23.10	6.42
Valeni	987	3,100	3,286	125	410.75	1.3	533.98	1.1	1.1	646.11	26.92	7.48
Slobozia Mare	2,036	6,040	6,402	125	800.30	1.3	1,040.39	1.1	1.1	1,258.87	52.45	14.57
Cislita Prut	460	1,300	1,378	125	172.25	1.3	223.93	1.1	1.1	270.95	11.29	3.14
Giurgiulesti	912	3,200	3,392	125	424.00	1.3	551.20	1.1	1.1	666.95	27.79	7.72
Free zone					909.50	1.3	1,182.35	1.0	1.0	1,182.35	49.26	13.68
TOTAL		25,555	27,088		3,386.04		4,401.85			6,508.59	271.19	75.33

The water supply system is connected to the SP1 pumping station and to the three water tanks 2,000 m^3 each, located on the pumping station compound.

The water supply system must ensure a continuous flow of $Q_{day\ max}$ = 6,508.59 m^3/day, Q_h = 75.33 l/s and the minimum service pressure for supplying water to local water storage facilities.

The water is pumped through the SP1 pumping station equipped with 2+1 NL80/250-37-2-12-50Hz pumps to the two water tanks 500 m^3 each, located between Valeni and Slobozia Mare villages.

The feeding pipeline runs along the Prut River and has the ground elevation ranging between 15m in Brînza village and 57m in Cislita Prut village.

The localities that will be connected to the feeding pipeline are located on the terraces formed in the Prut River's floodplain.

In Vadul lui Isac village, the water tank is located at the elevation of 86 m, 66 m higher than the elevation of the feeding pipeline. The water is pumped into the water tank through the local SP4 boosting station, equipped with 1+1 V3601-3/16/E/K/400-50 Helix pumps.

In Colibasi village, the water tank is located at the elevation of 90 m, 65 m higher than the elevation of the feeding pipeline. Because of this, water must be pumped through the local SP5 boosting station, equipped with 1+1 5202-3/16/E/K/400-50 Helix pumps.

In Brinza village, the water tank is located at the elevation of 125 m, 110 m higher than the elevation of the feeding pipeline. The water is pumped into the water tank through the local SP6 boosting station, equipped with 1+1 V2207-3/16/E/K/400-50 Helix pumps.

In Valeni village, the water tank is located at the elevation of 105 m, 80 m higher than the elevation of the feeding pipeline. Because of this, the water must be pumped by the local SP7 boosting station, equipped with 1+1 V3603/1-2/16/E/K/400-50 Helix pumps.

The SP2 pumping station, which is coupled with the two water tanks 500 m^3 each, pumps water through the main route to Cislita Prut village and to the water tank in Slobozia Mare village. The SP2 pumping station is equipped with two 2+1 NL65/250-30-2-12-50Hz pumps.

To fill the water tank in Giurgiulesti village through the main pipeline, the SP3 boosting station is located in Cislita Prut village, equipped with 2+1 NL50/160-5.5-2-12-50Hz pumps. The length of feeding pipelines along the main route supplying drinking water is 49,265 m, and the length of the local pipelines is 8,450 m with the diameters and lengths as provided in tables below.

Table 4. Parameters of water mains.

Diameter	**Length, m**
Main route	
DN400	18,690
DN355	5,500
DN280	11,095
DN225	3,780
DN200	10,200
TOTAL	**49,265**

Table 5. Parameters of the secondary network.

Diameter	**Length, m**
Local route	
DN180	1,370
DN160	3,800

DN140	2,310
DN75	970
TOTAL	**8,450**

The overall length of the supply pipeline composing the water supply system is 57,715 meters.

The type of water storage facilities and their capacity were established based on the landform of the served localities.

Water tanks or water towers were included to ensure extra pressure in the distribution network and the storage of compensation volumes in case of fire.

The data on the type of storage facilities, their capacity and their amount are provided in the table below.

Table 6. Parameters of water tanks and towers.

Locality	Ground elevation, m	Capacity, m^3	Amount
Water tank			
Vadul lui Isac	86	150	1
Colibasi	90	250	1
Brinza	125	150	1
Valeni	105	150	1
Slobozia Mare	95	250	1
Giurgiulesti	75	250	2
Water tower			
Brinza	125	25	1
Cislita Prut	65	50	2

Along the regional feeding pipeline, it was planned to install water tanks, with the location and capacity as provided in the table below.

Table 7. Parameters of water tanks

Water tanks	Ground elevation, m	Capacity, m^3	Amount
RAP (SP2)	35	500	2

6.2.4 Water storage facilities

The type water of the water storage facilities and their capacity was determined depending on the topography of the supplied localities.

Water reservoirs or water-towers were foreseen to ensure available pressure in the distribution network, storage of the compensation volumes and water for fire-fighting.

The total value is determined by the following equation:

$W = W_c + W_i$ [m3]

Where:

W_c – necessary volume for compensation of water outputs

Wi - necessary volume for fire-fighting.

The volume of water, which has to be stored in a reservoir for fire-fighting, is reserved to extinguish all outdoor fires that may simultaneously occur in the village, exterior hydrants have to function for 3 hours, along with the maximum water consumption in the village, with the following relation:

Wi = tinc Qi [m3]

Where:

tinc - duration of functioning of the exterior hydrants, tinc = 3 h

Qi – necessary water output for extinguishing all outdoor fires.

In accordance with STAS 2.04 02 84 tab.5, the water output designated for extinguishing outdoor fires, the number of possible simultaneous fires in the village, time necessary for extinguishing of one fire were established depending on the number of the residents.

6.2.5 Frumusica, Chioselia Mare, and Borceag

Three remotely located villages (Frumusica, Chioselia Mare, and Borceag) were grouped to propose a water supply for 3206 residents (see Annex 3).

The water supply system has to provide continuous distribution of the water output Qdailly max = 395.94 m3/day, Qo = 4.58 l/s and a minimum operative pressure of 10 meters of head for all consumers in the localities.

Along the route of the supply system, the maximum elevation is 225 meters (branch towards the Frumusica village) and the minimum elevation is 50 meters (at the border of the Borceag village). The difference between the two elevations is 175 meters. The maximum pressure in the system reaches 110.6 meters of head and the minimum pressure in the system is 1.76 meters of head. As a result, it is necessary to equip the pipeline with one pressure reducing regulator.

The overall length of supply pipelines is 49,265 meters and the length of the localities main pipelines is 10,630 meters. The breakdown of these pipelines by diameter and length is presented in Annex D, Tables 5 and 6.

The branch pipeline to Frumusica village operates by gravity and due to the difference in elevations, which is 25 meters, it can supply the water tower (elevation 200 meters, pressure 12 meters of head), which plays the role of water storage facility and water output compensator for the village. In Frumusica village, the difference between the elevations is 100 meters. Two pressure reducing regulators were provided to maintain the pressure lower than 60 meters of head within the village limits.

Due to the difference in elevations of 175 meters, the branch pipeline carrying water to Borceag village and Chioselia Mare village operates by gravity.

Downstream of the branching towards Frumusica village (which lies at an elevation of 225 meters), the supply pipeline is equipped with a pressure reducing regulator at an elevation of 150 meters.

There are two water towers foreseen at the entrance to Borceag village (elevation 100 meters). The pressure of the towers is 12 meters of head. As to the Cioselia Mare village (elevation 100 meters), there is one water tower with the pressure of 12 meters of head.

6.2.6 Alexandru Ion Cuza

The village is located along Cahul river, 8 km away from Vulcăneşti town, 37 km southward of Cahul city 210 km south-east of Chişinău. It neighbors the Cişmichioi, Etulia, Vulcăneşti, Vinogradovca, Cotlovina, Nagornoe villages and is at the border with Ukraine.

There are 887 households with 2812 residents in the village.

The water supply system must permanently provide a flow of Q=552.94 m^3/day and a working pressure of minimum 10 m head. There is a need to drill 2 additional (to the existing one) wells and build a water treatment station. The water will be accumulated in a reservoir with the capacity of 200 m^3, which ensures the accumulation of compensation volumes and the fire reserve.

In line with the Construction Norms and Regulations 2.04 02 84 tab.5 subject to the number of residents (between 1000 and 5000) a water flow of 10 l/s for fire protection system was adopted:

- The number of simultaneous fires in the community – 1.
- Duration of extinguishing a fire – 3 hours.

The supply for the village is gravitational and the water reservoir is located at a height of 100 m. The water distribution network is circular, with an approximate length of 24.0 km.

6.3 Rehabilitation measures (for existing assets).

The project do not include rehabilitation of rehabilitation of the existing water treatment plant. The rehabilitation of the existing water treatment plant is already scheduled to be financed from donor funds.

The main water pipe between water intake and water treatment plant is old and causes a water losses. Thus replacement of 8 km of iron pipe Dn 400 of costs of 20 million MDL is required and was included in the scope of this Feasibility Study.

Most of the distribution networks in localities requires replacement and this costs are taken into account by proposed investment measures. Also the distribution network in the city of Cahul is outdated and notices high volume of leakages. The leakage reduction was not included in the investment costs, however it is assumed that financial surplus of the regionalized operator will be used for that purposes.

6.4 Assessment of design and other documentation needed.

The feasibility study contains preliminary design for entire project area, however further works shall focus on each cluster separately.

A preliminary design must be followed by developing of the technical design. The technical design comprises of two elements:

- The presentation of the designing criteria used;
- The description of the technical characteristics of each component of the project;

Technical design is a formal document, showing the expected design solutions for planned investment. Document is used to obtain opinions, arrangements, approvals and finally to obtain construction permit. The process of obtaining construction permit makes take up to 12 months.

This feasibility study and technical design may be used in order to secure project financing.

This Feasibility Study was performed in accordance with Construction Norms (NCM L.01.07-2005 Regulation on substantiation of investment project in construction). In order to achieve the investment after the elaboration the feasibility study, the Law number 163 from 09.07.2010 regulates the following steps:

- town-planning certificate for design;
- notifications and studies for elaboration of project documentation;

- notification of connection to water supply and sewerage;
- marking plan of networks;
- topographical study;
- geotechnical field work;
- archaeological certificate regarding the permission of design;
- certificate of ownership regarding the land listed in design;
- notification from decentralized services in the territory: Centre of Public Health, Environmental Inspection, Fire Department Services, other services.
- construction permit.

The following step is developing the execution design. The execution design consists of a detail solutions included in the technical design. The execution design is used for selection of the contractor of works and quality control of works.

Based on technical and execution design, the tender documentation has to be prepared. Tender documentation may use price criteria for the selection of the contractor; however it is important that minimum quality requirements are set in the tender documentation. Most probably, due to probable support from international community, the international tender shall be organized. This may also add additional requirements to the tender procedure and needs for translation of the project documentation.

6.5 Implementation schedule.

The project could be implemented with 5 years. During the first year rehabilitation of existing assets for Cluster 0 and expansion of the network in localities are planned. In the same year the investments for cluster D shall be performed. During the second year, the common infrastructure for clusters A, B and C is planned together with infrastructure for cluster C. In the third year the common infrastructure for clusters A and B is planned together with infrastructure for clusters A and B. In fourth year, the infrastructure for Alexandru Ion Cuza is planned and part of the work on infrastructure for cluster E. In year fifth, the remaining part of the infrastructure for cluster E and finalization of the project is planned.

The financial implementation schedule is presented in the table below.

Table 6-8: Summary of the investment implementation schedule [MDL M]

	2014	2015	2016	2017	2018	Total
Pipelines	87.8	80.4	72.1	46.8	75.3	362.4
Water towers	8.6	5.4	3.0	0.3	0.6	17.9
Reservoirs	6.6	18.4	18.5	6.9	9.8	60.2
Pumping stations	5.6	7.6	12.3	3.0	5.5	33.8
Artesian wells	0.0	0.0	0.0	3.2	0.0	3.2
Water treatment plant	0.0	0.0	0.0	2.3	0.0	2.3
Land acquisition	3.1	2.0	4.0	0.6	1.0	10.7
Technical assistance	8.9	9.1	8.8	5.1	7.4	39.3

Contingencies	11.2	11.4	11.0	6.3	9.2	49.1
Total	131.7	134.2	129.6	74.5	108.8	579.0

6.6 Investment costs of selected option.

The total investment outlays amount to 579 million MDL (33,977 million EUR). The outlays involve the construction of:

- 23 pumping stations,
- water towers and reservoirs of total capacity of 12,400 m3,
- main distribution pipelines of 190.6 km,
- secondary distribution pipelines of 53.7 km,
- distribution pipelines (in villages) of 365.2 km,
- 3 artesian wells,
- land appropriation of 1,260,600 m2,
- technical assistance during construction period.

Table 6-9: Summary of the investment costs [MDL M]

	TOTAL
Pipelines	362.4
Water towers	17.9
Reservoirs	60.2
Pumping stations	33.8
Artesian wells	3.2
Water treatment plants	2.3
Land acquisition	10.7
Technical assistance	39.3
Contingency	49.1
Total	579.0

The detailed scope of the investment is provided in the Annex D.

6.7 Operating costs of selected option.

The summary of the variable costs forecast are provided in Annex F, Table 17, fixed costs in table 18 and total (fixed and variable) in Table 19. The operating cost forecast is described in Section 10.2.3.

7 Environmental analysis of selected option.

7.1 Environmental implications of the selected option.

As it was previously described under the option analysis, this project may have the following potential impacts:

- Improvement of the population's health,
- Security of disinfection process,
- Additional works for site strengthening and site maintenance,
- Pollution with building refuse,
- Temporal discomforts during the performance of the repair, construction and rehabilitation works.
- Removal of the construction waste,
- Damage of the existing communal sites,
- Labour security at the construction works.
- Leakage of fuel and lubricants from machines during the construction.
- Damage of trees and plants,
- Damage of cultural sites.

In order to minimize all possible negative impacts on the environment, below is proposed an Environmental Mitigation Monitoring Plan for the selected water supply option.

Table 7-1: Environmental Mitigation and Monitoring Plan for the selected water supply option.

Process	Impact or Concern	Mitigation Measures	Responsible authority for implementing mitigation measures	Requirements for monitoring	Responsible agency for monitoring and enforcement
Planning and pre-construction phase	Reduced downstream river discharge	Taking into account the increased number of water supply/irrigation projects that are planned, conduct a detailed study aiming to establish the quantities of water that can be recharged from Prut River, in order not to cause the disappearance of Lower Prut Ramsar wetland, or other impacts to economically important industries that are located downstream.	State Ecological Inspectorate / Ecological Institute	-	-
	Compliance to national legislation and standards	The water supply routes should not cross the terrains of landfills, cemeteries, animal burial places, manure deposits and other sources of infection. Assure that all necessary permits are obtained and all administrative bodies are consulted before staring the construction phase: The route of water supply pipes has to be consulted and approved by the regional Centre for Public Health; Before starting the construction/installation works the adjacent territory has to be cleared from sanitary point of view.	Contractor/ Local water authority	-	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
Construction Phase **Construction of a new water supply network / installation of water pipelines, water reservoirs, water castles**	Dust generation	Vehicles delivering materials should be well maintained and covered to prevent/reduce spills, emissions and dispersion To plan carefully construction works to minimize air pollution. Employment of dust suppression measures, use traffic routing measures, bound construction areas	Contractor	Periodical tests for air pollution, immediate actions in case of complains from nearby residents	Centre for Public Health, Regional Ecological Inspection, Local Public Authority

Process	Impact or Concern	Mitigation Measures	Responsible authority for implementing mitigation measures	Requirements for monitoring	Responsible agency for monitoring and enforcement
		Cleaning of the construction sites after completion of works			
	Pollution by waste gas from construction machinery and transport vehicles	Repair and maintenance of construction machinery and transport vehicles will be strengthened at normal time; traffic control will be properly done to avoid traffic jam and reduce gas emission	Contractor	Air quality monitoring	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
	Noise pollution/ vibrations from hauling tracks/ moving vehicles and working equipment	Control construction methods and used machinery and equipment Careful timing of works in residential areas)/ restrict construction to certain hours Limit for unnecessary vibration in the construction areas, To avoid loud beep signals in settlements/ to minimize disturbance to residents	Contractor	Periodic inspection of construction activities to ensure equipment noise and dust abatement systems are in place; work is carried out during normal construction hours	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
	Leakage of fuel and lubricants from machines during the construction	Prohibition for its pouring out into soil and drainage; Introduction of proper procedures for maintenance of the equipment characteristics;	Contractor/ Regional Ecological Inspection	Periodic inspection of construction activities,	Contractor/ Regional Ecological Inspection
	Littering of territory adjacent / road / garden damage to land-	To plan carefully construction works to minimize impact on flora, fauna, habitats/ careful sitting, alignment, design of associated infrastructure to	Contractor/ Local water authority / Local Public Au-	Periodic inspection of construction activities,	Regional Ecological Inspection, Local Pub-

Process	Impact or Concern	Mitigation Measures	Responsible authority for implementing mitigation measures	Requirements for monitoring	Responsible agency for monitoring and enforcement
	scape due to waste & excavated materials disposals/ stockpiling of materials	minimize impacts	thority		lic Authority
	Accidental potential pollution of soil and surface waters	To plan carefully construction works to minimize impact on water resources To prevent leaks/spills during transportation/ loading-unloading of constructional materials	Contractor/ Local water authority / Local Public Authority	Periodical tests of surface and underground water quality	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
	Rehabilitation and construction works will possibly result in removal or relocation of trees and vegetation along or within the construction sites.	Replanting trees and vegetation after rehabilitation, use the official wood source only.	Contractor/ Local water authority / Local Public Authority	Preventive measures, Periodic site inspection	Regional Ecological Inspection, Local Public Authority
	Access limits to footpaths and vehicle, to the work performance sites	Establishment of consequent work and methods (establishment of nameplates) for reduce of undesirable access; Provide safe access; Equipment for by-passes and pavements	Contractor/ Local water authority /	Periodical check of construction works	
	Increase of traffic discomforts	Usage of traffic ways; insurance of coordination with local authorities; permanent control and care of equipment	Contractor/ Local water authority	Periodical check	Patrol Inspectorate

Process	Impact or Concern	Mitigation Measures	Responsible authority for implementing mitigation measures	Requirements for monitoring	Responsible agency for monitoring and enforcement
	Hazard to the workers' security, transport during the construction	Make sure that all the precautions are strictly followed; limit the access to construction areas; Implementation of traffic security plan; Insure the safety of the workers' equipment; Observe national rules	Contractor/ Local water authority	Periodical check of construction works; observe the security plans	State Labour Inspectorate
Construction of pumping stations	Impact of accidental discharge of pollutant	Emergency measures for specific accidents will be worked out, so that control and solution can be done promptly in case of an accident; In case of an accident, the cause will be found out as soon as possible, to organize prompt repair and to solve the problem in the shortest possible time, to prevent spreading of pollution / leakage. To prevent leaks/spills during transportation/ loading-unloading of waste materials and waste water To plan carefully construction works to minimize air / water / soil pollution	Contractor/ Local water authority	Periodical check of construction works; observe the security plans	
	Complying with the technical design documents and effective construction norms	To be certain that the project implementation is complying with the technical design documents and effective construction norms. Verify if: Appropriate human health and worker safety measures during construction are developed and implemented by the construction company, which will be responsible for these measures; The documents prepared for specific works by the construction company are correct; The reconstruction works are conducted in ac-	Contractor/ Local water authority / Local Public Authority	Hire local technical supervisors, responsible for verifying the quality of performed reconstruction works	Centre for Public Health, Regional Ecological Inspection, Local Public Authority

Process	Impact or Concern	Mitigation Measures	Responsible authority for implementing mitigation measures	Requirements for monitoring	Responsible agency for monitoring and enforcement
		cordance with construction norms and according to construction technologies; construction timetables and traffic diversion schedules at the project site are posted			
	Complying with the Environmental standards and legislation documents and effective construction norms	Use materials of the best quality consistent with the character of works; Branded materials will be handled, stored, used and processes carried out, in strict accordance with manufacturer's instructions and recommendations;	Contractor/ Local water authority / Local Public Authority	Hire local environmental supervisor, responsible for verifying the environmental requirements	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
Installation of water castles and water reservoirs	Protection of water resources.	Fencing along the perimeter of the first sanitary protection zone. Greening the sanitary protection zone. Placing the warning signs on the perimeter of the first sanitary protection zone.	Contractor/ Local water authority /	Periodic inspection of sanitary protection zone around the potable water reservoirs and water castles	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
Operational phase **Maintenance of water supply network**	Improvement of the water quality	Repair and maintenance daily water supply network Annually cleaning and disinfection of water reservoirs, water castles. It is recommended to conduct this measure in April-May period. Cleaning and disinfection of water reservoirs and water castles each time after reparation or when a deviation of water quality was established. Placing of warning messages around the protection zones. Education of population.	Local water authority/ Local Public authority	Periodic tests of water quality	Centre for Public Health, Regional Ecological Inspection, Local Public Authority

Process	Impact or Concern	Mitigation Measures	Responsible authority for implementing mitigation measures	Requirements for monitoring	Responsible agency for monitoring and enforcement
	Reduction in morbidity associated with improper water treatment and distribution. The life expectancy will increase	Repair and maintenance daily water supply network Education of population on water borne disease and measures that has to be taken in order to protect their selves.	Local water authority/ Local Public authority	Periodic tests of water quality	Centre for Public Health, Regional Ecological Inspection, Local Public Authority
Maintenance of chlorinating systems	Hazard from the chlorination process	Establish vacuum-operating and corrosion-resistant systems; establish the chlorine leakage control; Establishing emergency response plan, presence of the protection and emergency equipment	Local water authority/ Local Public authority	Periodical check	Centre for Public Health, Regional Ecological Inspection,
Sustainable water use	Depletion of water resources; Pollution of soils and groundwater resources	Population education in sustainable water use and water pollution prevention measures. Use of water meters.	Local water authority/ Local Public authority/ State Ecological Inspectorate	-	-

7.2 Moldovan requirements regarding environmental impact assessment.

Environmental Impact Assessment (EIA) is an important and effective planning tool for predicting the potential environmental consequences of proposed developments. It is a means to identify unwanted effects before they occur and determine appropriate mitigation measures.

The EIA process considers the physical and biological impacts of proposed developments on the environment: air, land, water, plants, animals and people. Its scope includes a review of the effects that could bring adverse changes to the natural environment and the resulting short- and long-term effects that these changes could have on people.

In Moldova environmental impact assessment is foreseen by Law nr. 851 on ecological expertise and environmental impact assessment (1996). According to the law the ecological expertise is a preliminary environmental evaluation of planned economical activities on environmental state. The ecological expertise is compulsory to: new projects that foresee the water supply and sewerage systems.

Regulation on environmental impact assessment attached to the above-mentioned law establishes the goal, procedures, requirements imposed by environmental impact assessment and the list of activities for which the environmental impact assessment is required before the elaboration of projects design document. In this way, the following projects require the environmental impact assessment to be conducted before the elaboration of project design documents of the activity:

- Water inlets for enterprises, urban and rural localities with debit of 1 000 m^3/day for groundwater inlets and 10 000 m^3/day for surface waters inlet;
- Industrial and household waste water treatment installations from enterprises, urban rural localities with debit of more than 10 000 m^3/day.
- Any types of constructions within the riverbeds, protection belts of rivers and water basins.
- Irrigation systems and drainage systems with the surface of respectively 1000 ha and 100 ha and more.

In all cases the environmental impact assessment documents should compulsory pass the ecological expertise.

The beneficiary that intents to build, extend, rebuild, re-profile or demolish the existing building has to present the Declaration on EIA together with the documents on EIA. In declaration has to be addressed all objections and proposals of local public administration, ministries, and agencies together with the results of public debates.

The documentation passed for ecological examination is verified for the following aspects:

a) Level of exact evaluation of the expected impact of economic activity on the environment;
b) Need to conduct the economic activity on the chosen site and the mode how the activity will be conducted;
c) Character of the technical, engineering, architectural and urban planning solutions, as well as proposals on the use of raw materials, energy and natural resources;

d) adequacy and effectiveness of measures taken to avoid cases of damage to equipment and environmental pollution, as well as emergency response to eliminate consequences of pollution;
e) implementation of effective water treatment methods, excluding untreated wastewater discharges into water bodies;
f) introduction of new methods to restore soil fertility, improve, re-cultivate and prevent land erosion;
g) minimization of industrial waste resulting from use of mineral resources, based on advanced technologies;
h) effectiveness of technical solutions for processing, recycling and inhumation of industrial and agricultural waste, highlighting opportunities for regional cooperation in this field;
i) application of control methods recommended to ensure the environmental safety of the proposed economic activity and standardized quality of the environment;
j) development of measures to prevent or minimize the environmental consequences of the project.

A detailed description of the environmental impact assessment documentation requirements is presented in Regulation of environmental impact assessment.

In April 2012, a draft law on environmental impact assessment was presented for review to the parliament of the Republic of Moldova. The new law will abrogate the regulation on environmental impact assessment and will impose new principles, procedures and conditions for conduction of environmental impact assessment.

The new law will foresee that the following planned activities the need of conduction of environmental impact assessment has to be established:

- long distance water supply systems, of 5 km and more.
- water systems for artificial caption and recharge of the ground waters, of more than 1 mil. m^3.
- Wastewaters treatment plants, with the capacity of 50-150 equivalent inhabitants.
- Stockyards for the industrial sludge,
- Dams and other installations meant to retain water or to stock it for a long term, having the capacity between 1-10 mil. m^3,
- Works of transfer of water resources between river basins.

8 Implementation requirements

8.1 Regulatory requirements

Although there is a legal basis in the Republic of Moldova entitling local public authorities to cooperate or associate to provide public services and to protect common rights and interests, the current regulatory framework does not offer clear solutions with regard to specific mechanisms and forms of cooperation. The legislative gap regarding certain aspects of inter-community cooperation is also highlighted by lack of a methodological framework (guides, instructions, methodological notes, model legal documents) that would provide local authorities with a clear vision with regard to stages and forms of carrying out these cooperation projects.

Under these conditions, the main regulatory and policy acts regulating inter-community cooperation are as follows:

1) European Charter of Local Self-Government dated 15.10.85, ratified by the Republic of Moldova on 16.07.1997

Article 10 Local Authorities' Right to Associate
1. Local authorities shall be entitled, in exercising their powers, to cooperate and, within the framework of the law, to form consortia with other local authorities in order to carry out tasks of common interest.
2. The entitlement of local authorities to belong to an association for the protection and promotion of their common interest and to belong to an international association of local authorities shall be recognized in each state.

3. Local authorities shall be entitled, under such conditions as may be provided for by the law, to co-operate with their counterparts in other states.

2) Law No.436 of 28.12.2006 on Local Public Administration, Art.14 par.1, lit. j) stipulates that the local council *decides, under the conditions provided for by the law, about association with other LPAs, including from abroad, in order to carry out certain works and services of public interest, to promote and protect interests of LPA authorities, as well as to cooperate with economic agents and community-based organizations in the country and from abroad for the purpose of carrying out certain actions or works of common interest.* The same law stipulates under art.43, par. (1), lit. t) that *the district council decides, under the conditions provided for by the law, about association with other LPA authorities, including trans-border cooperation in order to carry out some works and services of public interest, to promote and protect the interests of LPA authorities, as well as to cooperate with economic agents and community-based organizations in the country and from abroad, in order to carry out certain actions or works of common interest.*

3) Law No.436 dated 06.11.2003 on the Standard Statute of Village (Commune), Town (Municipality) // Official Monitor 244-247/972, 12.12.2003

The Statute establishes conditions for cooperation of the public administration of an administrative-territorial unit with other public administration authorities in the county and the similar authorities abroad, the procedure for joining national or international bodies in order to protect and promote common interests.

4) Law No.435 of 28.12.2006 on Administrative Decentralization

Article 3. (Principles of Administrative Decentralization)

h) Principle of the public-private, **public-public**, public-civil partnership supposing guarantee of real cooperation possibilities for the government, local authorities, the private sector and the civil society

Article 5. Cooperation of Public Authorities

(1) LPA 1 and LPA 2, as well as CPA can cooperate, under the conditions of the law, in order to ensure implementation of public projects or services requiring joint efforts of these authorities.

(2) Activities that have to be carried out in cooperation are fixed in agreements signed between parties, under the conditions of the law, in strict compliance with the budget resources and assumed responsibilities.

(3) The signed agreements shall contain clear delimitation of sources of financing and limits of decision-making authority for each level of public administration separately, as well as the terms of agreement fulfillment.

(4) In order to realize local public interests successfully, to increase the efficiency of public property, local public administration authorities of levels one and two shall develop cooperation with the private sector based on public-private partnership contracts.

6) Law No.1402 of 24.10.2002 on Public Utilities

Stipulates under art.6 the principle of inter-community association and partnership
Art. 13: The Government shall ensure implementation of the general state policy on municipal services, in conformity with the government program and the objectives of the social economic development strategy of the country by: f) promoting inter-community partnership and association to establish and run zonal municipal systems;
Art.14 par. (4) LPA authorities can adopt decisions in relation to: c) association of municipal public services to make investments of common interest in municipal infrastructure;

7) National Decentralization Strategy for 2012-2015

I. Specific objective related to decentralization of services and competences

1.4. Creation of institutional, legal and financial instruments that would stimulate efficient delivery of services specific to decentralized competences (association, concession, contracting).

V. Specific objective related to administrative capacity

5.2. Consultation of local community members, including vulnerable groups over the options to build the ATU's capacity and to cooperate with other municipalities.
5.3. Creation of conditions for implementation of the ATU's capacity building and inter-municipal cooperation options.

8.2 Institutional requirements.

8.2.1 Roles and responsibilities of the public administrations.

Roles and responsibilities of public authorities in organization and provision of public WSS services have been generally and concisely described under point 4.2 of this study.

In this section, the institutional aspects of the inter-community cooperation model applicable to initiatives aimed at aggregation of public utilities in general, and WSS in particular, are analysed.

According to article 10 of the Public Utilities Law No.1402 of 24.10.2002, “public utilities are delivered/provided by specialized operators (municipal and individual companies, joint stock companies, limited partnerships, limited liability companies, companies with other legal forms of organization) […]”. Article 14 of the same law mentions that local public administration authorities adopt decisions related to (c) association of public utilities with a view to carrying out investments of common interest in the municipal infrastructure and in relation to (p) their participation with shareholders' equity or with assets in the capital or assets of economic agents for performance of works and delivery/provision of public utilities at the local and district level, as appropriate […]. On the other hand, the current legislation does not regulate the preferable (or allowed/prohibited) legal organization forms of those listed above for cases when the public service **is provided at the regional level by several local authorities through inter-community cooperation**. This means that any of the legal organization forms provided for by the current legislation are also applicable to the regional operator. Therefore, the task is to analyse these forms to identify their advantages and disadvantages for a specific case.

Although expressly providing for the entitlement of local authorities to associate and cooperate in providing public services, the current regulatory framework of the Republic of Moldova is not as explicit with regard to the legal organization forms and models of inter-community cooperation. Moreover, as analysis of the very few inter-community cooperation projects implemented or under implementation shows (including in the field of water supply and sanitation services), the choice and design of the legal organization model of cooperation establishment is one of the most difficult tasks and stages in implementation of the corresponding projects.

Under the conditions of an unclear and even deficient legislative regulation, design of one or several models of inter-community cooperation establishment is an exercise based on the analysis of a number of regulatory acts, as well as on taking into consideration the experience of certain countries in the region.

Two types of competences of local public authorities related to organization and operation of local public services can be distinguished: (1) part that can be delegated/given in concession to the operator directly related to the service provision itself and (2) part that cannot be delegated to the operator and is directly related to the public authority – such as tariff approval, quality monitoring, property-based decisions, etc. As a result and in case of designing a regional model of organization and provision of public services through inter-community cooperation, the two elements have to be treated as separate elements of the system. As a result, by founding a regional operator, delegation of the service and concession of the infrastructure related to this common operator, only the first category of duties is regionalized, while for regionalization of the second category related to the public authority, it is necessary to create a distinct infrastructure that local authorities would delegate a part of their competences to (in case the legislation would provide for a possibility to delegate these competences to associates from the LPA or possibly to another LPA).

Taking into consideration the above-mentioned, a complete model of inter-community cooperation institutionalization should have the following elements:

1. A regional operator that can be founded by all or a part of cooperating administrative-territorial units or can be a private operator servicing all or a part of cooperating localities. The regional operator can be founded under various legal organization forms not prohibited by law– JSC, LLC, LP (Limited Partnership), etc.

2. A regional decision-making/monitoring/coordination structure without a working goal, founded by administrative territorial units willing to cooperate in provision of the public service and to delegate competences such as tariff approval, possible operator selection, monitoring, etc. This would be a structure similar to the existing Romanian Association of Inter-Community Development, but which for the moment is not regulated in the Republic of Moldova. The national legislation expressly prohibits local authorities to establish associations under the form of community-based organizations, instead allows doing that under the form of a Union of Legal Entities. Another legal mechanism refers to the civil society contract. Nevertheless, this element of the cooperation institutionalization model cannot be fully functional in the Republic of Moldova, because the legislation does not provide for a possibility to delegate certain LPA competences to them, such as, for instance, tariff approval. Even if created, these associations could play only a symbolic coordination role. In order to create a functional association, it is necessary to amend and addend the legislation to cover regulation of the corresponding associations and a possibility of delegating them certain competences.

As a result, besides creation of the regional operator, which is the main pillar of public service regionalization, creation of the second institutional element (association, union of legal entities) is **optional** under the conditions of the current legislation**.** Moreover, a great part of duties that the association would take on could be taken on by the administrative board of the trade company (of the joint stock company in cases of the Cahul Rayon, where the working group has already selected this form of organization for the future regional operator).

<u>Stages in establishing/reorganization of the regional operator</u>

In order to establish the regional operator, it is necessary to take the following steps:

I. Preparation Stage:

- Development of opportunity/feasibility studies (near completion)
- Public debates, consultations (discussion of study findings, citizen information)
- Approval of studies by local/district council.

II. Implementation Stage (actual creation of the regional operator):

From the legal point of view, creation of a regional operator (Joint Stock Company) can start from two different situations:

1. Creation of a new regional operator through reorganization of the existing ***Apa Canal Cahul*** **Municipal Company** and increase of the shareholders' equity by participation of new founders in capital subscription.

2. Creation of a new entity – a Joint Stock Company. In this case, establishment of a new joint Stock Company starts from the scratch and is not based on the existing legal entity.

In case of Cahul, there is a preliminary agreement and understanding that the first option shall be applied, and namely: reorganization of the existing *Apa Canal Cahul*.

In order to reorganize the public company *Apa Canal Cahul* in a regional joint-stock company with public capital, the following steps are needed:

a. The local councils of future founders have to make decisions in principle on their participation in establishment/reorganization of the Joint-Stock Company (the model decision is presented in Annex No.1)

b. A working/negotiating group has to be created to determine the contribution of each locality to accumulation of the shareholders' equity of the future regional operator. The in-kind contribution has to be evaluated first of all by an independent specialized company. Also, the amount of the shareholders' equity of the future joint-stock company has to be decided upon/determined.

c. Local councils have to make the actual decisions on participation in establishment of regional joint-stock company. The exact contribution in cash and in kind of the corresponding administrative-territorial unit has to be expressly mentioned in the decision. The council has to adopt the company's Memorandum and Articles of Association and to authorize the mayor to sign them. A model decision on participation in establishment of a joint-stock company is presented in Annex 2.

d. The Memorandum and Articles of Association have to be signed by all founders.

e. Registration of a new legal entity, a joint-stock company, at the State Registration Chamber (there is a number of administrative steps that have to be followed) – more information is available at http://cis.gov.md/

f. Ensuring transfer of contributions in cash and in kind to accumulate the shareholders' equity of the joint-stock company. In-cash contribution has to be transferred until the founding general meeting, while in-kind contribution – within a month after the company's registration.

g. A founding general meeting has to be organized and take place.

8.2.2 Institutional agreements between the communes and the public service providers (service level agreements).

According to best international practices, the institutional arrangements between the service provider (that is, the regional water company based on an expanded "Apă-Canal" Cahul) and the communes it serves would be stronger if underpinned by a service level agreement. Service level agreements are a tool used to introduce commercial practices based on a contractual relationship into the dealings between the founder of the regional operating company and the company itself. An integral part of service level agreements are performance indicators, which should be established and measured based on the company's strategic plan (longer term plan) and business plan (short to medium-term plan).

This contractual, commercial relationship is introduced to replace the *ad hoc*, political relationships that commonly prevail in the delivery of utility services. Service level agreements are commonly used as a tool to improve public sector accountability and performance and often are required by international financing institutions (IFIs) as a precondition for awarding grants or extending loans.

Water companies and the communes to which they provider services often seek to implement service level agreements in order to escape the "vicious cycle" or "spiral," in which the service provider is unable to upgrade its infrastructure because it cannot collect sufficient revenues due to the fact that its customers no longer place any trust in the company's ability to provider services at a proper level. The following are characteristic of situations in which service level agreements are implemented:

- Low tariffs
- Low collection rates, due among others to culture of non-payment and poor enforcement of payments
- Inefficient use of resources by customers
- High operating costs
- Deferred maintenance and capital investments
- Deteriorating service levels
- Decreased customer willingness to pay for services

- Water company dependence on subsidies – both capital and operating subsidies
- Decreased water company autonomy and incentives for managers to make improvements
- Subsidies to water company do not materialise in times of economic crisis
- Water company defers payment of wages and accumulates other payment arrears
- On-going decline in service levels and customer support.

In more concrete terms, among others, parties implement service level agreements in order to provide a framework for reducing operating costs, reducing capital and operating subsidies, and increasing the ratio of cost coverage from user charges of services provided.

Experience from other countries in which service level agreements have been implemented in the utility sector enable the formulation of key lessons learned in the design and management of such agreements:

- Contract duration: the contract must indicate the period of time for which the contract is to be valid, as well as terms and procedures for extension of the contract.

- Monitoring: whereas the contract should set out the communes' rights and responsibilities for monitoring the water company's performance, it is equally important that the commune (or group of communes) have established a unit that has the capacity to control and assess the water company.

- Ownership and use of assets: the contract should contain details on the assets transferred to the water company, either for ownership or use. This includes the water company's rights and limits of use of assets and responsibility for repair and maintenance. In addition, responsibility for updating the register of assets used to provide the utility service needs to be assigned.

- Clear division of liability and risk: the service level agreement should set out the liability for the provision of services and which party assumes various risks involved in providing the service, including risk mitigation through means such as insurance. Typical types of risk include: operation and maintenance risk (who assumes responsibility for operation and maintenance in the event that costs cannot be sufficiently covered through user charges?), political risks (the water company should be insulated from the impacts of political changes in the communes), regulatory risks (who will cover the costs associated with changes in the regulatory environment), and revenue risks (who will make up the difference between required and actually collected revenues and who is responsible for increasing revenues?).

- Incentives and penalties: the contract should contain details on the consequences of failure to comply with the rights and obligations set out in the service level agreement.

- Linkage to implementation of strategic and investment plans: the service level agreement should be used to monitor the implementation of the water company strategic plan, investment plan, as well as maintenance and operating plans.

- Tariff (or price) setting procedures: the service level agreement should specify the components of tariffs (or prices) and how they will be calculated.

- Performance indicators and targets: the service level agreement should specify time-bound performance targets, that is, the achievement of certain performance targets by a certain date compared to the previous value for the indicator. These targets must be monitored.
- Incentives should be tied to performance: the service level agreement should include an incentives system, such as a performance-based remuneration system that rewards the management of the water company for meeting or exceeding performance targets set out in the service level agreement.
- Dispute resolution procedures: the service level agreement should include dispute resolution procedures, in accordance with the law.
- Termination of contract: the service level agreement should include provisions on how the contract may be terminated, including how uncompleted investment programs should be settled.

In summary, it is recommended that the future institutional solution should use a service level agreement to govern the relationship between the communes and the proposed regional water company.

8.2.3 Structure of the service provider, organization and staffing.

This section addresses two aspects of the service providers in the proposed service area. First, it briefly examines the list of current service providers in the area, including type of entity and the number of employees. Second, the structure, organisation, and staffing of the largest service provider – „Apă-Canal" Cahul – is examined in more detail.

There are 55 localities (36 communes and 18 villages) in the Cahul District, of which 24 currently have a water services provider, the most common form of which is municipal enterprise (10, or 42% of the total), followed by a section that is part of city hall (8, or 33%), commercial company – SRL (3, or 13%), commercial society – SA (2, or 8%), and water users' association (1, or 4%).

There are a total of 280 employees in these 24 water service entities, or an average of 11.66 employees per water service entity. The majority of these are employees of the „Apă-Canal" Cahul and it is the largest service provider. A total of 190 (according to the Annual Plan from 2013), or about 68%, of the total employees in the service area work for the Cahul service provider.

If the „Apă-Canal" Cahul employees are excluded, the remaining 23 entities employ an average of 3.91 persons. Thus, the small-size of the other service providers has disqualified them from further consideration as the basis for a future service provider. The largest service provider is in Cahul and for this and other reasons (such as existing infrastructure, organisational structure, and existing working procedures), it was deemed the most suitable organisation upon which to base the future service provider in the aggregated service area.

That said, the A-C Cahul will not immediately take over the other service providers. It is assumed that this process will take place gradually and be completed by 2019-2020.

At least three difference sources exist on the organizational structure. According to one structure, the company is divided into 5 departments with a total of 190 employees, as follows:

- Director (10 positions), including:
  - Director/Manager

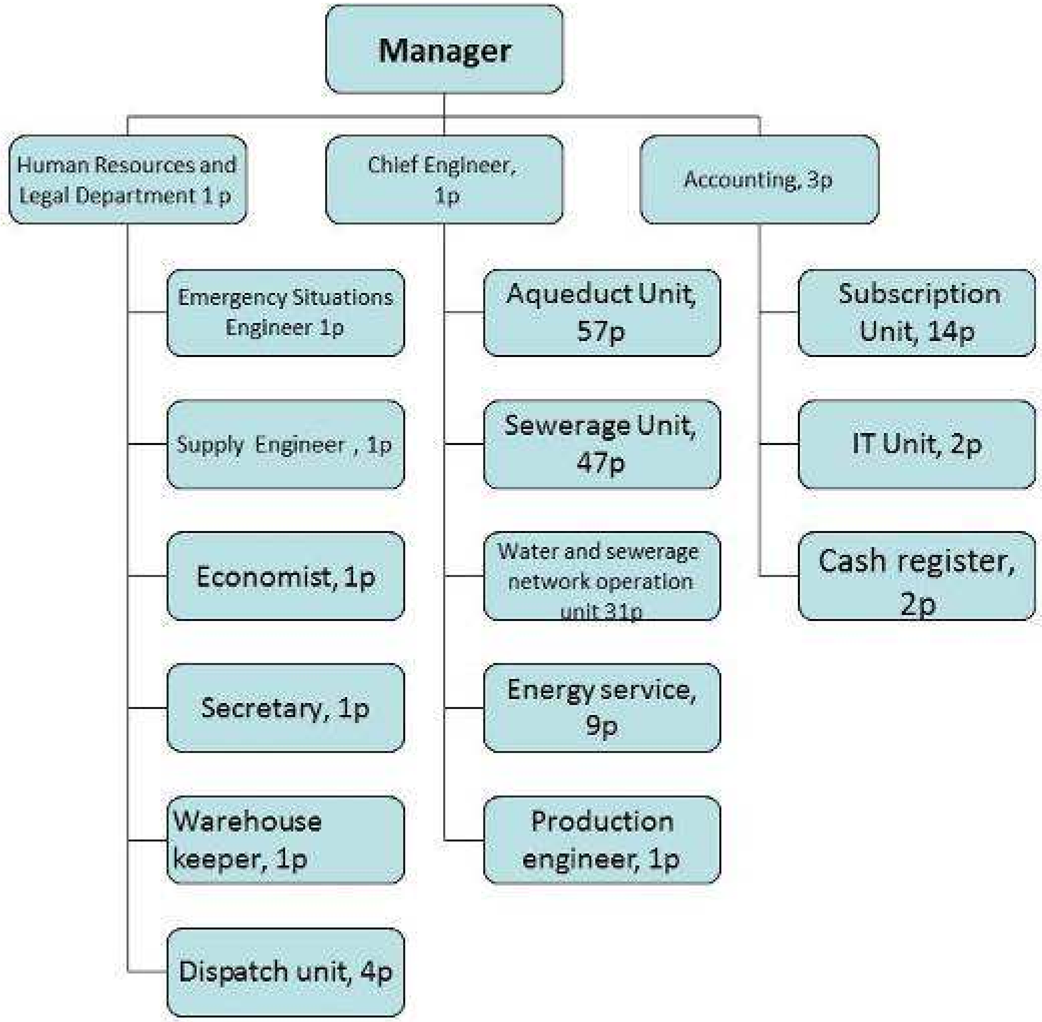
    - Human Resources/Legal
    - Emergency Situations Engineer
    - Supply Engineer
    - Economist
    - Secretary
    - Warehouse keeper
- Accounting Department (5 positions)
- Water Network Department (62 positions)
- Operations and maintenance service (33 positions)
- Sewer Network Department (51 positions)
- Commercial Department (24 positions)
- Other positions (5 other positions, including security and drivers).

According to the company organizational chart, however, the company is divided into three directorates, which are all subordinate to the company director:

- Human Resources and Legal Directorate (10 positions)
    - Human Resources and Legal Head
    - Emergency Situations Engineer
    - Supply Engineer
    - Economist
    - Secretary
    - Warehouse keeper
    - Dispatch Unit (4 positions)
- Chief Engineer Directorate (137 positions)
    - Chief Engineer
    - Water Network Unit (57 positions)
    - Sewerage Unit (47 positions)
    - Water and Sewerage Network Operations Unit (31 positions)
    - Energy Service (31 positions)
    - Production Engineer
- Accounting Directorate (21 positions)
    - Accountants (3 positions)
    - Subscription Unit (14 positions)
    - IT Unit (2 positions)
    - Cash register (2 positions).

Accordingly, the total personnel is 168. The organizational chart based on these figures is presented in the following chart.

Figure 8-1: Organisational chart of A-C Cahul



Finally, according to company cost data, personnel are divided into the following departments and units:

- Director (3 positions), including:
    - Director/Manager
    - Chief accountant
    - Chief engineer
- Corporate Directorate (13 positions), including:
    - Worker health and safety specialist
    - Human resources inspector, lawyer
    - Engineer, electrician
    - Engineer
    - Economist
    - Equipment engineer

    - Engineer, automation systems
    - Accounting (5 positions)
    - Driver.
- Water Network Department (62 positions)
- Operations and maintenance service (33 positions)
- Sewer Network Department (51 positions)
- Commercial Department (24 positions)
- Security (4 positions).

Accordingly, the total personnel is 190.

The company „Apă-Canal" Cahul currently provides water supply services to the city of Cahul, which has about 40,000 residents. Expansion of the services that the A-C Cahul provides will mean that conservatively up to 87,000 persons will need to be served (which would correspond to about a 70% service coverage rate given the total population of the Cahul District of 124,900). Current service coverage rates for water supply – among those localities that have water supply – range from a low of 11% in Ursoia to a high of 99% in Giurgiuleşti. The city of Cahul accounts for 64% of the water connections in the district (13,140 of 20,452) and nearly 89% of the sewerage connections (8,811 of 9,955). Overall, the city of Cahul accounts for 72% of all water and sewer connections in the district (21,951 of 30,407). As is seen in these data, basing the regional service provider on the A-C Cahul is the most effective way forward.

On the other hand, there are operational efficiencies to be gained in the A-C Cahul. One measure of operational efficiency is the performance indicator "number of employees per 1000 connections." When only the employees at A-C Cahul and the connections the company services are considered, this performance indicator is 8.66 employees per 1000 connections. Considering only the employees apart from A-C Cahul and the connections these other companies service, the performance indicator is even higher – 10.64 employees per 1000 connections. Considering all employees and connections in the regional service area, the performance indicator is 9.21 employees per 1000 connections. Typically, a modern water company serving an area of 70,000-120,000 persons can expect to have around 3-4 employees – or even lower – per 1000 connections.

Table 8-1: Performance indicators – staff efficiency, 2013

	Data/indicator	Cahul only	Cahul District	Total
1	Number of water connections	13,140	7,312	20,452
2	Number of sewerage connections	8,811	1,144	9,955
3	Number of total connections	21,951	8,456	30,407
4	Number of water employees	62	72	134
5	Number of wastewater employees	51	18	69
6 (4/1)	Water employees / 1000 water connections	4.72	9.84	6.55
7 (5/2)	Wastewater employees / 1000 wastewater connections	5.79	15.37	6.93
8 (4+5/3)	Total employees / 1000 connections	8.66	10.64	9.21

8.2.4 Operational arrangements.

This section deals with two topics:

- Assessment of the operational performance of the water company „Apă-Canal" Cahul
- Proposal for the organisational structure of the proposed regional service provider.

The assessment of the operational performance of the water company „Apă-Canal" Cahul is based on a list of important functions that a modern water company should perform in order best to serve its customers and to develop as a sustainable business entity. These are presented in the following table (Table 8-2).

Table 8-2: Gap analysis of primary functions of a water company

Function of water company	Best practices	Evaluation of current situation in other water companies in the service area	Evaluation of current situation in Apă-Canal Cahul	Steps to be taken to address main gaps
Water supply	Provide piped water of suitable quality and pressure, 24 hr/day; 365 days per year	The coverage ratio for water supply in the service area excluding Cahul is about 25%. Network in need of repair and expansion. Current spending inadequate to meet infrastructure needs.	The coverage ratio for water supply in Cahul is about 77%. Over the entire service area, the coverage ratio for water supply is about 40%. Water treatment facility requires rehabilitation. Network in need of repair and expansion. Current spending inadequate to meet infrastructure needs.	Investment programme required. Organisational entity required to manage and maintain existing and new infrastructure. Local populations require options for water supply beyond ground water, which often can be contaminated by wastewater and are prone to effects from drought. Financing is required to fill capital investment gap – local financing capacity is too low for a concentrated capital investment programme.
Wastewater collection and treatment	Collect and treat wastewater according to national regulations	Low level of centralised sanitation. Little or no sanitation services provided	Service coverage in Cahul is about 51%. WWTP in Cahul requires rehabilitation.	WWTP in Cahul will need to be rehabilitated and expanded. Sanitation services need to be increased. Wastewater treatment is required in some areas. Wastewater treatment needs to be provided where cost effective.
Expand and improve services	Prepare strategic plan covering 10-year period Prepare business plan covering 5-year period and including: • medium-term (5-year) capital investment plans. • medium-term (5-year) financial plans.	No existing plans	Business Plan exists, but is not updated on a regular basis. Strategic Plan was prepared for WSS sector development in Cahul District. A-C Cahul should also prepare a company-specific Strategic Plan No medium-term financial plan exists. An Action Plan has been pre-	Medium-term planning is required, covering a financial plan and an investment plan for a 5-year period. The plans should be updated annually. A company-specific strategic plan (covering a 10-year period) should be prepared. Multi-year (5-year) capital invest-

Function of water company	Best practices	Evaluation of current situation in other water companies in the service area	Evaluation of current situation in Apă-Canal Cahul	Steps to be taken to address main gaps
			pared for 2013 (annual plan), which shows 10.264 million MDL (approximately 640 thousand EUR) of investments.	ment plan should be prepared showing what will be done each year, how much will be spent, and how it will be financed. For investments that require more than one year to complete, the total estimated cost of the investment should be indicated.
Financial planning	Prepare medium-term (5-year) financial plans. Prepare financial statements with adequate description of all underlying assumptions.		Medium and long-term financial planning lacking (apart from that contained in business plan, which is not updated annually).	Medium-term (5-year) financial plans should be prepared. Financial statements require adequate description of all underlying assumptions.
Calculate cost-recovery tariffs	Prepare calculations that reflect the full-cost recovery tariff and are complaint with the polluter/user pays principle	Cost-recovery tariffs not calculated.	Cost-recovery tariffs not calculated.	Financial and planning staff of future regional operating company require training on preparation of proper tariff calculations that can be audited by national regulator.
Collect revenues	Collect tariffs that cover at least the full operating and maintenance costs and if possible the full capital costs (depreciation and debt service). Achieve revenue collection rate of at least 95% on the amounts billed.	Collected revenues insufficient operating and maintenance costs.	Collected revenues insufficient to cover operating and maintenance costs. According to plan of revenues and expenditures, 2013 should end in a small operating deficit. Cash flow deficits have appeared in previous years	Customer service staff of future regional operating company require training and procedures on revenue collection. Revenue collection rates should reach 95% within a period of 5-7 years. Affordability of services for the population needs to be well-understood and support mechanisms for those demonstrably unable to pay full price should be implemented.

Function of water company	Best practices	Evaluation of current situation in other water companies in the service area	Evaluation of current situation in Apă-Canal Cahul	Steps to be taken to address main gaps
Financial sustainability and independence	Water company is financially independent from its founders. If subsidies are provided, they are for the short-term and plans for their phasing out are clear.	Full costs are not covered.	Full costs are not covered. Financial independence not achieved.	Tariffs covering at least operating and maintenance costs need to be collected. Customers need to be encourage to connect to the water supply and wastewater systems with arguments showing benefits to public health and the natural environment.
Cost management	Water company prepares and implements plans to reduce operating and maintenance costs.	No evidence that targeted cost management is practised.	No evidence that targeted cost management is practised. Costs of repairs and interventions not adequately recorded and tracked.	Significant investment in information infrastructure required. Proposed regulatory structure (national regulator as well as regional operating company and its relationship with shareholders) should be designed to provide incentives to reduce costs.
Repair and maintenance	Planned maintenance of water and wastewater infrastructure carried out annually. Timely repair of defective network and production components. Timely replacement of defective components that cannot be repaired. Systematic reduction in production, treatment and supply costs, in particular due to reduction in leakages.	Planned maintenance does not exist. Insufficient human and financial resources to carry out maintenance programme. High leakage rates.	Maintenance is planned on an annual basis. Asset inventory requires updating.	Technical staff of future regional operating company require training and procedures for conducting scheduled maintenance. Revenues sufficient to cover operating and maintenance costs must be collected.
Customer service – connection, account management, billing, collec-	Procedures for new connections are simple. Billing and collection procedures are transparent (customer knows for what it is paying).	Inadequate customer service infrastructure to expand services.	Inadequate customer service infrastructure to expand services.	Customer service department requires investment in infrastructure (IT and working procedures) in or-

Function of water company	Best practices	Evaluation of current situation in other water companies in the service area	Evaluation of current situation in Apă-Canal Cahul	Steps to be taken to address main gaps
tion	Consequences for non-payment are imposed in accordance with the law and are not delayed for political or other reasons.			der to expand its service area.
Human resources management	Human resource functions exist: 1) human resources department or position; 2) systematic research and training for human resources staff on the best practices in HR management; 3) performance bonus system for managers implemented; 4) employee retention plan implemented; 5) annual training programme implemented.	No human resources functions exist.	Human resources functions require strengthening. Bulk of workforce nearing retirement (approximately 70% of workforce is over 50 and about 14% is over 60 years old).	Strategic and business planning needs to be implemented and performance indicators for the regional water company defined. Performance based bonus system needs to be implemented to guide company toward implementing its strategic and business plans. Annual employee training plan is required. Plan required to deal with aging workforce – specially retirement and replacement or consolidation of vacant positions
Regulatory compliance	A water company has its own laboratory, or access to a laboratory to demonstrate that the water it supplies meets requirements and that the wastewater it treats meets requirements for discharging into the environment.	Facilities lacking to demonstrate regulatory compliance.	Adequate laboratory facilities available.	
Performance indicators	Performance indicators are defined to guide the company toward implementing its strategic and business plans. These indicators are also used as a basis for a performance bonus system for managers.	No performance indicators are tracked	No performance indicators are tracked	Performance indicators for key aspects of operations should be defined and tracked in accordance with the strategic plan and business plan developed by the proposed regional water company.

Function of water company	Best practices	Evaluation of current situation in other water companies in the service area	Evaluation of current situation in Apă-Canal Cahul	Steps to be taken to address main gaps
Office and workspace	Regional water company must have sufficient physical infrastructure to perform its statutory tasks, including: 1) central office for customer service and corporate planning; 2) central office for storage of fleet and equipment; 3) central dispatcher for repair and maintenance crews; 4) field offices for equipment, maintenance staff and revenue collection staff.	Inadequate physical infrastructure to perform all listed functions. Some personnel exists, but insufficient, in particular for maintenance	Adequate facilities available for administration.	Facilities in towns and villages should be used to augment facilities in Cahul, in particular emergency response, repairs and maintenance, as well as meter reading and billing.

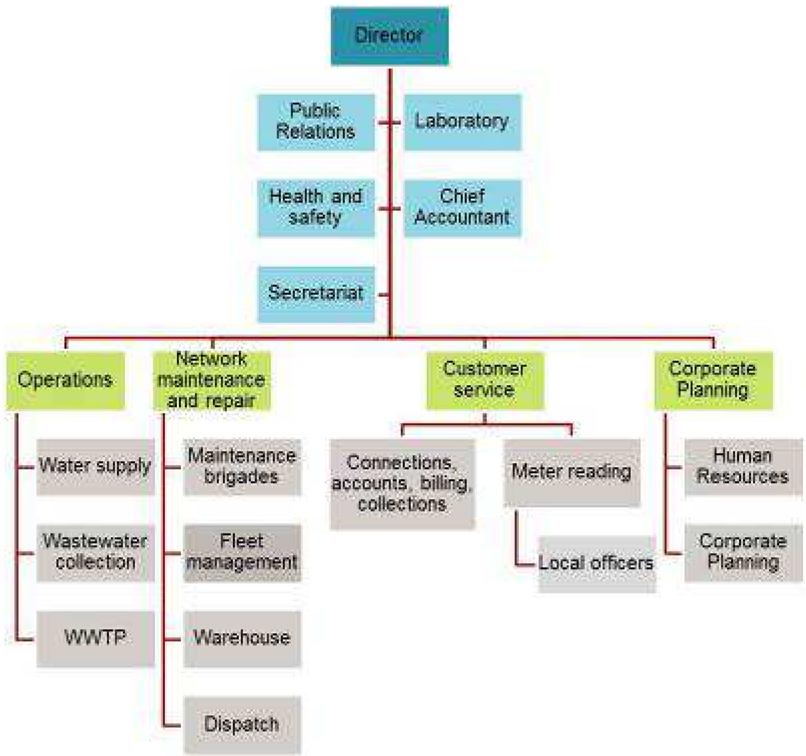
In order to fill the gap between the current situation in the various service providers, in particular the A-C Cahul, it is recommended that the A-C Cahul be restructured and the other apacanals in the service area be integrated into the A-C Cahul.

This structure will facilitate the performance of the main functions of a modern water company, as outlined in Table 8-2. The company will still need investment in:

- information capital – in particular, a comprehensive customer database, a system to track operating parameters of production and treatment facilities as well as the water and sewer networks, and a system to track operating and maintenance costs. In addition, a GIS system is required to supplement the customer database and augment other investments, such as in SCADA
- organisational capital – in particular, working procedures to facilitate the use and results from the information systems, job and departmental descriptions and duties, and performing all functions of a modern water company (see Table 8-2)
- Human capital – in particular, implementing human resources management, implementing a capital development plan, and conducting a hiring and training programme to ensure that adequate staff is available to perform functions of a modern water company. The recommended personnel needs are discussed in section 8.2.5.

The following figure (Figure 8-2) depicts the proposed organisational structure of the regional water company based on the A-C Cahul.

Figure 8-2: Proposed future organisational chart



The organisational structure is divided into the following components:

- Office of the Director – in addition to managing the four directorates (see below), the Director is the head of the regional apacanal
- Secretariat – supporting the Office of the Director
- Chief Accountant – responsible for managing the accounting office and meeting regulatory requirements for financial reporting
- Public Relations Department – responsible for managing the reputation and goodwill of the regional apacanal and in particular increasing the rate of connection to the water supply system (in conjunction with the Customer Service Directorate)
- Health and Safety Official – responsible for ensuring regulatory compliance with respect to health and safety
- Laboratory – responsible for ensuring regulatory compliance through sampling and testing
- Four Directorates, each headed by a manager, as follows:
  - Corporate Planning
  - Customer Service
  - Operations
  - Network Maintenance.

The four directorates, in turn, will include a number of departments, as follows:

- Corporate Planning – responsible for preparation of strategic plan, business plan, multi-year capital investment plan, and multi-year financial plan
  - Human resources – responsible for planning and managing human resources
  - Corporate planning – responsible for preparation of strategic plan, business plan, multi-year capital investment plan, and multi-year financial plan
- Customer Service – responsible for customer connections to both water supply and sewerage network, contracts with customers, customer accounts, meter reading, billing, and collections, and local offices in the service area
  - Customer accounts – responsible for maintaining customer accounts, including establishing new accounts, agreeing terms and conditions for customer connection, maintaining records of customer complaints, issuing bills, tracking payments, and managing revenue collection. In particular, the department is responsible, in cooperation with the Company Director and the Public Relations Officer, for encouraging connection to the water supply and sewer systems
  - Meter reading – responsible for conducting readings of meters installed at customers as well as management of local meter readers.
- Operations – responsible for operating and maintaining the water and wastewater infrastructure, in particular the production and treatment facilities
  - Water supply – responsible for operating and maintaining water production, treatment and supply facilities
  - Wastewater collection – responsible for operating and maintaining wastewater collection facilities
  - Wastewater treatment – responsible for operating and maintaining wastewater treatment facilities, when such become operational.

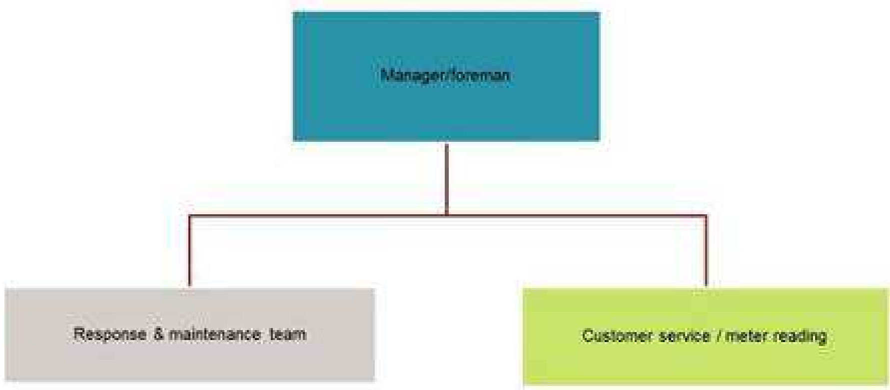
- Network maintenance and repair – responsible for maintaining and repairing the water and wastewater networks
    - Repair and maintenance brigades – teams responsible for repair and planned maintenance of water and wastewater networks
    - Fleet management – management of vehicles and mobile equipment used to operate and maintain both water and wastewater infrastructure
    - Warehouse – responsible for management of spare parts and small equipment used to operate and maintain both water and wastewater infrastructure
    - Local facilities – field offices for repair and maintenance brigades to keep basic equipment.

In designing the recommended structure for the future service provider, it was assumed that insofar as possible the existing employees would be utilised – both at the A-C Cahul as well as the other service providers in the Cahul District, provided their experience and training match that which is required.

It is recommended that field offices be established and function as offices for meter reading and payment, as well as a local technician to evaluate network emergencies and advise on a course of action. The local technician could be used immediately to address minor issues, such as shutting off valves when leaks occur until a repair brigade arrives. The field offices, therefore should contain some basic equipment for these minor interventions. It is recommended that one field office be established per cluster, apart from the central cluster (cluster “0” situated around Cahul).

The following figure (Figure 8-3) depicts the proposed organisational structure of field offices. In each case, the field offices are subordinate to their respective departments within the overall organisational structure of the regional water company.

Figure 8-3: Proposed future organisational chart, field offices



8.2.5 Proposed changes in personnel and personnel costs

In this section, the numbers of total personnel, together with costs, are proposed for the future regional water company. The following tables present in turn the proposed personnel by department, by year (Table 8-3) and the total personnel costs with and without the proposed project (Table 8-4). In this way, the incremental costs due to changes in personnel numbers can be seen.

For the current situation (2013-2014), the figures are presented from the perspective of the current A-C Cahul and all other service providers taken together. For years after 2019, the figures refer to the proposed regional water company that will replace or take over the existing service providers.

Table 8-3: Number of employees at A-C Cahul, selected years

Department	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A-C Cahul Employees	190	190	190	180	170	160	160	150	150	140	140	140	140	140	140	140	140	140
Of which, water	109	109	109	105	100	95	95	90	90	85	85	85	85	85	85	85	85	85
Of which, wastewater	81	81	81	75	70	65	65	60	60	55	55	55	55	55	55	55	55	55
Employees of other Service Providers	90	90	90	85	70	60	60	40	30	30	30	30	25	25	25	25	25	25
Of which, water	67,5	67,5	67,5	59,5	49	42	39	26	18	18	18	18	15	15	15	15	15	15
Of which, wastewater	22,5	22,5	22,5	25,5	21	18	21	14	12	12	12	12	10	10	10	10	10	10
TOTAL	280	280	280	265	240	220	220	190	180	170	170	170	165	165	165	165	165	165
Change from previous year	0	0	0	-15	-25	-20	0	-30	-10	-10	0	0	-5	0	0	0	0	0
Retirement (-)	0	0	0	14	20	10	10	20	10	11	16	12	10	10	10	8	0	0
Departure (-)	0	0	0	5	10	10	5	10	1	1	2	1	1	1	1	1	1	1
New Hires (+)	0	0	0	4	5	0	15	0	1	2	18	13	6	11	11	9	1	1

Note: Persons leaving on retirement are based on the estimate that 133 persons will be eligible and opt for retirement before 2030. This is based on the data on the current age of employees, that is, currently, 27 employees are above 60 years old, and 106 employees are between 50 and 60 years old. It is also assumed that any other retirees will come from the other service providers.

In this way, the key indicator “number of employees per 1000 connections” will decrease from the current very high value of 9.21 down to nearly 4.0 by 2025. As more connections and population are added to the service area, the key indicator “number of employees per 1000 population served” will also decrease from the current high 3.7 down to just 2.04 by 2025. These are reasonable indicators for a water company serving an area of mostly low population density.

According to the personnel plans presented in Table 8-3, the total personnel costs were calculated and presented in Table 8-4. The following assumptions were made in calculating the future personnel costs:

- Current costs were based on actual costs presented by the A-C Cahul.
- Since the costs presented by A-C Cahul were gross of social security tax, salaries were disaggregated into the following components:
  - Employer social security contributions (20.65% - based on the financial statements of A-C Cahul)
  - Employer health contributions (3.12% - based on the financial statements of A-C Cahul)
  - Employees also make contributions, but these are external to the cost structure of the water company.
- Real increases in salaries were assumed as in the financial analysis, that is: 2014 (4.4%); 2015 (4.70%); 2016 (4.6%); 2017 (4.65%); 2018 (4.70%); 2019 (4.65%); 2020 (4.7%) and 2021 and thereafter (6.0%)
- The salaries of the other employees (employed elsewhere apart from A-C Cahul) were estimated using the average salary per employee (in MDL/year) of 29,694 in 2013.
- Salary and wages costs for the “without project” scenario were calculated assuming only real increases in wages. Otherwise the current employment (and service levels) at A-C Cahul and the other service providers in the area are expected to continue.

As demonstrated in the table, if the employees of other service providers can be integrated into the organisational structure of A-C Cahul and efficiencies in the operation and maintenance of the infrastructure of both A-C Cahul and the other currently existing service providers can be realised, the project will ultimately lead to a savings in personnel expenditures compared to the situation in which no integration and expansion of water and wastewater infrastructure is undertaken. This savings is estimated at 420 thousand MDL in 2016 and it varies by year. In 2019, the “with project” scenario has a higher employment cost than the baseline scenario due to the fact that it is assumed that by this date the A-C Cahul will fully take over the operation of the water and wastewater service provisions in the service area. For the same reason, the 2020 costs are the same between the two scenarios. The estimated savings in personnel costs from implementation of the project – together with technical assistance, capacity building, and other efforts aimed at raising the efficiency of operations – are presented in Table 8-5.

Table 8-4: Personnel costs, with and without project, selected years (in thousand MDL/year)

Category	2013	2014	2015	2020	2025	2030	2035	2040	2045
With project, MDL/year	6 983	7 290	7 633	9 585	11 139	14 216	18 144	22 075	24 122
Salaries and wages, water	3 239	3 379	3 538	4 728	5 454	6 961	8 885	10 809	11 812
Employer social security contributions	669	698	731	976	1 126	1 438	1 835	2 232	2 439
Employer health contributions	101	105	110	148	170	217	277	337	369
Salaries and wages, wastewater	2 403	2 511	2 629	3 016	3 545	4 525	5 775	7 026	7 678
Employer social security contributions	496	519	543	623	732	934	1 193	1 451	1 585
Employer health contributions	75	78	82	94	111	141	180	219	240
Without project, MDL/year	6 983	7 290	7 633	9 585	12 827	16 370	20 893	25 420	27 777
Salaries and wages, water	3 239	3 381	3 540	4 446	5 949	7 593	9 691	11 790	12 884
Employer social security contributions	669	698	731	918	1 229	1 568	2 001	2 435	2 660
Employer health contributions	101	105	110	139	186	237	302	368	402
Salaries and wages, wastewater	2 403	2 509	2 627	3 298	4 414	5 634	7 190	8 748	9 559
Employer social security contributions	496	518	542	681	911	1 163	1 485	1 806	1 974
Employer health contributions	75	78	82	103	138	176	224	273	298
Incremental personnel costs (“with project” minus “without project”), MDL/year	-	-	-	-	-1 688	- 2 154	-2 749	-3 345	-3 655

Table 8-5: Estimated personnel cost savings, with project scenario, 2015-2035 (in thousand MDL/year)

Category	2015	2016	2017	2018	2019	2020	2021	2022	2023
Gross savings (-) / cost (+) of the “with project” scenario	-	-420	-879	-1 381	1 445	-	-535	-1 134	-1 202
Year	2024	2025	2026	2027	2028	2029	2030	2031	2032
Gross savings (-) / cost (+) of the “with project” scenario	-1 274	-1 688	-1 772	-1 861	-1 954	-2 051	-2 154	-2 262	-2 375
Year	2033	2034	2035	2036	2037	2038	2039	2040	2041
Gross savings (-) / cost (+) of the “with project” scenario	-2 494	-2 618	-2 749	-2 859	-2 973	-3 092	-3 216	-3 345	-3 445
Year	2042	2043	2044	2045					
Gross savings (-) / cost (+) of the “with project” scenario	-3 548	-3 655	-3 655	-3 655					

8.2.6 **Financial needs and resources**

Currently Apa-Canal Cahul has limited financial resources from tariff to invest into operating equipment.

The needs for the expanded operator include:

- leakage detection equipment and services: comprehensive hydraulic modelling of the distribution system with appurtenant measurements and model calibration and leakage detection program and leakage detection equipment (loggers, correlator) including water utility staff training;
- GIS system and its implementation, including inventory of existing assets;
- SCADA system for distance monitoring and automatic control of pumping stations and other equipment;

9 Organization of sewage collection and treatment.

9.1 Requirements for sewage collection and treatment.

The legal requirements for sewage collection and treatment are established by several regulatory acts, and especially in the Government's Decision No. 1141/10.10.2008 on approval of the Regulations of Conditions for Urban Sewage Evacuation to Natural Recipients. According to point one of these Regulations, their aim is to protect the environment against pollution caused by sewage evacuation, as well as to set admissible limit values of the main quality indicators for these waters. The conditions for sewage evacuation are presented in Annex No.1 to these Regulations.

According to point 3 of the Regulations, its provisions cover only treated urban sewage and sewage evacuated from sewage treatment stations. The provisions of the Regulations apply to:

a) Design, endorsement and, as appropriate, authorization of new water use works, as well as discharge of sewage from the existing treatment stations, extension or technological re-development of facilities that evacuate treated or untreated sewage;

b) Establishment of the degree of preliminary treatment of industrial sewage entering the collection systems and urban water treatment stations.

The Regulations stipulate that before evacuation to natural recipients, household and industrial sewage collected within the municipal sanitation network shall be subject to a corresponding treatment, according to provisions of this Regulations and the current legislation.

The urban sewage treatment stations built in compliance with conditions of these Regulations have to be conceived, designed, built, run and maintained so that to have sufficient performance in all the climate conditions specific to the place where they are located. It is necessary to take into consideration the seasonal variations of load at the moment of conceiving these installations.

Also, it is required for evacuations from urban sewage treatment stations to correspond to prescriptions in Annex No.1 of the Regulations.

Analysis of sewage discharged from the basins shall be based on filtered samples. Nevertheless, solid material concentration in total suspense of non-filtered water samples cannot exceed 150 mg/l.

For evacuations from urban sewage treatment stations in sensitive areas, prescriptions from Annex No.2 of the Regulations on Conditions for Evacuation of Urban Sewage Evacuation in Natural Recipients apply.

Sanitary epidemiological requirements for the quality of treated sewage discharged in natural recipients come under the competence of the Ministry of Health.

Evacuation points for urban sewage are chosen based on the maximum reduction of effects on the recipient.

Treated sewage shall be reused every time it is possible with endorsement of relevant authorities depending on the origin and field of use. Re-use of these waters has to take place under the conditions of reduction to the minimum of negative effects on the environment.

Mud resulted from sewage treatment shall be treated and deposited correspondingly or reused when it is necessary. The procedure for its depositing or use has to reduce to the minimum the negative effects on the environment and is specified in design projects of new treatment stations or in water management authorizations.

Mud use can take place only with endorsement of the line authorities depending on the origin and field of application.

Industrial and household sewage discharged in urban sanitation networks shall comply with the technical conditions and requirements of authorizations for sewage discharge in the sanitation systems of localities.

The Regulations also provide for certain restrictions regarding evacuation of urban sewage, and namely establish that sewage evacuated to natural recipients cannot contain:

a) Polluting substances with a high degree of toxicity stipulated under point 17 of the Regulations, as well as substances prohibited by specialized studies;

b) Solid materials in suspense over the admitted limit that could lead to depositions in minor beds of water courses or in lake ditches;

c) Substances that could lead to turbidity increase, foaming or change in the organoleptic properties of recipients compared to their natural condition.

Point 17 establishes classes and groups of substances especially selected based on their toxicity, persistency and bioaccumulation, and namely:

a) organohalogen compounds;

b) organostanne and organophosphoric compounds;

c) substances with cancer-generating properties;

d) organic mercury compounds;

e) organosilicate compounds;

f) radioactive waste concentrated in the environment or in aquatic organisms.

It is prohibited to evacuate individual substances belonging to classes or groups of substances listed under point 17 that are highly dangerous to natural recipients together with sewage.

Sewage coming from curative or preventive healthcare institutions (infectious diseases hospitals, tuberculosis sanatoriums, biological medicine (serums and vaccines) preparation institutions), from zoo-technical units and slaughter houses cannot be discharge in recipients without having been subject to specific disinfection before that.

Discharge of treated sewage in the network of drainage channels, irrigation or agricultural land shall take place only with endorsement of environmental and healthcare bodies.

Chapter V of the Regulations provides for monitoring of municipal sewage evacuation from the treatment station to natural recipients. In this sense, it is stipulated that urban sewage, before being evacuated to natural recipients, has to be monitored in comliance with the control procedures established in the working project of the treatment station and in these Regulations.

Monitoring of sanitation networks and/or municipal sewage treatment stations and any direct evacuation to natural recipients makes up the obligation of all the public service providers/operators, of relevant state supervision and control bodies.

Treatment stations shall be designed or modified so that it would be possible to take representative influent, station effluent, treated effluent and final effluent samples before evacuation to the recipient.

The monitoring methods used are standard current methods applied at the national level.

Samples are taken from control points for the period of 24 hours or within regular intervals of time proportional to the debit, upon evacuation – if considered necessary, and upon entering the treatment station – in order to track the conformity with prescriptions established in these Regulations. National and, as appropriate, international sampling laboratory practices are applied: ISO or EN methods respectively, for the level of sample degradation from the moment of sampling till the moment of laboratory testing to be the smallest possible.

It is considered that treated sewage complies with the fixed maximum admissible values for relevant/interesting parameters, if water samples for each relevant parameter taken separately show that they comply with the fixed value, thus:

a) For parameters from Annex No.1 – the maximum number of samples that can deviate from the fixed concentration values expressed in concentrations and/or reduction per cents is stipulated in Annex No.3;

b) For parameters featured in Annex No.1 that are expressed in concentration values – the maximum number of samples taken under the conditions of standard running cannot deviate more than 100% from the parameter values. For concentration values that correlate to the total of solid materials in suspense, deviation can reach up to 150%;

c) For the parameters provided for in Annex No.2 – the annual average of samples has to comply with the values corresponding to each parameter.

Extreme values for corresponding water quality are not taken into consideration, if they result from an unusual situation, such as showers.

Chapter VI of the Regulations provides for the procedure for establishing admissible limit values of pollutants in sewage evacuated to natural recipients. The maximum admissible limits of sewage load with pollutants upon evacuation to natural recipients are provided for in Annex No.1 to these Regulations and represent concentrations expressed in mg/dm^3. The values of these limit concentrations are established for momentary samples, average concentrations are not allowed and they are measured at the control point located before the discharge point.

Admissible values specified above are established in compliance with the provisions of these Regulations and fit in:

1) Environmental project endorsements issued for:

a) New facilities;

b) Existing facilities modifying or improving technological sewage production or treatment processes;

c) Existing facilities providing for building up of sewage production or treatment capacity;

d) Other existing facilities that modify the value of their end parameters by investments;

2) Water management authorizations issued to:

a) New users, when water management endorsement provides for conditions similar to those covered by these Regulations;

b) Existing water users, only after having realized and applied the corresponding sewage treatment capacity.

The issuer can establish admissible values in environmental project endorsements and water management authorizations at a lower level than provided for in Annex No.1 to these Regulations based on the load of already existing pollutants in the recipient upstream from the sewage evacuation point and taking into account the characteristics of the natural recipient (according to the procedure for establishing its quality category).

For substances that do not have maximum admissible limits provided for in current standards or regulations, the former are set based on the studies developed by specialized institutions authorized by the Government's decisions. Studies shall also comprise methods of qualitative and quantitative analysis of corresponding substances, as well as adequate treatment technologies. Maximum admissible limits shall be approved by the Government in accordance with the established procedure.

In case of sewage containing polluting substances over the limit values established by these Regulations, it is obligatory to subject them to additional treatment or take adequate technological measures until reaching the admitted value.

Under the conditions created upon discharge of sewage by total or partial breakdown of treatment station, as a result of natural calamities, environmental and healthcare bodies can make derogations from provisions of these Regulations.

Within the period of biological stages activation at treatment stations, of regular inspections or performance of technological re-development works, or building up the capacity of the treatment station, given endorsement of environmental and healthcare bodies, the fish inspection, it is allowed to exceed the limit values of quality indicators, if they do not endanger the health of the population, aquatic ecosystems and do not produce material damage.

Endorsement is applied for by the water user at least 30 days before the scheduled start date of inspections, repairs, works, technological sampling or activation of biological treatment stations. The corresponding endorsement establishes the duration, for which overvalues are admitted, but not more than 30 days, as well as maximum admissible values of quality indicators for this period.

Existing users that accomplish their treatment capacity, have to conform to the requirements of these Regulations with regard to those values, for which they exceed the limit values from Annexes No.1 and No.2 to these Regulations, within 3 (three) years.

The Regulations stipulates under final provisions that public service operators or, as appropriate, owners of treatment stations or systems of sewage evacuation to natural recipients have the obligation to ensure corresponding set-up and operation of evacuated sewage debit meters registering and metering debits, to provide for facilities allowing water sampling for analysis in well-established places and, to the extent possible, to install automated evacuated sewage quality determination systems measuring parameters specific to the carried out activity. For sewage with debit over 500 l/s discharged in recipients with at least three times higher debits, dispersion/diffusion systems shall be foreseen at the evacuation point.

In order to protect water sources form pollution:

a) Sewage and/or mud containing nutrients shall be used in fertilization or irrigation of agricultural land or forests with agreement of holders of the corresponding land and with endorsement of competent authorities of the Ministry of Agriculture and Food Industry and the Ministry of Health;

b) It is obligatory to ensure impermeability of all the mud deposits. Possible infiltrations, as well as precipitation water flowing from those deposits have to be collected and treated so that to comply with the provisions of these Regulations.

The sewage sampling point is the point of final discharge of sewage in the recipient with a view to controlling the conformity to the provisions of the Regulations.

Monitoring frequency and, correspondingly, the minimum number of samples to take at regular time intervals are established by the water management authorization depending on the size of the treatment station and the qualitative impact of discharge on the natural recipient.

9.2 Wastewater balance projection.

For discussion on sewage collection and treatment, wastewater balance needs to be estimated. Basically volume of wastewater equals to the volume of water consumed. In rural areas, however it is not always true. There are two reasons for that:

- In rural areas water often is used for agriculture purposes and watering gardens;
- Results of the willingness to pay study clearly provides that many of households in rural areas does not have a proper equipment for water consumption (like bathrooms), thus often wastewater will come from toilets only;

However in long term we may expect that volume of wastewater will equal to the volume of water consumed. This will be because use of water for agriculture purposes will be limited (due to high costs of water) and more households will be properly equipped with bathrooms when economic situation will improve.

9.3 Possible measures to improve the problem of sewage collection and treatment.

9.3.1 Waste water management

The purpose of this sanitation section is to provide the reader an overview on wastewater management and to present possible solutions for the district of Cahul.

The main aspects are:

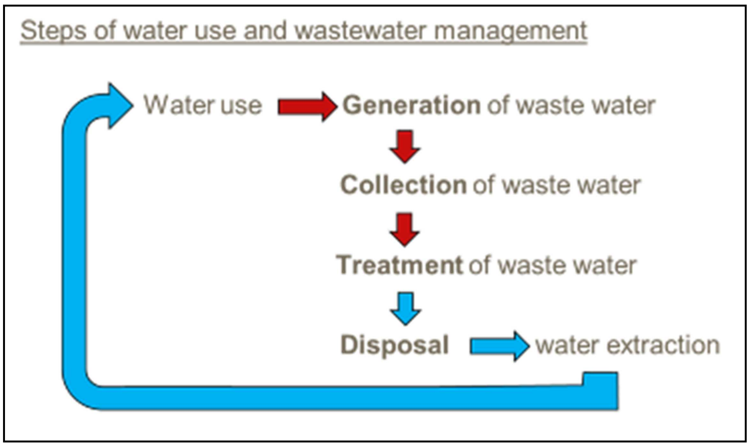
- Sanitation services presently provided in the district of Cahul
- Settlement patterns and specifics regarding wastewater management in rural vs. urban areas
- Possible options for centralized wastewater management
- Rough investment and O&M costs estimate

This shall be seen as the first step of the sanitation planning process and will provide a basic understanding regarding the planning. A feasibility study on wastewater management/sanitation for the considered area is proposed as a next step.

9.3.2 The need for waste water management

Water is a resource used by humans for different purposes: domestic water use, irrigation in agriculture, production processes etc. For these intentions, water is first taken from its natural cycle and then used for the above-mentioned objectives. Afterwards, it is given back to the natural cycle in a different location than where it was extracted, and also typically in a different quality. When back in its natural cycle the water is used by nature, or again by humans in other locations. This water/wastewater circle shows that the water is used but not depleted. The responsibility falls on humans - the water users. They must use the water in the most efficient way possible and return it to nature - preferably as close as possible to the local circle where it was extracted and with the same quality of water as was extracted.

Figure 9-1: The water/waste water management principle



We call the generation of wastewater (the use of water) the collection, treatment and disposal of wastewater as wastewater management. The objective of proper wastewater management is to protect the environment (e.g. nature in general, rivers, and underground water sources) and human health by reducing disease through riskless water consumption and proper wastewater disposal.

9.3.3 What does it take to manage wastewater?

The facilities for wastewater management are sanitation systems. Sanitation systems are a combination of different functional units that together manage the different waste water from households, institutions, agriculture or industries in order to protect people and the environment.

The main factors involved in managing wastewater:

- Collection system (a centralized sewer system or a decentralized organized collection e.g. properly managed septic tanks)
- Wastewater treatment plant (different treatment technologies available)
- Operation and management of facilities
- Customers/population paying for the service
- Funds for capital investment

9.3.4 The sanitation situation in Moldova and in the district of Cahul

Presently, there are 623 localities in Moldova that have a centralized wastewater management system. These include 3 municipalities, 52 towns and 565 rural localities. The technical condition of the sewerage networks in these localities include 25 % as satisfactory, 13 % in need of repair, 40 % requiring full refurbishment, 15 % heavily deteriorated and 7 % under construction.

The centralized wastewater infrastructure includes 464 WWTP's (Wastewater treatment plants). However, due to the poor technical conditions of the WWTPs, an estimated 80% of the wastewater volume is untreated.

In the majority of the 565 rural localities, all registered as having some kind of centralized wastewater management infrastructure, the infrastructures are obsolete, derelict and/or non-operated. 49 % of the population is living within communities where buildings have no connections to sewerage networks.14

The district of Cahul (estimated population 125.000) is comprised of 55 settlements, including one urban center - the district capital of Cahul (estimated population). The other settlements are rather rural, some containing several hundreds of inhabitants, but most having a population below 5.000.

Sanitation services are mainly provided in the city of Cahul where the utility operates the WWTP and the sewer system. The sewer system is, for the most part, in rather poor condition and the WWTP is basically outdated. The sanitation facilities in other settlements are insignificant The sanitation facilities in other settlements are insignificant except in the locality of Rosu which is connected to the sewer system of Cahul.

Table 9-1: Sanitation services in the district of Cahul. Source: Social and Economic Development Strategy For Cahul District 2012-2017, 2012

No.	Indicator	UM	Settlements			
			Total district	Urban area	Rural area	
					communes	villages
1	Number of settlements	number	55	1	36	18
2	Settlements benefiting from sewerage		4	1	10	0
3	Total population	number	124.8	39.7	77.3	7.8
4	Population benefiting from sewerage services from the public network	number	35.4	34.5	0.9	0
		%	28.4%	86.9%	1.2%	0%

These facts indicate that wastewater management's main challenge is dealing with primarily rural or semi-rural areas generating higher specific costs for centralized wastewater management and often lacking management capacities.

The administration for the district of Cahul developed a Social and Economic Development Strategy 2012-2017 (SEDS), which was approved in 2012. The WSS component of this SEDS was developed with the international support of the GIZ. The sanitation was given a rough estimation and its future developed was proposed for clustered localities. The SEDS foresees six pre-defined clusters, which, include localities located within a certain distance of one another or belong to a sub-basin of a small river. It seems reasonable that in planning for wastewater management, areas (or in case of the SEDS called clusters) and not only individual localities are focused on in order to define and choose the most appropriate solution.

For the scope of the study at hand, this clustering is alreay considered at this stage when general solutions are discussed and the specifics of rural vs. urban areas are outlined. The selection of a certain technology as well as the decisions regarding centralized vs. de-centralized facilities is an issue requiring a much more detailed analysis than this study currently contains.

9.3.5 **How to organize wastewater management?**

When thinking about organizing a wastewater management, the main task is ensuring it's sustainable. Unfortunately, there is no standard solution for wastewater management that can simply be implemented in the localities. The infrastructure needs to be redesigned according to the planning area specifications. Typically, the wastewater treatment is the

[14] Republic of Moldova's Water Supply & Sanitation Strategy (Revised Version 2012) – 2nd Draft October 2012

more complex of the two processes (the other option would be the wastewater collection) and therefore requires a, more or less, sophisticated technical facility - WWTP. On the other hand, water collection constitutes the main share of the investments when referring to centralized wastewater management and therefore opens up the question for implementing a centralized or decentralized wastewater management system.

Sanitation systems can be considered sustainable only if they protect human health as well as the environment. The systems must also be technically and institutionally appropriate, economically viable and socially acceptable. All of the factors influencing the sustainability of a sanitation system, such as local conditions, applicable regulations and user preference will play a role in finding the most ideal solution. Involvement of the users and relevant stakeholders from the start will ensure that the system is most appropriately devised for the specific locality and its economic and environmental situation.

The main steps for planning and organizing wastewater management are listed below and should be considered for feasibility and further planning:

- The identification of the problem is an important component of successful project planning. If problems and their causes are not identified, the project is more likely to fail.
- The identification, assessment and understanding of the baseline state: e.g. geographic limits, settlement patterns, socio-economic patterns, system financing, legal frameworks, natural environmental conditions or the present infrastructure.
- The definition of the requirements regarding the sanitation system and its functions, (e.g. protection of water sources…), costs and management issues etc.
- The analysis and comparison of the possible solutions with regards to all criteria. At least three solutions must fulfill the requirement terms and should be presented to the community.
- The selection of the most appropriate solutions must evaluate and compare the possible options.

9.3.6 **Wastewater treatment**

Wastewater treatment is defined as the transformation of wastewater for safe reuse or disposal in order to minimize health risks for people and protect the environment from pollution. The main substances that need to be treated/removed from domestic wastewater are solids, the biological and chemical oxygen demand (i.e. COD and BOD), nutrients (mainly nitrogen and phosphorus), and pathogenic microorganisms (pathogens). Other possible pollutants that need to be treated are heavy metals or persistent organic compounds (e.g. pesticides, pharmaceuticals, micro pollutants) mainly emitted from industry and agriculture.

Domestic wastewaters are primarily treated with the biological wastewater treatment processes. The selection of the specific technology from the different biological wastewater treatment processes depends predominantly on the context and local conditions. The main potential of wastewater treatment optimization lies in the reuse of the products (e.g. water and nutrients), the energy requirement, availability of land, the O&M structures and the optimization of scale (centralized vs. decentralized wastewater treatment).

9.3.6.1 Identification of possible treatment systems

In order to identify possible treatment systems there are two important focus points to consider: on the one hand simple and reliable processes and on the other, the treatment of the wastewater to levels corresponding with the European Commission directives for urban wastewater.

The principles below were followed when trying to define the most suitable wastewater treatment processes for the focused area. The primary treatment should be of the highest technical standard in order to avoid direct contact with the waste. For treatment processes requiring the removal of solids, fine screens that automatically remove the screenings into a container are proposed. For sand removal only aerated systems are proposed containing integrated fat removal.

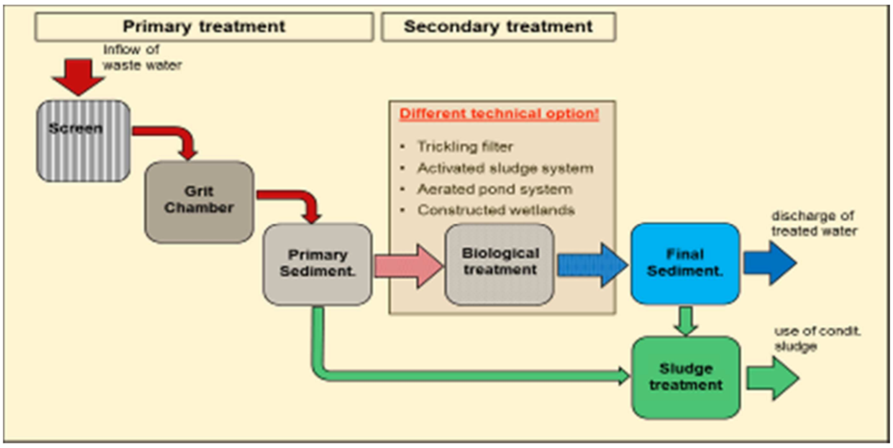
The classic activated sludge process with its primary sedimentation and a high loaded aeration tank was not considered. The connected anaerobe digestion with the reusable gas process requires sophisticated equipment, know how, experience and last but not least a competent legal and institutional framework to allow for safe and efficient operation. This is the given basis for the considered area. Only low loaded aeration tanks without anaerobic digestion are considered, which makes the facilities much simpler.

The relevant treatment systems available for application in the area are further described and analyzed:

- **Low load trickling filters** with primary sedimentation in Imhoff Tanks, followed by secondary sedimentation
- **Low load activated sludge process** without primary sedimentation
- **Aerated pond system** with primary sedimentation in Imhoff Tanks, followed by sedimentation ponds
- **Constructed wetlands** with preceding primary sedimentation in Imhoff Tanks, followed by a horizontal flow CW, a vertical flow CW, a horizontal flow CW and finally, a free water surface pond

The following process scheme shows a general set-up, which is basically identical to the proposed treatment. Only the biological treatment step uses different technologies, which are outlined below.

Figure 9-2: Scheme of the waste water treatment steps.



9.3.6.2 Primary treatment

9.3.6.2.1 Screening

For the removal of solids it is proposed to apply fine screens with 6mm strainers that automatically remove the screenings into a container. Compactors are not required, however a washing installation is recommended to reduce the total amount and organic content of the screenings making the disposal easier. The screenings are to be disposed in a landfill after drying.

9.3.6.2.2 Sand and fat removal

In domestic wastewater only little fat is contained and can be easily removed with an aerated sand and grit removal unit. For sand removal only aerated systems are proposed with integrated fat removal. Fat removal is not necessarily required for an aerated pond system, but it is strictly recommended for trickling filter systems. The removed sand is pumped into containers with dewatering wholes, then the sand can be washed by sand washing units and reused. If not washed, the sand should be disposed in a landfill.

9.3.6.2.3 Primary sedimentation

It is proposed to use the “Imhoff Tanks” for the primary sedimentation and fermentation of the settled solids. The Imhoff Tank is a two level sedimentation tank and allows effective primary treatment with minimum mechanical equipment. The disadvantage of the Imhoff Tank, as opposed to the sophisticated anaerobe digestion, which reuses gas, is that the construction is difficult due to the 10m depths and that it releases greenhouse gases such as CO2 and CH4. Pipes connected to the sludge hoppers can remove the fermented sludge, which has thickened into dry solid concentrations of up to 10%. It is proposed to pump the sludge from a common sump into sludge thickeners, which can serve as either storage or a mixing unit with sludge from the secondary treatment. Alternatively the sludge can be directly pumped into drying beds.

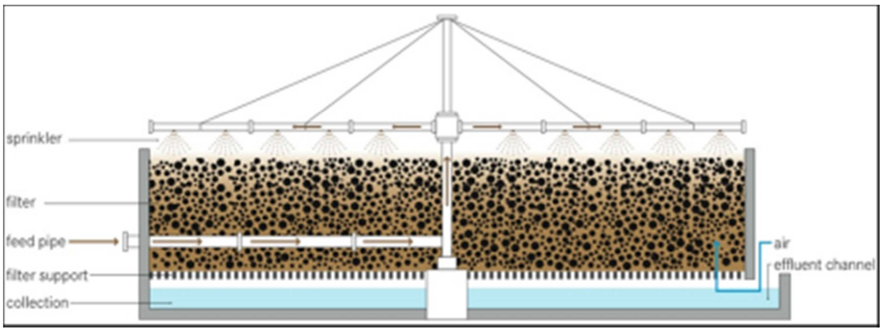
9.3.6.3 Secondary treatment

The secondary treatment step is also known as the biological wastewater treatment, as it uses microorganisms in the processing and cleansing of wastewater. Many microorganisms are able to degrade organic and inorganic substances that are present in wastewater. The secondary treatment takes advantage of this ability and supports it with aerators in order to provide optimal living conditions for the microorganisms. All further described options for the secondary treatment make use of this principle.

9.3.6.3.1 Trickling filters

Trickling Filters (also called bio-filters, biological filters and/or biological trickling filters) are aerobic fixed film systems. The bio mass - responsible for the degradation of the organic pollutants - forms a biofilm, which is fixed to a kind of filter media with a high surface area of rocks, gravel, plastic modules, etc. Trickling filters are constructed as cylindrical towers at a height of up to about 5-7m and are filled with a suitable filter media. Wastewater is pumped up to the top of the tower and distributed by rotating sprinklers over the filter material. The air circulation between the filter mediums in the open cylinder secures the aeration. It is also recommended to apply the low load type, which allows for aerobic sludge stabilization and nitrification. Trickling filters are typically applied for settlements between 1.000 and 50.000 inhabitants. Their big advantage, compared to the alternative options, is the relatively low power consumption.

Figure 9-3: Trickling filter schematic cross-section, Source: TILLEY et al. (2008)



As final the sedimentation unit, a rectangular or circular tank with a sludge scraper is proposed. Re-circulated back flow effluent water shall gravitate from a separate chamber at the effluent of the final sedimentation tank to the sump of the feeder pump and into the trickling filter. The excess sludge from the final sedimentation shall be pumped into the sludge thickener.

The sludge thickeners serve as a sludge storage unit and as a loading station (e.g. farmers using sludge in agriculture). Sludge, which is not immediately re-used can be stored and dried in the drying beds.

<u>**Advantages and disadvantages of the Trickling Filter**</u>

- Few mechanical parts (pumps, sprinkler, valves) **+**
- Easy process control **+**
- Ability to handle and recover from shock loads **+**
- Level of skill and technical expertise needed to manage and operate the system is moderate **+**
- The cost to operate a trickling filter is very low (low power consumption) **+**
- Filter needs to be covered (icing!!) **-**
- Clogging of the filter (use proper filling material and proper hydraulic operation **-**

9.3.6.3.2 Activated sludge process (ASP) – extended aeration

The activated sludge process (ASP) is the classical process applied in most treatment plants in EC countries. Activated sludge consists of flocks of bacteria, which are suspended and mixed with wastewater in the aeration tank. The bacteria use the organic pollutants to grow and transform these into energy, water, CO2 and new cell material. Oxygen has to be supplied for the organism in the aeration tank, which is equipped with aeration and mixing devices and the bacteria have to be kept floating and in contact with the wastewater.

After purification and before discharging the water it has to be separated from activated sludge in the secondary sedimentation unit. In order to keep a certain concentration of activated sludge in the aeration tank, the settled sludge from the final sedimentation unit has to be returned into the aeration tank. This is done via the return sludge pumping unit.

Figure 9-4: Activated sludge aeration tank, Source of image: T. Simmons/Indiana University of Pennsylvania

When the sludge unit load is kept extremely low, the bacteria growth is minimal and the sludge removed from the system is stabilized, meaning it cannot be further fermented and does not produce odor when anaerobically stored. This extremely low load in the activated sludge process is called extended aeration process.

The excess sludge will be pumped into static sludge thickeners. For further sludge treatment the sludge can be stored in ponds for re-use in agriculture.

Advantages and disadvantages of the Activated Sludge Process (ASP) – extended aeration

- The removal of phosphorus and nitrogen is possible (not required below 10.000 PE) **+**
- High treatment performance (removal of phosphorus and nitrogen is possible) **+**
- For the extended aeration process no primary sedimentation with the fermentation of primary sludge is required. **+**
- Little land required **+**

- High-tech centralized system, not adapted for small communities **-**
- Very high construction and maintenance costs **-**
- Operation is very expensive - requires permanent professional operation high power consumption and costly mechanical parts **-**
- Fails in case of power failure or fall-out of technical equipment **-**

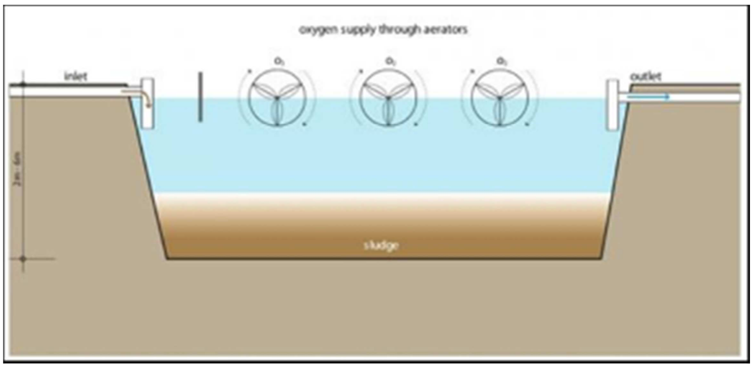
9.3.6.3.3 Aerated pond system

The aerated ponds principle operation is similar to the ASP described above, however it uses simpler electromechanical equipment and a pond instead of concrete tanks. The final sedimentation tanks are replaced by sedimentation (maturation) ponds, which do not require any mechanical equipment.

Aerated ponds can be compared to an extremely low loaded activated sludge process (ASP) as described above. The aerated ponds replace an intensified aeration step with sophisticated electromechanical equipment and the final sedimentation ponds do not require the usage of any mechanical equipment.

The aerated ponds are constructed at a depth of up to 3-4 m; the sedimentation ponds should be about 1.5 m deep. The surface areas required are pretty high and can be reduced by inserting a primary treatment, which reduces the incoming load in a range of about 30%.

Figure 9-5: Schematic view of an aerated pond. Source: TILLEY et al. (2008)



Aeration and mixing of the activated sludge flocks is achieved by simple surface aeration systems - like floating turbine aerators.

The produced excess sludge contains little water content and is nearly mineralized and thus can be easily stored and re-used. The sludge settles in the sedimentation ponds and needs to be dug out every 4 - 7 years. The aerated ponds can be constructed with a mineral sealing (clay). The system is typically applied for settlements up to a few thousand inhabitants, if the value of the land is not too high.

<u>**Advantages and disadvantages of the Aerated Pond System**</u>

- Good resistance against shock loading **+**
- Maintenance and operation relatively simple **+**

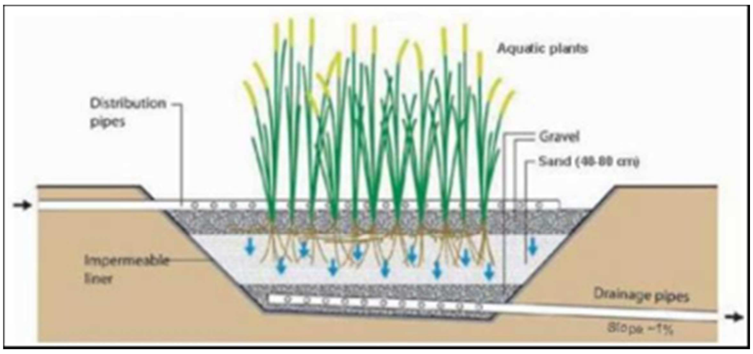
- Few mechanical parts (only aerator) +
- Can be operated by semi-professional staff +
- No problems with insects or odors if designed correctly +
- Big land requirement -
- Potentially problematic in winter time -

9.3.6.3.4 Constructed wetlands

Constructed wetlands use a natural process and provide simple and effective wastewater treatment. They are constructed and planted soil bodies, which are horizontally or vertically flown through after the primary wastewater treatment.

The wastewater must be evenly distributed and controlled across the wetland cells. A waterproof liner made of clay or geo-membrane is used on the sides and on the bottom of the cell to prevent leaks and assure adequate water for the wetland plants. This cell is planted with wetland plants such as cattails and bulrushes. Roots and stems of the plants form a dense mat creating an environment that supports a wide range of physical, chemical and microbial processes. These processes separately and in combination remove the total suspended solids (TSS), reduce the influent biochemical oxygen demand, transform nitrogen species, provide storage for metals, and cycle phosphor.

Figure 9-6: Schematic cross-section of a vertical flow constructed wetland. Source: Morel and Diener (2006)



As wastewaters flow through the system, suspended solids and trace metals settle and are filtered. Plants and organic material also absorb these trace metals. Organisms that live in water, on rocks, in soil, and on stems and roots of wetland plants use these organic materials and nutrients as food. Plants provide much of the oxygen supply for the organisms and keep the soil open with the roots activities, which, in turn, provide water flow.

<u>Advantages and disadvantages of the Aerated Pond System</u>

- Utilization of natural processes +
- No chemical & electrical energy required +
- Low operation and maintenance costs +

- High treatment performance +
- Long start up time to work at full capacity -
- Large areas land needed (e.g. 4m²/capita) -
- High quality filter material is not always available and expensive -
- Not very tolerant to cold climates -

9.3.7 Sludge treatment, sludge disposal, sludge re-use

Independently from the secondary treatment systems described in section 9.3.6.3, the removed waste load will be transformed into CO2 and into bio mass in the form of sewage sludge. The secondary (biological) treatments produce two sorts of sludge:

1. Primary sludge from primary sedimentation
2. Excess sludge from secondary treatment processes

All identified technical options in section 9.3.6.3 - except for the Extended Aeration (ASP) – use the Imhoff Tanks and related sludge production. Primary sludge from the Imhoff tanks is already well thickened and has reduced its organic matters through the fermentation process.

The excess sludge produced from the secondary treatment differs considerably in amount and dry solid concentration depending on the applied technology. The extended aeration process (ASP) has a few disadvantages due to the missing primary sedimentation process. A fundamental consequence is that the primary sludge amount is removed as excess sludge with extremely high water content. The sludge must be further de-watered in order to reduce its water content. Aerated ponds have very little excess sludge production. The removal of the accumulated sludge every 6 years is sufficient. The constructed wetland options have practically no secondary sludge production.

This sludge needs to be further processed and finally disposed or reused.

The sludge typically has a water content of more than 95% (except in aerated ponds) and needs to be dewatered. For the reduction of the water content different options can be used. The mechanical dewatering with additives, as used in western European countries, reduces the water content up to 70-80%. After the hygienisation of the sludge through thermo treatment or composting processes the sludge is disposed, incinerated or reused e.g. in agriculture.

For Moldova, and specifically in rural areas, natural de-watering processes and the re-use of the sludge in agriculture are proposed. These are not only cost efficient, but also much easier to handle.

9.3.8 Evaluation of wastewater treatment systems

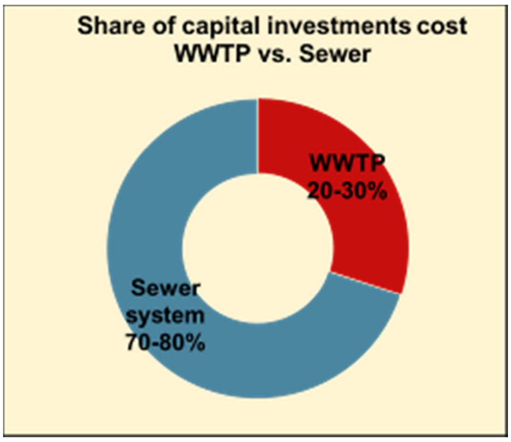
The evaluation to find the most suitable solution can only be done individually for the specific locality. The different systems described above have different advantages and disadvantages when considering technology, investment and operational costs.

The most relevant factors to be considered for selecting treatment option are:

- The settlement pattern (rural vs. urban areas)
- Other local conditions such as topography, availability of land for facilities, population commitment, etc.

It must be taken into consideration that specific costs (per capita) for treatment facilities decrease with the increasing population connected to the system. However, this should not lead to the false conclusion that a high population in connection with a central WWTP is the best solution; especially not in sparsely populated areas. This would typically require longer sewer systems, which in turn amount to the bigger proportion of the investment costs. A study of investment costs in Austria showed that the sewer systems make up 80% of the costs while the wastewater treatment facilities amount to only about 20%.

Figure 9-7: Share of investment costs of WWTP vs. sewer system

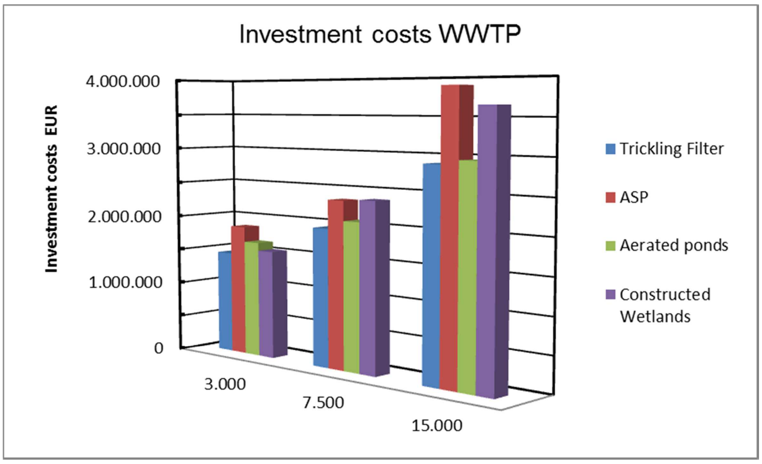


In order to illustrate the distinctions of treatment technologies, the above-described technologies have been compared in terms of investment and operation costs.

Considering the settlement patterns of the study area, the investment costs for the treatment plant size of 3.000 PE, 7.500 PE and 15.000 PE has been compared.

One can see a significant difference in the cost of investment between the various treatment technologies and the sizes of the facilities. The dominating factor in regards to the investment costs for the trickling filter and the ASP is the aeration facilities, these include the trickling filter themselves and the aeration basins contain the electro mechanical equipment.

Figure 9-8: Investment cost for the WWTP of different technologies and sizes



The aerated ponds and the constructed wetlands require much more land, which is necessary for the technology and there contains 50% of the investment costs for bigger facilities (assuming EUR 20.- per m²).

This fact already leads to the conclusion that aerated ponds and constructed wetlands are rather suitable for smaller agglomerations and/or in areas where land is available and rather cheaply so.

Beside the investment costs, the costs for operation and maintenance are also very relevant factors in the decision making process for treatment technologies. Operation and maintenance influence the wastewater management costs permanently, as opposed to the one time investment costs. Figure 9-9 show the significant differences between the technologies. The reason for the difference between the ASP and the constructed wetlands, for example, is mainly the energy consumption, which is high for the ASP and very low for the constructed wetland.

Figure 9-9: O&M cost for WWTP of different technologies and sizes

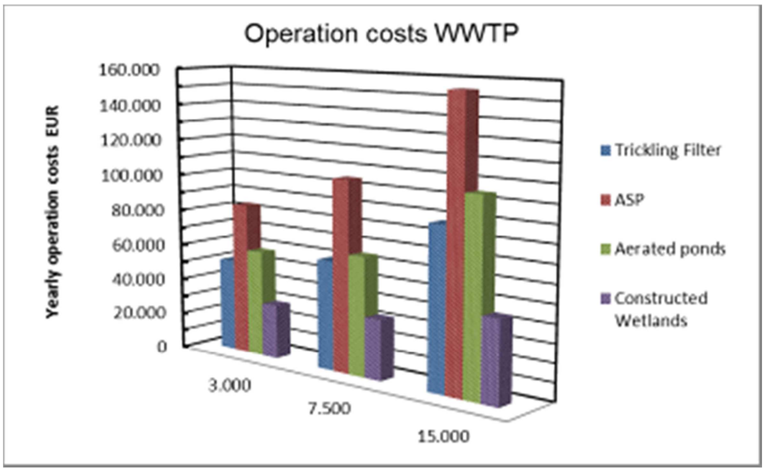
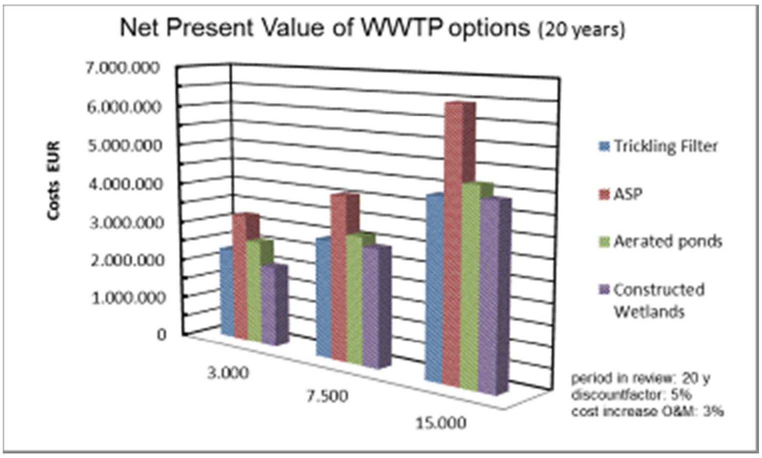


Figure 9-10 calculates and compares the net present values, the investments and the operation costs for a given period.

Figure 9-10: The NPV for WWTP of different technologies and sizes



The most suitable system and setup results point to The NPV in combination with the mentioned strengths of the different technological options and the specifications of the service area. These local specifications can be summarized by distinguishing between urban and rural areas and have the same relevance as the applied treatment technologies - the specifics are explained in the sections below.

9.3.9 Specifics of urban and rural areas

The main aspects consist of the different forms of housing schemes, the population number in the areas and the available management capacities. From a facility standpoint, it is more the wastewater collection than the treatment that is the most relevant factor. As mentioned in earlier up to 80% of centralized wastewater management cost is made up of the wastewater collection, which is typically the sewer system. In dispersed settlements the population number or households which can be connected to a certain sewer length for wastewater collection is much lower than in cities where the houses are closer together and multi-story buildings accommodate a larger number of households.

For rough estimations, we can assume that rural areas are able to connect roughly 30 households per 1 kilometre of sewer length whereas urban areas connect 150 households for the same length.

Figure 9-11: The investment costs for WWTP and sewer system and NPV for the same size and technology but with the difference of rural and urban settlement patterns

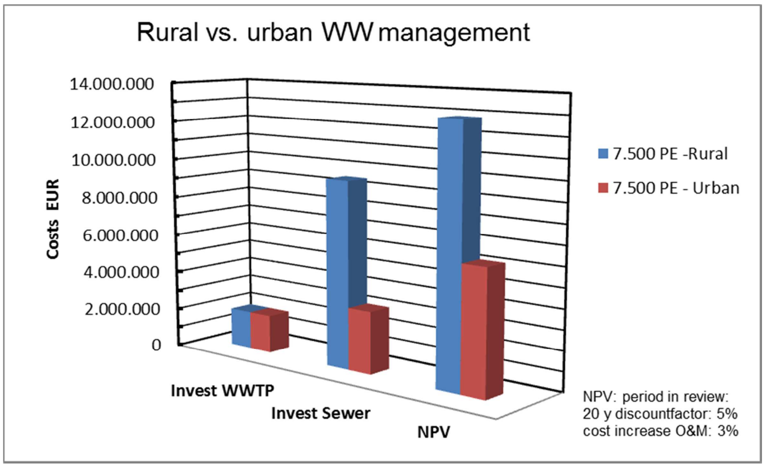
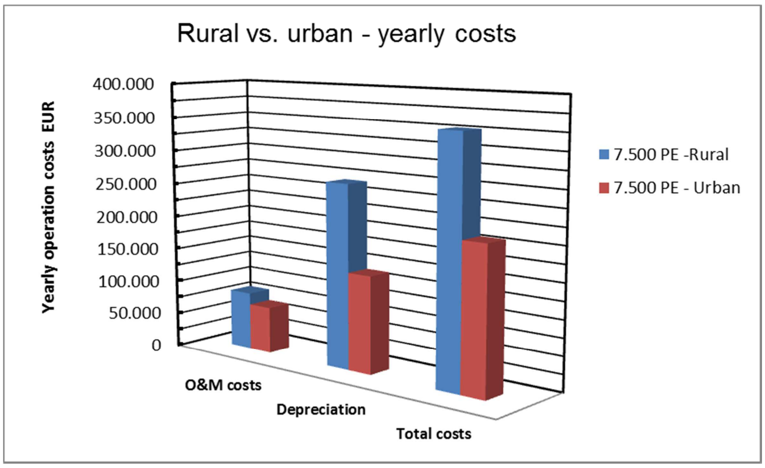


Figure 9-11 shows the investment costs (WWTP and sewer system) and the NPV (incl. operation costs) over 20 years for the same size of treatment plant using the same technology for rural vs. urban areas. Therefore, the rural area shows a significant higher NPV than for the urban settlement pattern. In this regard it is relevant to also see the effect on the operation costs and the full costs needing to be covered with the income of the utilities. The yearly costs of the wastewater management facilities consist of the operation and maintenance costs (man power, energy etc.) as well as the depreciation costs of the facilities. For the WWTP the depreciation period is calculated at 25 years, and the sewer system at 50 years. These costs are ideally passed on to the consumer of the services and should be within a range that the population can afford. Afterwards, financially sustainable wastewater services can be discussed.

Figure 9-12: The yearly O&M costs, depreciation and the sum of the total costs for WWTP and sewer system for the same size and technology but with the difference of rural vs. urban settlement patterns



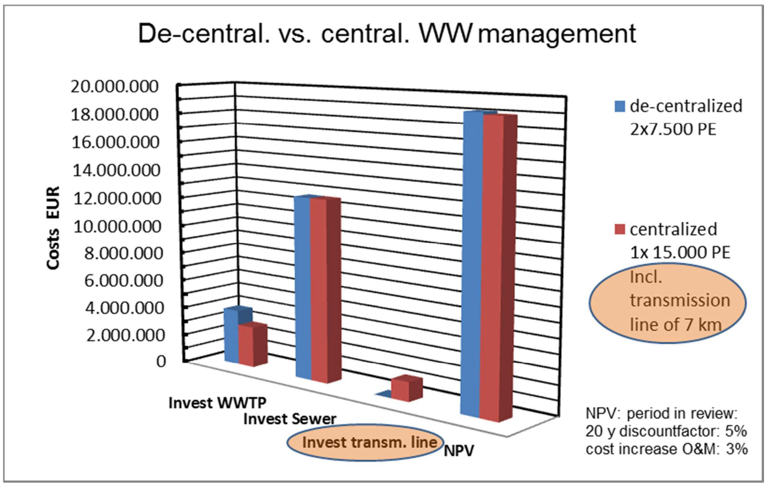
The O&M costs differ between the two systems by about EUR 17.000 due to the longer sewer system in the rural area, which is not very significant compared to the figures considering the depreciation differences of EUR 140.000.-/year. The yearly financial burden per capita in this example is EUR 27.- in urban areas and EUR 47.- in rural areas for full cost recovery, which is approximately 70% higher!

9.3.10 Centralized vs. de-centralized waste water managements systems

A very important issue, which is often discussed when planning wastewater infrastructure, is whether to establish centralized or decentralized wastewater facilities. The options to be investigated are whether to install a number of smaller decentralized WWTP's, which can help reduce the cost intensive sewer systems or to reduce the number of WWTP's altogether, which would lead to reduced investment and operation costs for the treatment. The answer lies not in one system or the other, but in the analysis of the project area as a whole, the appropriate planning process and option analysis. We know that typically centralized systems are becoming increasingly expensive mainly due to the longer sewer systems as demonstrated above (rural areas). However, only an option analysis shows which option fits for the specific area. The example in Figure 9-11, two areas with 7.500 inhabitants each and separate WWTP's (de-centralized) and sewer systems, can be used to investigate how the NPV would change if a joint WWTP (centralized) and an additional transmission line to connect the two localities would be planned.

The calculation showed that the NPV for the centralized WWTP includes a transmission line of 7km (about EUR 19 per meter), resulting in the fact that a central WWTP for the example areas is more efficient as long as the distance from the locality (which doesn't have its own WWTP) to the central WWTP is below 7km (see Figure 9-13).

Figure 9-13: The comparison of investment costs and NPV for two centralized WWTP vs. one bigger centralized WWTP



Decentralization of wastewater treatment or collection can be further downscaled to the individual house level in rural areas where the centralized systems are no longer efficient or not affordable for the consumer.

Technologies which are relatively simple (no high-tech appliances or chemical additives), allowing community organisations or private, small-scale operators to manage the system can be considered for the individual houses or small agglomerations.

Such solutions, among others, are:

Septic tanks (ST) - A septic tank is an underground watertight chamber that receives wastewater through a pipe from the inside of one or more buildings. Settling and anaerobic digestion reduce solids and organics. Septic tanks are primary treatment methods; the moderately treated effluent is infiltrated into the ground on site or transported via a sewer, which can be simplified (as there are no solids) into a secondary treatment. Accumulating faecal sludge needs to be dug out of the chamber and correctly disposed of regularly and can be collected for agricultural use.

Anaerobic baffled reactor (ABR) – is an improved septic tank, which, after a primary settling chamber, uses a series of baffles to force the wastewater to flow under and over the baffles as it passes from the inlet to the outlet. The wastewater gets in contact with the active biomass, which results in an anaerobic degradation of suspended and dissolved organic pollutants. The remaining sludge needs to be removed every 1 to 3 years and further treated (agriculture possible). The effluents need to be infiltrated into the ground on site or transported via a sewer, which can be simplified (as there are no solids) to a secondary treatment.

Small scale constructed wetlands (SCW) - is a planted filter bed for the secondary or tertiary treatment of wastewater. Pre-treated wastewater (e.g. from a septic tank) is distributed over the whole filter surface and flows vertically through the filter. The water is treated by a combination of biological and physical processes. SCW are simple in operation and maintenance and achieve a high purification performance.

ECOSAN Latrines (ESL) – are urine-diversion dehydration toilets, which are simple and low-cost, on-site sanitation facilities that make use of the dehydration processes for the safe on-site treatment of human excreta. ESL diverts all liquids, and the separately collected urine is rich in nutrients and low in pathogens, which can be used as fertiliser. Faeces from ESL can be composted for agriculture use.

Collecting pit (CP) – these are wastewater tanks with no outlets and can be used where, for example, wastewater cannot be discharge into a sewer system and a WWTP. All the wastewater accruing is stored in the wastewater tanks until it is disposed by a truck and transported to a WWTP for treatment.

9.4 Assessment of costs for waste water management in the district of Cahul

9.4.1 General and price basis and unit costs

As described in the water supply section, the entire rayon has been divided into clusters, as defined in the Socio-Economic Development Strategy. The demographic forecast developed for the water demand calculations is assumed for the waste water management too. The forecast for the year 30 is basis for the calculations.

In contrast to the water supply calculations, which according to the ToR are much more detailed than for the wastewater management, the cost assessments are based on the population and not on the water demand or the wastewater production. This is due to the uncertainty of the water consumption, especially in rural areas. The WWTP are typically designed for specific pollution loads and sewer systems for the water flow - lower water consumption does not necessarily result in a lower pollution load. An overview of costs, which should be provided within this study section are calculated in unit prices per capita that have been derived from projects in Moldova as well as in EU countries. In a separate wastewater management study which, may be planned in the nearer future, the water production and the pollution loads should be investigated and considered in the calculations.

The key figures for the assessments:

- Population:

Table 9-2: The population in the district of Cahul today and in the year 30 considered for the assessment of costs

Area	Population		
	today		in year 30
Cluster 0	42.676		58.060
Cluster A	5.420		4.009
Cluster B	8.510		7.327
Cluster C	15.518		12.306
Cluster D	11.466		8.481
Cluster E	34.070		41.491
Grupul Borceag Frumusica, Chioselia	3.207		2.371
Total	**120.867**		**134.046**

- Unit costs

Table 9-3: Units and costs used as a basis for the investment and the O&M assessment price basis for 2013

Population in the clusters	unit costs for WWTP		unit costs sewer system				
	capital investments	O&M	sewer incl. manholes	house connection	pressure pipe	pumping station	O&M Sewer&PS
	[EUR/c]	[EUR/c*y]	[EUR/m]	[EUR]	[EUR/m]	[EUR/pc]	[EUR/m*y]
< 3.000	480	19	145	500	60	35.000	0,8
3.000 - 7.000	420	15	145	500	60	35.000	0,8
7.000 - 10.000	370	13	145	500	60	35.000	0,8
clusters/localities which will be connected to the Cahul WWTP	170	7	145	500	60	35.000	0,8

- Investment costs

  Investment costs include capital investments for the WWTP and the sewer system (incl. manholes and pumping stations and pressure transmission lines) and also the costs for the house connections. The infrastructure is designed for the full coverage of the district of Cahul for the population forecasted for the year 30, based on today's prices and costs.

- Operation and maintenance costs

  The O&M costs include all costs necessary for operation as a means of operation and maintenance, manpower, incidentals and administration. The O&M is calculated for the infrastructure forecasted for the year 30; based on today's prices and costs.

- Depreciation

Table 9-4: Depreciation as % of investments used as calculation basis

Category of assets	as % of investment
Waste water treatment, pumping stations	4%
Sewer systems	2%

- Households:

  One Household was calculated to comprise of three people

9.4.2 Investment and O&M costs assessment

The cost assessments are based on the units and unit prices as well as on the population figures outlined in section 6.1. The assessment is done on a local level, but aggregated here for the clusters. For the city of Cahul, a new WWTP is calculated and a sewer system for the extension of the existing system to cover the forecasted increase of population until the year 30 is also included in the calculations. According the clusters on which this study is based on, it is preliminary planned to connect in future all localities from the clusters 0, C, and E to the WWTP in Cahul. The investment costs for the WWTP Cahul are calculated accordingly.

The total investment costs for established and centralized wastewater management systems are assessed at EUR 146,76 million, whereof EUR 27,69 million amount for the wastewater treatment and EUR 119,07 million the wastewater collection (sewer system and house connections).

Table 9-5: Investment costs assessed for the waste water management systems in the district of Cahul, aggregated for clusters

Area	Investment costs					
	Waste water treatment [mEUR]	sewer system [mEUR]	house connections [mEUR]	pressure pipes [mEUR]	pumping stations [mEUR]	Total [mEUR]
Cluster 0	9,87	8,35	3,04	0,18	0,11	21,55
Cluster A	1,68	5,06	0,67	0,76	0,11	8,28
Cluster B	2,71	10,12	1,22	1,86	0,18	16,08
Cluster C	2,09	19,09	1,89	2,70	0,28	26,05
Cluster D	3,14	13,80	1,41	1,93	0,25	20,53
Cluster E	7,05	32,25	6,92	2,81	0,28	49,31
Cluster FCB Frumusica, Chiosela, Borceag	1,14	2,81	0,40	0,54	0,07	4,96
Total	**27,69**	**91,49**	**15,55**	**10,77**	**1,26**	**146,76**

It is assumed that the implementation of all the facilities is realistic only for a period of about 15 years. Considering the price basis of the cost assessment (which is 2013), a yearly 3% price increase and a continuous and equal investment over the next 15 years, the result will be an investment package of EUR 182 million.

The assessed O&M based on the units and unit prices as well as on the population figures outlined in Table 9-3 costs is aggregated for the clusters as well.

Table 9-6: O&M costs assessed for the waste water management systems in the district of Cahul; aggregated for clusters

Area	O&M costs/depreciation						
	O&M WWTP [mEUR/y]	O&M Sewer system & PS [mEUR/y]	Total O&M per year [mEUR/y]	O&M costs per capita and year [EUR/c*y]	Depreciation per year [mEUR/y]	O&M incl. depreciation per year [mEUR/y]	O&M incl. depreciation per capita and year [EUR/c*y]
Cluster 0	0,41	0,14	0,55	9,49	0,80	1,36	23,35
Cluster A	0,06	0,04	0,10	24,50	0,20	0,30	74,74
Cluster B	0,10	0,08	0,18	24,00	0,38	0,56	75,78
Cluster C	0,09	0,14	0,23	18,48	0,57	0,80	64,67
Cluster D	0,11	0,10	0,21	25,01	0,48	0,69	81,39
Cluster E	0,29	0,22	0,51	12,19	1,13	1,64	39,49
Cluster FCB Frumusica, Chiosela, Borceag	0,05	0,02	0,07	28,58	0,12	0,19	80,57
Total	**1,09**	**2,58**	**1,84**		3,69	**5,53**	

9.5 The EU Urban Waste Water Treatment Directive and the implication for the Rayon of Cahul

In November 2013 the EU and the Republic of Moldova initialled an Association Agreement in order to further strengthen relations and cooperation between the EU and the Republic of Moldova and their citizens.

The Association Agreement aims to deepen political and economic relations between Moldova and the EU, and to gradually integrate Moldova into the EU Internal Market.

It focuses on support for core reforms, economic recovery, governance, sector cooperation and the far reaching liberalization of Moldova's trade with the EU. One of the key areas among many others is the environmental protection.

The Urban Waste Water Treatment Directive[15] (UWWTD) is one of the major water policy tools in the EU and becomes now relevant for the Republic of Moldova too. The objective of the UWWTD is to protect the environment from the adverse effects of discharges of urban waste water from settlement areas and of biodegradable industrial waste water from the agro-food sector. The UWWTD requires the appropriate collection of sewage and regulates discharges of waste water by specifying the minimum type of treatment to be provided and setting maximum emission limit values or the major pollutants.

The Association Agreement with Moldova means regarding the water quality and the resource management that the Republic of Moldova undertakes to gradually approximate its legislation to the Directive No 91/271/EEC on urban waste water treatment as amended by Directive 98/15/EC and Regulation (EC) No 1882/2003

The experience of the EU member states show that the implementation of the UWWTD has been challenging mainly because of the financial and planning aspects related to major infrastructure investment such as sewerage systems and treatment facilities.

Table 9-7: Provisions of the UWWTD to be applied following the Association Agreement

	Provisions of the UWWTD to be applied	Number of years[16] within the provisions shall be implemented.
1.	adoption of national legislation and designation of competent authority/ies	3
2.	assessment of the status of urban waste water collection and treatment	5
3.	identification of sensitive areas and agglomerations (Article 5 and Annex II)	6
4.	preparation of technical & investment programme for the implementation of the urban waste water treatment requirements (Article 17)	8

The Association Agreement foresees for Moldova within 8 years basically the identification of the status and the preparation of a programme how to implement the UWWTD in future and does not imply capital investments in waste water management.
The requirements of the UWWTD refer primarily to the waste water collection and treatment in agglomerations larger than 2,000 PE. The member states get timelines for the implementation of this directive.
Focussing now to the Rayon of Cahul we have to consider that just a view of the localities is bigger than 2,000 PE. However, it does not mean that the localities are not subject of the UWWTD as the definition of agglomerations is following:

'Agglomeration' means: an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point"

The term agglomeration refers in the first place to a <u>sufficiently concentrated area</u> for urban wastewater to be collected and conducted to an urban waste water treatment plant. Thus it is likely that in the in the Rayon of Cahul some neighbouring localities together or even a hole cluster as defined for the feasibility study at hand are considered as agglomeration. Other localities will be considered as individual agglomerations below 2,000 PE and will therefore not become subject of the UWWTD.

[15] Directive 91/271/EEC, OJ L135 of 30.5.1991

[16] Years after the entry into force of the Association Agreement

The identification of agglomerations becomes a continuous process within the wastewater management planning, including the consideration of realistic capacities of development, operation and maintenance of the system's facilities. Only thorough analyses of individual feasibility studies which study the area in much more detail can provide a proper identification of agglomerations.
The identification of the agglomerations is one of the provisions for Moldova following from the Association Agreement and shall be completed within 6 years after the entry into force of this agreement.
It can be assumed that after identification of the agglomerations according the UWWTD definition, Moldova will be focused to comply with the requirements of the UWWTD. Consequently, waste water facilities for agglomerations < 2,000 PE will follow as a next step after having covered the larger agglomerations in the national implementation programs.

10 Financial and economic analysis

The financial model is structured in nominal Moldovan leis (MDL), forecast begins in 2014.

Financial and economic analysis was based on macroeconomic assumptions on forecast of GDP per capita, wages increase and prices of electricity described below (Macroeconomic forecast).

The financial and economic analysis was prepared using incremental analysis, which considers the differences in the costs and benefits between the do something alternative(s) and a single counterfactual without the project, that is, in principle, the BAU[17] scenario[18], in reference to the EU Guide to Cost-Benefit Analysis (further EU guide) of investment projects.

The BAU scenario was prepared using following assumptions:

- Service area is restricted to the current service area of Apa-Canal Cahul, no new connections and no expanding of the service area is forecasted;
- Revenues from water services are proportional to the water demand in cluster 0;
- Revenues from sewage are proportional to the unit water consumption in cluster 0;
- Fixed costs and depreciation are not changed;
- Variable costs are proportional to the unit water consumption in cluster 0;
- No new investments are forecasted;

The details of the financial and economic analysis are presented in Annex F, tables 1-36 as follows:

- Table 1. Demographic forecast
- Table 2. Number of households
- Table 3. Water demand – households
- Table 4. Water demand – industry
- Table 5. Water demand – institutions
- Table 6. Water demand by clusters
- Table 7. Water demand – total
- Table 8. Depreciation rates
- Table 9. Summary of investment costs
- Table 10. Depreciation
- Table 11. Gross Value of Assets
- Table 12. Net assets
- Table 13. Depreciation costs
- Table 14. Electricity consumption
- Table 15. Forecast of energy prices
- Table 16. Variable costs – summary
- Table 17. Fixed costs
- Table 18. Total costs
- Table 19. Calculation of the water tariff

[17] Business as Usual

[18] In fact, the BAU scenario is an adjusted “do-minimum” scenario used as the reference solution. This is because in some cases, the BAU (do-nothing) scenario cannot be considered acceptable because it produces catastrophic effects.

- Table 20. Tariff affordability
- Table 21. Loan repayment schedule – loan 1
- Table 22. Loan repayment schedule – loan 2
- Table 23. Loan repayment schedule – total
- Table 24. Profits and losses - with project
- Table 25. Profits and losses - without project
- Table 26. Working Capital - with project
- Table 27. Working Capital - without project
- Table 28. Balance sheet - with project
- Table 29. Balance sheet - without project
- Table 30. Cash flow - with project
- Table 31. Cash flow - without project
- Table 32. Financial analysis on profitability of the investment
- Table 33. Calculation of NPV on own capital
- Table 34. Economic analysis
- Table 35. Assumptions for sensitivity analysis
- Table 36. Sensitivity analysis

The financial analysis was prepared in an annual presentation and covers a time horizon of 30 years. Calculation of NPV was conducted for a 30-year reference period as the most appropriate infrastructure investments in the water-sewer sector and also advised by EU guide for water and environment (Table 2.2 of the guide which provides reference time horizon in years).

Historical financials for 2010, 2011 and 2012 are used as the basis for the financial model. Data from 2012 is used as basis for the current costs structure and all values are adjusted to 2013.

The exchange rates used for the analysis are following:

1 EUR = 17,0397 MDL

1 USD = 12,8943 MDL

It has been assumed that the real exchange rate is unchanged over the period.

Macroeconomic forecast

1. Gross Domestic Product (per capita % of change and constant versus current)

The major source of the forecast is Poverty Reduction Strategy (source: http://www.imf.org/external/pubs/cat/longres.aspx?sk=40895.0).

The National Development Strategy (NDS)—known as "Moldova 2020"—was approved by the Parliament of the Republic of Moldova on July 11, 2012 and officially published on November 30, 2012. The Strategy is not only a policy guide for the Government of Moldova but also the base for relations with IMF and other IFOs. The Strategy sets the priorities for country development for the time horizon 2012-2020. At the same time the Strategy assumes two development scenarios one that is called as the base case scenario and the other called the scenario Moldova 2020.

The base case scenario, which regards a continuation of trends of the last decade, assumes that Moldova will develop as it has done to date, with the same economic, social, political phenomena, with rising remittances and the same pace of reforms. The base case scenario estimates an average annual GDP growth of 4.7% during 2012-2020.

The implementation of the Strategy’s priorities, considering the direct and quantifiable effects of each priority, supplements this annual growth rate by more than 1.2% annually, forming thus an alternative scenario called Moldova 2020, in this feasibility study called Optimistic scenario. The annual supplement to the additional GDP growth will emerge gradually, but will accelerate rapidly and sustainably, from 1.1% (2015) to 2.1% (by 2020), continuing beyond the analysis horizon used in this study. The difference is small at first glance, but in developed economies an annual GDP growth difference of 2% is sometimes the difference between stagnation and growth, or the difference between normal growth and economic boom. Hence, the alternative scenario assumes that, due to effects only, in 2020 the GDP will be 12% higher compared to the base case scenario and, with each year beyond 2020, this difference will grow significantly. Along with the implementation of these priorities, the annual income per capita by 2020 will be on average 12% higher compared to the base case scenario and 79% higher compared to 2011.

Taking into account that the National Development Strategy 2012-2020 that serves as the Poverty Reduction Strategy and is the official base for internal programming and for bilateral relations between the Government of the republic of Moldova and the IMF and other International Finance Organisations it may be concluded that the annual percentage changes in GDP presented in the Strategy can serve as a reference for the Feasibility Study projections.

Table 10-1: Gross Domestic Product annual percentage of change based on the information provided by Poverty Reduction Strategy (own estimations)

Scenario/ Years	2014	2015	2016	2017	2018	2019	2020
Base case scenario	4.40	4.70	4.60	4.65	4.70	4.65	4.70
Moldova 2020 scenario (Optimistic)	5.40	5.80	5.90	6.40	6.50	6.40	6.70
Pessimistic	1.00	1.10	1.30	1.75	1.80	1.75	2.00

According to the Poverty Reduction Strategy there are two scenarios of annual GDP growth rate change: the base case scenario and the Moldova 2020 scenario. The base case scenario assumes that in the period 2012 – 2020, the annual GDP growth rate will be on average 4.70%. The scenario Moldova 2020 assumes that GDP will be higher than in the base case scenario in 2015 by 1.10% and in 2020 by 2.10%. Table 3 presents GDP growth estimates from 2012-2020 based on the assumptions and figures provided in the PRSP. This Feasibility Study includes also a third scenario, pessimistic, where growth is half of the provided by base scenario.

Table 10-2: Gross Domestic Product annual percentage of change in the feasibility study (own estimations)

Scenario/ Years	2014	2015	2016	2017	2018	2019	2020
Base case scenario	4.40	4.70	4.60	4.65	4.70	4.65	4.70
Optimistic scenario	5.40	5.80	5.90	6.40	6.50	6.40	6.70
Pessimistic Scenario	2.20	2.35	2.30	2.33	2.35	2.33	2.35

Extending the GDP projection beyond 2020, it is assumed that the high growth will continue until 2025 as a result of structural reforms. In later years, however, growth will gradually slow, achieving the growth of 4% in 2040. Table 52 presents the projection of GDP 2025-2050 according to the above assumptions. In the optimistic scenario, growth will remain high, while there will be stagnation in the pessimistic scenario.

Table 10-3: Gross Domestic Product annual percentage of change projection 2025-2040

Scenario/ Years	2025	2030	2035	2040
Base case scenario	6,00	5,00	5,00	4,00
Optimistic scenario	6,00	5,00	5,00	5,00
Pessimistic Scenario	3,00	2,50	2,50	2,00

Wages

According to the Statistical Bureau of the Republic of Moldova the gross average monthly salary was 2971,7 MLD in 2010. The average salary in 2010 was higher by 8% comparing to the gross average salary in 2009. The Table 6 presents the gross average salaries in 2004 – 2010.

Table 10-4: Gross average monthly salary [MDL]

	2004	2005	2006	2007	2008	2009	2010
Gross average monthly salary	1103.1	1318.7	1697.1	2065.0	2529.7	2747.6	2971.7

Since wages growth is strictly connected to the GDP increase, this feasibility study uses the same forecast for the wage increase as for GDP increase.

Population

According to the Statistical Bureau of the Republic of Moldova, the population of Cahul Rayon has increased slightly in the past 5 years. Most of the increase, however, took place in the city of Cahul.

The Statistical Bureau of the Republic of Moldova does not provide information on a population projection – neither for the country as a whole, nor for its rayons and communities. The only population projection for Moldova was found on the World Bank web site http://go.worldbank.org/KZHE1CQFA0 .

The projection for the horizon 2010-2050 assumes decreasing population of Moldova. Using the same trend, the feasibility study uses the following assumptions:

- Population in cluster 0, which represents the city of Cahul and surrounding villages will increase by 1% annually;
- Population in cluster E, which represents the villages located along the Prut River will increase by 0.5% annually;
- Population in other clusters will decrease by 1% annually.

Electricity prices

Electricity prices have a significant influence on costs of providing services and on proposed tariff.

While electricity prices in Moldova are below the European average, they are among the highest when compared to disposable household income. Thus, the following factors will affect electricity prices:

- Regulation and government policy to keep the prices on low level;
- Price of gas as a major fossil fuel used in the power generation in Moldova;
- Situation in Transnistria, from where Moldova imports electricity at a low price due to subsidized prices of gas in Transnistria;
- Development of grid connections to Romania and Ukraine;
- General growth of the country's GDP and increase in disposable household income, which may provide the government with the possibility of relaxing control on electricity prices.

Based on these factors, the feasibility study makes following assumptions:

- By 2020, the real increase in electricity prices will be limited to 1% annually;
- In years 2020-2030, it will be proportional to the half of GDP increase;
- After 2030, it will be proportional to the GDP increase;
- In the pessimistic scenario, it will be proportional to half of GDP increase by 2020 and then it will be proportional to the GDP increase;
- In the optimistic scenario, there will be annual real growth of 1%.

The following table summarizes the assumed future electricity price increases..

Table 10-5: Increase of electrify prices [MDL]

Scenario/ Years	2014	2015	2016	2017	2018	2019	2020	2030	2040
Base case scenario	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	2.5%	4.0%
Pessimistic scenario	2.2%	2.4%	2.3%	2.3%	2.4%	2.3%	2.4%	5.0%	4.0%
Optimistic Scenario	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

10.1 Assessment of financing capacity of local entities

10.1.1 Financial assessment of the rayon and communes

The financial assessment of rayon and communes was done by reviewing their capital investments in previous years. In response to the questionnaire, the Rayon Council and 11 communes responded providing data for years 2010-2012. Most of the communes either did not allocate own funds for capital investment or allocated small amounts ranging from 10 to 100 thousand MDL. This indicates that the capacity of communes to finance capital investment is not significant and amounts of 15-20 lei per capita. The average amount of 17.5 lei per capita was used to estimate the contribution of communes.

The Rayon Council has more significant sources. The following table presents the summary of the own sources that the rayon has spent on capital investments over the previous three years and is planning in 2013.

Table 10-6: Summary of the Rayon's funds spent on capital investments [million MDL]

	2010	2011	2012	2013 (plan)
Funds allocated for capital investments from all sources	9	25.1	15.8	16.5
Funds allocated for capital investments from own budget	0.6	0.480	1.6	2.2

The support for water supply projects is not the only task of the Rayon Council, thus it was estimated that the Rayon Council would be able to spend 0.5 million MDL annually on the project.

The following table summarizes the own sources that the communes and rayon may spend for capital investments.

Table 10-7: Estimate of local contribution of communes and rayon [million MDL]

Commune	Annual contribution
Communes	2.222
Rayon	0.5
Total	**2.722**

10.1.2 Financial assessment of the water enterprise

The financial assessment of water enterprise – Apa Canal Cahul – was based on the financial statements of the water utility from 2010, 2011 and 2012. It has to be emphasized that the Apa Canal Cahul already has two loans from the World Bank of 1.5 and 2.775 million USD The details of the loans are provided in the section 10.2.3 Forecast of operating costs.

In the tables below a balance sheet, profit and loss, and cash flow statements are presented and analysed.

Table 10-8: Balance sheet of Apa-Canal Cahul [MDL]

	30.12.2010	31.12.2011	31.12.2012
Assets			
Long-term assets	**40 829 546**	**43 542 646**	**44 690 980**
Intangible assets	19 797	18 821	11 887
Long-term tangible assets	40 247 126	42 961 202	44 116 470
Long-term financial assets	562 623	562 623	562 623
Current assets	**10 682 068**	**10 223 074**	**9 653 511**
Inventories	1 178 693	1 405 019	1 475 291
Short-term receivables	2 194 294	2 432 334	2 858 709

Cash and cash equivalent	7 262 130	6 324 147	5 253 617
Other current assets	46 951	61 574	65 894
Total assets	**51 511 614**	**53 765 720**	**54 344 491**
Liabilities			
Equity capital	**16 738 374**	**16 154 633**	**16 000 975**
Share capital	14 436 045	14 436 045	14 436 045
Reserves	5 551	5 551	5 551
Undistributed profit	-1 220 594	-1 563 513	-4 194 389
Net profit in current year	*-1 121 736*	*-87 572*	*-2 627 732*
Special purpose funds	3 517 372	3 276 550	5 753 768
Long-term borrowings	**33 590 629**	**34 917 210**	**35 591 911**
Short-term liabilities	**1 182 611**	**2 693 877**	**2 751 605**
Short-term borrowings	103 375	1 455 665	1 501 860
Accounts payable to suppliers	478 786	340 114	366 365
Other accounts payable	*600 450*	*898 098*	*883 380*
to employees on remuneration of work	356 224	340 342	351 804
to employees on other operations	3 275	2 706	2 665
to the social security institution	48 832	149 353	133 735
on taxes	191 147	169 992	149 377
Total liabilities	**51 511 614**	**53 765 720**	**54 344 491**

Analysing the balance sheet one may notice that long term assets are financed form the long term borrowing (WB loans) and partially from the equity. Unfortunately, equity is small in relation to the total assets due to accumulated losses. Fortunately, short-term liabilities are insignificant however there is a big difference between current assets and current liabilities, which means that the company has very high liquidity, which is not needed.

The following tables present the structure of short-term receivables and accounts payable.

Table 10-9: Structure of short-term receivables of Apa-Canal Cahul at the end of 2012 [MDL]

Short-term c short-term receivables on commercial invoices	**31.12.2012**	
	MDL	**%**
Claim to which the payment term did not come yet	1 387 002	51%
<3 months	682 420	25%
From 3 months to 1 year	382 165	14%
> 1year	280 258	10%
Total	**2 731 845**	100%

Table 10-10: Structure of accounts payable of Apa-Canal Cahul at the end of 2012 [MDL]

Accounts payable **on commercial in-**	**31.12.2012**	
	MDL	**%**

voices		
Debts to which the payment term did not come yet	366 365	100%
<3 months	0	
From 3 months to 1 year	0	
> 1year	0	
Total	366 365	100%

The next table presents the profit and loss statement of Apa-Canal Cahul in 2010, 2011 and 2012. In all three years Apa-Canal Cahul generated losses.

Table 10-11: Profit and loss statement of Apa-Canal Cahul for 2010, 2011 and 2012 [MDL]

	2010	2011	2012
Income out of sales	***13 710 269***	***14 546 486***	***15 461 926***
– water and sanitation supply	12 132 733	13 650 782	14 057 806
– other activities	1 577 536	895 704	1 404 120
Cost of sales	***12 933 058***	***13 554 489***	***14 304 827***
– water and sanitation supply	12 566 008	13 103 401	13 692 486
– other activities	367 050	451 088	612 341
Gross profit	***777 211***	***991 997***	***1 157 099***
Other operational income	***244 811***	***350 439***	***65 310***
General and administrative expenditures	***2 082 234***	***2 139 855***	***2 251 524***
Commercial expenditures	***696 356***	***717 715***	***720 191***
Other operational expenditures	***494 949***	***514 689***	***592 478***
Result from the operational activity	*-2 251 517*	*-2 029 823*	*-2 341 784*
Profit (loss) untill tax	-1 121 736	-87 572	-2 627 732
Income tax	0	0	0
Profit net	***-1 121 736***	***-87 572***	***-2 627 732***

The next table presents cash flow statement of Apa-Canal Cahul in 2010, 2011 and 2012. In all three years, Apa-Canal Cahul had significant cash balances at the end of year.

Table 10-12: Cash flow statement of Apa-Canal Cahul for 2010, 2011 and 2012 [MDL]

	2010	2011	2012
Operational activity			
Cash receipts	15 830 272	17 816 177	17 101 006
Cash payments to suppliers and contractors	5 441 170	7 163 051	7 707 599
Cash payments to employees	6 728 317	6 659 026	6 815 050
Payment of interests	483 420	499 134	550 946
Other payments	1 463 504	2 963 015	2 110 390
Net cash flow from operational activity	**1 713 861**	**531 951**	**-82 979**

Investment activity	-242 877	-669 122	-17 000
Financial activity	-820 998	-800 812	-970 551
Net cash flow in the current period	**649 986**	**-937 983**	**-1 070 530**
Cash at the beginning of the period	6 612 144	7 262 130	6 324 147
Cash at the end of the period	**7 262 130**	**6 324 147**	**5 253 617**

The structure of costs of water supply and for wastewater services is important for the financial and economic model. The structure for 2012 is provided in two tables below.

Table 10-13: Structure of costs for water services at Apa-Canal Cahul for 2012 [thousand MDL]

	thousand MDL	MDL/m3	%
electricity	2 606.4	2.85	25.2%
labour remuneration	3 238.8	3.55	31.3%
social insurance	669.4	0.73	6.5%
health insurance	101.0	0.11	1.0%
fuel	273.4	0.3	2.6%
Depreciation	1 172.7	1.28	11.3%
material costs	1 019.7	1.12	9.8%
General and administrative expenditures	779.0	0.85	7.5%
including taxes	617.3	0.67	6.0%
Maintenance	360.7	0.39	3.5%
Other expenditures	141.3	0.15	1.4%
Total	**10 362.4**	**11.33**	**100.0%**

Table 10-14: Structure of costs for wastewater services at Apa-Canal Cahul for 2012 [thousand MDL]

	thousand MDL	MDL/m3	%
electricity	630.9	0.86	11.3%
labour remuneration	2 403.0	3.26	43.1%
social insurance	496.2	0.67	8.9%
health insurance	74.9	0.1	1.3%
fuel	225.0	0.31	4.0%
depreciation	1 174.9	1.59	21.0%
material costs	18.6	0.03	0.3%
general and administrative expenditures	423.2	0.57	7.6%
including taxes	335.3	0.45	6.0%
Maintenance	65.8	0.09	1.2%
Other expenditures	69.2	0.09	1.2%
Subtotal	**5 581.7**	**7.57**	**100.0%**

The last table in this section provides indicators of financial efficiency of the company

Table 10-15: Indicators of financial efficiency of Apa-Canal Cahul for 2010, 2011, 2012 [MDL]

Indicator	2010	2011	2012
current assets	10 682 068	10 223 074	9 653 511
short-term liabilities	1 182 611	2 693 877	2 751 605
net working capital	**9 499 457**	**7 529 197**	**6 901 906**
income from water and wastewater sales	12 132 733	13 650 782	14 057 806
water and wastewater costs	12 566 008	13 103 401	13 692 486
Result on water and wastewater services	-433 275	547 381	365 320
Profitability of water and wastewater services	**-3.6%**	**4.0%**	**2.6%**
Total revenues from operational activities	13 955 080	14 896 925	15 527 236
profit / loss on operating activities	-2 251 517	-2 029 823	-2 341 784
Profitability of operating activities	**-16.1%**	**-13.6%**	**-15.1%**
Total revenues	13 955 080	14 896 925	15 527 236
Net profit / loss	-1 121 736	-87 572	-2 627 732
Profitability of sales	**-8.0%**	**-0.6%**	**-16.9%**
the average balance of inventories	1 178 693	1 405 019	1 475 291
costs of sales	12 933 058	13 554 489	14 304 827
Inventory turnover of the stocks of goods and materials, days	**33**	**37**	**37**
Current assets	10 682 068	10 223 074	9 653 511
Short-term liabilities	1 182 611	2 693 877	2 751 605
Current liquidity	**9.0**	**3.8**	**3.5**
Money resources (440 row, F1)	7 262 130	6 324 147	5 253 617
Short term liabilities	1 182 611	2 693 877	2 751 605
Quick ratio	**6.1**	**2.3**	**1.9**

The repayment of loans coupled with the weak financial position of the utility leads to the conclusion that water utility is unable to co-finance the project. However if the pricing policy is adjusted, water utility will be able to co-finance small part of the project.

The co-financing capacity of the other water utilities from the Rayon (but excluding the city of Cahul) was not taken into account because their financial condition is too weak (basically they manage cash to cover the costs of electricity); thus, they will not contribute to the co-financing of the project.

10.1.3 Additional sources of income

There are two additional sources of project financing: “local contribution” and tariffs. Local contributions, that is co-financing of capital investment projects by citizens, are widely used in Moldova. The possible local contributions were proposed based on the experience in Moldova in implementing other investment projects. Accordingly, the estimated contribution of citizens is 1000 MDL per household connected to the system[19].

These funds will spend for local distribution network, thus households already connected to the local water supply system will not contribute because usually they already had been contributing the building of the local network. Thus only households not connect to the water supply were taken into account.

It is estimated that 20,089[20] households will be connected due to project realization. This estimates the local contribution 10.045 million MDL.

Tariffs could be a source of financing of the WSS capital project, in particular to help repay existing and future loans. On the other hand, from the analysis of the required tariff and the Affordability and Willingness to Pay Study, it is clear that in the Cahul Rayon, the tariff would be too high to be affordable at normal water consumption rates. In addition, the Apa Canal Cahul currently has a loan from the World Bank and its creditworthiness has been fully absorbed by the need to repay this loan.

Therefore, the tariff will not be used to contribute to project financing.

The following table summarizes the local sources of financing during the 5 years of project implementation.

Table 10-16: Estimate of local sources of project financing [million MDL]

Source	1	2	3	4	5	Total
Communes	2.222	2.222	2.222	2.222	2.222	11.110
Rayon	0.500	0.500	0.500	0.500	0.500	2.500
Local contribution	4.018	4.018	4.018	4.018	4.018	20.089
Apa Canal	0.000	0.000	0.000	0.000	0.000	0.000
Total	6.740	6.740	6.740	6.740	6.740	33.699

As indicated when calculating the financial gap, project is not profitable (FNPV(K)~=0) when own contribution achieve 124.560 million MDL. This means additional 90.861 million MDL shall be raised from national sources.

10.2 Financial analysis

10.2.1 Investment costs

The total investment outlays amount to 579.00 million MDL (33.977 million EUR). The outlays involve the construction of:

- 23 pumping stations,

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[19] This is not the total household spending capacity, as the connection to the water supply system also has to be financed.

[20] Out of 41 454 households, 20 528 are already connected to the water supply in the city of Cahul and in some communes. From the remaining 20 926, it is estimated that initially 70% but finally 90% will be connected. Relatively low connection rate reflects the real situation in the coutry and as well that demographical statistic does not always reflect the reality (some people are registered but do not live in Moldova).

- water towers and reservoirs of total capacity of 12,400 m3,
- main distribution pipelines of 190.6 km,
- secondary distribution pipelines of 53.7 km,
- distribution pipelines (in villages) of 365.2 km,
- 3 artesian wells,
- land appropriation of 1,260,600 m2,
- technical assistance during construction period.

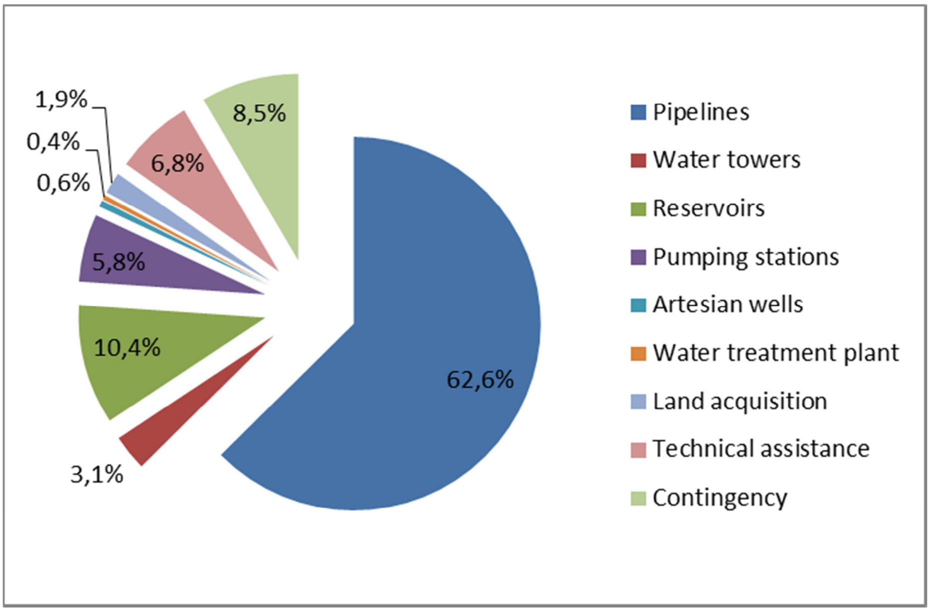
The presented construction costs were prepared using conceptual design estimates. Using the information obtained, the costs were estimated based on the team's many years of engineering experience in conducting design works, tenders and investment supervision in water management. In the calculations, the team took into account the different investment conditions. The costs are inclusive of VAT.

The costs do not include rehabilitation of already existing assets in the City of Cahul, in particular the rehabilitation of the existing water treatment plant. The rehabilitation of the existing water treatment plant is already scheduled to be financed from donor funds.

Table 10-17: Summary of the investment costs [MDL M]

	TOTAL
Pipelines	362,4
Water towers	17,9
Reservoirs	60,2
Pumping stations	33,8
Artesian wells	3,2
Water treatment plants	2,3
Land acquisition	10,7
Technical assistance	39,3
Contingency	49,1
Total	579,0

Figure 10-1: Structure of project investment outlays



10.2.2 Financing of selected option, assessment of need for additional financing (financing gap)

10.2.2.1 Project financing plan

The total investment outlays will be financed by:

- Communes and towns participating in the project
- Rayon administration
- Citizens providing local contribution
- Water utility
- Domestic and international donors.

The following methods for assessing the amount to be financed from each source of financing were used:

Table 10-18: Methods used for assessing the amount to be financed from each source of financing

Source of financing	Method used to estimate share in project financing
Communes and towns participating in the project	Review of previous 3 years spending on capital investments. 17.5 MDL per capita annually was used for estimating the share of communes.
Rayon administration	Annually, analysis of previous three years of the Rayon's spending on capital investments in WSS.
Citizens providing local contribution	The practice of "local contribution" – co-financing of capital investment projects, including water supply, by citizens – is widely used in Moldova. The estimate was based on the Affordability and Willingness to Pay Study prepared by the NGO "Contact-Cahul," as well as on experience from other projects in Moldova. The estimated contribution of citizens is 1000 MDL per household which will be con-

	nected to the system.
Domestic and international donors	The assumption is that remaining part of the investment costs will be financed by donors. Donors may not spend more than the estimated "financing gap"[21]. The calculation of the required donor contribution takes into account that the project should not lead to financial losses for residents and communes; thus, the social discount rate of 5% is used to determine the financial net present value (FNPV(K)) of the project. The donor contribution is then determined at the level at which FNPV(K) is equal to zero.
Water utility	The water utility may co-finance the project from tariffs. As the level of tariff is above affordability level, it means that currently the water utility will have no capacity to co-finance the project. Also, currently Apa Canal Cahul has no further creditworthiness due to losses and repayment of the WB loan.

The following table presents the investment outlays and its financing:

Table 10-19: Summary of the investment outlays and financing structure [MDL M]

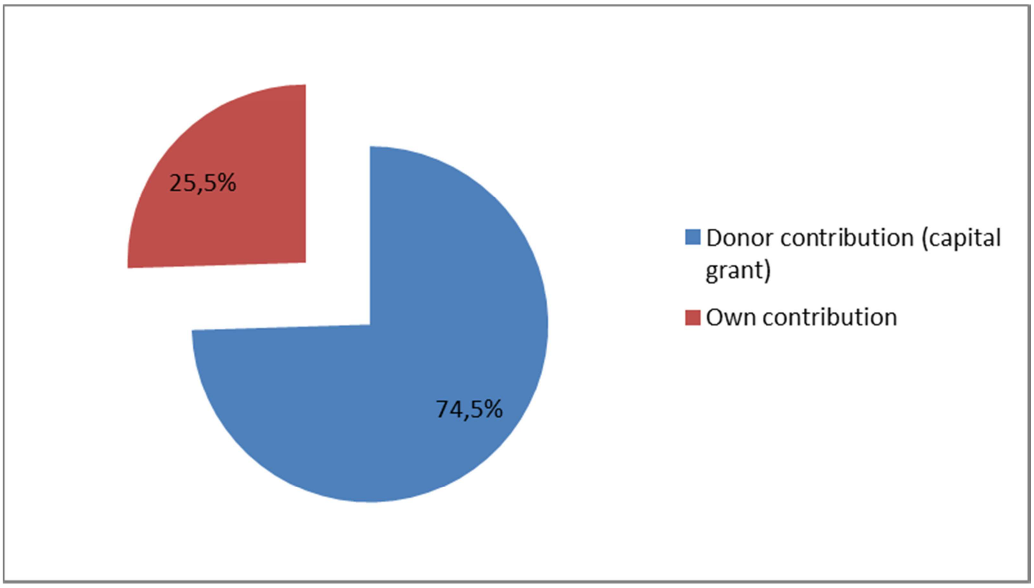
Project investment outlays	
Pipelines	362,4
Water towers	17,9
Reservoirs	60,2
Pumping stations	33,8
Artesian wells	3,2
Water treatment plants	2,3
Land acquisition	10,7
Technical assistance	39,3
Contingency	49,1
Total	**579,**0

Project financing	
Communes and towns participating in the project	11.1
Rayon administration	2.5
Citizens providing local contribution	20.1
Domestic and International donors	431.3
Other domestic sources	113.9
Water utility	0.0
Total	**579.0**

The donor contribution was estimated as 74.5% of the total investment costs, while the local sources' contribution is 25.5%.

[21] This is not an EU financing gap calculation, however, it is based on a similar assumptions.

Figure 10-2: Structure of project financing [%]



The project will be implemented during the period from 2014 to 2019 and implementation schedule is as indicated in the following table.

Table 10-20: Summary of the investment implementation schedule [MDL M]

	2014	2015	2016	2017	2018	Total
Pipelines	87,8	80,4	72,1	46,8	75,3	362,4
Water towers	8,6	5,4	3,0	0,3	0,6	17,9
Reservoirs	6,6	18,4	18,5	6,9	9,8	60,2
Pumping stations	5,6	7,6	12,3	3,0	5,5	33,8
Artesian wells	0,0	0,0	0,0	3,2	0,0	3,2
Water treatment plant	0,0	0,0	0,0	2,3	0,0	2,3
Land acquisition	3,1	2,0	4,0	0,6	1,0	10,7
Technical assistance	8,9	9,1	8,8	5,1	7,4	39,3
Contingency	11,2	11,4	11,0	6,3	9,2	49,1
Total	87,8	80,4	72,1	46,8	75,3	579,0

10.2.3 Forecast of operating costs

A detailed cost structure of Apa Canal Cahul for the year 2012 was presented in section 10.1.2 (Financial assessment of the water enterprise). The summary of the operating costs of water supply services of the Apa Canal Cahul was presented in the Table 10-13. It has to be emphasized that the analysis was limited to the costs of water supply only and excludes wastewater and other services. The cost structure was used as a basis for the expenditure forecast with and without the project.

The following assumptions were used for the expenditure forecast:

- **Direct costs for labour – salaries and benefits**. The project entails changes in staffing, which are described in section 8.2.5; For both options, an average real growth rate equal to the wages increase forecast was used. Three scenarios of wage increase were prepared (see macroeconomic forecast) and base case is presented in the financial forecast, while two other scenarios are discussed and presented in the sensitivity analysis.
- **Direct costs (chemicals for treatment)** Currently, the costs are estimated at 0,42 MDL/m3 of water treated. No real increase is forecasted.
- **Direct costs (electricity).** The following assumptions were used for unit consumption, while increase in costs of electricity is discussed in the sensitivity analysis:
    i. **For treatment in the water treatment plant in Cahul.** Currently, the electricity consumption for treatment is estimated at 0,1026 kWh/m3 of water treated. No real increase is forecasted.
    ii. **For treatment in the water treatment plant for Borceag Frumusica, Chioselia.** The consumption of chemicals for treatment is estimated at 2,685 MDL/m3 of water treated. No real increase is forecasted.
    iii. **For treatment in the water treatment plant for Alexandru Ioan Cuza.** The consumption of chemicals for treatment is estimated at 1,9233 MDL/m3 of water treated. No real increase is forecasted.
    iv. **For pumping at water intake.** Currently, the electricity consumption for treatment is estimated at 0,2685 kWh/m3 of water abstracted.
    v. **For pumping at the city of Cahul and cluster 0.** Currently, the electricity consumption for treatment is estimated at 0,6383 kWh/m3 of water treated.
    vi. **For pumping at new pumping stations.** The electricity consumption for new pumping stations was estimated, taking into account pumps parameters. The following table summarizes the unit consumption of electricity for 1 m3 of pumped water:

Table 10-21: Unit consumption of electricity [kWh/m3]

Pumping station	Unit consumption of electricity
	kWh/m3
SP1	0.0690
SP1D	0.2474
SP1E	0.1247
SP2	0.0966
SP2D	0.2103
SP2E	0.1648
SP3	0.1541
SP3D	0.3683
SP3E	0.0529
SP4	0.2122
SP4E	0.0809
SP5	0.0888
SP5	0.3421
SP5	0.1280
SP6	0.1635
SP6E	0.3307

SP7	0.1782
SP7E	0.2240
SP8	0.3045
SP9	0.0953
SP10	0.1220
SP11	0.2912
SP12	0.3690
SP17	0.9058
SP14	1.7460

Electricity consumption forecast is provided in the Annex F, table 14, price of energy forecast in the table 16[22] (current price adjusted by forecast of real changes of electricity prices)

- **Maintenance costs.** Currently, the maintenance costs are 361 thousand MDL annually. The maintenance costs (excluding labour) of a new assets was estimated as 2% of the respective assets' value.
- **Costs of fuel.** Currently, the costs of fuel for water supply are 273,4 thousand MDL annually. Due to expanding the service area, it is forecasted that costs of fuel will be tripled during the 5 years of construction.
- **Financial costs.** Currently, the financial costs depend on the fees and interest paid for two loans from WB: for 1.5 million USD and for 2.755 million USD. The financial forecast contains the loan repayment schedule for both loans.
- The conditions of the loan of 2.775 million USD are as follows:
    - The repayment period is 30 years;
    - The grace period is 6 years;
    - The commitment fee is 0,5% per tranche;
    - The interest rate is 1,5% per year.
    - Capital repayment: on every October 15th and April 15th, starting with the year 2009 up to 2033, the amount of 115 625 USD paid annually.
- The conditions of the loan of 1.5 million USD are as follows:
    - The repayment period is 30 years;
    - The grace period is 6 years;
    - The commitment fee is 0,5% per tranche;
    - The interest rate is 1,5% per year.
    - Capital repayment: on every May 15th and 15 November, starting from 2015 up to 2038, the amount of 62 500 USD paid annually.

  The loan repayment schedule is provided in Annex F, tables 21, 22 and 23.
- **General administration costs.** General administration costs are currently 141,3 thousand MDL annually. For the expenditure forecast, due to expansion of the service area, it is predicted that the costs will double during the 5 years of construction; this costs does not include staffing, changes of which, due to project implementation are described in the section 8.2.5.
- **Depreciation.** Currently, depreciation is at the level of 1 173 thousand MDL annually. After the project implementation, depreciation will increase to 16.3 million MDL annually according to the following table:

[22] It has to be noted that current price of electricity in the city of Cahul is 1.40 MDL/kWh, while in other places will be 1.58 MDL/kWh what reflects the difference in prices according to the connection line.

Table 10-22: Estimation of depreciation costs [MDL M]

Category of assets	as % of investment	MDL M
Pipelines	2.0%	7.2
Water towers	6.3%	1.2
Reservoirs	5.0%	3.0
Pumping stations	6.3%	2.1
Artesian wells	4.0%	0.1
Water treatment plant	10.0%	0.2
Land acquisition	0.0%	0.0
Technical assistance[23]	2.8%	1.1
Contingencies	2.8%	1.4
Total		**16.3**

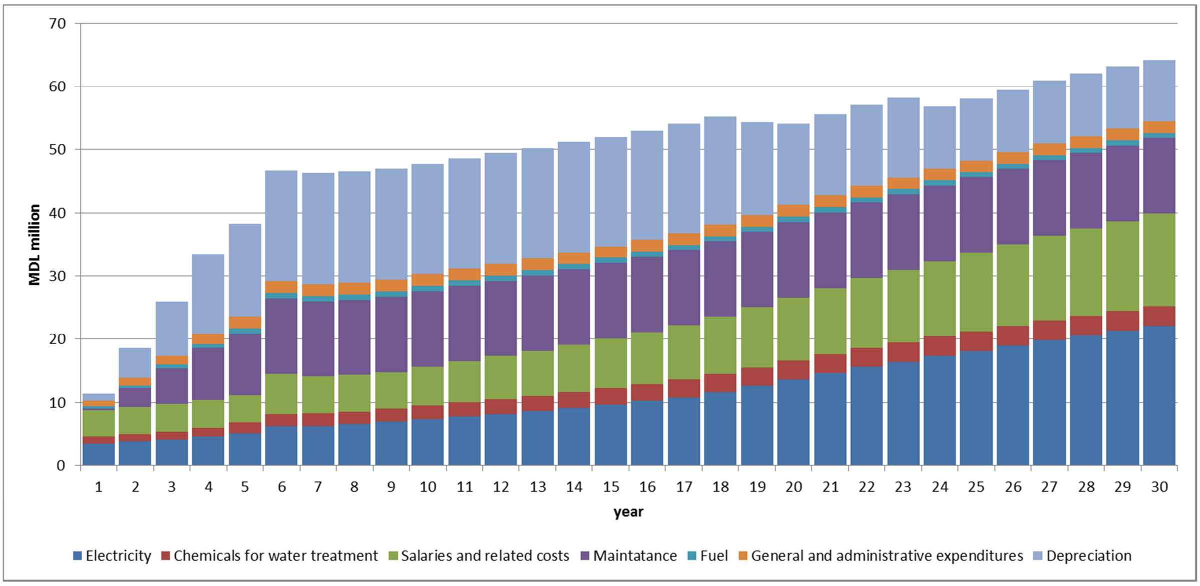
While depreciation costs are not taken into account for project sustainability analysis, they are taken into account in the tariff policy discussion.

Details on depreciation forecast are presented in Annex F, Tables 8-143which also include calculation of net assets that is further used for the balance sheet forecast.

The summary of the variable costs forecast are provided in Annex F, Table 16, fixed costs in table 17 and total (fixed and variable) in Table 18.

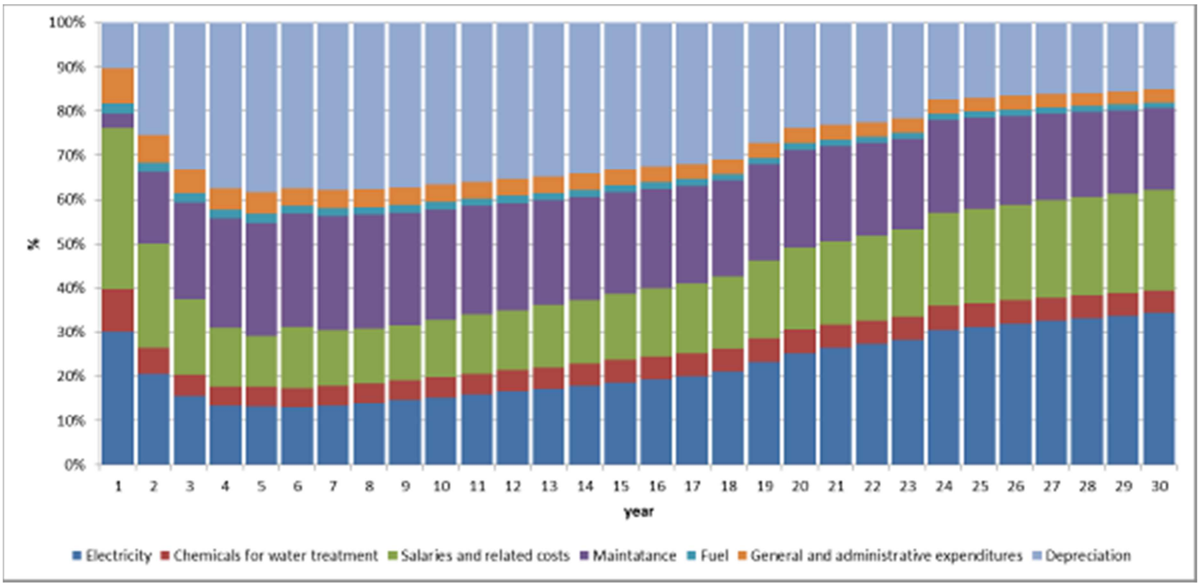
The following figures illustrate the operating costs forecast and changes in the costs structure.

Figure 10-3: Operating costs forecast [MDL M]



[23] Calculated as average of depreciation of fixed assets

Figure 10-4: Forecast of changes in the cost structure [%]



10.2.4 Revenue forecast (including tariff calculation)

10.2.4.1 Tariff calculation

To estimate revenues for the water utility in the future, an average tariff has to be assessed. This is done by taking into account:

- Operating and maintenance cost of the system: this includes direct costs of labour, energy, chemicals, fuel, maintenance, financial and administrative costs;
- The need to respect the polluter pays principle and charge a full cost recovery tariff (including depreciation) in the long run;
- The need to have a positive cumulative cash flow in the water utility to maintain sustainable operations. This means that the tariff calculation shall include reserve for irregular receivables; the forecast of irregular receivables is described in sensitivity analysis;

The table 19 in the Annex F contains calculation of the tariff without and taking into account depreciation. The proposed tariff takes into account changes in the demand (caused by price elasticity) and affordability. If tariff with depreciation exceed affordability level, lower tariff is proposed.

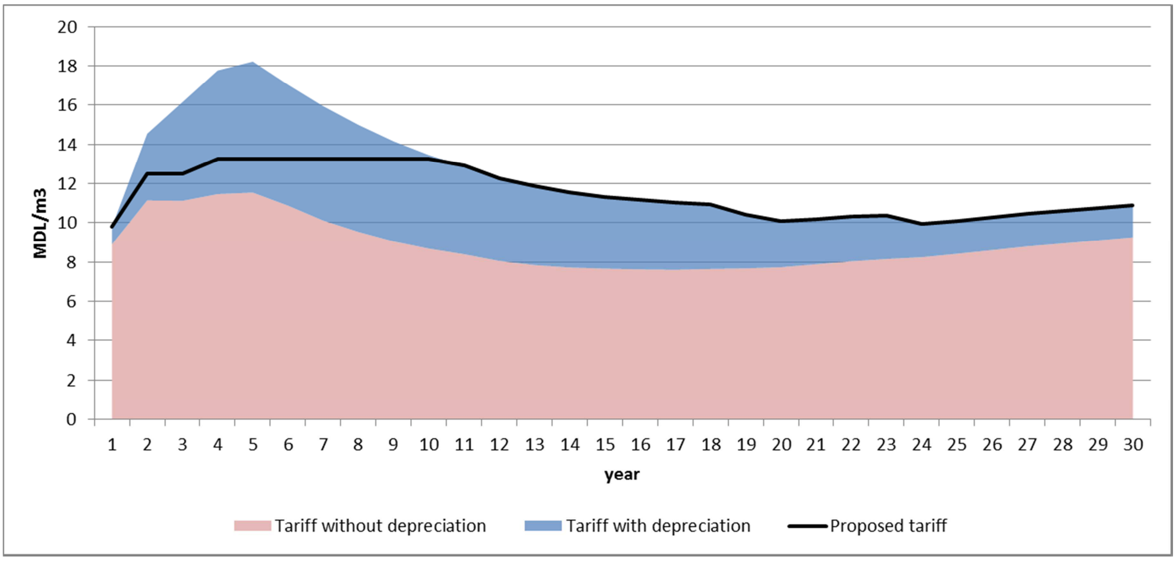
Based on the foregoing, the future tariff is proposed as illustrated in the following table.

Table 10-23: Tariff calculation for the option with the project [MDL M]

	1	2	3	4	5	10	20	30
Total costs for tariff calculation	12.79	20.13	27.69	35.25	40.02	49.42	55.54	65.82
Water sale [m3]	1 304 855	1 384 574	1 714 802	1 984 456	2 196 394	3 674 869	5 519 315	6 059 536
Tariff [MDL/m3] without depreciation	8.90	11.14	11.12	11.46	11.54	8.68	7.73	9.26
Tariff [MDL/m3] with depreciation	9.80	14.54	16.15	17.76	18.22	13.45	10.06	10.86
Proposed tariff [MDL/m3]	9.80	12.47	12.47	13.23	13.23	13.24	10.07	10.87

The following figure illustrates how the tariff was proposed. During the construction period, when capital costs raises significantly while water sale is limited, it is proposed that tariff does not contain depreciation costs of new assets. This would stimulate the water consumption and will keep the tariffs below affordability constrains. After the project is completed and water consumption will rise, the tariff may include depreciation (so it will be a full cost recovery tariff). The estimation shows that full cost recovery tariff can my applied since year 10 of the forecast.

Figure 10-5: Forecast of the tariff [MDL/m3].



10.2.4.2 Tariff affordability

The detailed analysis of the tariff affordability is presented in the section 10.3 and 10.4 while in this section the impact of tariff affordability on water consumption is analysed.

The tariff was optimised in order to determine the maximum possible price level. Together with an increase in charges, the daily unit consumption per capita is declining. Therefore, tariffs are proposed that are close to the upper limit of social acceptance levels.

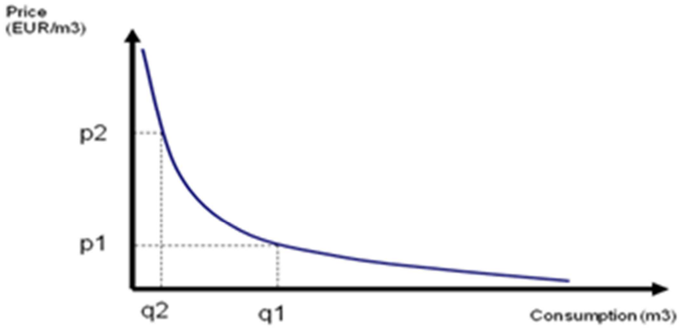
The level of optimal tariffs for water and sewage is about 3 - 4% of household income, whereas the tariffs for water only are about 1.5%-2% of household income.

The following assumptions for tariff optimization were used:

- Tariff shall at least cover calculated unit costs without depreciation;
- Tariff may not exceed calculated unit costs with depreciation;
- Current water consumption is about 60 lcd in the city of Cahul and about 50 lcd in other communes;

Price and income elasticities of demand reflect the actual observed behaviour in response to a change in quality of service. The methodology is based on the price elasticity and income elasticity of demand. Price elasticity of demand measures the responsiveness of the quantity of service demanded to a change in its price. It is found by observing the percentage change in quantity demanded in response to a one per cent change in price. It is also the slope of the demand curve (see below) and is found by dividing the change in the quantity the consumer demand by the change in the price.

Figure 10-6: Illustration of price elasticity [EUR/m3].



For most services, as the price increases, the demand for that service will decrease; thus, utility services have a negative price elasticity of demand.

Income elasticity of demand measures the responsiveness of demand for a service to a change in the real income of the customer demanding the service. It is found by observing the percentage change in demand give a percentage change in income. It is also the slope of the income-demand curve and is found by dividing the change in the quantity the consumer demands by the change in consumer's real income. For most services, as income increases, the demand for that service will also increase. Most utility services should exhibit a positive income elasticity of demand.

The consumption after the change in tariff is calculated taking into account the price elasticity of demand as follows:

$$C_{new} = C_{old} + Ep \times \frac{p_{new} - p_{old}}{p_{old}} \times C_{old} = C_{old} \times (1 + Ep \times \frac{p_{new} - p_{old}}{p_{old}})$$

Where

- C_{new} consumption of water after changing the price for households
- C_{old} current consumption of water by households
- p_{new} price of water after changing the price
- p_{old} price of water before changing the price
- Ep price elasticity of demand for water.

Another factor that will affect tariff policy and demand is income elasticity. Basically, income elasticity indicates by how much consumption will change when household income increases or decreases. In Moldova, household income is rising every year;[24] in rural areas, however, the increase is much slower than in cities, in particular Chisinau. Nevertheless, this increase will affect water demand and tariff affordability.

The consumption after the change in income is calculated taking into account income elasticity, as calculated in the following formula:

$$C_{new} = C_{old} + Ei \times \frac{I_{new} - I_{old}}{I_{old}} \times C_{old} = C_{old} \times (1 + Ei \times \frac{I_{new} - I_{old}}{I_{old}})$$

[24] Except 2009 when it decreased due to financial crisis

Where

C_{new} consumption of water after changing household income

C_{old} current consumption of water for households

I_{new} new household income

I_{old} household income before changes

Ei income elasticity of demand for water.

The financial and economic model in the feasibility study takes into account both price and income elasticity.

The elasticities depend on water consumption; thus, the following elasticity indicators were used:

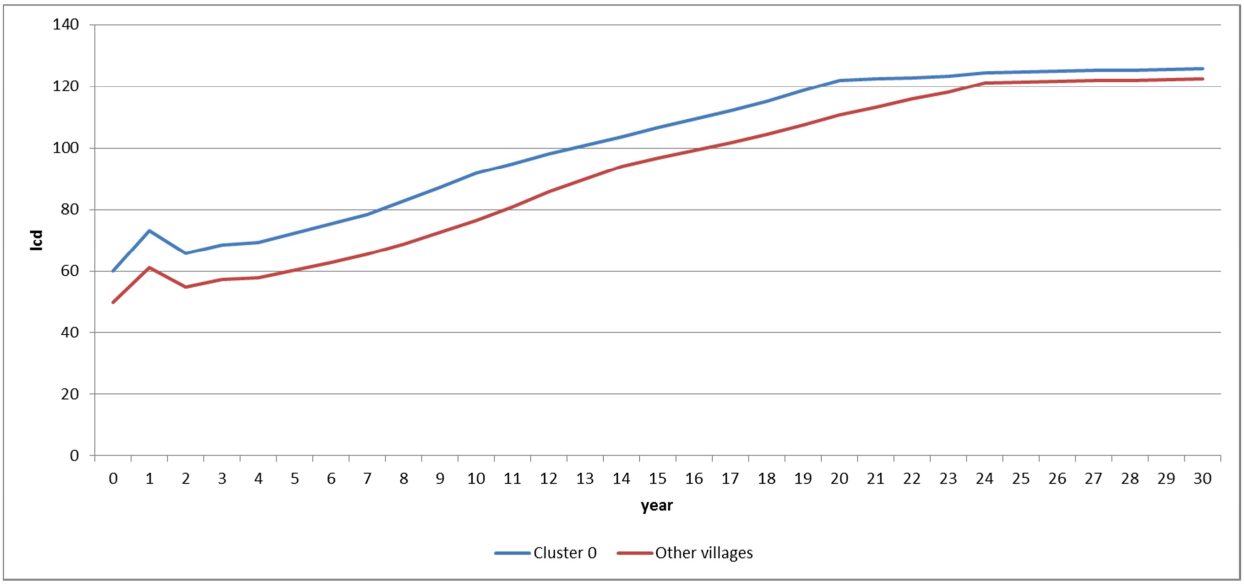
Table 10-24: Price and income elasticities

Water consumption [lcd]	elasticity
Price elasticity	
50-120	-0.1
Income elasticity	
50-90	0.9
90-120	0.5
above 120	0.1

Using the calculation presented above, the water demand forecast, presented in section 6.1, was estimated for the entire time horizon of the project. The estimate takes into account not only the affordability threshold, but the proposed tariff is optimised for the total revenue from the project.

The following figure presents the changes in unit consumption of water caused by tariff increase. After initial decrease in consumption, due to rise of the tariff, it is forecasted future increase in consumption. This increase will be caused because unit cost will decrease when the entire project is completed and due to income elasticity.

Figure 10-7: Forecast of the unit consumption of water in Cluster 0 and in other clusters [MDL/m3].



10.2.4.3 Revenue forecast

The revenues calculation was based on the demand analysis taking into account water delivered and proposed tariff for water. The revenues calculation also takes into account the other revenues of the Apa Canal Cahul (wastewater and other services) and are the revenues are the same as for BAU scenario.

10.2.4.4 Income statement

The profit and loss (income) statement illustrates the financial performance of the operator in each year of the reference period. It should be noted, however, that financial statements are more relevant instruments to assess the financial situation of business entities/commercial companies. The negative values of net profit are acceptable and do not mean that the operator will face cash flow problems during the implementation phase. In the long term, however, financial losses mean that the revenue tariffs do not cover O&M and capital costs.

The forecasted income statement was presented in Appendix F, tables 24, 25 and 26 for scenario with project, BAU and incremental.

10.2.5 Cash flow forecast and financial indicators

Working capital

The working capital sheet illustrates the current assets and current liabilities of the company and is use to estimate balance sheet and cash flow. For the calculation of working capital, following assumptions were made:

Table 10-25: Assumption for calculation of working capital

Current assets or liabilities	Average payment period
Inventory	60 days
Short-term receivables	30 days
Accounts payable to suppliers	15 days
Accounts payable to employees	30 days

As currently payment periods are different, it is forecasted that during 5 years of construction period, there will be no changes in the working capital.

The forecast of working capital is presented in the Annex F, table 26 and 27 for the “with project” and BAU scenario.

Balance sheet

The balance sheet illustrates the 'net worth' of the company. It reveals the company's assets, liabilities and owner's equity at certain point of time (e.g. end of the year). The assets must be equal to liabilities plus owner's equity. Balance sheet is an important financial statement as it indicates what the company owns and owes at the moment the balance sheet is prepared.

The balance sheet forecast is presented in Annex F, tables 28, 29 for with project and BAU scenario.

Cash flow

A cash flow analysis was carried out for the project. The cash flow statement is a basic instrument used to assess the financial sustainability of the project and the operator of the infrastructure. The purpose of carrying out a cash flow analysis is to verify whether the project operator faces of cash flow constraints. The projections were made for the entire reference period, i.e. 30 years. As cumulative cash flow is positive in each year of project analysis, the project is considered **financially sustainable**. The cash flow analysis is presented in Annex F, tables 30 and 31 for with project and BAU scenario.

The amount of the financial surplus is not sufficient to repay the new loan to increase the local contribution in the investment expenditures. On the other hand, it should be emphasised that during 30 years the project is able to direct 301.62 million MDL for replacing the pipes to decrease leakages. These additional investments are required to address the critical issues initiated by leakage detection activities.

It has to be emphasised that the table 30 in the annex F – as the major purpose is to present project sustainability – does not present incremental values but values for the “with project” option.

10.2.5.1 Financial performance of the project - NPV and IRR calculation

The analysis of NPV was based on discounting the incremental cash flows (operating surpluses) generated by the water supply system. The nominal discount rate used for the financial analysis was 5% over the entire forecast period.

In estimating NPV, no re-investment rate was assumed and thus it was assumed that the generated funds (available funds at the end of each year) are not re-invested (e.g., paid into term deposit accounts or put into treasury bills). This assumption avoids distortions in the NPV due to differences in the price of capital because usually the present reinvestment rate differs from the price of capital (in the present case, the discount rate).

A key element in determining the NPV of a project is its residual value, defined at the end of the forecast period. The residual value was defined at a level equal to the net present value of the fixed assets at the end of the forecast period.

The NPV analysis was conducted using an incremental cash flows model. This means that the financial projections were constructed in such a manner so as to identify additional cash flows generated by the investment.

The table 32 in Annex F presents the incremental cash flows used to calculate the FNPV(C) of the project. FNPV(C) means that financial net present value of the Investment is calculated. This indicator and FRR(C) - Financial Rate of Return of the Investment – illustrate the profitability of the investment project. Inflows include the increase in revenues associated with increasing the volume of water delivered. On the expenditures side, investment outlays and changes in operating costs were taken into account.

It is important to point out that the project involves an increase in the amount of water delivered. For this reason, the return on the investment should be viewed from the social rather than financial perspective.

The calculated NPV at a 5% discount rate for a 30-year operating period is negative. This attests to the fact that the project does not generate a return and is financially unprofitable.

This is a typical result for a project in which costs are incurred (capital and operating) but revenues do not significantly increase. Other investments in the water sector obtain similar results.

Negative financial indicators (rate of return) for a project cannot serve as the sole basis for determining whether a project should be pursued. These results, however, serve as the basis for estimating the social benefits associated with the project.

FNPV (C)=	-376.83	Million MDL
FRR (C)=	-1%	

The financial analysis on profitability of the own capital contribution was also conducted. The analysis is similar to that presented above, but takes into account the capital contribution to the project only and does not count grant (donor) contribution to the project.

The results are positive but close to 0, what is according to the assumption that external co-financing shall do not lead to the profitability of the own funds.

FNPV (K) =	0.00	Million MDL
FRR (K) =	5%	

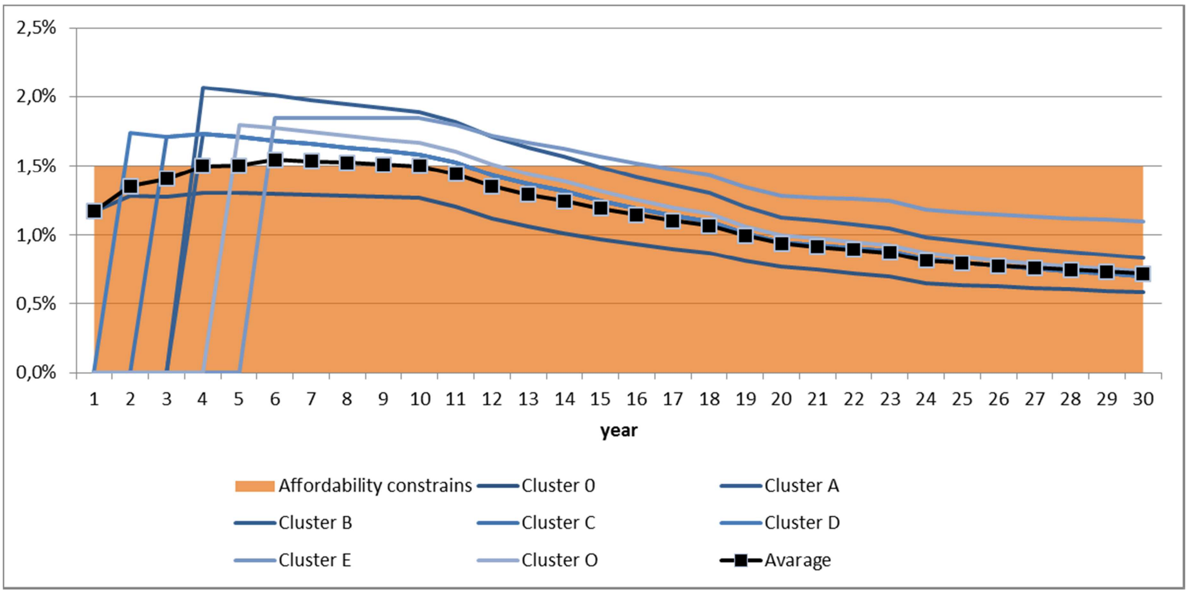
10.3 Affordability of tariffs for water supply, sewage collection and treatment

10.3.1 Affordability of tariffs for water supply

The following table presents the tariff calculation for water for households and its relation to the affordability threshold: 1.5%-2%. As discussed, the tariff should cover at least operating and maintenance costs and shall not exceed a level covering O&M and capital costs (depreciation). In case the calculated tariff is higher than the affordable tariff, a subsidy to the price from the commune was proposed. The tariff affordability, presenting the bills for water as a percentage of disposable household income, is presented in Table 20 in Annex F. The most problematic is the time period during and just after project implementation. Thereafter, the expansion of the service area, increase in household income, and higher water consumption will lead to lower unit costs and the impact of the affordability constraint will lessen. For the first years of the project implementation, it is proposed that tariff does not contain the component of capital costs (depreciation), otherwise the proposed tariff would be too high and the affordability constraint would lead to a further decrease of water consumption. The average bill in these years slightly exceeds 1.5% of average disposable household income. In order to soften the affordability constraint, it is proposed that communes in which the affordability limit is exceeded provide a subsidy to the price of water.

The proposed bill for water as a percentage of disposable household income is presented by figure below.

Figure 10-8: Proposed tariff and tariff affordability [MDL/m3]



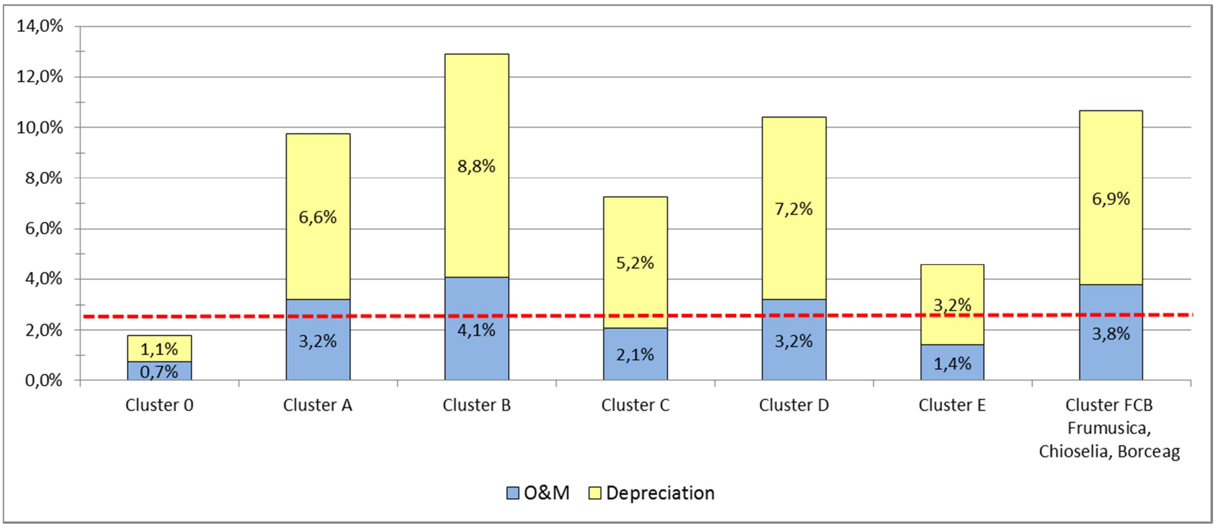
10.3.2 Affordability of tariffs for sewage collection and treatment

As explained in section 10.2.4 the level of optimal tariffs for water and sewage is about 3 - 4% of a household income, whereas the tariffs for water are only about 1.5% - 2%; consequently 2% – 2.5% remain for sanitation expenses. The tariff should cover at least operating and maintenance costs and should not exceed a level covering O&M and capital costs (depreciation).

The assessment of the affordability is based on the assessed O&M costs outlined above and on the disposable household income identified and forecasted for the district.

The chart below presents the O&M as a percentage of disposable household income. It can be seen that the O&M costs already for 4 out of the 7 clusters exceeds the threshold of 2.5% and that the depreciation exceeds the threshold by far.

Figure 10-9: O&M costs as a percentage of disposable household income



When analysing the depreciation for the individual clusters, one can clearly see that the reason for the high values is the settlement pattern and that the already described specifics of rural areas in regards to investment costs become effective. For example, the localities in Cluster B, out of 8 localities 6 have a population below 1.000, this leads to higher investment costs for wastewater collection and treatment and consequently to higher depreciation costs per capita. The clusters C and E benefit from the connection to the WWTP of Cahul which allows to make use of economies of scale and leads to lower O&M costs than a number of decentralized WWTP would cause

At the moment the clusters 0, C, and E are below the defined threshold of 2.5% and can therefore afford the wastewater services; or in other words can cover the related O&M costs. However, literature and several development institutions consider even 5% of disposable household income for water and sanitation as appropriate. In this case, in all clusters except clusters B and FCB the population would be able to afford the O&M costs. It is also necessary to take into account that the facilities can only be implemented over a certain period (assumed 15 years) and that a yearly price increase of about 3% for the investment and O&M need to be considered. In parallel the disposable household income will increase by 4% - 5% on a yearly basis according to the forecast. This means that the increase in price is smaller than the disposable household income and will influence the affordability positively and it can be expected that in all clusters the population could afford the O&M in the future, and some of them could even take depreciation into account as well.

When the local or regional administration decide to undergo a detailed investigation of the wastewater management options for the localities in the future, options for the decentralized wastewater management or on site collection and treatment should be considered. This would allow for the development of the most sustainable solution for the individual localities and would result in the instalment of centralized solutions where appropriate and affordable. It is assumed that especially in the smaller localities there is a potential to install effective, but simple facilities (see section 9.3.10) to organize the wastewater management.

10.4 Results of affordability and willingness to pay analysis

An affordability and willingness to pay study was conducted in the service area in order to investigate the following issues:

- Socio-economic conditions of households that are connected to central water supply and to wastewater treatment systems, as well as socio-economic conditions of those using other sources of water supply, including aspects that affect water consumption such as:
    i. Employment
    ii. Livestock ownership
    iii. Garden area
    iv. Greenhouse ownership.
- Average annual water consumption, by locality, in cubic meters per household per month, as reported by the local mayor
- Respondent self-estimate of water consumption
- Water consumption habits, including:
    i. Consumption of other sources of water
    ii. Consumption of bottled water
    iii. Reasons for not consuming more water
- Assessment of customer satisfaction
    i. Reasons for satisfaction
    ii. Reasons for dissatisfaction
- Self-assessment of ability to pay for improved services
- Improved water supply and quality
- Wastewater collection and treatment.

The results were divided into three groups: those connected to pipe water supply system, those without a water pipe, and those not connected to a water supply system but with access to a centralized water supply system in their community.

The survey and analysis was conducted by NGO organization "Contact-Cahul" commissioned by GIZ office in Moldova. The survey and analysis was done for each cluster separately, thus the results are provided according to cluster.

While the results are presented in the following chapters, this summary focuses on affordability and willingness to pay only; other issues are not addressed in this section of the report.

10.4.1 Cluster 0 without city of Cahul

Cluster 0 comprises the communities of Roșu, Cahul, Crihana Veche, Pașcani, Manta. Of the total number of 3350 households in rural areas, only 1456 are connected to the centralized water supply, which is an average of 485 households per village or 43%.

Part of the cluster is already connected to the water network from Apa-Canal Cahul.

Survey of households

A survey was performed in 78 households, with a total of 222 household members. The main results are summarized below.

Demographics

- Employment – the survey revealed that 31% of respondents were employed in Moldova, 16% were unemployed, whilst 33% were working abroad, 3% had their own businesses, 13% were retired, and 26% were children and youth under 16 years.
- Livestock ownership – respondents owned 1665 livestock, of which 1576 of poultry, pigs, goats and sheep – 67 and 22 meat cattle and horses.

- Garden area – most gardens have an area of 50-100m2 – 59%, followed by 20% of households with an area of 150-200m2, 14% have 100-150m2, 4% of households have gardens larger than 300 m2, and 3% of households have gardens of 250-300 m2.
- Greenhouse ownership – Most of the households surveyed have greenhouses which were grouped into several segments:100 to 200 m2 (25% of owners of greenhouses), 200-400m2 (12%) and over 400m2 (5 7%). Most greenhouses were recorded in Manta, and some in Crihana.

Households connected to a water supply system.

The average household income in this respondent group was 3334.6 lei. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Additional water sources – some households that have a water supply system also use water from other sources such as: 8 from well located on the street, 7 from well located in yard; 6 collect storm water; 3 have water delivered by cistern. Additional water is used as follows – 18 for household needs, 9 for irrigation, 9 for livestock (more than one answer was possible);
- 28% of households' daily water consumption is more than 100 litres (self-estimation), 61-100 litres for 25% of households, 21-40 litres for 21%,13% for 10 to 20l and 13% for 41-60 litres.
- 58% of respondents reported purchasing bottled water. The main reasons is that the water is often disconnected (14 respondents from Crihana and Manta) and because tap water is not potable (4 respondents);
- All respondents showed their bills. Those that did reported bills from the previous month ranging from 6 to 423 lei, with an average amount of 75.3 lei. These households consumed 8.9 m3 of water on average, and the average cost of water is about 7.5 lei/m3, varying from 6 to 9 lei/m3.
- 47% of respondents stated that they could afford to pay more for better quality water, 30% stated they were satisfied with the water quality in order to emphasise that they could not afford to pay more for water of better quality, and 23% would like to have better quality water, but could not afford it.
- Respondents overwhelmingly agreed (96%) with the proposal that they should pay for the collection and treatment of wastewater, whilst 4% disagreed.

Households that are not connected to a centralized water supply but have access to a centralized water supply system in their community.

This group included 25 of the surveyed households. The average household income in this respondent group is 2171 lei, with a range of 250 to 9000 lei.

- Source of water:
  - Shallow wells in their yard as an alternative supply – 60%;
  - About 36% of the respondents reported using water from a public well, neighbour's well, or well in the street;
  - 12% of the respondents said that they have cisterns to store the water from the centralized water pipe. The average storage capacity of the cisterns is 6.15 m3;

- Water consumption: of those that used a shallow well in their yard, the average consumption was 18.2 buckets per day. Of those that used the public well or other sources, the average consumption was 6.11 buckets per day.
- 28% of respondents reported purchasing bottled water. 4 households buy 1-5 bottles a month, two households buy 5-10 bottles a month.
- In most cases (20 households), the distance from the household to the centralized water supply network is less than 500 meters. 4 households are located at a higher distance: 500-1000m.
- 92% of the respondents would like to use water from a centralized water supply system.
- Respondents were asked to state the reason why they were not connected to the network. The most frequently given reason for non-connection to the centralized water supply system is the impossibility to pay the contribution fee required to connect (14 households). Others cited their possession of a well in the yard or some other source.
- 50% of the respondents would pay 15 lei more for water of better quality.

10.4.2 **Cluster A**

Only the biggest communities in Cluster A: Burlacu and Taraclia de Salcie, have a centralized water supply system. In Burlacu. 75% of households are connected to the centralized system, in Taraclia de Salcie – 45%. In Burlacu, only 11% of households connected to the supply system have a meter installed. In Taraclia de Salcie, no households have a meter installed and there are no recordings of water consumption.

Survey of households

A survey instrument was administered in 31 households, with a total of 103 household members, in Cluster A. The main results are summarized below.

- Most family members are children or students under 16 years - 35%, followed by the unemployed - 24% and retired - 21%. 20% of people are employed (in their own business, in the country or abroad)
- Respondents owned 532 livestock, of which 88% are poultry, pigs, goats and sheep – 11% and 1% meat cattle and horses
- Most gardens have an area of 150-300m2
- Only 2 of the 31 households surveyed have greenhouses that cover an area of 150m2 and 400m2 respectively.

Households that are connected to water supply system

- 19 were connected to the water supply system, which is 61%. Of these, 16 households have tap out in the yard;
- 53% of the households with water supply, have their wastewater handled by septic tank with leach fields directly into the soil, while 36% use direct leaching into the soil and 11% of households have septic systems with truck disposal of wastewater.
- Most households that have a water supply system also use water from other sources such as: 36% well located in yard, of which 5% of households have installed pump in the well; 32% well located on the street and 27% collect rainwater.

- Use of additional water sources – 35% for household needs, 34% for irrigation, 31% for livestock.
- 32% said they used more than 21-40 litres per day (per household), 21% consumed 41-60 litres per day. The largest volume of water consumed - 100 litres per day - is reported by 5% of respondents. Average daily consumption per household is about 41-60 litres;
- 37% of respondents reported purchasing bottled water.
- 74% of the respondents said that main reason of low consumption is that “our current consumption is sufficient.” Only 16% of respondents cited as their main reason high costs and lack of funds for paying for water. Finally, 10% cited as their main reason that they lacked money to invest in bath and kitchen equipment that could be used to increase consumption.
- Only some of respondents showed their bills. Those that did reported bills from the previous month ranging from 7 to 30 lei, with an average amount of 18.3 lei. These households consumed 4 m3 of water on average, and the average cost of water is about 5.5 lei/m3, varying from 3 to 7 lei/m3;
- 63% of respondents stated that they could afford to pay more for better quality water, 11% stated they were satisfied with the water quality and price, and 26% would like to have better quality water, but could not afford it.
- Of those stating they could afford to pay more for better quality water, 53% stated they could pay 1-3 lei more per 1 m3 and 23% of the respondents stated they could pay 4-7 lei more for 1 m3,.
- Respondents overwhelmingly agreed (88%) with the proposal that they should pay for the collection and treatment of wastewater, whilst 12% disagreed.

Households that do not have a water pipe

- 60% of households indicated that the main source of water are shallow wells, with an average of 6.5 buckets per day. The other part of the respondents indicated that they use water from a public well or neighbour's yard, with an average consumption of 4.6 buckets per day.
- Participants who do not have the yard or nearby wells use tanks. On average, tanks have a volume of 4 m3.
- Out of the participants who use wells, 60% were satisfied and 40% are not satisfied with the quality of water. The causes of dissatisfaction are: bad taste, colour and odour.
- 83% of households surveyed said they are not aware of the quality of water they use. However all respondents do not believe that water from wells is verified by a laboratory.
- 83% said that they would like to use water from a water supply system and 17% said they do not want to so do.
- 83% said they are willing to pay for water of better quality.
- As for paying for wastewater collection and treatment, only half of the respondents answered in the affirmative or negative, of those that did answer, two-thirds are willing to pay, and one third - not.

Households that are not connected to a water pipe but have access to a centralized water supply system in their community

This group includes 6 of the surveyed households.

- Source of water
    - three of them had a shallow well in their yard
    - three of the respondents reported using water from a public well, neighbour's well, or well in the street
    - All of the households have a tank that can be filled with water
- In most cases the distance from the household to the centralized water supply network is 500-1000 meters. Less respondents are located at a distance of 1000-1500m or less than 500m.
- 83% of the respondents would like to use water from a centralized water supply system.
- The most frequently given reason for non-connection to the centralized water supply system is the impossibility to pay the contribution. Others cited their possession of a well in the yard or some other source.
- Only one of the households is willing to pay for water of better quality. They are willing to pay 15 lei/m3.

10.4.3 **Cluster C**

Part 1

Due to different situation in some villages of the cluster C, it was divided into two parts.

Part 1 consists of Doina, Iasnaia Poleana, Rumeanțev, Badicul Moldovenesc, Larga Nouă, Larga Veche, Baurci Moldoveni, Andrușul de Sus, Andrușul de Jos, Cotihana.

Of the total number of 3694 households in all villages, 1111 are connected to the centralized water supply, which is about 30%.

The average annual consumption per household per month is estimated in 5 villages, where the average is 4.67 m3 each month in summer and 6.2 m3 in winter. Average price of water services is 9 lei for 1m3 of water, varying according to the following data: Badicul Moldovan - 8 lei per m3, wide - 7 lei per m3 Andrus Upper -10 lei Andruşul Lower - or 10 or 15 lei and lei Cotihana -10 lei.

A different case is the village of Lower Andruşul, which has two rates for payment for water supply: 8 lei and 10 lei per m3. If citizens pay services before 15^{th} day of each month - the price is 8 lei and if they pay after the 15^{th}, then the price per m3 is 10 lei.

In the households in the Doina commune, meters are not installed and people do not pay for drinking water supply services.

Survey of households

A survey was performed in 60 households, with a total of 222 household members. The main results are summarized below:

- the survey revealed that 26% of respondents were employed in Moldova, followed by children and students - 24%, 17% were unemployed, 17% retired, 13% were working abroad, 3% had their own businesses.
- respondents owned 1068 livestock, of which 982 birds, 70 pigs, goats and sheep and 16 meat cattle and horses
- most gardens have an area of 100-150m2 – 27%, followed by 12% of households with an area of 150-200m2, 12% have over 200-250m2

- only two of the 60 households surveyed have greenhouses that cover an area of 100m2 and 200m2 respectively.

Of those households surveyed, the first group in Cluster [C] examined was those households that are connected to a water supply system.

The average household income of households that are connected to a water supply system is 2920 lei. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Additional water sources – most households that have a water supply system also use water from other sources such as: 8 from well located in yard, 13 from well located on the street, 4 households use rainwater;
- Use of additional water sources – 15 for household needs, 34% for irrigation, 31% for livestock
- 33% of household water consumption is 41-60 liters daily. 10 to 20 liters - 4% of households. 21-40 liter - 17%, 61-100 liter - 21%, more and more households 25% and consumes a large volume of water more than 100 liters of water.
- 58% of respondents reported purchasing bottled water. Of those, only two respondents answered that the tap water is not drinking water;
- More than half (60%) of those who buy bottled water buy 1-5 bottles per month. 10% buy 5-10 bottles per month, 20% buy 10-20 bottles and 10% buy more than 20 bottles.
- 21 households presented their bills from the previous month ranging from 8 to 220 lei, with an average amount of 50.4 MDL. These households consumed 5.55 m3 of water on average, and the average cost of water is about 9 lei/m3, varying from 7 to 10 lei/m3.
- 58% of respondents stated that they could afford to pay more for better quality water, 38% stated they were satisfied with the water quality, and 4% would like to have better quality water, but could not afford it.
- of those stating they could afford to pay more for better quality water, 7 stated they could pay 1-3 lei more per 1 m3, 4 of the respondents stated they could pay 4-7 lei more for 1 m3, while 3 would be able to pay 8-10 lei more for 1 m3. Nine respondents gave no answer to this question.
- Respondents overwhelmingly agreed (82%) with the proposal that they should pay for the collection and treatment of wastewater, whilst 18% disagreed.

The group households that do not have a piped water supply comprised of 30 households:

- More than half (53%) of responses indicated that they have shallow wells and the rest (47%) have wells in the yard.
- The average consumption is 9.33 buckets daily. As for the question about the use of water from a public well, street, or neighbour's yard, 56% answered yes, 44% - no. On average, a household uses 14.5 buckets per day.
- An alternative source is the accumulated water in the tank, which is filled by transporting water from the aqueduct. This source is used by a third of households.
- 89% want to be connected to the centralized water supply system, 11% (three households) did not.

- The majority of households surveyed (78%) said they were willing to pay for water of better quality, 11% would like to have good water but are not able to pay, and 7% are satisfied with the current situation.
- On average families interviewed could pay 58 MDL monthly for water, while amounts ranged from 10 to 200 lei per month.
- If the water supply network is built, most households indicated that they would be able to pay a contribution up to 3000 lei (37%), 1000 lei (26%), 500 lei (18%), 5000 lei (4%) and 15% would not be able to pay at all.

The third surveyed group were households that are not connected to piped water supply but have access to a centralized water supply system in their community.

This group includes nine of the surveyed households in the cluster. The average household income in this respondent group is 2133 lei, with a range of 500 to 7000 lei. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Source of water
    - o 5 shallow wells.
    - o Three other households said "I take water from a public well, the well in the courtyard or street, or neighbour".
    - o 11% of households have a water tank that can be filled with water from the AC with a volume of 2m3.
- Of those that used a shallow well in their yard, the average consumption was 7-8 buckets per day. Of those that used the public well or other sources, the average consumption was 4.33 buckets per day.
- Bottled water is purchased by two households, on average 1-5 bottles a month.
- In most cases, the distance from the household to the centralized water supply network is less than 500 meters and only in one case between 500 and 1000m.
- 67% of the respondents would like to use water from a centralized water supply system.
- The most frequently given reason for non-connection to the centralized water supply system is the impossibility to pay the contribution for connection. Others cited their possession of a well in the yard.

Part 2

Separate part of the Cluster C comprises the communities of Cucoara, Chircani, Zîrnesti, Paicu, Tretesti. The settlements have an average of about 795 inhabitants and about 318 households.

In Zirnesti and Cucoara there is a centralized water system. In the village Cucoara 75% of households are connected to the centralized water supply and 81% in Zirnesti. Treteşti lacks piped water supply. The average level of connection to a piped water supply is 78 % .The average annual consumption per household per month is about 7-7.5 m3 in summer and in 5 m3 in winter. All households in the Cluster that are connected to the centralized water supply system have water meters.

Survey of households

A survey instrument was administered in 29 households, with a total of 110 household members. The main results are summarized below.

- the survey revealed that 22% of respondents were unemployed, whilst 24% were pensioners, 18% were working abroad, 3% had their own businesses, and 19% were children under 16 years old or students.
- respondents owned 755 livestock, of which 95% are birds; pigs, goats and sheep – 4% and 1% meat cattle and horses
- most gardens have an area of 150-200m2 – 21%, 50-100m2 – 14%, 100-150m2 – 14%, 17% have gardens of 200m2 - 250m2, 17% of households have gardens larger than 300 m2, and 17% of households have gardens of 250-300 m2.
- only one household has a greenhouse, which has an area of 300m2.

Households that are connected to a piped water supply system.

The average household income in this respondent group was 2977 MDL. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- 59% of the households with water supply, have their wastewater handled by septic tank with leaks directly into the soil, while 23% use direct leaking into the soil and a 18% have septic systems with truck disposal of wastewater.
- most households that have a water supply system also use water from other sources such as:
    - 36% well located in yard, of which 5% of households have installed pump in the well;
    - 39% well located on the street,
    - 9% collection of storm water.
- Use of additional water sources – 43% for household needs, 34% for irrigation, 18% for livestock
- respondents were asked to evaluate the amount of water they used per day (in litres:
    - 32% said they used more than 61-100 litres per day (per household),
    - 21% more than 100 litres,
    - 18% 10-20 litres,
    - 18% 21-40 litres,
    - 9% consumed 41-60 litres.
- 59% of respondents reported purchasing bottled water. The respondents said that they consume bottled water because tap water is not potable;
- More than half (67%) of those who buy bottled water buy 1-5 bottles per month. 16% buy 10-20 bottles per month and 17% buy more than 20 bottles.
- The bills from the previous month ranged from 5 to 210 lei, with an average amount of 49.5 MDL. These households consumed 9.5 m3 of water on average, and the average cost of water is about 5.54 lei/m3.
- 64% of respondents stated that they could afford to pay more for better quality water, 27% stated they were satisfied with the water quality in order to emphasise that they could not afford to pay more for water of better quality, and 9% would like to have better quality water, but could not afford it.
- of those stating they could afford to pay more for better quality water, 71% stated they could pay 1-3 MDL more per 1 m3 and 29% of the respondents stated they could pay 4-7 lei more for 1 m3.
- Respondents overwhelmingly agreed (91%) with the proposal that they should pay for the collection and treatment of wastewater, whilst 9% disagreed.

Households that do not have a piped water supply.

This group comprised just three households. The average household income in this respondent group was 2000 lei.

All households indicated in the responses that they have a well in the courtyard, but all use water from a public well or a well in the courtyard or street neighbour. On average, they use 15 buckets a day.

All households surveyed said they were willing to pay for water of better quality. Two households stated that they would pay 15 lei per m3 only if the final amount for payment of water services is 45-50 lei monthly. As for paying for wastewater collection and treatment thereof, the respondents answered “yes”. If the network of water supply was going to be built and passes near the house of surveyed households, two would be able to pay a contribution up to 3000 lei, one up to 500.

Households that are not connected to a water pipe but have access to a centralized water supply system in their community.

This group includes four of the surveyed households. The average household income in this respondent group is 1530 MDL, with a range of 500 to 2500 MDL. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Source of water
    - Two households stated they had a shallow well in their yard as an alternative supply
    - Two households reported using water from a public well, neighbour’s well, or well in the street
    - One household have a cistern to store the water from the centralized water pipe.
- Of those that used a shallow well in their yard, the average consumption was 3.3 buckets per day. Of those that used the public well or other sources, the average consumption was 10 buckets per day.
- Two households reported purchasing bottled water. One consumes up to 5 bottles per month and the other one 5-10 bottles per month.
- In all cases the distance from the household to the centralized water supply network is up to 500 meters
- All respondents would like to use water from a centralized water supply system.
- Willingness to pay for water quality improvements – No respondent has indicated whether he agrees to pay 15 lei per m3 of water of better quality.

10.4.4 Cluster E

The mayor’s offices generally report high connection rates to the water supply system, ranging from a low of Cislita Prut (0%) up to 100% in Brinza. For the entire cluster, the average connection rate to the water system is 56%.

According to data obtained from the mayors’ offices, the annual average consumption per household per month averages 11.4 m3 for with averages ranging by locality from 5 m3 (Slobozia Mare) to 12.38 m3 (Vadul lui Isac). In the summer, the average is 21.85 m3, while the wintertime average is 6.68 m3.

All households in the cluster that are connected to the centralized water supply system have water meters. About 3% of the total number of households have debts for the payment of water bills. However, all of them have 1-3 months of payment delay.

The price of water in the cluster varies from 2 MDL per m3 in Cislita Prut to 7 MDL per m3 in Văleni. Văleni and Colibasi have differentiated tariffs based on the level of consumption. Colibasi's highest tariff, however, is 7 MDL per m3 for more than 20 cubic meters, whereas Văleni charges up to 20 MDL for over 50 tons of water.

Survey of households

A survey instrument was administered in 97 households, with a total of 359 household members, in Cluster E. The survey comprised questions on: demographics and socio-economic conditions. The main results are summarized below:

- significantly, the survey revealed that 26% of respondents were unemployed, whilst 24% were employed in Moldova, 6% were working abroad, 2% had their own businesses, 13% were retirees, and 29% were children under 16 years old.
- respondents owned 3028 livestock, of which 93%, pigs, goats and sheep – 6% and 1% meat cattle and horses
- most gardens have an area of 50-100m2 – 55%, followed by 18% of households with an area of 100-150m2, 10% have over 150-200m2, 9% have gardens of 200m2 - 250m2, 6% of households have gardens larger than 300 m2, and 2% of households have gardens of 250-300 m2.
- 18% of the total number of interviewed households grow vegetables in greenhouses.

Households that are connected to a water supply system.

The average household income in this respondent group was 2977 MDL. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- 63% of the respondents were connected to the water supply system. All but two of those connected have outside taps in the yard (yard well) and two households
- of the households with water supply, 67% have their wastewater handled by septic tank with leach fields directly into the soil, while 18% use direct leaching into the soil and a few households have septic systems with truck disposal of wastewater.
- most households that have a water supply system also use water from other sources such as: 23% well located in yard, of which 16% of households have installed hydrophore in the wells; 23% collection of storm water (most of which are in Slobozia Mare village and some from Căslita Prut); 7% delivered by cistern (mostly from Slobozia Mare)
- Use of additional water sources – 48% for household needs, 41% for irrigation, 23% for livestock (more than one answer was possible)
- For more than half of the respondents, the water consumed for drinking is taken from the artesian well – 85%, while 12% consume surface water and 3% consume water from the river.
- Respondents were asked to evaluate the amount of water they used per day (in litres). 33% said they used more than 100 litres per day (per household), 26% consumed 41-60 litres per day
- 63% of the respondents were connected to the water supply system. All but two of those connected have outside taps in the yard (yard well) and two households

- 39% of respondents reported purchasing bottled water. Of those, only one respondent answered that the tap water is not drinking water. In the other 13 cases, the respondents said that they consume bottled water because of taste, when on holidays, and to give to children
- More than half (55%) of those who buy bottled water buy 1-5 bottles per month. 36% buy 5-10 bottles per month and only 9% buy more than 20 bottles. Some respondents (from Slobozia Mare) said that they buy water in 6-liter bottles to use for drinking and cooking.
- Nearly all respondents could show their bills. Those that did reported bills from the previous month ranging from 5.5 to 200 MDL, with an average amount of 48 MDL. These households consumed 9.8 m3 of water on average, and the average cost of water is about 4.8 lei/m3, varying from 2.5 to 6.5 lei/m3.
- 66% of respondents stated that they could afford to pay more for better quality water, 30% stated they were satisfied with the water quality in order to emphasise that they could not afford to pay more for water of better quality, and 4% would like to have better quality water, but could not afford it.
- Of those stating they could afford to pay more for better quality water, 33% stated they could pay 1-3 MDL more per 1 m3, 20% of the respondents stated they could pay 4-7 lei more for 1 m3, while 3% would be able to pay 8-10 lei more for 1 m3.
- Respondents overwhelmingly agreed (83%) with the proposal that they should pay for the collection and treatment of wastewater, whilst 17% disagreed.

Households that do not have a piped water supply.

This group comprised just two households. The average household income in this respondent group was 3250 MDL.

This group consumes less water, but is more likely to use water deliveries to a cistern to use for irrigation. One of the two households was dissatisfied with the water quality, citing poor taste of water. Neither household felt it was informed about the quality of the water, nor did they believe it was checked in a laboratory.

Both households wanted to be connected to the centralized water supply system and would be willing to pay for the connection. Yet, neither would pay 15 MDL/m3 or more for water of even the best quality. Both respondents stated that they would pay for collection and treatment of wastewater. Significantly, both households stated that they could afford to pay contribution up to 1000 MDL for a water connection.

Households that are not connected to a water pipe but have access to a centralized water supply system in their community.

This group includes 34 of the surveyed households. The average household income in this respondent group is 2543 MDL, with a range of 635 to 7800 MDL. One-third of respondents stated that they have remittances from abroad in addition to these incomes, but no amounts were indicated. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Source of water
    - Shallow wells – About 65% stated they had a shallow well in their yard as an alternative supply
    - Public wells and other sources – About 26% of the respondents reported using water from a public well, neighbor's well, or well in the street

  - o Cisterns – 43% of the respondents said that they have cisterns to store the water from the centralized water pipe. The average storage capacity of the cisterns is 1.46 m3.
  - o Rain water – 29% of households collect rain water, while 14% store the water in cisterns bringing water from the well. The cisterns' capacity is 3m3 on average.
- respondents were asked to evaluate the amount of water they used per day (in litres). Of those that used a shallow well in their yard, the average consumption was 18.7 buckets per day, or about 187 litres per day per household. Of those that used the public well or other sources, the average consumption was 5.88 buckets per day, or about 58.8 litres per household per day
- 53% of respondents reported purchasing bottled water. About 29% of the interviewed households buy 5-10 bottles of water. 21% consume less bottled water – 1-5 bottles and 3% of those who buy bottled water buy more than 20 bottles.
- In most cases (56%), the distance from the household to the centralized water supply network is less than 500 meters. Less respondents (32%) are located at a distance higher than 500-1000m. Three households – up to 1000-1500 meters and only one household is located at more than 1500 meters from the centralized water supply network
- 79% of the respondents would like to use water from a centralized water supply system.
- Respondents were asked to state the reason why they were not connected to the network. The most frequently given reason for non-connection to the centralized water supply system is the impossibility to pay the contribution. Others cited their possession of a well in the yard or some other source.
- Willingness to pay for water quality improvements – 41% stated they could pay up to 15 MDL per 1 m3 for better quality water, whilst 59% said they would not be willing to pay.

10.4.5 Cluster Borceag, Chioselia Mare and Frumușica

Borceag has a centralized water supply with significant problems with its water source. Services to the villages Chioselia Mare and Frumuşica will be completed in the near future with the construction of an aqueduct and water supply to public institutions. Frumuşica also renovated a portion of the network to which 74 households are connected. It is the main source of water for the towns that have a centralized water system. Laboratory tests have been conducted on the water quality for the past two years.

Of the total of 500 households in Borceag, 400 (80%) are connected to the centralized water supply.

In Borceag, the annual consumption per household is 3.5 m3 each month, in summer reaching each 5m3 and in winter 2m3 each. Every household is metered and pays 11 lei for 1m3 of water.

74 out of 275 households in Frumuşica are metered. Citizens pay a 11.5 lei per m3.

Survey of households

A survey performed in 18 households, with a total of 76 household members. The survey comprised questions on: demographics and socio-economic conditions. The main results are summarized below.

- significantly, the survey revealed that 33% of respondents were unemployed, whilst 21% were children up to 16, 22% were retirees, 21% were working in the country or abroad or had their own businesses.
- respondents owned 386 livestock, of which 88% were birds; pigs, goats and sheep – 11% and 1% meat cattle and horses
- most gardens have an area of 200-300m2.
- none of the households have a greenhouse.

Households that are connected to a water supply system.

The average household income in this respondent group was 2977 MDL. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Connection to water supply system
    - o Water supply – 63% of the respondents were connected to the water supply system. All but one of those connected have outside taps in the yard.
    - o Wastewater – of the households with water supply, 58% have their wastewater handled by septic tank with leach fields directly into the soil, while 25% use direct leaching into the soil and 17% of households have septic systems with truck disposal of wastewater.
    - o Additional water sources – most households that have a water supply system also use water from other sources such as: 41% well located in yard, 41% well located on the street, 18% collection of storm water
    - o Use of additional water sources – 42% for household needs, 25% for irrigation, 33% for livestock (more than one answer was possible)
- Respondents were asked to evaluate the amount of water they used per day. 67% said that they use 4-5 buckets per day, 42% said that they use 21-40 litres, 25% said that they use 7-10 buckets per day, 8% -100 litres per day.
- 58% of respondents do not buy bottled water.
- The vast majority (80%) of those who buy bottled water buy 1-5 bottles per month. 20% buy 10-20 bottles per month.
- All respondents but one could show their bills. Those that did reported bills from the previous month with an average amount of 82 lei. These households consumed 7.35 m3 of water on average, and the average cost of water is about 11 lei/m3.
- 58% of respondents stated that they could afford to pay more for better quality water, 17% stated they were satisfied with the water quality and 25% would like to have better water, but could not afford it.
- Of those stating they could afford to pay more for better quality water, 62% stated they could pay 1-3 lei more per 1 m3, 25% of the respondents stated they could pay 4-7 lei more for 1 m3, while 13% would be able to pay 8-10 lei more for 1 m3.
- Respondents overwhelmingly agreed (92%) with the proposal that they should pay for the collection and treatment of wastewater, whilst 8% disagreed.

Households that do not have a piped water supply.

This group comprised just one household with income of 1600 lei. The standard of living of the family is self-described as satisfactory.

This household does not have a well in the yard but it uses a well from a neighbour's yard, on average 10 buckets per day. Bottled water is purchased up to 5 bottles of 1.5 litres per month. The respondents was satisfied with the quality of water used and believed that the water is subject to verification in a laboratory. The residents were informed about water quality and would like to use water from a water supply system. The household agreed to pay 15 lei more for 1 m3 water, provided that the water would be of better quality.

The respondent reported that it could afford a connection payment of up to 3000 MDL in the event that a water supply network is built near the respondent's house.

Households that are not connected to a water pipe but have access to a centralized water supply system in their community.

This group includes six of the surveyed households. The average household income in this respondent group is 2150 lei, with a range of 1000 to 4000 lei. Only one respondent claimed to have remittances from abroad. Key data on their connection to their water supply, consumption, and willingness to pay are summarized as follows:

- Source of water
    - Shallow wells – one household has a shallow well in their yard as an alternative supply
    - Public wells and other sources – five respondents reported using water from a public well, neighbour's well, or well in the street
    - Cisterns – two households said that they have cisterns to store the water from the centralized water pipe.
- Respondents were asked to evaluate the amount of water they used per day. Those that used a shallow well in their yard, consume 10 buckets per day. Of those that used the public well or other sources, the average consumption was 7.75 buckets per day.
- Two respondents reported purchasing bottled water, 5 bottles (each1.5 litres) a month
- In most cases (50%), the distance from the household to the centralized water supply network is less than 500 meters. In both cases up to 1000 meters, but in the case of 1000 to 1500 m .
- All of the respondents would like to use water from a centralized water supply system.
- 75% stated they could pay up to 15 lei per 1 m3 for better quality water.

10.5 Economic/cost benefit analysis - description of social benefits and costs (qualitative analysis)

Preparing an economic analysis (Cost-Benefit Analysis, CBA) is important for infrastructure projects; especially those co-financed using international donor aid.

The objective of a CBA is to analyse a measure's impact on society's well-being in the region (or country) in which the project is implemented. This approach is what makes a CBA differ from a financial analysis, which only takes into account the costs and benefits that accrue to the investor as a result of the measure. A CBA should include the total costs and benefits from the perspective of the public that benefits from the project. The fundamental rule in selecting projects holds that benefits from the measure should exceed its costs. In essence, for a CBA this means that the measure should generate a positive economic net present value (ENPV).

In describing the economic effectiveness of the project, the CBA includes the following indicators:

- ENPV
- ERR.

The starting point for calculation of these indicators is the financial cash flows from the financial analysis.

Many methods exist to estimate the social costs and benefits for CBA purposes. The general rule holds that outlays on the project should be described in terms of their opportunity cost, while the benefits (effects) of the measure should be measured by the society's willingness to pay to obtain a given effect. Often the benefits transfer technique is used, which involves extrapolating results from studies from sectors and projects similar to the analysed project.

10.5.1 Analysis of socio-economic costs

Price distortions on means of production

Shadow prices arise when distortions occur in a given market, which lead to the costs of a factor of production to differ from the cost that society incurs. Market distortions may be caused by the existence of a monopoly, quotas and price regulation.

Due to the competitive market for factors of production, no price distortions on factors of production were considered. Only electricity prices – which are regulated – differ from market values and appropriate corrections have been made.

Wage distortions

The scale of the project is not large and given the unemployment rate in Moldova, it is not expected to distort wages.

Tax aspects

The project does not involve negative tax aspects.

External costs

Investments in water supply and water distribution network involve external costs generated due to the temporary exclusion of land and streets from use; yet, these costs are taken into account in investment outlays (possible damages/compensation, repairs of the road). Moreover, the project has a positive impact on the natural environment and no other external costs are expected.

A CBA should take into account social costs that are not compensated and that have a significant impact for the wider public apart from those that refer directly to the project.

The decline in the value of land in the vicinity of the water storage tank, water towers and pumping stations – these types of objects do not motivate buyers, which means that land in the vicinity will have a lower value – could be an external cost. Yet, the facilities' location was selected outside built-up areas, close to the existing water production facilities and will not be significant or will have minimal impact.

Non-financial costs

It is not expected that the project will involve non-financial costs.

Social costs resulting from additional employment

Additional employment is not required for the project operation. It is required for the project implementation but will not distort the labour market and thus social costs do not arise due to the investment.

10.5.2 Analysis of socio-economic benefits

Price distortions on the means of production

The effect of engaging unemployed persons during construction was taken into account. This aspect is described in the section on social benefits from additional employment.

Tax aspects

Transfers include all taxes, fees, financial costs and subsidies. These should be excluded from a CBA because they do not constitute a cost to society but rather a transfer of income (a tool for the redistribution of income). They do not contribute to an increase or decline in social welfare.

Value Added Tax

The VAT contained in investment outlays is a transfer and the cash flows used to calculate ENPV have been corrected by the amount of this tax.

External benefits

The concept of external effect is associated with the imperfections of the functioning of the market. An external effect occurs when the actions of one economic actor cause a change in the welfare of another economic actor and this change is not compensated. In other words, the external effect occurs if the utility function or production function of entity 'A' contain real (that is, monetary) variables, the value of which were determined by other entities (person, company, government) without their taking into account the impact on the level of welfare of actor 'A'.

In the present project, a number of external benefits arise due to implementation. Among the main external effects, the following should be mentioned:

- Health effects due to reduction of pollution in the water
- Social effects due to uninterrupted water supply
- Economic development effects.

Health benefits

The approach to estimating benefits from water quality improvement programmes involves determining the positive health effects that will result from the programme and assigning a monetary value to them. This approach, however, requires precise study of the relationships between pollution in the source and a response (e.g., improvement of health, reduction in morbidity). This relationship is described in a dose-response function. While these studies have been conducted in EU countries for various pollutants, their application in water quality improvement programmes has many limitations.

The economic valuation of the benefits from implementing a water quality improvement programme is difficult due to the low number of studies conducted on this issue as well as the need to determine precisely the physical effects of these programmes (knowledge of the dose-response relationship is essential).

Evaluating the benefits based on data from studies conducted in other countries does not yield authoritative results due to the differences in the conditions that prevail in project impact area. Further limitations in evaluating programme benefits are due to the inability of estimating some benefits in monetary terms. The literature indicates that these results should be viewed in the context of many assumptions, limitations and uncertainties in evaluating benefits. Limitations include, inter alia, lack of available data on illnesses caused by water pollution, underestimation of economic costs of water pollution, etc.. P.

Faircloth[25] describes four types of benefits of implementing water quality improvement programmes:

- Health benefits
- Amenity benefits
- Non-use benefits
- Benefits for water users – agriculture, households.

Another problem is that although it is obvious that the amount of pollution in water will be reduced, quantitative data on nitrates and other pollutions differs from commune to commune and are not available. The situation in communes where there is no water supply is even more difficult to estimate. However there are studies that estimate, especially health benefits. ECOTEC report[26] provides estimation of benefits of avoided water-related diseases. Per capita value for Romania (good proxy for Moldova) is 27 EUR per capita and this value was used for the estimation.

Social effects due to uninterrupted water supply

Current working conditions in communes which have water supply are not optimal. The source is often working close to its maximum capacity and sand is often observed. Sand and poor maintenance often cause failure of the pumps. As the result, high pressure fluctuations in the water distribution network occur and sudden interruption of water supply is observed.

The valuation of the social benefits for uninterrupted water supply is difficult, thus it was not quantified.

New business enterprises

Demand analysis uses the annual increase in businesses proportional to the GDP increase. Currently, the supply system, especially in communes outside the City of Cahul, is not able to provide water for new businesses. This situation is due to high level of leakages in the water distribution network in the City of Cahul and lack of the network in other communes. The situation reduces the possibilities of business development or the business will have to find other sources of water - this may cause very high social costs if the project is not implemented (or high social benefits for the project implementation). Having in mind limitations in valuation of the social benefits from establishing new businesses, shadow prices for delivery of water to new business were used. The shadow price was estimated at 30 MDL/m^3, as equal to the production price and distribution costs (including distribution by cisterns). The shadow price was applied to the demand from business from all clusters but cluster 0.

Non-financial benefits

Apart from those described elsewhere in this chapter, no non-financial benefits in this project were identified.

Social benefits resulting from additional employment

In a CBA, additional employment is a cost because the project is using labour resources that become unavailable for alternative social purposes.

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[25] Peter Faircloth (Cranford Economics) and others “Approximation of Environmental legislation A Study of the Benefits of Compliance with the EU Environmental Acquis”

[26] THE BENEFITS OF COMPLIANCE WITH THE ENVIRONMENTAL ACQUIS FOR THE CANDIDATE COUNTRIES

Two separate methods exist of estimating the social benefits of additional employment:

- Using accounting wages below the current wages in the project
- Estimating the income multiplier of investment revenues on the social income resulting from the project that will be higher than the income for private investors.

Both methods have disadvantages and limitations. In this CBA, results are corrected so that the cost of employing persons from the ranks of unemployed is equal to zero.

The following social effects from additional employment were taken into account in the analysis:

- Increase in the number of jobs during investment implementation (temporary effect);
- New jobs resulting from the economic development made possible due to investment implementation.

The first effect was estimated and described in detail below, while the second effect is not quantified.

Increase in jobs during investment implementation

Project implementation results in additional employment. This will be a temporary effect from the infrastructure investments in which a significant portion of the investment outlays is associated with labour. Full automation is not possible during construction of the water and sewer networks, especially in excavation works, and thus the required labour includes a significant portion of low qualified workers from the ranks of the unemployed. Due to the lack of detailed data on outlays, typical cost estimates of similar project scopes were analysed in order to determine the share of wages for low qualified labour in total outlays. Based on this analysis, a share of 30% of such labour in outlays was assumed and in the CBA this result was adjusted so that the cost of employing these persons was equal to zero.

Reducing developmental disparities among regions

The project's impact on reducing developmental disparities among regions results foremost from the expansion of access to technical infrastructure. Tasks completed under the project have a positive impact on increasing investment also in the entire region.

Two aspects are of key importance for reducing the level of development between regions. Expansion of infrastructure is the basic element of development in the region and is viewed by residents as a requirement. A lack of infrastructure leads to a degradation in the region and an outflow of persons toward areas that are better developed.

The second element in reducing developmental disparities between regions is linked to the strict relationship between the expansion of communal infrastructure – including water– and economic development. The project provides not only for constructing a water pipes but also gives the possibility for business development in commercial and service (agriculture) areas. The lack of a water capacity is a large barrier to development of these areas because transporting water by cisterns is much more expensive. This discourages potential investors from developing activities in the area that is lacking basic infrastructure.

10.5.3 Economic rate of return (ERR) and economic net present value (ENPV)

Table 34 in Annex F contains a calculation of the economic rate of return (ERR) and the economic net present value (ENPV).

This table includes the results of the financial analysis that were corrected for transfers, external effects and price distortions on factors of production.

The net cash flow balance was corrected for the social costs and benefits described earlier:

Fiscal corrections:

- VAT

Price distortions:

- Engaging unemployed persons during construction
- Price distortions for electricity prices

External effects:

- Shadow prices related to business development
- Benefits of avoided water-related diseases

The calculation does not take into account the grant because it is a transfer.

After making the above corrections, the surplus after corrections was calculated; this in turn was the basis for calculating the economic rate of return (ERR) and the economic net present value (ENPV).

The calculated ERR is 14% while the ENPV is 211.23 million MDL at a discount rate of 5%.

The CBA lists many factors that were not expressed in monetary terms. If it were possible to estimate them, the value of ERR would be considerably higher. The positive result of the economic analysis (ENPV greater than zero) indicates that from a public perspective, the project should be implemented.

10.6 Sensitivity analysis

A sensitivity analysis was conducted to analyse the forecast in the event of changes in the following variables:

- Initial connection rate. It is assumed that 70% of the households in the expanded service area will connect to the water network after the network is operational. The sensitivity was conducted for initial connection rate varying from 60% to 80%.
- Percentage of new connections per year. As initial connection rate is conservative, it is assumed that there will be some new connections every year, until the connection rate reaches 90%. It is assumed in the financial analysis that the increase will be by 2% annually. The sensitivity analysis was conducted for incremental percentage of new connections per year varying from 0.5% to 4.0%.
- Real Wage Increase. The real wage increase indicator is used in the financial model to determine the costs of employment and also to determine the increase in disposable household income. The sensitivity analysis was done not by changing a single indicator on annual real wage increase, but rather switching the entire forecast for the entire time horizon of the project. Thus, three forecasts of real wage increase were prepared (as described in the section on macroeconomic assumptions):
    - Base case
    - Half base case
    - Pessimistic.
- Real GDP growth. Similarly to Real Wage Increase, three forecasts of real GDP growth were prepared and described in section 10 on macroeconomic assump-

tions. The real GDP growth is used in the financial model to forecast increase in water demand from industry and institutions. The proposed forecasts are: base case, optimistic, pessimistic.

- Collection rate. Currently Apa-Canal Cahul has very good collection rate, even collecting old debts from previous years. In the expanded service area, however, the collection rate could be lower and increase in the future when financial situation of water consumers improve. Thus, two scenarios for the collection rate were prepared: base case and low case. In the Base case, the collection rate quickly increases – reaching 98% in year 6, or increasing by 0.5% annually. In the Low case, the collection rate slowly increases by 0.1% annually.
- Cost of electricity. Similarly to Real GDP growth, three forecasts of real increase of electricity prices were prepared and described in section 10 on macroeconomic assumptions. The proposed forecasts are following: base case, optimistic, pessimistic.

For each variable, the sensitivity analysis provides results for:

- FNPV(C)
- FRR(C)
- FNPV(K)
- FRR(K)
- Financial sustainability (TRUE/FALSE – indicating whether the cumulated cash flow is positive during the entire time horizon of the analysis).

The results of sensitivity analysis are presented in Annex F, Table 36.

The analysis shows that project is sensitive to real wage increases and electricity price increases, while it is less sensitive to changes in other variables. Nevertheless, in none of the cases did the project lose financial sustainability (cumulated cash flow less than zero).

11 Risk analysis (description of risks).

11.1 Technical risks.

Technical risks of the project are limited due to existence of the water intake and water treatment plant. The only technical risks are associated with the construction of new water pipelines, pumping stations and reservoirs. All these aspects are widely practiced I Moldova and only the scale of the project may cause some risk: possible constructor may not be prepared to undertake such a big project what may cause delays in the project implementation.

11.2 Environmental risks.

The project may cause following environmental risks:

- Security of disinfection process: chlorinated reagents that will be used for water storage of more than 6 hours can pose a public health risk.
- Pollution with construction waste: This waste may pose a temporary and insignificant negative impact on groundwater quality.
- Temporary nuisance during the construction phase. The negative impact includes: dust from construction works, noise during excavation, possible effects of vibration on old houses, and transportation of the constructed elements.
- Removal of construction waste: Waste will be generated during the construction of facilities.
- Damage to existing communal sites: old water pipeline networks, transmission equipment and telephone lines can be damaged during installation and repair works.
- Labour security at the construction works.
- Leakage of fuel and lubricants from machines during construction.
- Damage to trees and plants:.

11.3 Institutional risks.

The inter-communal co-operation in Moldova is not well established and cases of working inter-communal co-operation in WSS sector are very limited. Also LPA has little of experience in inter-communal co-operation. Thus the major institutional risk is associated with inter-communal co-operation. This may cause a significant delay in project preparation and transformation of the operator into the regional one.

11.4 Financial risks.

There are three types of financial risks of the project:

- Investment costs;
- Operating costs;
- Revenues;

The current study is based on preliminary investment costs estimations, thus still it has to be considered that investment costs are rough estimated. Only after the execution design is prepared the investment costs will be estimated with high precision while after the selection of the contractor in tender procedure, the final investment costs will be determined. The risk associated with investment costs is mitigated in the current study by taking into account high unit costs and contingencies.

The project may also face the problem of higher operating costs. This could be associated with poor costs control by the regional operator, for example overstaffing the company.

The third group of risks is associated with low revenues collection. This risk coulod be caused by several reasons:

- Low connection rate to the network;
- Low water consumption;
- Low collection rate of the bills for services;
- Low tariff caused by disagreement of LPAs for cost recovery;

In order to reduce financial risks in operational phase, it is advised that Financial and Operational Improvement Programme for the regional operator is prepared and implementation is monitored.

11.5 Conclusions and recommendations.

The technical, financial and environmental risks of the project are limited and usually easily mitigated by such a projects. The institutional risk is much higher due to lack of experience in Moldova. It is recommended that during the project preparation and implementation, specially attention is paid to the institutional problems of inter-communal co-operation.

12 Annexes

Annex A	Model Decision of Local Council on approval in principle of participation in establishment of a joint stock company
Annex B	Model Decision of Local Council on participation in establishment of a regional operator in the form of a joint-stock company
Annex C	Concept drawings of the selected option
Annex D	Estimation of investment needs
Annex E	Technical calculations
Annex F	Financial and economic analysis
Annex G	Detailed drawings