REPUBLIC OF MOLDOVA

APA CANAL CHISINAU

CHISINAU WATER SUPPLY & SEWAGE TREATMENT - FEASIBILITY STUDY

Contract No: C21156/ECWC-2010-01-01

Phase B Report - FINAL

August 2012

seureca A Subsidiary of VEOLIA ENVIRONNEMENT

In association with and Business Consulting Institute

European Bank for Reconstruction and Development and EU Neighbourhood Investment Facility

LIST OF ABBREVIATIONS AND ACRONYMS

ACC	S.A. Apa Canal Chisinau
CAPEX	Capital Expenditure
CRM	Customer Relation Management
CCTV	Closed Circuit Television
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
ERP	Effective Resource Planning
EU	European Union
GDP	Gross Domestic Product
GIS	Geographic Information System
HDPE	High Density Polyethylene
HR	Human Resources
LTIP	Long-Term Investments Programme
MIS	Management Information System
MTU	Universitatea Tehnica a Moldovei (Moldovan Technical University)
NRW	Non-Revenue Water
O&M	Operation and Maintenance
OPEX	Operation Expenditure
PIP	Priority Investments Programme
PIU	Project Implementation Unit
ToR	Terms of Reference
VAT	Value-Added Tax
W/W (w/w)	(Foul) Wastewater.
WWTP	Wastewater Treatment Plant

TECHNICAL ABBREVIATION

BOD	Biological oxygen demand
COD	Chemical oxygen demand
EUR or €	Euro
km	Kilometre
M	Million
m^3/d	Cubic metres per day
MDL	Moldovan Leu
mm	Millimetre
p.e.	Population equivalent

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EXECUTIVE SUMMARY

As the entity ultimately responsible for the water and wastewater service, the Municipality of Chisinau has commenced a programme of works intended to rehabilitate the city's water supply and wastewater collection and treatment assets.

In the framework of the European Union Neighbourhood Initiative, the European Bank for Reconstruction and Development, together with co-funders: KfW Entwicklungsbank and the European Investment Bank, support the initiative through a phased investment programme, provided within the European Union Neighbourhood Investment Fund.

As Seureca Consulting Engineers, in association with our local Moldovan partners: Business Consulting Institute and SC Ingineria Apelor SRL, we have been appointed to prepare a Feasibility Study that will identify and address the issues associated with the current water and wastewater service provision in Chisinau.

The Feasibility Study is to be prepared within three phases:

Phase A: An inventory and assessment of the current situation to be delivered within an "*Inception Report*";

Phase B: The preparation of the Investment and Action Plan, and

Phase C: Conclusion of the Study and the elaboration of preliminary designs.

Following submission and approval of the "*Inception Report*" and a Workshop that followed the completion of Phase A, this, the Phase B Report has been prepared to set out our work under Phase B.

Our experts have produced Detail Reports on their Phase B activities, and these are being submitted to the PIU for dissemination within ACC, for comments and acceptance by the respective ACC experts, and thus by ACC. Where comments are received, these will be incorporated into the final version of each expert's Report.

The Phase B Report does not repeat fully the content of the experts' Reports, but has been written as a collective Executive Summary of those Reports. Should a reader require further information concerning any matter raised in the Phase B Report, he is directed to the appropriate Detail Report.

The Phase B Report considers not only the technical issues associated with a proficient water and wastewater service provision by ACC, but also the institutional issues associated with a modern, customer orientated service provider. An action plan is provided to reduce the current establishment to one in line with other similar utilities, in particular Bucharest, and also such as the introduction of a comprehensive Management Information System.

The results of the water measurement campaign have been used in conjunction with the findings of the Soci-Economic Survey to determine future domestic and non-domestic water demand, and thus "return to sewer" flows. The potable water demand and wastewater flows, with due allowance for peak factors, have been used, in conjunction with the constructed hydraulic computer models, to size the assets proposed as necessary to ensure the ability of ACC to meet customer levels of service within the design horizon of the Feasibility Study.

The various specific Studies within the Feasibility Study e.g. Pilot Leakage Study and the GIS, have all progressed satisfactory during the Phase and we have been able to use the conclusions of the Studies in our final recommendations. We have provided an Action Plan for NRW reduction to an acceptable 25%. The determination of the NRW target together with the determination of future domestic consumption has enabled us to provide, and agree with ACC, a future water balance upon which future water source and treatment capacity has been based. Our proposals for water procurement are that the STA plant continues as the main water treatment plant for Chisinau, but that the local ground water sources are developed to provide an emergency back-up in case of pollution in the River Nistru, the source of water for treatment.

Both the water and wastewater measurement campaigns have proved to be invaluable for the calibration of the water and wastewater network computer models. The results of the measurement campaigns and the models have not only been used to prepare the network extension and rehabilitation proposals, and are now available to ACC as future tools within the planning and operational functions.

We have given attention to the requirements of the wastewater treatment plant. Options have been discussed with ACC and a preferred option based upon the activated sludge process agreed. The plant process has been designed to treat the wastewater such that the final effluent is suitable for discharge to a "sensitive area" as defined by the EU Directive.

During the course of our work, we have identified two issues for resolution outside of the Feasibility Study:

- The first is ownership of the "public interest" assets. There remains uncertainty about the ownership which will, eventually require resolution;
- Secondly, the water and wastewater connections to private residences and commercial buildings are owned by the owner of the building. Where the building is under municipal ownership ownership remains with ACC, which is responsible for the maintenance and eventual replacement of the connection. Such a policy means that when the network is rehabilitated, the connections may be left with their inherent problems related to age and condition. We suggest that this is not in line with accepted best practice, is not conducive to the satisfactory operation of the network and is unfair to people who remain responsible for the services.

As a summary of our proposals and of the PIP, we have prepared a series of Fact Sheets that are provided at the end of this Executive Summary. The PIP that we propose for consideration is provided in the following table:

Priority Investment Programme By Function

Field	Sub-Category	% of PIP	Cost	Rank	Description	% of PIP	Code
Drinking Water	Treatment	6%	3,000,000 €	14	Urgent rehabilitation works including Electro chlorination plant	5.0%	DW-T-01
			548,000 €	13	Treatment of the water produced from Ialoveni well field	0.9%	DW-T-03
	Network	25%	12,468,000 €	9	Rehabilitation of 190 km of water pipes and 3,270 block service connections+ hydraulic fittings	20.9%	DW-N-05 / DW-N-02 DW-N-04 / DW-N-01
			2,256,000 €	10	Rehabilitation of reservoirs	3.8%	DW-N-15 / DW-N-14
			303,000 €	11	Pressure reduction on the network	0.5%	DW-N-04 / DW-N-12
			108,000 €	12	Adaptation of the water distribution system to the new production scheme: By-pass of SAN facilities, New PS from Zone 2 to Tohatin, New PS from Tohatin tanks to VdV Ghidighici dilution	0.2%	DW-N-13
	Pumping	1%	825,000 €	6	Rehabilitation of the existing PS	1.4%	DW-P-01
	O&M	3%	1,678,000 €	8	Equipment for operating the drinking water network	2.8%	DW-OM-03 /DW-OM-04 DW-OM-01 /DW-OM-05 / DW-OM-02

Field	Sub-Category	% of PIP	Cost	Rank	Description	% of PIP	Code
	Other	7%	4,244,000 €	15	EMERGENCY PLAN (Rehabilitation of the wells + treatment facilities + adaptation of distribution system)	7.1%	DW-O-05 / DW-O-06 / DW-O-04
Wastewater	Treatment	45%	26,595,000 €	4	First phase of upgrading the WWTP for Chisinau (New pre-treatment, light rehabilitation of primary settling, biological tanks and secondary clarification, separated thickening for biological excess sludge, anaerobic digestion with energy generation, sludge dewatering)	44.6%	WW-T-01 / WW-P-01
	Network	5%	2,903,000 €	2	Renewal of sewers (15 km)	4.9%	WW-N-02 / WW-N-01
	Pumping	2%	1,051,000 €	3	Rehabilitation of PS	1.8%	WW-P-02 / WW-P-03
	O&M	3%	1,683,000 €	1	Equipment for operating the wastewater network	2.8%	WW-OM-01
Other	O&M	3%	1,300,000 €	16	Purchase of MIS equipment	2.2%	O-OM-01
			389,000 €	5	Replacement of the electrical lines in STA, SAN, SESE, SSP	0.7%	O-OM-03
			325,000 €	7	SCADA: Upgrading or renewal of the equipment for drinking & wastewater PS + Data Storage + Implement a unique tool for data processing	0.5%	O-OM-02

Field	Sub-Category	% of PIP	Cost	Rank	Description	% of PIP	Code
SUMMARY By FACILITY							
SUB-TOTAL for DRINKING WATER			25,430,000 €				
SUB-TOTAL for WASTEWATER			32,232,000 €				
SUB-TOTAL for OTHER			2,014,000 €				
TOTAL			**59,676,000 €**			**100.0%**	

Priority Investment Programme by Priority

Rank	Description
1	Equipment for operating the wastewater network
2	Renewal of sewers (15 km)
3	Rehabilitation of Wastewater PS
4	First phase of upgrading the WWTP for Chisinau (New pre-treatment, light rehabilitation of primary settling, biological tanks and secondary clarification, separated thickening for biological excess sludge, anaerobic digestion with energy generation, sludge dewatering)
5	Replacement of the electrical lines in STA, SAN, SESE, SSP
6	Rehabilitation of the existing water pumping stations
7	SCADA: Upgrading or renewal of the equipment for drinking & wastewater PS + Data Storage + Implement a unique tool for data processing
8	Equipment for operating the drinking water network

Rank	Description
9	Rehabilitation of 190 km of water pipes and 3,270 block service connections+ hydraulic fittings
10	Rehabilitation of reservoirs
11	Pressure reduction on the network
12	Adaptation of the water distribution system to the new production scheme: By-pass of SAN facilities, New PS from Zone 2 to Tohatin, New PS from Tohatin tanks to VdV Ghidighici dilution
13	Treatment of the water produced from Ialoveni well field
14	Urgent rehabilitation works including Electro chlorination plant
15	EMERGENCY PLAN (Rehabilitation of the wells + treatment facilities + adaptation of distribution system)
16	Purchase of MIS equipment

Finally, we would like to record our appreciation of the assistance and guidance provided to us by the senior managers and staff of ACC. Without the help provided, this Report would not have been possible.

Fact Sheets Summarizing the PIP

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-N-13

Field: Drinking Water / Wastewater / Other

Sub-Category: Network / Pumping / Treatment / Operation & Maintenance / Other

Type of Operation: Adaptation of network operation

Objective:
Adapt the current water distribution system to the one recommended (with the decomissionning of the water treatment plant in Vadul Lui Voda (SAN))
Dilute the water produced in the well fields to achieve potable water standards

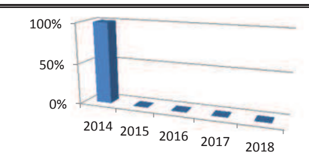
Overall description of the investment:
By-pass of the reservoirs in the water treatment plant in Vadul Lui Voda (SAN) with a pipe ND 315 HDPE SDR 17
Implementation of a new Pumping Station in Tohatin city to transfer the water from Chisinau to Tohatin tanks (with a new buildng)
3 pumping groups of 169m3/h each at 10mwc and an efficiency of 66% with an installed power of 21kW
Implementation of new pumps in the Pumping Station of Tohatin to transfer the water from Tohatin PS to Vadul Lui Voda
3 pumping groups of 182m3/h each at 15mwc and an efficiency of 66% with an installed power of 34kW
In the Pumping Station of Ghidighici, the following investments are planned:
a pipe (ND 225 HDPE 17) to dilute the water produced by the wells and ensure the quality and a check valve (ND300)

More Details available in the reports entitled "Investment Program - Water Supply Network"

Estimated CAPEX: 108,000 € or 1.7 Mlei **% of the PIP:** 0.2%

Priority Rank: 1/30

Schedule of Implementation:



Map with the location of the investment:

Project Benefits:

1- Improvement of the Water Distribution System and of the operation
Maintaining the two facilities SAN and STA in operation is more expensive in costs and energy than to operate only STA
Moreover, for the same capacity, the rehabilitation of one site (namely STA) is much cheaper than the rehabilitation of two separate facilities. The cost of the water produced by the two treatment plants is the same and the quality of the water treated in STA is better than the one treated in SAN
SAN cannot be considered as a back-up system in case of pollution of the Nistru
Decomissioning SAN will allow an economy of scale and rationalize the production

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-OM-04

Field:
- [ ] Drinking Water
- [ ] Wastewater
- [ ] Other

Sub-Category:
- [ ] Network
- [ ] Pumping
- [ ] Treatment
- [ ] Operation & Maintenance
- [ ] Other

Type of Operation: Purchase of Equipment

Objective:

Implement the best practices in the operation of the Drinking Water Network in order to increase the efficiency of the interventions

Overall description of the investment:

Purchase of equipments for the maintenance of the Water Supply Network for each team (19 teams in total)

Automated tools working with a generator or a heat motor (as sawing machinery, jack hammer, drill…)

Safety equipments (gaz detector, protection clothes, road signalisation)

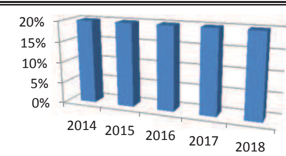
Manual tools (specific tools to work on HDPE pipes, specific spanners and tools for cleaning…)

More Details available in the report entitled "Network Operation Recommendations"

Estimated CAPEX: 101,000 € or 1.6 Mlei **% of the PIP:** 0.2%

Priority Rank: 2/30

Schedule of Implementation:



Images of the investments

Jackhammer

Specific tools for HDPE pipes

Spanner

Project Benefits:

1- Improvement of the operational efficiency

The number of interventions performed in 2010 was 14,024 and a progressive increase has been observed from 2006

The implementation of best practices to perform these interventions will lead to an improvment of the work conditions and of the interventions efficiencies.

2- Improvement of the staff's safety

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: O-OM-02

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Purchase of Equipment

Objective:
Improve the operational efficiency by automazing the monitoring and the regulations of the water supply and wastewater collection systems

Overall description of the investment:

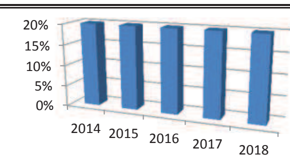
Extension of the existing systems in the Water and Wastewater Pumping Stations
Implementation of a Data Storage room with dedicated servers.
The exisitng data (water and wastewater PS, Termocom, Water Treatment Plant…) should be redirected
Implementation of a unisque tool for data processing

More Details available in the report entitled "SCADA Report"

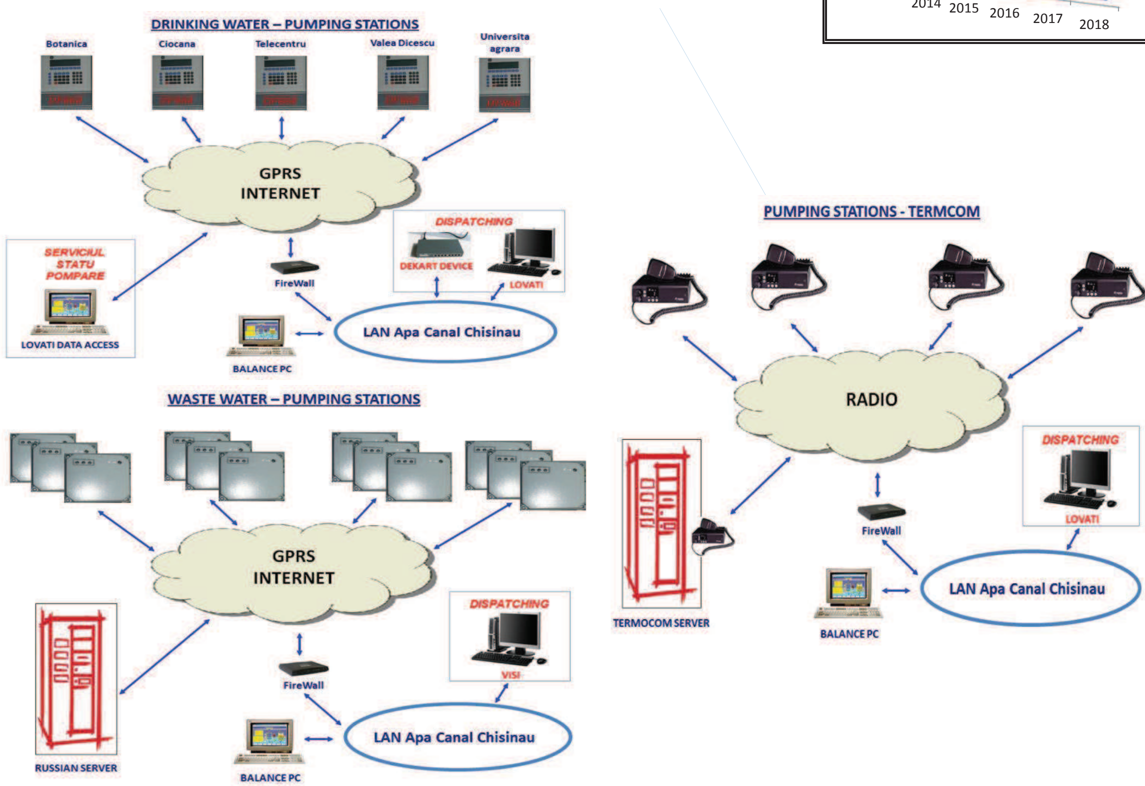
Estimated CAPEX: 325,000 € or 5.2 Mlei **% of the PIP:** 1%

Priority Rank: 3/30

Schedule of Implementation:



Images of the investments



Project Benefits:

1- Improvement of Service Reliability and efficiency
SCADA System provides a live picture of the status of items in the water supply and wastewater collection schemes, which can be controlled remotely in order to cope with various situations
Therefore, enhancing the monitoring and the automated regulations of the systems will facilitate the operation of the systems

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-OM-01

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Purchase of Equipment

Objective:

Implement the best practices for the leak detection on the Water Distribution Network

Overall description of the investment:

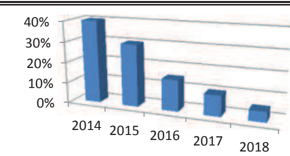
Purchase of equipments for the two leak detection Teams:
- Light commercial vehicles to transport the equipments and staff
- Automated tools for the acoustic detection (ground microphones, high quality headphones, equipment with correlation…)
- Safety equipments
- Generator, working with a drill, dewatering pump…

More Details available in the report entitled "Network Operation Recommendations" and "Non Revenue Water Analysis"

Estimated CAPEX: 82,000 € or 1.3 Mlei — **% of the PIP:** 0.1%

Priority Rank: 4/30

Schedule of Implementation:



Images of the investments

Portable Accoustic Correlator and accesories

Portable Accoustic Ground Microphone and accesories

Generator

Project Benefits:

1- Improvement of the operationnal efficiency

45% of water losses are due to hidden losses (12,658,685 m3 in 2010)

The implementation of a preventive permanent leakage detection with adequate equipments will enable to decrase greatly the number of hidden losses and therefore the volume of water lost by leakages

The volume of non-revenue water will decrease, enhancing the performances of the Supply Water network

2- Improvement of the environment

Minimize the water resources wastage and lead to energy savings (less water to pump and to treat)

Improve the quality of the water by decreasing the risks of contaminations, and the reliability of the water supply

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-T-03

Field:
- [ ] Drinking Water
- [ ] Wastewater
- [ ] Other

Sub-Category:
- [ ] Network
- [ ] Pumping
- [ ] Treatment
- [ ] Operation & Maintenance
- [ ] Other

Type of Operation:
Construction of new treatment facilities

Objective:
Ensure a potable quality of the water abstracted from the wells for the daily use

Overall description of the investment:

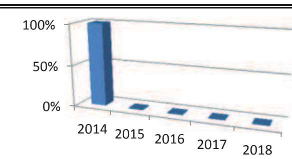
Implementation of a "Package Treatment Plants" for the well Fields of Ialoveni
The Water will be treated on a daily basis with an Aeration tower, a sand Filtration and a Chlorine Disinfection
for a daily capacity of 5,000m3/day in order to remove ammonia and TDS
An extension of the plant is planned in the framework of the emergency plan, in order to treat the full capacity of the wells (20,900m3/day)

More Details available in the reports entitled "Underground Water Resources" and "Water Production"

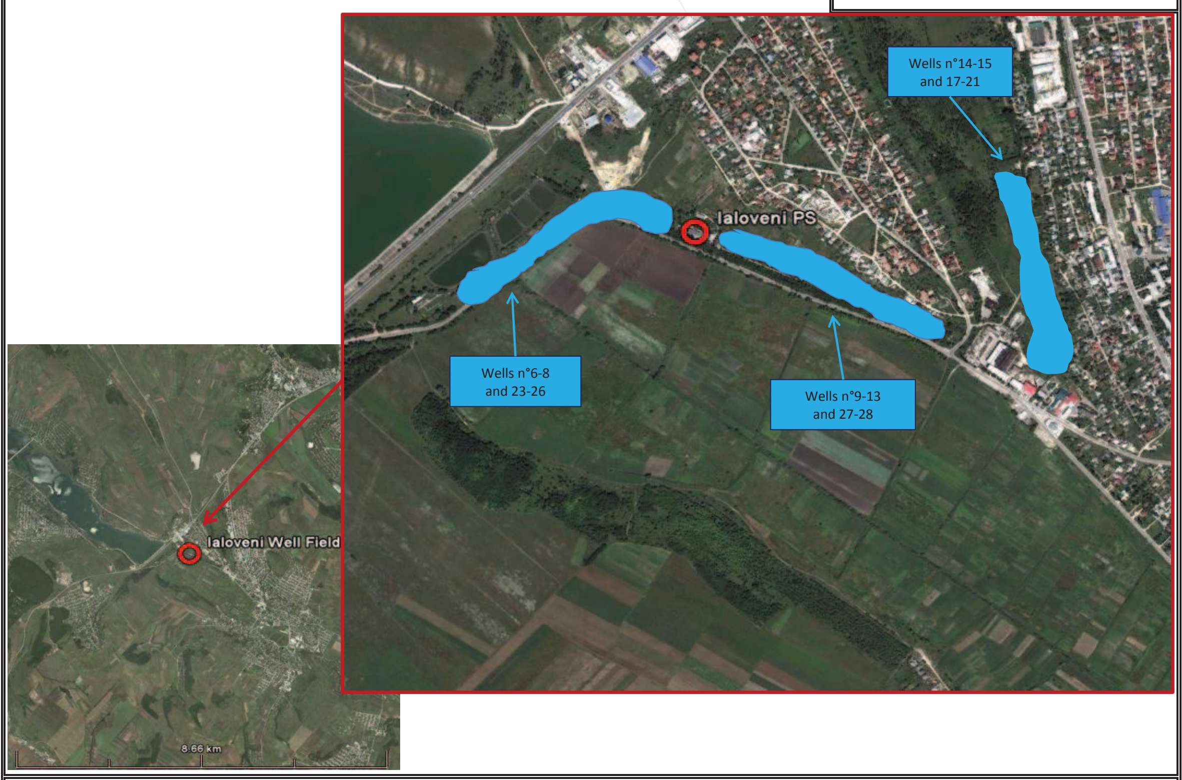
Estimated CAPEX: 548,000 € or 8.8 Mlei **% of the PIP:** 1%

Priority Rank: 5/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Secure the Quality of the Drinking Water Supply
The Water produced in the well Field of Ialoveni will be treated properly to meet the Standards for drinking water (upgrading of the current situation)

2- Compliance with Moldovan Standards
The water supplied in Ialoveni will be compliant with Moldovan Standards for drinking water

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-N-04

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Adaptation of network operation

Objective:

Reduce the pressure on the network in order to reduce the water losses and the number of leakages without deteriorating the current level of service (sufficient pressure will be ensured to the last floor of the high buildings)

Overall description of the investment:

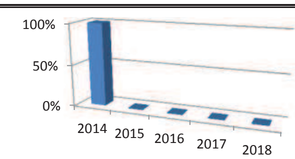
Implementation of 16 pressure reducers (from ND100 to ND200) on isolated parts of the networks:
Each Pressure reducer is equipped with a flowmeter and two pressure sensors
The valves that will have to be operated in order to isolate the concerned parts of the network
3 booster systems will have to be created to supply isolated buildings and 2 booster systems will have to be put back in operation

More Details available in the report entitled "Investment Program - Water Supply Network"

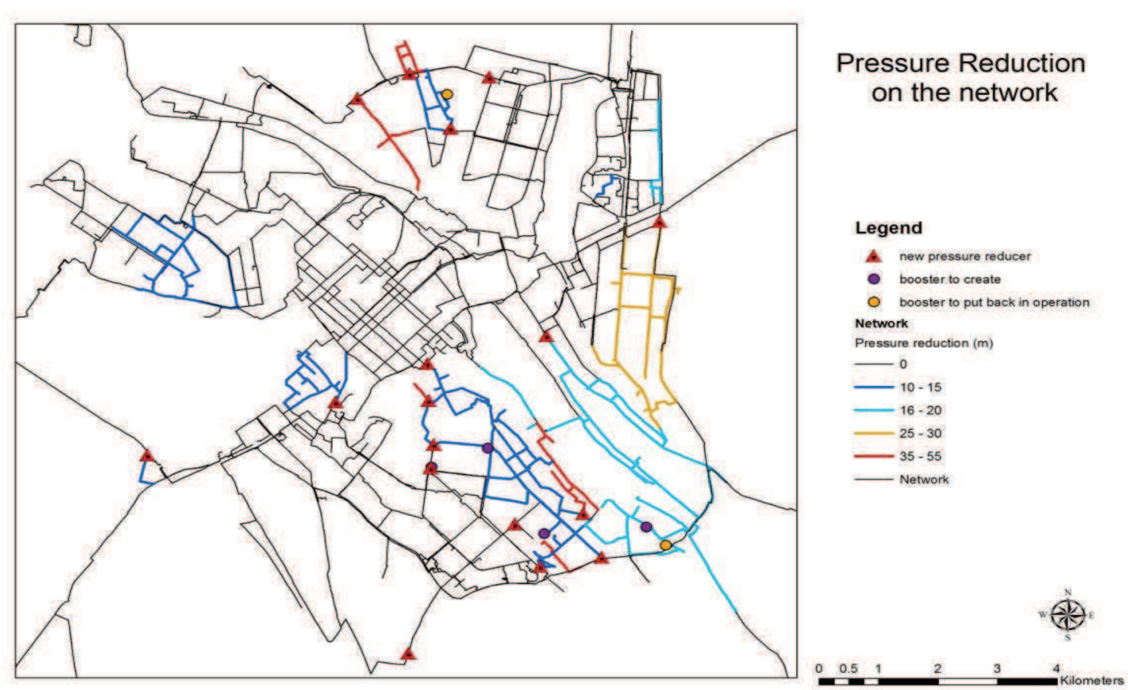
Estimated CAPEX: 303,000 € or 4.8 Mlei **% of the PIP:** 1%

Priority Rank: 6/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:
The Water losses can be reduced by 10% if the pressure reduction is implemented
The number of new leaks will decrease

2- Improvement of the environment
Minimize the water resources wastage and lead to energy savings (less water to pump and to treat)

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: WW-P-02

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Other

Objective:

Improve the safety of the electrical installations in the all the wastewater pumping stations and improve the electrical maintenance

Overall description of the investment:

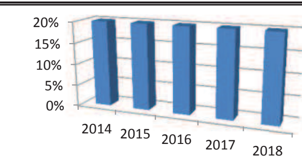
Installation of new electrical boards in the 30 wastewater pumping stations on the network and in the WWTP;
the electrical boards for the pumps over 100kW include soft-starters
(If the implementation of the electrical panels is too slow, it has to be noticed than plexiglas panels (to cover electrical connection over 24V) should be installed in the meantime to ensure the safety of ACC's workers)

More Details available in the report entitled "Audit and recommendations for wastewater Pumping Station"

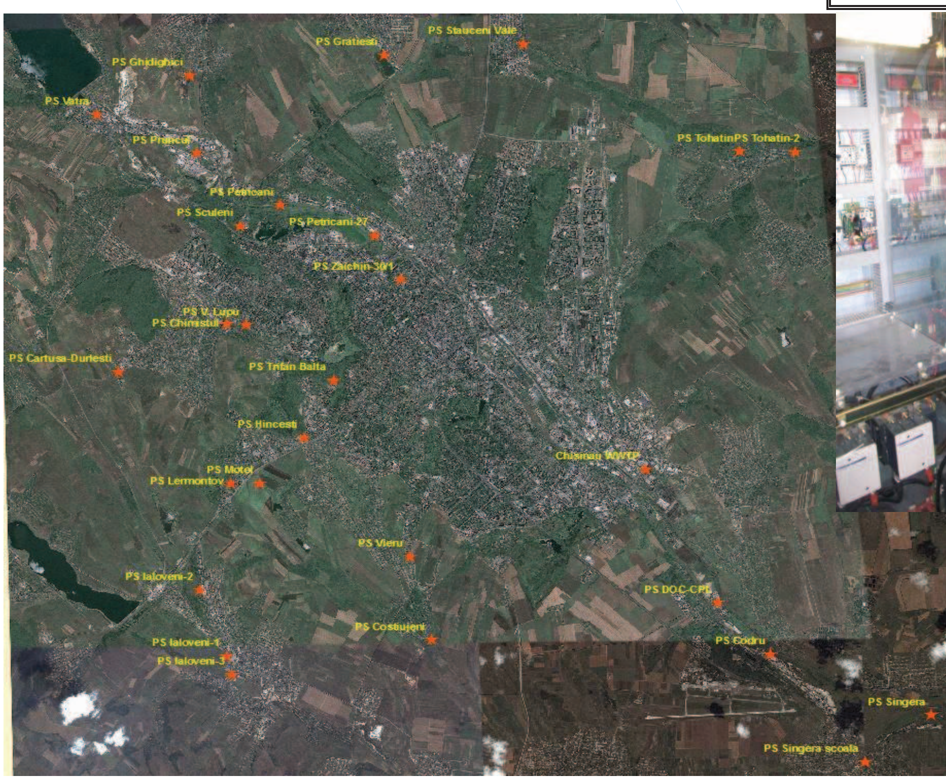
Estimated CAPEX: 204,000 € or 3.3 Mlei **% of the PIP:** 0.3%

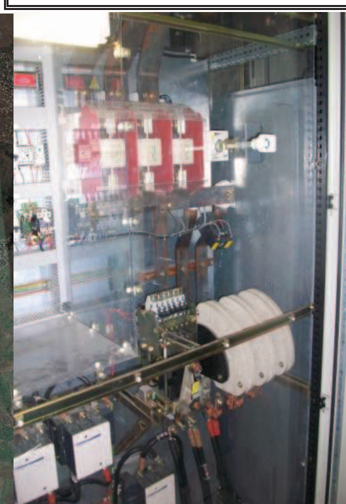
Priority Rank: 7/30

Schedule of Implementation:



Map with the location of the investment:





Project Benefits:

1- Improvement of the operational efficiency
Great improvement of the safety of ACC's staff as the current electrical panels are outdated and unsure
Implementation of best practices for the wastewater pumping stations that will improve the operation

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-O-04

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Construction of new treatment facilities

Objective:

Part of the Emergency Plan which ensures the supply of the water in case of pollution of the Nistru or of Flooding of the water intake
Achieve a potable quality of the water for the daily use and for the emergency use

Overall description of the investment:

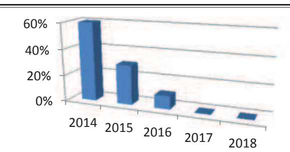
Implementation of "Package Treatment Plants" for the well Fields of Ghidighici, Balisevschi and Petricani
Implementation of an extension in Ialoveni Treatment Plant to treat water in case of emergency
The Water will be treated on a daily basis with an Aeration tower, a sand Filtration and a Chlorine Disinfection for the daily capacities of:
790m3/day (Ghidighici); 1,130m3/day (Petricani) and 850m3/day (Balisevschi)
H2S, Ammonia, TDS and Sulphates will therefore be treated to achieve Standards for drinking Water
An Additional space will be planned to treat the water in case of emergency with an Aeration and a Disinfection for the capacities of
7,110m3/day (Ghidighici), 10,170m3/d (Petricani) and 7,650m3/day (Balisevschi) and 15,900m3/day (Ialoveni)
For emergency use (i.e. temporarily supply), the water can contain concentrations in TDS, ammonia or sulphate above the standards
The Quality of water remains unharmful for health as long as the supply is not permanent

More Details available in the reports entitled "Underground Water Resources" and "Water Production"

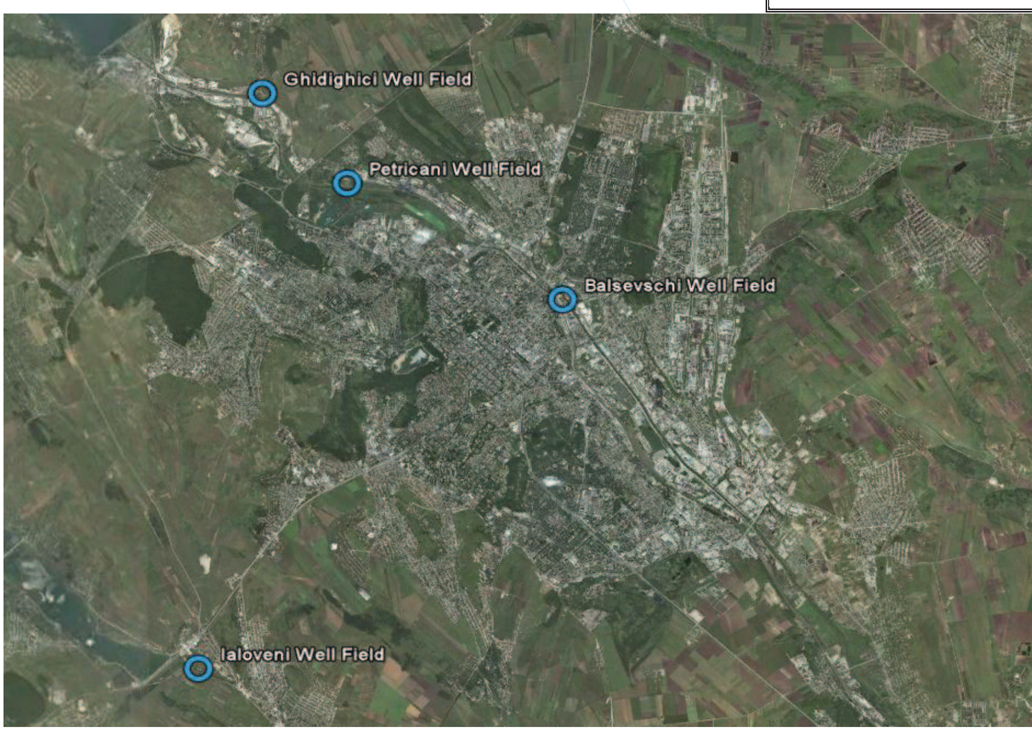
Estimated CAPEX: 764,000 € or 12.2 Mlei **% of the PIP:** 1%

Priority Rank: 8/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Secure the Sustainibility of the Drinking Water Supply
Chisinau' network is currently supplied at 97% by water coming from the Nistru.
The risks of pollution of the Nistru or of flooding of the water intake are high and it would stop the supply of water to the whole city
The emergency plan would ensure 34% of the volume into supply in 2015 and 50% in 2035 (with acceptable quality) to the whole city

2- Secure the Quality of the Drinking Water Supply
The Water produced in the well Fields of Ghidighici and Balisevschi will be treated properly to meet the molodan Standards for drinking water (upgrading of the current situation in Ghidighici)

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-N-02

Field:
- [ ] Drinking Water
- [ ] Wastewater
- [ ] Other

Sub-Category:
- [ ] Network
- [ ] Pumping
- [ ] Treatment
- [ ] Operation & Maintenance
- [ ] Other

Type of Operation:
Replacement of connections

Objective:
The rehabilitation of the connections made of steel will lead to
decrease the number of repairs
decrease the Water Losses

Overall description of the investment:

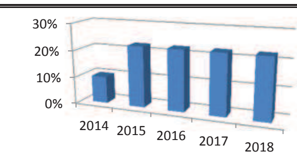
Replacement of 2,270 connections made of steel when replacing the steel pipes of the group 2 (Project DW-N-05)
The investments concern only the connections for blocks
The connections for individual houses will be replaced as well but will be invoiced to the inhabitants
The definition of the pipes to be replaced (and therefore the dependent connections) will be based on the statistical analysis of the georeferenced leakages thanks to the use of the GIS.
But the opportunity of a replacement (given by the program of road rehabilitation) will be seized

More Details available in the report entitled "Investment Program - Water Supply Network"

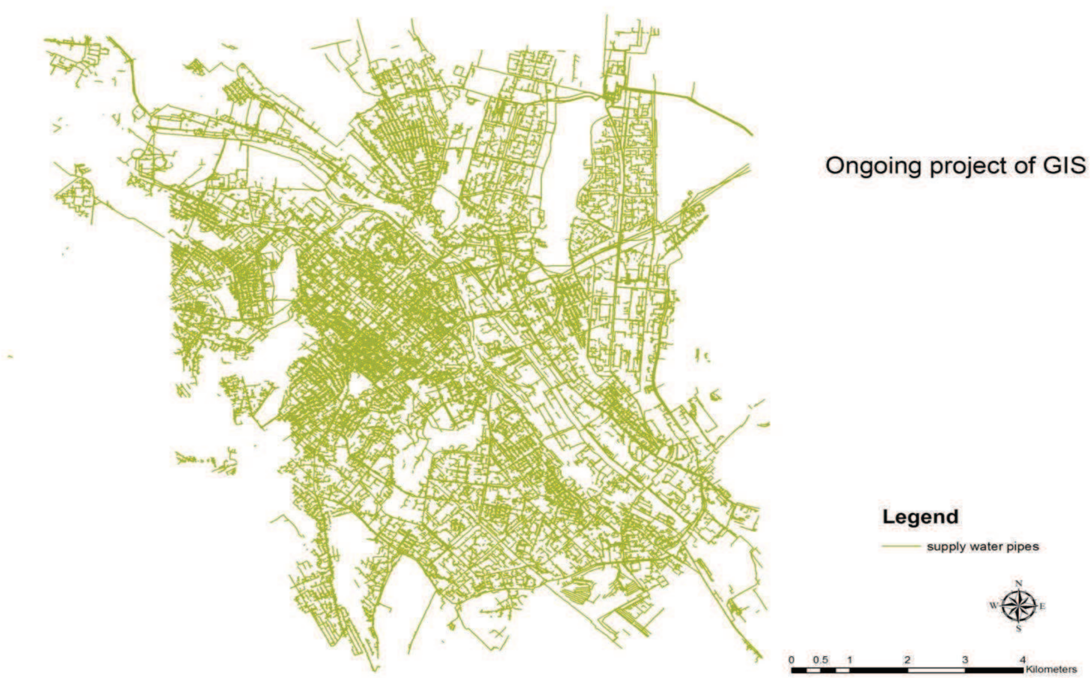
Estimated CAPEX: 1,589,000 € or 25.4 Mlei **% of the PIP:** 3%

Priority Rank: 9/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:
32% of the repairs are due to leakages on service connection (the ratio is 3.5 repairs/ 100 connections)
90% of the the burst on service connections appear on steel connections
Replacing the steel connections will greatly decrease the number of repairs and the number of water losses

2- Improvement of the environment and of the service reliability
Minimize the water resources wastage and lead to energy savings (less water to pump and to treat)
Improve the reliability of the service for the blocks and houses concerned

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-OM-02

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Purchase of Equipment

Objective:

Implement the best practices in the operation of the Drinking Water Network in order to increase the efficiency of the interventions

Overall description of the investment:

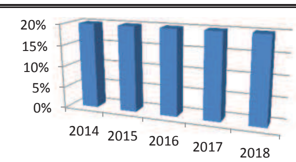
DW-OM-02
Purchase of equipments for the maintenance of the Water Supply Network for each team (19 teams in total)
A Small truck (5 to 10T) for the transport of the teams, the equipments and the raw materials
A Trailer for mini excavator

More Details available in the report entitled "Network Operation Recommendations"

Estimated CAPEX: 646,000 € or 10.3 Mlei **% of the PIP:** 1%

Priority Rank: 10/30

Schedule of Implementation:



Images of the investments

Trailer for mini-excavator

Small Truck 5 -10 T

Project Benefits:

1- Improvement of the operationnal efficiency
The number of interventions performed in 2010 was 14,024 and a progressive increase has been observed from 2006
The implementation of best practices to perform these interventions will lead to an improvment of the work conditions and of the interventions efficiencies (the current trucks are in average 20 year-old)

2- Improvement of the corporate image of ACC within the population and the company

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-O-06

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Adaptation of network operation

Objective:
Part of the Emergency Plan which ensures the supply of the water in case of pollution of the Nistru or of Flooding of the water intake
Adaptation to the current network operation to an operation in emergency period : the production of the water will be relocated at the well fields

Overall description of the investment:
Implementation of new pumps for emergency purpose in the pumping stations of :

Ialoveni: 2 pumping groups of 421 m3/h each at 165mwc and an efficiency of 70% for an installed power of 542 kW
Schinoasa: 2 pumping groups of 402 m3/h each at 30mwc and an efficiency of 70% for an installed power of 94 kW
Buiucani for the Zone 4: 2 pumping groups of 285 m3/h each at 97mwc and an efficiency of 68% for an installed power of 221 kW
Petricani for the Zone 2: 2 pumping groups of 201m3/h each at 120mwc and an efficiency of 66% for an installed power of 197kW

Rehabilitation of the pumps for daily purpose (that have to be oversized for the emergency plan) for the pumping stations of:

Petricani for the Zone 1: 2 pumping groups of 140m3/h each at 55mwc and an efficiency of 65% for an installed power of 64kW
Ghidighici: 2 pumping groups of 165m3/h each at 54mwc and an efficiency of 66% for an installed power of 74kW
Balisevschi for Zone 2: 2 pumping groups of 177m3/h each at 125mwc and an efficiency of 66% for an installed power of 184kW

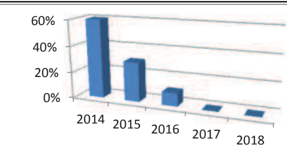
Implementation of a pipe (500m of ND 600 ductile iron) between the Pumping Station of Petricani and the Transfer Pipe of Doina (transfer pipe from STA to Buiucani)

More Details available in the report entitled "Investment Program - Water Supply Network"

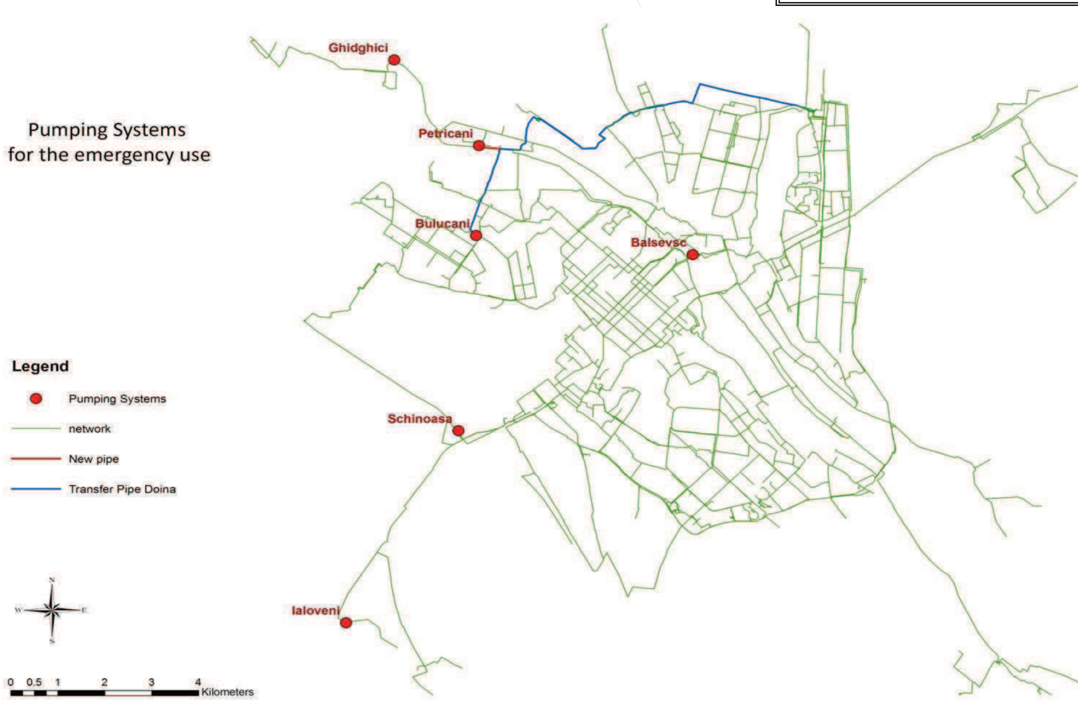
Estimated CAPEX: 888,000 € or 14.2 Mlei **% of the PIP:** 1%

Priority Rank: 11/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:
1- Secure the sustainibility of the drinking Water Supply
Chisinau' network is currently supplied at 97% by water coming from the Nistru.
The risks of pollution of the Nistru or of flooding of the water intake are high and it would stop the supply of water to the whole city

The emergency plan would ensure 34% of the volume into supply in 2015 and 50% in 2035 (with acceptable quality) to the whole city for the whole period of the emergency situation

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-N-14

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Rehabilitation of reservoir

Objective:
Secure a storage capacity superior to 50% of the peak demand per hydraulic entity.

Overall description of the investment:
Rehabilitation of the tank n°5 (10,000m3 in concrete, rectangular) in the Water Treatmant Plant in Chisinau (STA):
- The tightness of the reservoir is not ensured anymore: the roof waterproofing elements have to be rehabilitated
- The prefabricated panels from the roof show pronounced corrosion
- The partition walls of the reservoirs have collapsed and should be rehabilitated
- The fittings should be replaces because of the visible degradation due to rust on the suction and discharge pipes is visible
- The access scale to the reservoir should be replaced as it is a danger for ACC staff

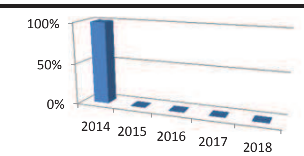
Rehabilitation of the 4 other tanks at STA (2 reservoirs of 10,000m3 and 2 reservoirs of 5,000m3):
- walls rehabilitation in the reservoir n°4, fittings, ladders

More Details available in the report entitled "Investment Program - Water Supply Network"

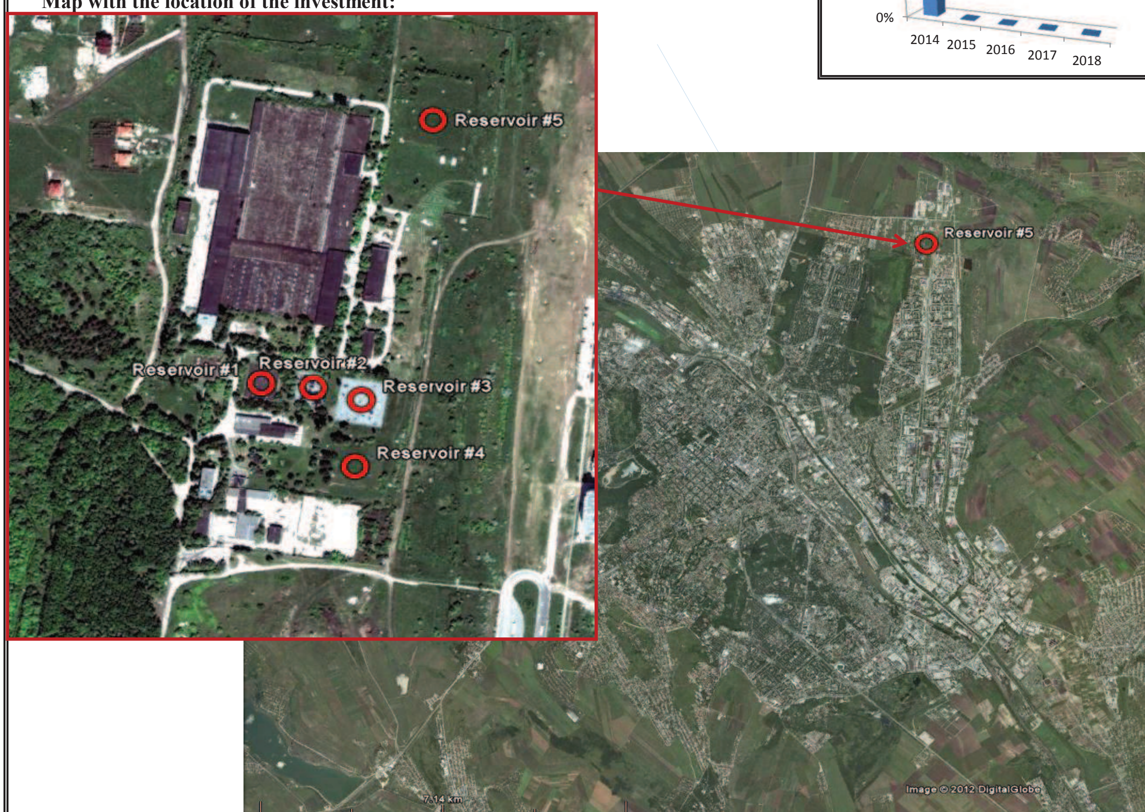
Estimated CAPEX: 840,000 € or 13.4 Mlei **% of the PIP:** 1%

Priority Rank: 12/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Secure the quality of the drinking water supply
The missing of partition walls as well as the poor tightness conditions of the roof impact the quality of the water

2- Secure the sustainability of the drinking water supply
It is important to maintain storage facilities in order to have a reserve of at least 50% of the peak demand
The missing of the partition walls increases the stress applied on the walls, which leads to the building's resistance reduction.

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: O-OM-03

Field:		**Sub-Category:**		**Type of Operation:**
	Drinking Water		Network	Rehabilitation of
	Wastewater		Pumping	Electrical Lines
	Other		Treatment	
			Operation & Maintenance	
			Other	

Objective:

Reehabilitate electrical lines for important facilities in order to ensure electrical supply and therefore comply with Moldovan regulations.

Overall description of the investment:

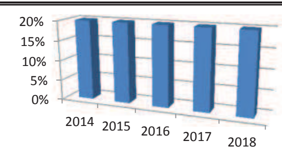
Implementation of two lines between SAN and the water intake in Vadul Lui Voda: 7,600m; 2 lines with 2 three-phase cables (section 3x240mm)
Rehabilitation of a line that supplies STA from an independent energy source than the other existing lines: 2,500m; 1 line with 1 three-phase cables with a section 3x185mm
In the Wastewater Treatment Plant, the electrical lines need to be rehabilitated to ensure 2 independent sources of electricity to facilities
250m; 1 line to be implemented with 1 three-phase cable with a section 3x70mm
480m; 1 line to be rehabilitated with 1 three-phase cable with a section 3x240mm
1280m; 1 line to be rehabilitated with 1 three-phase cable with a section 3x240mm
Install a secure and direct line to supply the pumping station and the well field of Ghidighici: 1 line with 1 cable three-phase (section: 3x120mm)

More Details available in the report entitled "Investment Program - Water Supply Network"

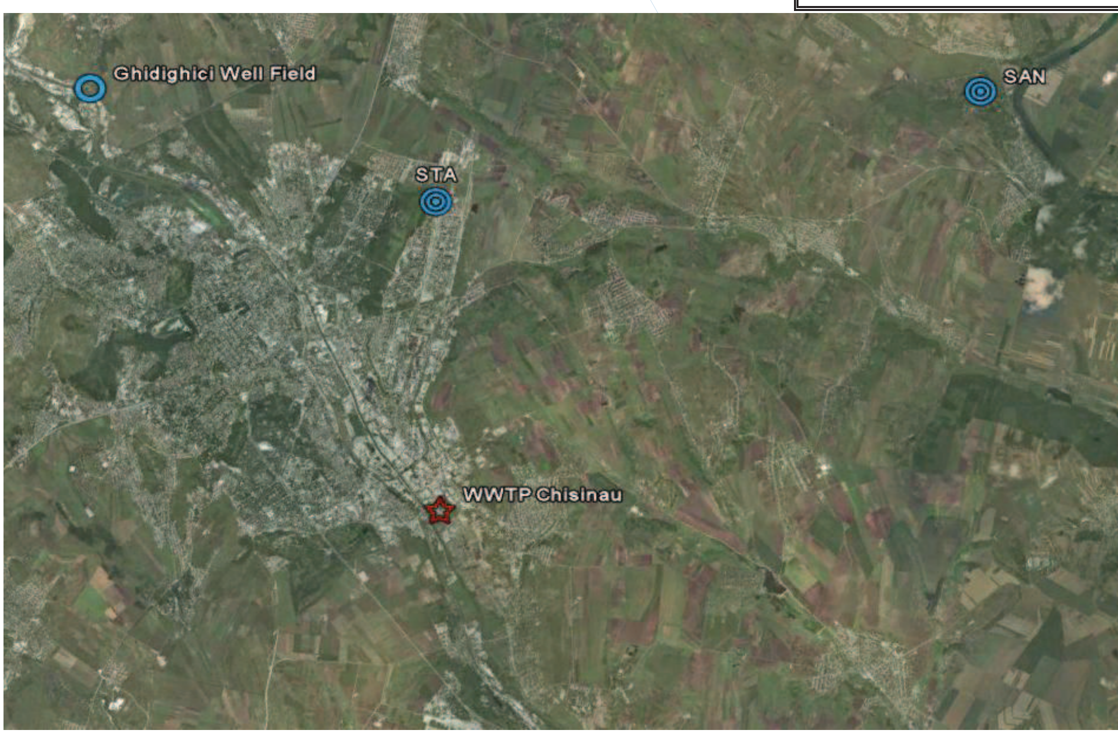
Estimated CAPEX: 389,000 € or 6.2 Mlei **% of the PIP:** 1%

Priority Rank: 13/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Compliance with moldovan regulation
The facilities of "fiability 1" should be supplied by two independent sources of energy

2- Improvement of the efficiency
Due to the flooding of the Nistru in 2009, only one line remains to supply the facilities of the water intake.
This line is old (started operation in 1972). The rehabilition and adjunction of lines will secure the electricity supply
In the Treatment Plants, the lines are old and undergo often failures.
In Ghidighici vicinity, the electrical line is overhead and supports illegal connections
In some facilities, the electricity supply is essential to ensure the water supply of the city

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-N-01

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Replacement of connections

Objective:

In the seven most leaking zones of the city, rehabilitate the connections made of steel to
decrease the number of repairs
decrease the Water Losses

Overall description of the investment:

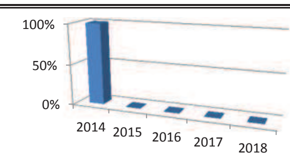
Replacement of around 1,000 connections made of steel when replacing the pipes of the priority programm (project DW-N-04)
The investments concern only the connections for blocks
The connections for individual houses will be replaced as well but will be invoiced to the customers

More Details available in the report entitled "Investment Program - Water Supply Network"

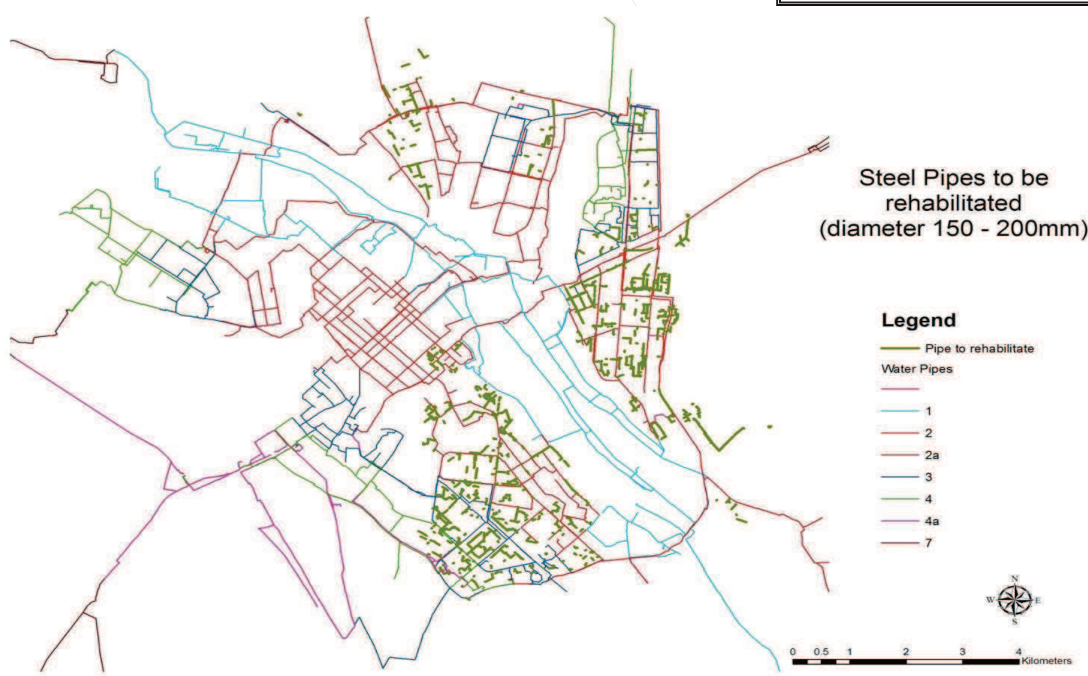
Estimated CAPEX: 700,000 € or 11.2 Mlei **% of the PIP:** 1%

Priority Rank: 14/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:
32% of the repairs are due to leakages on service connection (the ratio is 3.5 repairs/ 100 connections)
90% of the the burst on service connections appear on steel connections
Replacing the steel connections will greatly decrease the number of repairs and the number of water losses

2- Improvement of the environment and of the service reliability
Minimize the water resources wastage and lead to energy savings (less water to pump and to treat)
Improve the reliability of the service for the blocks and houses concerned
Improve the quality of the water by decreasing the risks of contaminations

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-OM-05

Field:
- [ ] Drinking Water
- [ ] Wastewater
- [ ] Other

Sub-Category:
- [ ] Network
- [ ] Pumping
- [ ] Treatment
- [ ] Operation & Maintenance
- [ ] Other

Type of Operation:
Purchase of Equipment

Objective:

Implement the best practices in the operation of the Drinking Water Network in order to increase the efficiency of the interventions

Overall description of the investment:

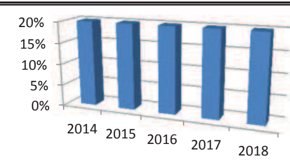
Purchase of equipments for the maintenance of the Water Supply Network for the interventions on the big pipes
A JCB (backhoe loader)
A excavator on wheel (14T)
A dump truck 4x6 (26T)

More Details available in the report entitled "Network Operation Recommendations"

Estimated CAPEX: 260,000 € or 4.2 Mlei **% of the PIP:** 0.4%

Priority Rank: 15/30

Schedule of Implementation:



Images of the investments

JCB (backhoe loader)

Excavator on Wheel

Dump Truck 4x6 (26T)

Project Benefits:

1- Improvement of the operational efficiency
The number of interventions performed in 2010 was 14,024 and a progressive increase has been observed from 2006
The implementation of best practices to perform these interventions will lead to an improvment of the work conditions and of the interventions efficiencies.

2- Improvement of the corporate image of ACC within the population

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: WW-OM-01

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Purchase of Equipment

Objective:

Implement the best practices in the operation of the Wastewater Network in order to enhance the safety of ACC's staff, to decrease the impact on the environment and to increase the operational efficiency of ACC

Overall description of the investment:

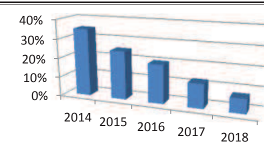
Purchase of equipments for the maintenance of the Wastewater Collection System:
Perform visual inspection with CCTV equipment dedicated to the inspection of Waste Water Collecting System or with QuickView equipment (5)
Perform preventive action on the wastewater collection system with two combined jetting and Pumping trucks (with 6 nozzles per truck)
Perform "reaction cleaning" (as today) with new Jet units on trailers (5)
Adequate and necessary safety equipments as gaz detector, portable scale, ropes and harnesses, protection clothes, road signalisation…
New vans for transportation of Staff and equipment (the current ones are more than 20 years old)
A smoke generator to detect misconnections between the wastewater and stormwater networks
General intervention equipment (shovel, ...)

More Details available in the reports entitled "Network Operation Recommendations" and "Wastewater Collection System"

Estimated CAPEX: 1,683,000 € or 26.9 Mlei **% of the PIP:** 3%

Priority Rank: 16/30

Schedule of Implementation:



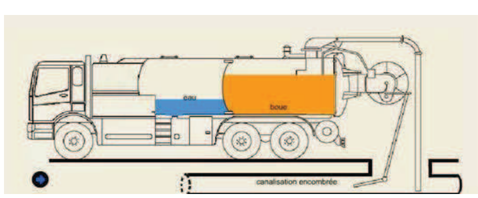
Images of the investments

CCTV truck

QuickView equipment

Jet unit on trailer

Gaz detector



Combined jetting and Pumping Truck

Smoke generator

Nozzles

Project Benefits:

1- Improvement of the operationnal efficiency
The current hydrocleaning trucks provide a pressure of 25 to 40 bars, while the initial nominal pressure was 120 bars.
Interventions cannot be performed on pipes with a diameter bigger than 400mm. Moreover, it is not currently possible to perform interventions in the small streets
There is currently no CCTV equipment available to inspect the pipes
Currently, there are 8.8 blockages/km and the number of pipe collapse is 150 events per year. Implementing the best practices (with the avaibility of recommended equipments) will greatly improve the efficiency of the interventions and of the network

2- Improvement of the environment
Reduce the pollution of the environment due to flooding of the Wastewater Collection Systems by removing the clogging and ensuring that the wastewater and stormwater networks are separate

3- Improvement of the safety of ACC' staff that operate today without gaz detectors

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: WW-P-03

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Renewal of pumps

Objective:

Rehabilitate the pumping stations for which the efficiency is not optimum and where significant savings can be made
Remediate odour problems

Overall description of the investment:

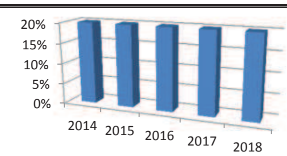
Rehabilitation of 9 existing pumps (the investments take into account the pumps, motors and frames) in the following pumping stations
Phase 1: Pumps n°1 and 2 (both with a targeted specific energy of 4.2 Wh/m3/mwc) in Vatra and
Pump n°2 in Codru (with a targeted specific energy of 4.6)Wh/m3/mwc
Phase 2: Pumps n°1 and 3 in Codru (both with a targeted specific energy of 4.3 Wh/m3/mwc) ;
Pumps n°1 and 2 in Vieru and Pump n°1 in Codru V. Lupu (with a targeted specific energy of 4.6 Wh/m3/mwc);
Pump n°3 in Vatra (with a targeted specific energy of 4.2 Wh/m3/mwc)
Complete rehabilitation of two wastewater pumping stations :

More Details available in the report entitled "Audit and recommendations for wastewater Pumping Station"

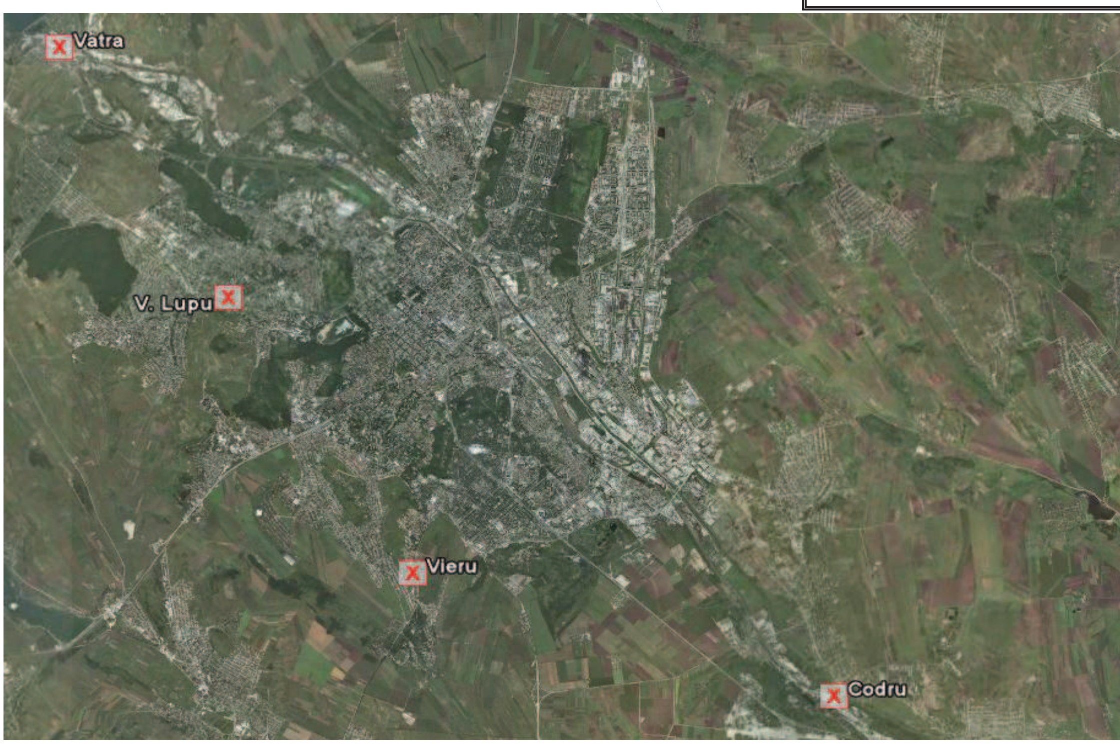
Estimated CAPEX: 847,000 € or 13.6 Mlei | **% of the PIP:** 1%

Priority Rank: 17/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:
Reduction of the electrical consumption: for the phase 1, the savings of energy will be superior à 50% of the current consumption of the pumps; for the phase 2, 30% of the current energy consumption will be avoided
RoI is around 3 years for both projects

2- Improvement of the environment
This project would save 350 MWh every year
It would remediate odour problems created by these pumping stations

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-N-15

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Rehabilitation of reservoirs

Objective:
Secure a storage capacity superior to 50% of the peak demand per hydraulic entity.

Overall description of the investment:
Rehabilitation of 34 reservoirs operated by ACC (out of 39 reservoirs (the reservoirs at the STA are rehabilitated in the project DW-N-14)):
ranging from 1,000m3 to 10,000m3 with a total capacity of 113,800m3:
- 1 reservoir is in a very bad condition (Tohatin, n°1: 10,000m3, rectangular in concrete)
- 17 reservoirs are in a bad condition (requiring a investment superior to 0.5M MDL)
- 16 reservoirs are in a correct conditions and require the rehabilitation of a few fittings

The generic problems encountered in the reservoirs are:
- The prefabricated panels from the roofs show pronounced corrosion
- The partition walls of the reservoirs have collapsed and should be rehabilitated
- The fittings should be replaces because of the visible degradation due to rust on the suction and discharge pipes is visible
- The access scale to the reservoir should be replaced as it is a danger for ACC staff

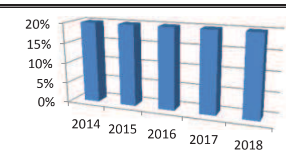
Rehabilitation or installation of a chlorination system for the tanks in the following PS:
Telecentru, Tohatin, Valea Dicescu, Buiucani, Ciocana, Schinoasa, Airport, Codru MDK, Colonita, Independenta,
Sîngera andStauceni

More Details available in the report entitled "Investment Program - Water Supply Network"

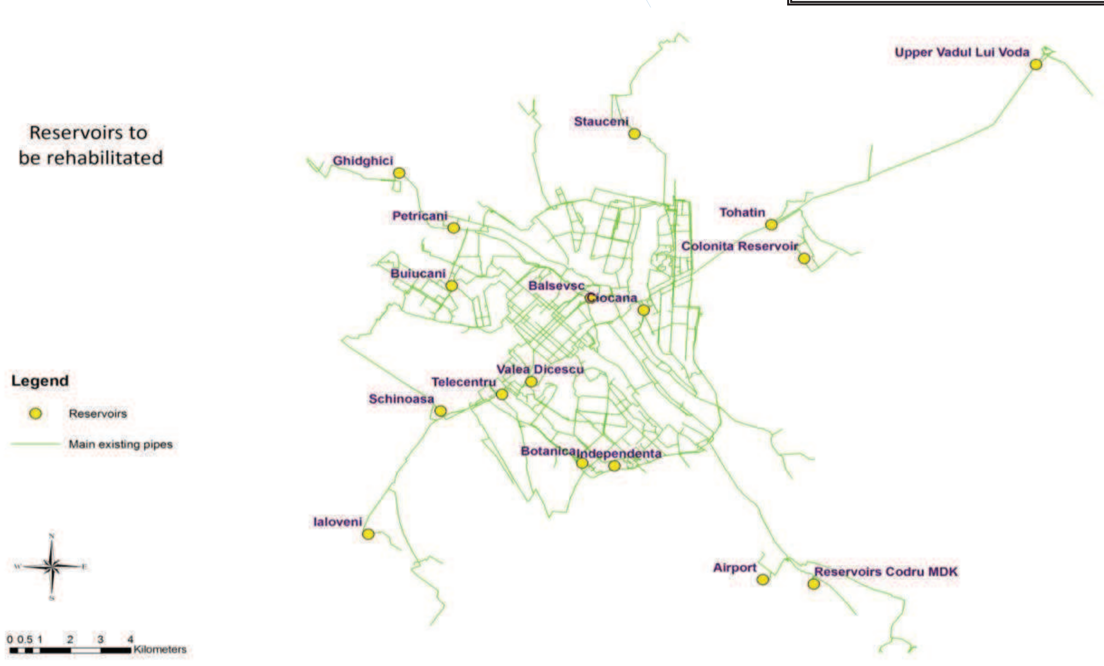
Estimated CAPEX: 1,416,000 € or 22.7 Mlei **% of the PIP:** 2%

Priority Rank: 18/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:
1- Secure the quality of the drinking water supply
The missing of partition walls has a negative influence on the quality of the water
All the reservoirs in the study area will be equipped with a chlorination system

2- Secure the sustainability of the drinking water supply
It is important to conserve storage facilities in order to have a reserve of at least 50% of the peak demand in each hydraulic entity

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: WW-N-01

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Renewal of sewers

Objective:

Rehabilitation of the pipes, assess as very urgent rehabilitation works to increase the efficiency of the collection system and to mitigate the impact on the environment

Overall description of the investment:

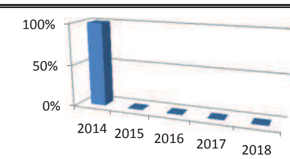
Rehabilitation of 4,800m of wastewater pipe under priority #1, as defined jointly by ACC and the consultant
- 120m of a pipe with a nominal diameter 160-200mm (on Maatevici street)
- 3,110m of a collection pipe with a nominal diameter 400mm (on Pogdorenilor street)
- 1,620m of a collection pipe with a nominal diameter 400mm (on Petricani street)

More Details available in the report entitled "Wastewater Collection System"

Estimated CAPEX: 968,000 € or 15.5 Mlei **% of the PIP:** 2%

Priority Rank: 19/30

Schedule of Implementation:



Map with the location of the investment:

Project Benefits:

1- Improvement of reliability of the service
Improve the structural stability of the wastewater network and reduce the risks of breakage and collapse of the pipes
Reduce therefore the risk of major problem (flooding, discharge of wastewater into the environment, collapse of the roads…)

2- Improvement of the environment
Reduce the risks of pollution of the environment by discharge of wastewater into the natural waterways

3- improvement of the corporate image of ACC within the population

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-P-01

Field: Drinking Water / Wastewater / Other

Sub-Category: Network / Pumping / Treatment / Operation & Maintenance / Other

Type of Operation: Renewal of pumps

Objective:

Rehabilitate the pumping stations where the efficiency can be increased or where important energy savings can be made

Overall description of the investment:

Prioritary rehabilitation of the existing pumps in the pumping Stations:

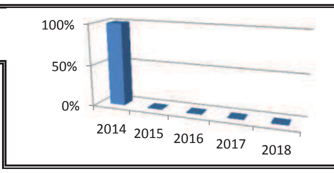
Treapta IIA Raw Water: 2 pumping groups of 5,032 m3/h each at 48mwc and an efficiency of 75% for an installed power of 1747 kW
Buiucani towards the Zone 3: 2 pumping groups of 296 m3/h each at 22mwc and an efficiency of 68% for an installed power of 52 kW
Buiucani towards the zone 4: 2 pumping groups of 400m3/h each at 60mwc and an efficiency of 70% for an installed power of 187 kW
Independenta towards the Zone 3: 2 pumping groups of 568 m3/h each at 47mwc and an efficiency of 74% for an installed power of 198 kW
Independenta towards the zone 4: 2 pumping groups of 291m3/h each at 100mwc and an efficiency of 68% for an installed power of 233 kW

More Details available in the report entitled "Investment Program - Water Supply Network"

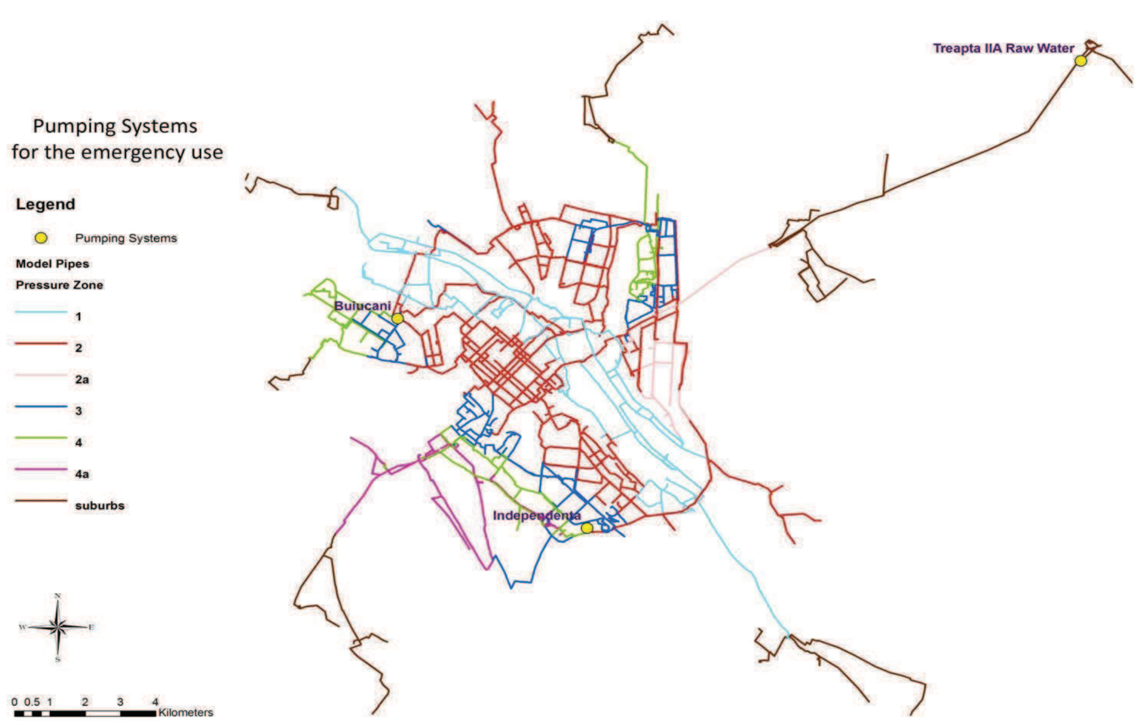
Estimated CAPEX: 825,000 € or 13.2 Mlei **% of the PIP:** 1%

Priority Rank: 20/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:
In Trepta IIA PS, the efficiency is good (69%) but the expected efficiency of a new pump is 75% and the gain would be 1,369,880 MDL/year, which give a payback time of 5.4 years for a forecasted lifetime of the equipment of 30 years in Buiucani and Independenta PS, the efficiencies are respectively 43% and 51% and the combined gain would be 1,677,620 MDL/year, which give a payback time of around 1 year for all the pumps in these two pumping stations

2- Improvement of the environment
This project would save 2,277,929 kWh every year

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-OM-03

Field: Drinking Water / Wastewater / Other

Sub-Category: Network / Pumping / Treatment / Operation & Maintenance / Other

Type of Operation: Purchase of Equipment

Objective:

Implement the best practices in the operation of the Drinking Water Network in order to increase the efficiency of the interventions

Overall description of the investment:

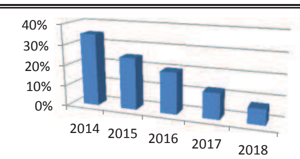
Purchase of equipments for the maintenance of the Water Supply Network for each team (19 teams in total)
A mini-excavator 3T with several types of buckets and hammers
A generator, a compressor and Ram down machinery (working with heat motor)

More Details available in the report entitled "Network Operation Recommendations"

Estimated CAPEX: 589,000 € or 9.4 Mlei **% of the PIP:** 1%

Priority Rank: 21/30

Schedule of Implementation:



Images of the investments

Generator

Mini-excavator 3T

Ram down machinery

Project Benefits:

1- Improvement of the operationnal efficiency
The number of interventions performed in 2010 was 14,024 and a progressive increase has been observed from 2006
The implementation of best practices to perform these interventions will lead to an improvment of the work conditions and of the interventions efficiencies.

2- Improvement of the environment
The old trucks, equipped with a welding infrastructure, have a very high fuel consumption rate of 40L /100 km
The implementations of generator will therefore minimize the energy consumption

3- Improvement of the corporate image of ACC within the population and the company

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-N-06

Field:
- ☐ Drinking Water
- ☐ Wastewater
- ☐ Other

Sub-Category:
- ☐ Network
- ☐ Pumping
- ☐ Treatment
- ☐ Operation & Maintenance
- ☐ Other

Type of Operation:
Renewal of water pipes

Objective:

Rehabilitate the pipes with the highest linear repair index in order to reduce the number of repairs and the water losses

Overall description of the investment:

Rehabilitation of the current network (160km) : 42% of the group 2 - Steel pipes with a nominal diameter between 100mm and 200mm

122,000m of the existing steel pipes of nominal diameter : 100mm with an average LRI of 9 burst/km/year

23,000m of the existing steel pipes of nominal diameter : 150mm with an average LRI of 20 burst/km/year

15,000m of the existing steel pipes of nominal diameter : 200mm with an average LRI of 21 burst/km/year

The definition of the pipes to be replaced (and therefore the dependent connections) will be based on the statistical analysis of the georeferenced leakages thanks to the use of the GIS.

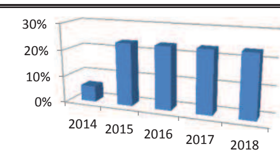
But the opportunity of a replacement (given by the program of road rehabilitation) will be seized

More Details available in the report entitled "Investment Program - Water Supply Network"

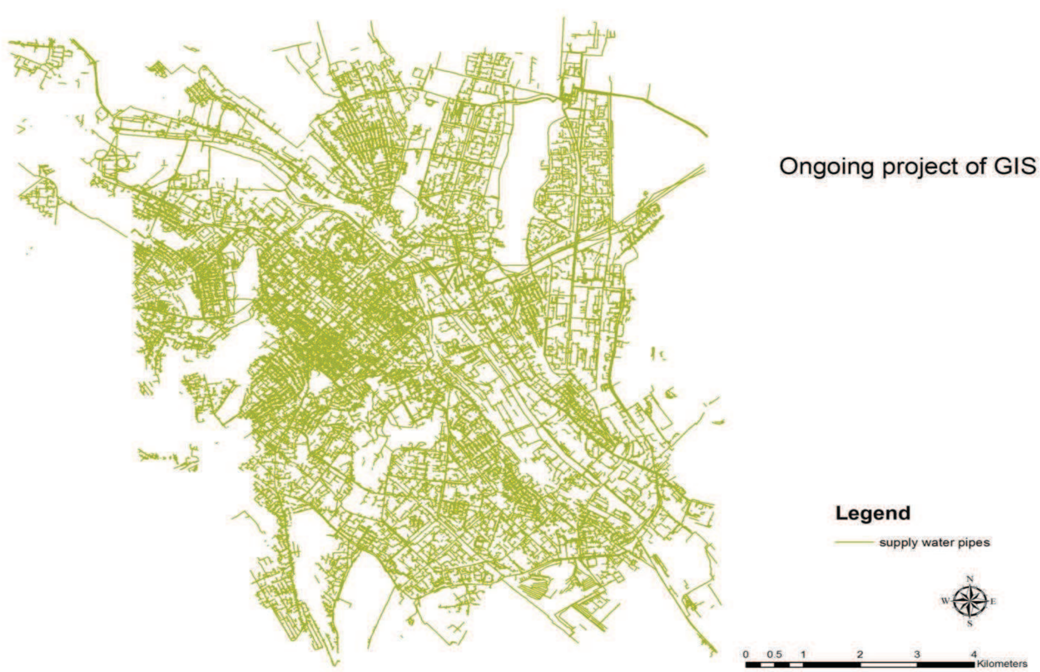
Estimated CAPEX: 7,747,000 € or 124.0 Mlei **% of the PIP:** 13%

Priority Rank: 22/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:
The existing average assessed LRI of the pipes is about 12 burst/km/year. If the rehabilitation of the connections is carried out at the same time, the number of repairs will decrease by 16% and the water losses will decrease by 15%

2- Improvement of the environment
Minimize the water resources wastage and lead to energy savings (less water to pump and to treat)
Improve the reliability of the service for the whole city

3- Improvement of the corporate image of ACC within the population
The results from the household survey show that the population consider that the rehabilitation of the pipes will contribute to improving the water quality. Moreover, the survey shows that this is one of their major concern

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-O-05

Field: Drinking Water / Wastewater / Other

Sub-Category: Network / Pumping / Treatment / Operation & Maintenance / Other

Type of Operation: Rehabilitation and Construction of wells

Objective:
Part of the Emergency Plan which ensures the supply of the water in case of pollution of the Nistru or of Flooding of the water intake
Rehabilitation of the alternative water sources: Groundwater Well Fields

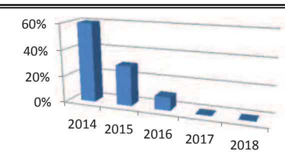
Overall description of the investment:
Rehabilitation of the wells for the Emergency Plan:
Rehabilitation of 21 wells in Ialoveni Well Field (for a total capacity of 20,900m3/day and a daily production of 5,000m3/day)
Rehabilitation of 11 wells in Ghidighici Well Field (for a total capacity of 7,900m3/day and a daily production of 790m3/day)
Rehabilitation of 9 wells in Petricani Well Field (for a total capacity of 11,300m3/day and a daily production of 1,130m3/day)
Rehabilitation of 6 wells in Balisevschi Well Field (for a total capacity of 8,500m3/day and a daily production of 850m3/day)
Creation of 15 new wells in the vicinity of the Water Treatment Plant (STA) (for a total capacity of 15,000m3/day)
A study will be performed to assess the possibility of rehabilitation of all the wells (with a visual inspection).
If the rehabilitation appears impossible, new wells will be drilled on the same site.

More Details available in the report entitled "Underground Water Resources"

Estimated CAPEX: 2,592,000 € or 41.5 Mlei **% of the PIP:** 4%

Priority Rank: 23/30

Schedule of Implementation:



Map with the location of the investment:

Project Benefits:
1- Secure the sustainibility of the drinking Water Supply
Chisinau' network is currently supplied at 97% by water coming from the Nistru.
The risks of pollution of the Nistru or of flooding of the water intake are high and it would stop the supply of water to the whole city

The emergency plan would ensure 34% of the volume into supply in 2015 and 50% in 2035 (with acceptable quality) to the whole city for the whole period of the emergency situation

Code: O-OM-01

Field:
- [ ] Drinking Water
- [ ] Wastewater
- [ ] Other

Sub-Category:
- [ ] Network
- [ ] Pumping
- [ ] Treatment
- [ ] Operation & Maintenance
- [ ] Other

Type of Operation:
Purchase of Equipment

Objective:

Improve the operational efficiency within ACC by standardizing the reporting, defining a single source of information to assist the decisions, controlling thoroughly the financial activities.

Overall description of the investment:

Implementation of a full ERP system (Enterprise Resource Planning)
- Licences for the software
- Technical assistance to implement the system
- Purchase of hardwares

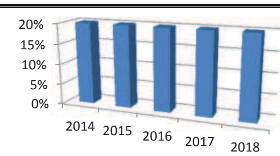
More Details available in the report entitled "Management Information System Report"

Estimated CAPEX: 1,300,000 € or 20.8 Mlei

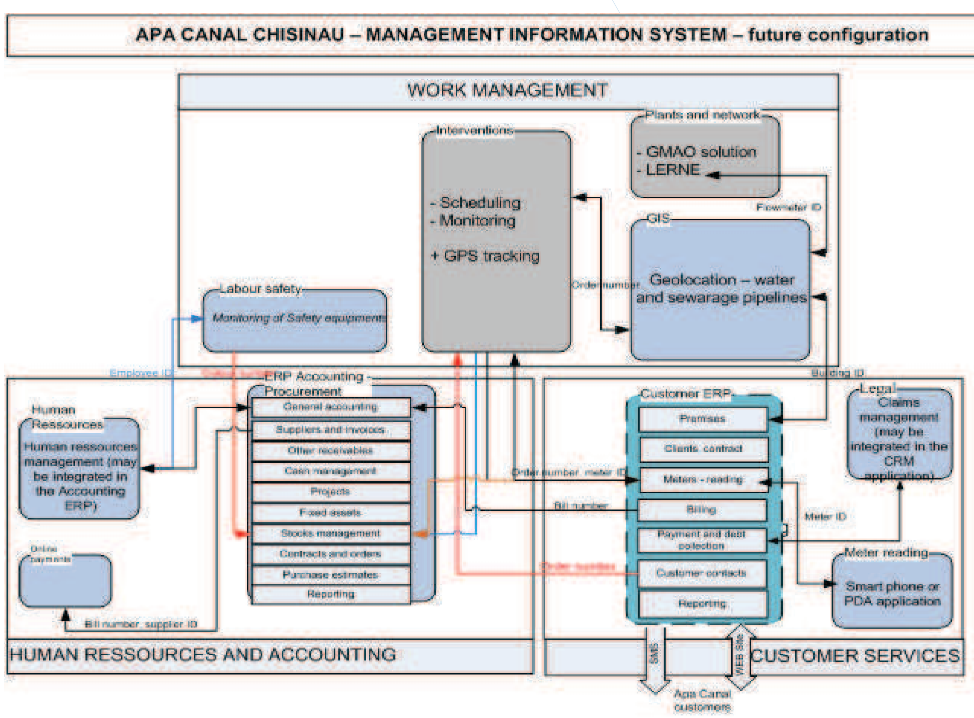
% of the PIP: 2%

Priority Rank: 24/30

Schedule of Implementation:



Images of the investments



Project Benefits:

1- Improvement of the operational efficiency

The implementation of a MIS would increase the efficiency of the customer's management department, the stock management, the financial and accounting departement, and the production department (through the implementation of the GIS)

The unification of the different existing systems would facilitate the work of the different departments using information systems and the maintenance activity of IT teams

2- Improvement of the corporate image of ACC within the population

The results from the household survey show that the population considers the answer to clients complaints and the information to customers as one of the key services that ACC should improve

The implementation of the ERP will improve the satisfaction degree of the population

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-N-12

Field:
- [ ] Drinking Water
- [ ] Wastewater
- [ ] Other

Sub-Category:
- [ ] Network
- [ ] Pumping
- [ ] Treatment
- [ ] Operation & Maintenance
- [ ] Other

Type of Operation:
Purchase of Equipment

Objective:

Improve the quality of repairation on the network in order to decrease the number of leaks and increase the efficiency of ACC's repairations

Overall description of the investment:

Hydraulic fittings for the repairs
- Stainless Steel Pipe Repair Clamps to repair circumferential breaks
- Couplings large tolerance to repair Longitudinal Splits
- "Permatight" Seals to repair the leaks on valves

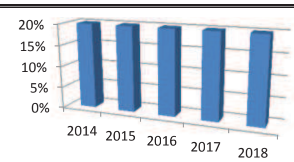
Hydraulic fiitings for the new connections (using a all-in-one solution to prevent future leaks)

More Details available in the report entitled "Network Operation Recommendations"

Estimated CAPEX: 200,000 € or 3.2 Mlei **% of the PIP:** 0.3%

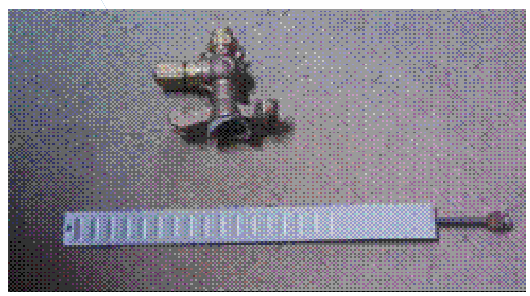
Priority Rank: 25/30

Schedule of Implementation:



Images of the investments

Coupling Large Tolerance



All-in-one Connection

Stainless Steel Pipe Repair Clamp

Project Benefits:

1- Improvement of Customer Service and reliability of the service
The number of operations performed in 2010 was 14,024 and a progressive increase has been observed from 2006
30% of leakages occur on previously repaired leaks; the implementation of good practices for the repairation will decrease the number of leaks. This will lead to decrease in the Water Losses.

2- Improvement of the operational efficiency
Implementation of international best practices

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: WW-P-01

Field: Drinking Water / Wastewater / Other

Sub-Category: Network / Pumping / Treatment / Operation & Maintenance / Other

Type of Operation: Renewal of pumps

Objective:

Rehabilitate the pumping stations for which the efficiency is not optimum and where significant savings can be made

Overall description of the investment:

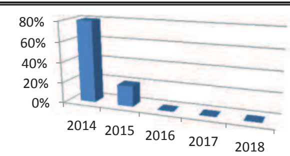
Renewal of the pumps at the inlet of the Waste Water Treatment Plant: 4 pumping groups
Dry weather flow: 2 pumping groups of 3,400 m3/h each at 12,5 mwc (135 kW, 400 V motors) with VFD, 78% efficiency or 3.5 Wh/m3/mwc;
Additional pumps for rain events: 2 pumping groups of 6,000 m3/h each at 17 mwc (320 kW, 400 V motors), fixed speed, 78% efficiency or 3.5 Wh/m3/mwc;
Hydraulic equipment and ancillaries.

More Details available in the report entitled "Audit and recommendations for wastewater Pumping Station"

Estimated CAPEX: 400,000 € or 6.4 Mlei **% of the PIP:** 1%

Priority Rank: 26/30

Schedule of Implementation:



Map with the location of the investment:

Project Benefits:

1- Operational expenditures savings:
Reduction of the electrical consumption: -50% (from 5.1 GWH/y to 2.5 GWH/y)
RoI < 2 years, when the forecasted lifetime of this type of equipment is 20-30 years

2- Improvement of the environment
This project would save 2,600 MWh every year

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: DW-T-01

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Rehabilitation of the existing plant

Objective:

Implement a safe disinfection unit to comply with Moldova regulations regarding the storage of hazardous chemicals

Overall description of the investment:

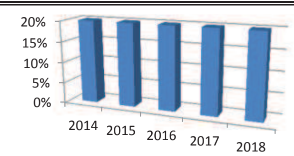
Implementation of an Electroclorination Plant, that produces NaClO, in order to desinfect the water produced in STA
Urgent general rehabilitation works in the WTP

More Details available in the reports entitled "Proposals for the Disinfection of Potable Water" and "Water Production"

Estimated CAPEX: 3,000,000 € or 48.0 Mlei **% of the PIP:** 5%

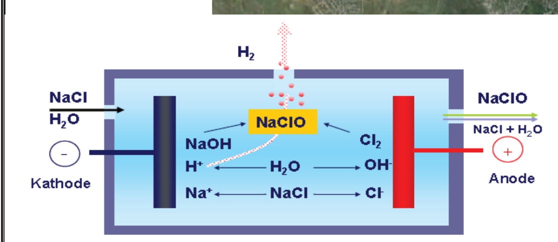
Priority Rank: 27/30

Schedule of Implementation:



Map with the location of the investment:

Principle of NaClO Production by electrolysis



Project Benefits:

1- Compliance with the Moldovan regulation
The average use of Chlorine at STA is 600kg/day. According to Moldovan regulations, 15 days of chemical supply should be stored on site. As the nearest dwellings are less than 500m away from the Chlorine storage building, an alternative to chlorine storage has to be found. The electrochloration would address all the issues

2- Improvement of the Service Reliability and of the Safety
The operation will be facilitate at the WTP and the rehabilitation works would improve the safety of the workers

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study
Priority Investment Programme

Code: WW-T-01

Field: Drinking Water / Wastewater / Other

Sub-Category: Network / Pumping / Treatment / Operation & Maintenance / Other

Type of Operation: Construction of new treatment facilities

Objective:

Implementation of the first phase of the new WWTP in order to effectively treat the wastewater and to implement a sustainable solution for the disposal of the sludge

Overall description of the investment:

Implementation of the first phase of construction for the Wastewater Treatment Plant

Construction of new pretreatment facilities, consisting of fine screen and tanks for sand and grease removal

Upgrading of the electrical work

Treatment of the sludge by implementing a separated thickening unit for biological excess sludge, a mixing tank, a digester (3 tanks of 7,700m3) and centrifuges for sludge dewatering

The existing co-generation facilities will be used

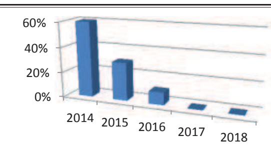
The digestion needs a secure treatment process. Therefore the rehabilitation of the air blowers, the primary settlers, aeration tanks and secondary clarifiers is necessary

More Details available in the reports entitled "Wastewater Treatment Plant", "Chisinau WWTP - Audit Report" and "Carbon Report"

Estimated CAPEX: 26,195,000 € or 419.1 Mlei **% of the PIP:** 44%

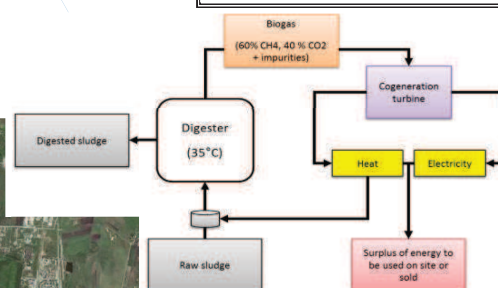
Priority Rank: 28/30

Schedule of Implementation:



Map with the location of the investment:

Sludge thickening unit



Sludge digestion principle

Project Benefits:

1- Improvement of the operational efficiency

The sludge will be stabilized, solving the odour issues encountered today. This stabilized sludge could be used without any setbacks for agricultural purposes

The volume of sludge will be reduced (dryness will reach 28%). As the storage for sludge on site is limited, it will give time before the implementation of a sustainable solution for sludge disposal, chosen conjointly by ACC and the municipality.

2- Improvement of the environment

The energy consumption will decrease. Moreover, 50% of the electricity consumed on site will be produced by biogas and will therefore be a "green energy"

The final treated wastewater quality will improve and the implementation of this first step is compulsory to lead to a sustainable treatment and sludge disposal in the future

The effluent will comply with the discharge limits and the future wastewater treatment plant will comply with european standards on nitrogen and phosphorus removal

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: DW-N-05

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Renewal of water pipes

Objective:

In the seven most leaking zones of the city, rehabilitate the pipes with the highest linear repair index in order to reduce the number of repairs and the water losses

Overall description of the investment:

Rehabilitation of the current network: "group 1 - Priority programme" .

These pipes are located in the seven zones with the most important water losses in the city

17,800m of the existing steel pipes with a nominal diameter of 150mm with an average LRI of 20 burst/km/year

12,200m of the existing steel pipes with a nominal diameter of 200mm with an average LRI of 21 burst/km/year

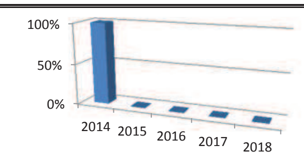
The replacement of the pipes will be done with the diameters considered the most economical

More Details available in the report entitled "Investment Program - Water Supply Network"

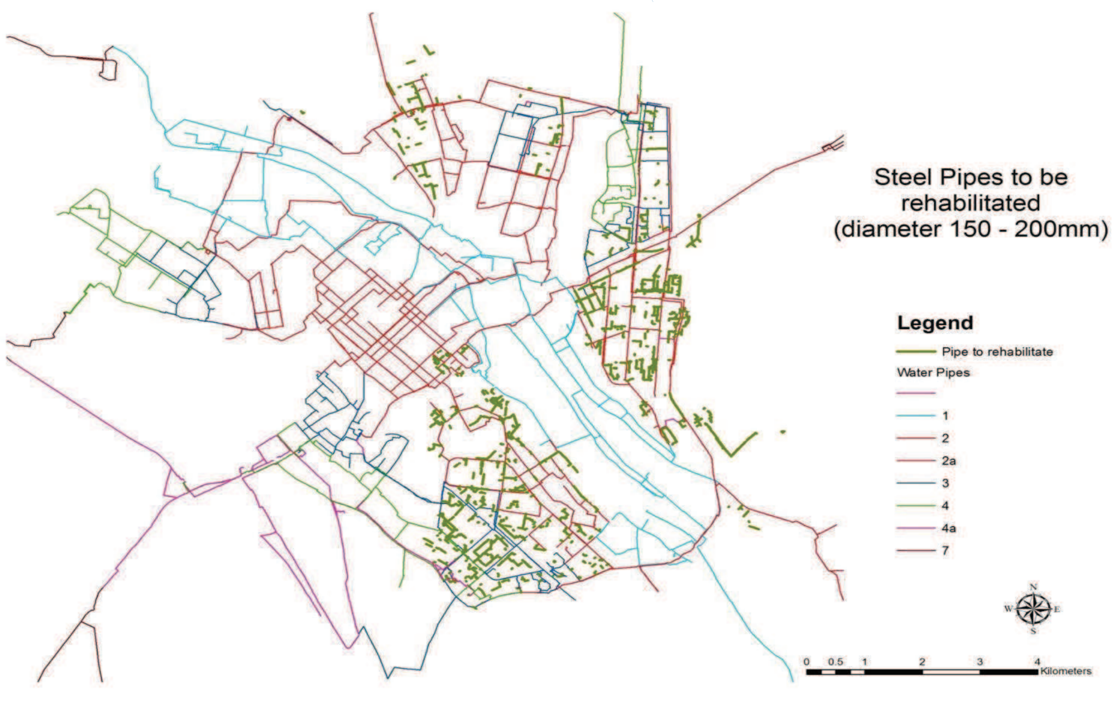
Estimated CAPEX: 2,232,000 € or 35.7 Mlei **% of the PIP:** 4%

Priority Rank: 29/30

Schedule of Implementation:



Map with the location of the investment:



Project Benefits:

1- Operational expenditures savings:

The existing average assessed LRI of the pipes is about 21 burst/km/year. The reparations will decrease by 5%

The water losses will decrease by 3%

2- Improvement of the environment and of the Service

Minimize the water resources wastage and lead to energy savings (less water to pump and to treat)

Improve the reliability of the service for the whole city, as well as the quality of water by decreasing the risks of contamination

3- Improvement of the corporate image of ACC within the population

The results from the household survey show that the population consider that the rehabilitation of the pipes will contribute to improving the water quality. Moreover, the survey shows that this is one of their major concern

Moldova: Chisinau Water Supply & Sewage Treatment - Feasibility Study

Priority Investment Programme

Code: WW-N-02

Field:
- Drinking Water
- Wastewater
- Other

Sub-Category:
- Network
- Pumping
- Treatment
- Operation & Maintenance
- Other

Type of Operation:
Renewal of sewers

Objective:

Rehabilitation of the pipes, assess as very urgent rehabilitation works to increase the efficiency of the collection system and to mitigate the impact on the environment

Overall description of the investment:

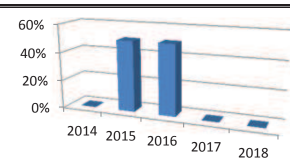
Rehabilitation of 9,600m of wastewater pipeq under priority #2, as defined jointly by ACC and the consultant
- 8% for pipes with nominal diameter smaller than 200mm
- 50% for pipes with nominal diameter between 200 and 400mm
- 42% for pipes with nominal diameter larger than 400mm

More Details available in the report entitled "Wastewater Collection System"

Estimated CAPEX: 1,935,000 € or 31.0 Mlei **% of the PIP:** 3%

Priority Rank: 30/30

Schedule of Implementation:



Map with the location of the investment:

Project Benefits:

1- Improvement of reliability of the service
   Improve the structural stability of the wastewater network and reduce the risks of breakage and collapse of the pipes
   Reduce therefore the risk of major problem (flooding, discharge of wastewater into the environment, collapse of the roads…)

2- Improvement of the environment
   Reduce the risks of pollution of the environment by discharge of wastewater into the natural waterways

3- improvement of the corporate image of ACC within the population

1. INTRODUCTION TO THE PHASE B REPORT

1.1. STRUCTURE OF THE REPORT

The final deliverable within the project *"Moldova: Chisinau Water Supply & Sewage Treatment – Feasibility Study"* comprises a Feasibility Study to be prepared within three phases:

- Phase A: An inventory and assessment of the current situation to be delivered within an "*Inception Report*";
- Phase B: The preparation of the Investment and Action Plan, and
- Phase C: Conclusion of the Study and the elaboration of preliminary designs.

Following submission and approval of the "*Inception Report*" and a Workshop that followed the completion of Phase A, this, the Phase B Report has been prepared to set out our work under Phase B, as required by the Terms of Reference.

The Report comprises six distinct elements:

- A summary of the Inception Report to act as an introduction to the project and the water and wastewater service delivery in Chisinau;
- A written "walk through" of the Phase B work provided in a logical sequence of the water and wastewater service delivery i.e. water demand; water procurement, treatment and delivery; wastewater collection and treatment, and institutional and financial matters;
- A schedule of work completed against each of the Phase B tasks;
- The draft Prioritised Investment Programme for discussion;

A full review of the current status of the water and wastewater service provision in Chisinau and the issues identified within the Phase A, can be found in the "*Inception Report"*. In the same Report, there is to be found the background to the project and an analysis of the socio-economic situation in Moldova and Chisinau.

The overview of the service provision contained within this Phase B Report is only provided as far as is required to understand the issues discussed in the Phase B Report.

1.2. CONTENT OF THE REPORT

The content of the Report is intended to set out the work completed within Phase B, and to highlight any issues that may have arisen during the Phase B work.

1.3. EXPERT'S DETAILED REPORTS

Our experts have produced Detail Reports on their work, and these have been submitted to the PIU for dissemination within ACC, for comments and acceptance by the respective ACC experts, and thus by ACC. The comments that have been received will be incorporated into the final version of the expert's Report.

The Phase B Report does not repeat fully the content of the experts' Reports, but has been written as a collective Executive Summary of those Reports. Should a reader require further information concerning any matter raised in the Phase B Report, he is directed to the appropriate expert's Detail Report.

Expert's Reports submitted, and their current status, are:

Table 1: Detail Reports Submitted and their Status

Report	Date	Status
Assessment of Industrial Discharges	May 2011	Draft Report. Comments received from ACC
Environmental evaluations of the current practices	August 2011	Draft Report. Comments received from ACC
Response Plan on emergency situation	September 2011	Draft Report. Comments received from ACC
Institutional Report	October 2011	Final Report. Accepted by ACC
Potable Water Supply Network – Measurement Campaign	November 2011	Final Report. Accepted by ACC
Water Demand Assessment 2010-2035	January 2012	Final Report. Accepted by ACC
Human Resources Report	January 2012	Draft Report. Comments received from ACC
Network Operation	January 2012	Draft Report. Comments received from ACC
SCADA Report	January 2012	Draft Report. Comments received from ACC
Management Information System (MIS)	January 2012	Draft Report. Comments received from ACC
Water Production	March 2012	Draft Report. Awaiting comments from ACC
Wastewater Collection System	March 2012	Draft Report. Awaiting comments from ACC
Water Supply – Investment Program	March 2012	Draft Report. Awaiting comments from ACC
Wastewater Treatment	March 2012	Draft Report. Awaiting comments from ACC
NRW Assessment	March 2012	Draft Report. Awaiting comments from ACC
Underground Water Resources	March 2012	Draft Report. Awaiting comments from ACC
Potable Water Supply Network – Model calibration and hydraulic diagnosis	March 2012	Draft Report. Awaiting comments from ACC
Stakeholders Involvement Plan - Draft	March 2012	Draft Report. Awaiting comments from ACC

1.4. PIP DATA SHEETS

A series of data sheets are included into the Executive Summary.

The sheets set out the objectives, deliverables, priority and the required investment within our recommended PIP.

2. SUMMARY OF THE INCEPTION REPORT

2.1. PROJECT BACKGROUND

As the entity ultimately responsible for the water and wastewater service, the Municipality of Chisinau has commenced a programme of works intended to rehabilitate the city's water supply and wastewater collection and treatment assets.

In the framework of the European Union Neighbourhood Initiative, the European Bank for Reconstruction and Development, together with co-funders: KfW Entwicklungsbank and the European Investment Bank, support the initiative through a phased investment programme, provided within the European Union Neighbourhood Investment Fund.

Seureca Consulting Engineers, in association with their local Moldovan partners: Business Consulting Institute and SC Ingineria Apelor SRL, have been appointed to prepare a Feasibility Study that will identify and address the issues associated with the current water and wastewater service provision in Chisinau.

The contract for the preparation of the Feasibility Study commenced on 1st December, 2010 and is of twenty months duration.

2.2. STUDY OBJECTIVES

The overall objective is to prepare a Feasibility Study as the basis for prospective loans and grants to fund the proposals recommended by the Study.

In addition, there are specific deliverables:

- The purchase of GIS software and hardware, and the establishment of a GIS database with training of ACC staff in the application of the software;
- A long-term sludge disposal strategy with particular emphasis upon a "quick-fix" solution to the current odour and environmental problems associated with sludge management at the wastewater treatment works;
- A viable and sustainable alternative for the current use of chlorine gas for water disinfection;
- A tariff study and affordability analysis;
- A Non-Revenue Water Pilot Study, and
- A draft Service Agreement between the Municipality and ACC.

2.3. S.A. Apa Canal

The designated water and wastewater service provider within Chisinau is S.A. Apa Canal Chisinau (ACC), created in 1997, out of the state enterprise Regia Apa Canal Chisinau. The company is a joint stock company, with the Municipality holding 100% of the share capital. The activities of the company are supervised by a Board, with representation from the Municipality.

2.4. Definition of the Project Study Area

The Project Study Area is not specifically designated within the consultant's Terms of Reference; reference is made merely to "Chisinau" or the "Municipality".

Nevertheless, we have considered that the project study area and the ACC service area should have common boundaries.

Following the submission of the Inception Report and the Workshop, the Project Study Area has been defined to be the service area of ACC i.e. to include:

- Those communities that are located within the administrative boundary of the Municipality, irrespective of whether ACC is the water or wastewater service provider, and
- Those communities within which ACC is either the water or wastewater service provider.

As identified within the Inception Report, there is no legal or formal record that defines the service area of ACC. We have recommended in the Inception Report that for the commercial security of ACC, there should be a clear legal definition of the service area that establishes ACC as the sole water and wastewater service provider within the stated geographical area.

2.5. Overview of the Water and Wastewater Service

2.5.1. Water Resources & Treatment

ACC draws water from a single river source and groundwater sources.

The main source of water for Chisinau is the River Nistru, located about 20 km east of Chisinau. From the intake, raw water is supplied to the Chişinau and Nistru water treatment plants. Combined, the water treatment plants produced more than 97% of the potable water delivered to the network in 2010.

83% of the total is supplied from the Chisinau works; 14% from the Nistru plant.

The remaining 3% is supplied from wells, located in the city.

Raw water procurement from the different sources and the treatment processes are discussed in Section 0.

There has been a dramatic decline in the volumes of water abstracted since 1997, but of late the abstraction has stabilised, as shown in Table 2.

Table 2: Raw Water Abstraction 1997:2010

Source		Volumes abstracted (Mm^3/yr)		
		1997	2005	2010
Nistru river source	Chisinau treatment works	147	69	68
	Nistru treatment works	18	12	11
	Total	165	81	79
Groundwater wells		12	2	2
TOTAL		**177**	**83**	**81**

2.5.2. Water Distribution Network

The operation of the water network is complex and incorporates twenty pumping stations, around sixty tanks, of which fifty are in operation, and eighty boosters, supplying water within five pressure zones.

The pressure within the network is required to be maintained between 10 and 60 metres (0.1 to 0.6 MPa). Pressure is regulated by valves and by six pressure reducing valves in the network. As discussed later in Section 3.8.4.3, energy dissipated by the regulation system is significant.

Boosters, within the basement of buildings, are used to supply to the upper floors of taller buildings that could not otherwise be supplied.

Records of the length of the network vary, but the considered total length is 1,844[1]kms. The length of the different materials used is shown in Table 3.

Table 3: Pipe Materials within the Distribution Network

Network Element	Pipe Length (km)					
	Steel[2]	Cast Iron	Asbestos cement	Concrete	HDPE	Total
Raw & Technical water	60	0	0	13	0	73
Distribution	698	699	5	25	344	1,771
TOTAL	**758**	**699**	**5**	**38**	**344**	**1,844**

523km (28%) of the network is of diameter up to 100mm, of which 290km (55%) is of steel. Almost 60% of the pipes are more than 20 years old, and 263km of cast iron pipes were laid over 40 years ago.

We observed that ACC operate a greater length of network than the official length. Many pipes not included in ACC balance, appear to be accepted by ACC as their responsibility as a part of their system. Although only about 60% of the service area has been digitised

[1] As per ACC balance

to date, the length of pipes input into the GIS is in excess of the network length stated in ACC balance by more than 36%.

The rate of pipe failures is the equivalent of 40 leaks a day.

2.5.3. WASTEWATER COLLECTION

Within the older areas of Chişinau, there exist three "wastewater" collection systems: (i) for sewage wastewater; (ii) another for surface and storm water drainage including from roads, and (iii) a drainage system for the collection of groundwater.

ACC is responsible only for the collection of sewage, or foul, wastewater. The surface water drainage system is operated and maintained by a 100% Municipality owned company: "Exdrupo".

The wastewater collection systems are designed as "separate" systems. As indicated by the flows received at the wastewater treatment works during heavy rainfall, some surface water does find its way inevitably into the "foul" wastewater system.

The sewerage system serves between 70% and 80% of Chisinau city; approximately 66% of the cities and villages in Chişinau Municipality. About 75% of network in the cities and villages outside Chişinau Municipality, are operated by ACC.

The sewer system was commenced in 1912, within the older city centre area which is generally on the left bank of the River Bîc. The latest pipes were laid in the 1970's and 1980's with the development of the city that took place during that period. There have been few sewers laid since that period.

The wastewater network operated and maintained by ACC is considered to comprise approximately[3] 985km of sewers, of which 77km are considered as "main collectors". All materials commonly used for sewer networks are found in Chisinau with the greatest number being small diameter vitrified clay.

In line with the reduced volumes of potable water supplied, the "return to sewer" flows have also decreased with the result that many of the sewers are over-sized. Over design of the sewers is also a factor in the less than self-cleansing flows found in many sewers.

As the system has been designed as a separate system, there are no stormwater overflows. Stormwater does find its way into the sewage network, but does not seem to cause flooding. The probable reason being that, with the reduced flows in the network, there is adequate capacity within the system to "store" stormwater and gradually to release the excess flow to the treatment works, without localised flooding.

The condition of the sewers is considered to vary between "very poor" - 39km of concrete sewers and "good" – 63 km for the HDP and PVC sewers.

[3] As for the potable network, the length of sewers operated by ACC and which we have input into the GIS is greater than the length stated in the ACC balance

2.5.4. WASTEWATER TREATMENT

The wastewater treatment plants operated by ACC are the Chisinau plant, and smaller works at Coloniţa, Goianul nou, and Vadul lui Vodă.

2.5.4.1. Chisinau Plant

The Chişinau wastewater treatment plant is located southeast of the city, approximately 7km from the city centre, beside the River Bic into which the final effluent is discharged.

With the low flows and the fact that it is within the city area, flowing ultimately into the Black Sea, under EU standards it would be classified as a sensitive watercourse.

The treatment works have been constructed in successive phases; the first phase of the WWTP was put into operation in September 1968. The wastewater flow to the works is approximately 152 000m^3/d, considerably below the works design capacity.

The wastewater treatment process is described in Section 3.10.

2.5.4.2. Other Plants

Coloniţa plant has a capacity of 400m^3/d and was built in1974. The mechanical primary treatment comprises de-gritting and screens. The treatment is biological with biological sludge discharged into the sludge drying beds.

The Vadul lui Voda plant, built in 1975, has a theoretical capacity of 5 600 m^3/d. It has treated an average of 2 000 m^3/d in 2010 from Vadul lui Voda City, Balabaneşti and Vaduleni villages, which includes the bathing areas, poultry farms and the wine factory.

2.6. INSTITUTIONAL ASPECTS OF ACC

The institutional aspects of ACC are discussed within each of the appropriate sub-sections of Section 3.2.

3. ACTIVITIES WITHIN PHASE B OF THE STUDY AND CONCLUSIONS

3.1. INTRODUCTION

Within this Section, we have set out the work performed within Phase B[4], together with conclusions drawn. Following a discussion on "*Institutional Development and Capacity Building in ACC*", the Section continues in logical sequence that follows the activities within the water and wastewater service delivery i.e. water demand; water procurement, treatment and supply and wastewater collection and treatment.

The Section concerns itself more with the outputs and conclusions of the Phase B activities, than with the methodologies, for which reference should be made to the Detail Reports of our experts, referred to in Table 1 and included as Appendices.

Except where cost comparisons are made within an option evaluation process, for clarity and to avoid duplication, all costs are collected together within the Prioritised Investment Programme.

3.2. ACC INSTITUTIONAL DEVELOPMENT

3.2.1. INSTITUTIONAL

3.2.1.1. Government Policy towards the Sector

The "*National Environmental Policy Concept*", 2001, is the main policy document for the sector. The Government has prioritised the improvement of water and wastewater services, and the "*Economic Growth and Poverty Reduction Strategy*", adopted by Parliament in 2004, included the achievement of the Millennium Development Goals, as a long term objective.

The *"Strategy for Water Supply and Sewage Disposal in Communities of the Republic of Moldova*", approved in 2007, sets out specific medium and long-term objectives for the period 2008-2025, which includes decentralisation of services; promotion of sustainable development; environmental protection and social partnership. As part of the *"Sector Policy Support Programme"*, supported by the EU and implemented by the Ministry of Environment, a technical assistance for the implementation of the Strategy commenced in 2011. Three particular topics relevant to the institutional evolution of the water and wastewater service delivery within Moldova are to be considered:

- The relationship between the local government organisations and the operators;
- The relationship between the operators and the National Agency for Regulation in Energy, the sector "Regulator", and

[4] Some activities have been on-going from Phase A, e.g. the measurement campaigns

- The process for reduction in the number of operators i.e. regionalisation.

3.2.1.2. ACC's Charter

The ACC Charter (Statute) provides details of the respective roles, rights and duties of ACC.

There is no formal mandate from the Chisinau Municipality to ACC to provide the water and wastewater service, on behalf of the Municipality. The delegation of services is implicit, only. A similar situation exists where ACC provides the service within other local authority areas.

The ACC Charter permits ACC to:

- Engage in all businesses associated with the provision of water and sewerage services, under which ACC operates a central heating service (Charter Clause 3.2), and
- Develop businesses not necessarily connected to the water sector (Clause 3.4).

The Charter does not specify:

- The specific area within which ACC can provide the services, nor
- Any exclusivity for ACC to provide the services.

3.2.1.3. Asset Ownership

Ownership of the "public interest" assets operated by ACC remains unclear. Municipality decisions 27/25 of December 2000 and 3/16 of August 2003, together with the Civil Code of 2003 and the Moldovan 2007 Law on Local Government, as well as the 2008 definition of ACC's assets by the General Assembly of ACC Shareholders i.e. the Municipal Council, are contradictory or otherwise unclear.

Similar lack of clarity exists for the assets operated by ACC within other local authority areas.

The issue requires resolution, but probably will not occur until the regionalisation process is established – as previously discussed in Section 3.2.1.1.

3.2.1.4. Applicable Laws

The applicable laws are set out within the Inception Report, Section 3.1.2.

A new Water Law has been drafted to harmonise Moldovan water policy with the EU Water Framework Directive 2000/60 CE. This law on Water nr.272 from 23.12.2011, has been approved and published in "Monitorul Oficial" in April 2012. The law will come into force on the 26.10 2013. Human Resources

The following is a summary of the main findings and recommendations made within the Detail Report: *"Human Resources"*, to which reference should be made for further details.

3.2.1.5. Overview

The current organisational structure within ACC is similar to that in local government and, we suggest, is not appropriate for a modern customer orientated service provider. The structure is linear, with six hierarchical levels. The hierarchal levels and reporting lines are clearly established, reinforced by the controls and rules of delegation for each subdivision and department. In summary, the following points were identified:

- There are few horizontal, transverse communications;
- Centralisation is strong without delegation to operational units;
- Concentration of resources without benefit of economies of scale often due to lack of previous investment in assets and business systems, and
- Specialisation of staff within a single activity.

Lack of investment in automation and rehabilitation; minimal use of contractors and social policies for full employment have resulted in high staffing ratios[5] compared with comparable utilities. The mean age of employees is 49, with 890 employees (45%) aged over 50 years. 25% are approaching or have passed retirement age.

Proposed Organisational Structure

We recommend that ACC considers an organisation structure similar to that shown below, which is typical of that found in many modern water service providers.

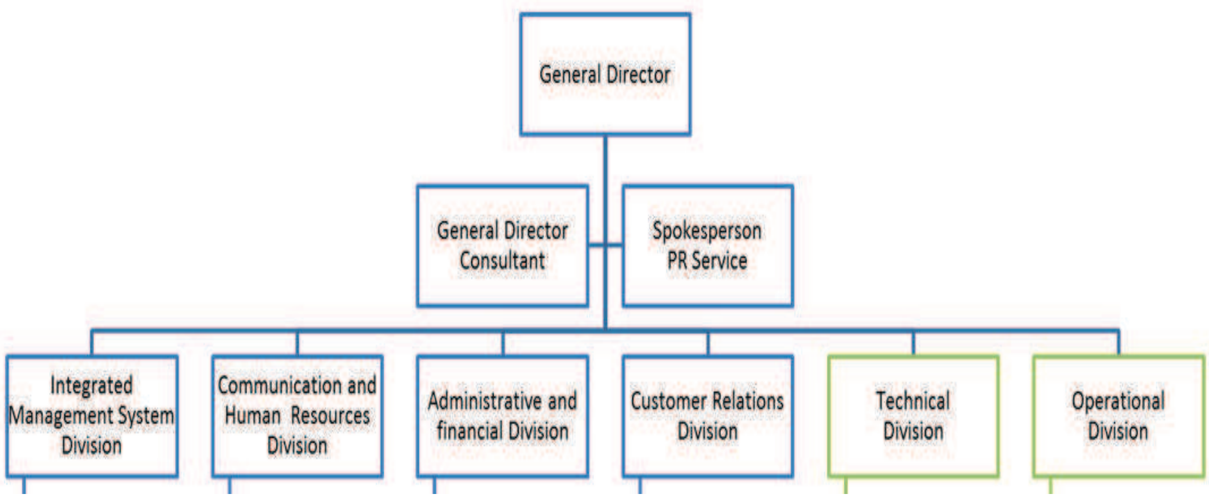


Figure 1: Proposed Organisational Structure

The main features of the organisation are:

[5] The current staffing ratio of 2.5 employees/1000 population is high compared with 0.9 for Bucharest.

- A limit number of Directors under the General Director, performing as an executive committee of a size to facilitate rapid decision-making;
- Divisions focused upon strategic business units, with clear areas of responsibility;
- A separate division for all customer service activities, and
- A clear separation between asset owner and asset operator activities lending itself to outsourcing and, if found necessary, to a Service Agreement between asset owner and asset operator units.

3.2.1.6. Staff Rationalisation

Environment for Staff Rationalisation

In writing this Phase B Report, we are aware of the Moldovan economic environment and of the staff employment laws and policies that prevail. Moldovan laws must be respected and we have tried to formulate our proposals sensitive to the difficulties that would befall any ACC employee who is made redundant in Chisinau.

Some of the proposals, e.g. for a reduction in network gang size, would come as a cultural shock to many, and could be resisted. As painful as the changes may be, they are changes that need to be made if ACC is to benefit from the investments proposed in the Feasibility Study and included into the financial analysis that we have made of ACC.

We would suggest that ACC appoints a senior manager into the role of Change Manager, in order to facilitate the introduction of the changes.

Target Establishment

Before there can be any major reduction in the staff establishment, the reasons for the high staffing levels needs to be tackled. Without investment in the infrastructure assets and business systems, it is unrealistic to expect ACC significantly reduce staff numbers; yet still provide the required level of customer service. The only exception could be outsourcing, as discussed later in this Section.

We believe that, whilst a reduction of the establishment implemented with a policy of increased salary payments will the enhance quality of service, the net financial effect for ACC will be neutral, as any reduction in salaries will result in reduced permitted revenue under the cost + fee tariff setting methodology. For customers though, they will receive a better service at a lower tariff.

Though staff reductions cannot commence yet, there is no reason not to set out the long-term Action Plan that will be required to reduce the establishment to a number more comparable with other utilities.

Within the Inception Report, a long-term target was suggested of 1.5 employees/per 1,000 customers[6] and a 5:1 operational to administrative ratio. Such ratios would see an establishment reduced to 1,200, from the current 1,935, comprising 1,000 operational staff and 200 administrative staff, a reduction from 1,485 and 450, respectively.

[6] Comparable with that now achieved in Bucharest

The age distribution of employees shows that almost 900 employees will retire within the next 10yrs. A further 511 are within the age group 41 to 50yrs and some might be expected to choose voluntary early retirement, if the conditions were suitable. It follows that within a ten year period, the establishment could be reduced by almost 900 employees, possibly higher. Such a reduction would meet the target reduction of 735 without the need for any compulsory redundancies.

The problem is that those who retire are not necessarily in positions that can be “lost”. It can be expected that the reduction in the establishment will require a substantial re-training programme as people are re-assigned to new tasks.

Two ways to assist the process are:

- Jobs that are no longer considered necessary within an efficient organisation are taken out of the establishment, and
- Outsourcing.

Removal of Jobs from the Organisational Structure

In addition to plant operators, whose numbers can be reduced as plants are automated, other options for considerations are:

- Network gang sizes to be reduced from the current eight people. We recommend teams of 2-3 people[7] as it is an efficient ratio safety/efficiency/cost. However, the Moldovan situation does not allow yet implementing this recommendation as the law requires at least 4 people. Not all jobs require an excavator, permitting a reduction to effectively a two-man gang for many tasks;
- Electrical and mechanical skills be combined with fitters skilled in both the electrical and mechanical maintenance of plant, and
- Mobile plant operators visit several sites, rather than be based full-time on a single site.

We appreciate that these are significant deviations from current ACC practice and could only introduced after due worker consultations and with training.

Outsourcing

Outsourcing will allow ACC to concentrate upon its core business; will allow specialist skills to be brought into the company when required, and will allow ACC to benefit from the experiences of others, all at lower cost.

The activities of ACC that could be outsourced most easily concern non–core business activities of office and buildings janitor, maintenance and security services; and vehicle and plant maintenance. We understand that these activities account for 287 employees, i.e. 14.3% of total staff.

The recommended course of action to outsource these activities is to contract the activities to a specialised provider who would continue to employ the former ACC staff.

[7] 1 skilled plumber who would act as gang supervisor, 1 plant operator and 1 unskilled worker

The Heat Engineering Division is economically autonomous and could be sold in total.

Other potential activities would be some IT activities; to hire rather than own expensive excavator plant, and for outsourcing of network maintenance activities to a local contractor.

A training programme will be a necessity if new skills and practices are to be introduced into ACC, and will need to be outsourced to derive the necessary skills. Some training - particularly that associated with investment in new treatment plant and business systems - can best be provided by the contracted supplier. Other training could be provided in association with other utilities who have already invested in the required workshop and training centre facilities, and are appropriate e.g. Bucharest.

When considering outsourcing, ACC will need to bear in mind that staff will be required to prepare the outsourcing contract documents, supervise the work and agree payments.

New Roles Created

As ACC continues to move towards being a customer orientated service provider, other roles will be created and/or require additional staff to those currently employed in the expanded roles e.g. customer service representatives and leak detection gangs.

With the automation of plant and the introduction of SCADA, there will be a move away from the traditional requirement for skills in “heavy” electrical and mechanical plant maintenance, towards skills in electronics and “lighter” technologies.

3.2.1.7. Rejuvenation of the Workforce

We recommend that ACC considers lowering the average of the workforce which would (i) lower OPEX by decreasing salary expenses and (ii) bring more dynamism and new ideas to ACC. A younger, newer workforce would be less resistant to change.

ACC would need to be able to offer good career opportunities in order to attract younger staff and would need to be able to deliver career prospects if it is to retain a younger, trained workforce.

3.2.1.8. Staff Development

Complementary to any rationalisation of the establishment and the rejuvenation of the workforce, ACC will need to provide a comprehensive staff training programme that is focused on the needs of the business; not the preferences of an individual. Training will be required:

- For new technology and processes associated with the investments made;
- To introduce cultural changes, and
- To equip staff with knowledge where new concepts in work practices are introduced.

Training should be provided with a framework of staff appraisal where (i) an employee is assessed as suitable[8] for further training, (ii) the training meets a recognised business need, (iii) the required skills set for a post are set out, (iv) the skills of an individual in, or proposed for, a post are assessed against the skills required for the post and (v) training needs are identified and programmed for delivery.

Following training, the effectiveness of the training should be monitored.

3.2.1.9. Wages Structure

The current wage structure of ACC is complex with salary based as much upon seniority, as performance. As Moldovan law permits, we recommend that ACC adopts a more simplified wage structure where an employee's salary is assessed primarily in line with the required skills of the post held, and with the employee's performance in meeting assigned objectives.

3.2.1.10. Action Plan for Introduction Human Resource Recommendations

Reference has been made previously to the difficulties in introducing change and the desirability of a Change Manager to assist the process. The changes proposed in this Report are at a "conceptual" stage and will need to be supported and further developed within a strategic Human Resources Plan prepared by ACC staff, as set out below.

The key tasks to be performed within an Action Plan would be:

Year 1

- Senior managers prepare a strategy for a reduced establishment identifying areas where the workforce could be reduced and where additional resources will be required, based upon the "*Human Resources Report – Good Practices and Recommendations*", prepared within this Feasibility Study;
- ACC appoint a Change Manager as a senior manager reporting directly to the Director General;
- Discussions are held with employee representatives at the earliest opportunity to encourage their acceptance of the strategy;
- Employee workshops are held at which the proposals are openly discussed with emphasis upon the safeguards to be provided, and
- Employees are canvassed to see who would be prepared to leave early with appropriate compensation.

Year 2

- ACC explores the opportunities for outsourcing and, if considered adequate, outsource activities, and

[8] The employee is not on the verge of retirement, is not likely to leave and the training can be immediately applied.

- A training provider is procured who assists with the preparation of appraisal and training procedures, and trains.

Year 3 onwards

Implement reduction in the establishment within a time-frame dependent upon investments made; the ability to introduce re-training and the introduction of improved business procedures and processes.

3.2.1.11. Human Resource Department

It is recommended that all Human Resource activities[9] are brought together into a single Human Resource Department, with a Director reporting directly to the Director General, as shown in Figure 1.

A single department would concentrate the skills within one location and would allow the appointed single HR Director to implement the necessary changes without the need for cross reference to other HR associated directors.

3.2.2. Management Information System

Most computer systems used in ACC are developed internally within the IT Department. The systems have been developed directly in Oracle or are older systems of MS DOS type which are difficult to use and do not meet the business needs of ACC.

There is no integrated MIS and the existing applications have been developed at the request of certain departments or services. Commonly, applications deal only with the activities in the department that requested the application. Consequently, there is no "total picture" of a process or activity across all ACC departments.

The preparation of management reports is difficult, particularly when information has to be correlated from various applications.

Our main recommendation is for the implementation of an integrated ERP system that will include:

- The CRM component for managing customer-related activities;
- Stock and procurement management;
- Financial and accounting flows, and
- Network computerized management, through the GIS system.

As the implementation of an effective solution involves financial resources that may not be available to ACC, several short-term recommendations have been made in the Detail Report: "*Management Information System*" which can be implemented at minimal, based on the existing information and resources.

[9] Currently spread between the departments of Human Resources, Health & Safety and of Economic Analysis and Prices.

For an MIS to be effective, it is essential that good quality data is entered for which there quality control is required.

3.2.3. Network Management

3.2.3.1. Water Network

Organisation

The efficient management of the water and wastewater networks are important as, in addition to any financial considerations, it is the network operations that most directly and moist visibly affect the service to customers, either in the delivery of water or the collection of wastewater.

Currently, all operations come within the Technical and Production Directorate. The various departments, their responsibilities and the number of staff within each department are provided in Table 1 of the Report: "*Network Operation Recommendations*".

As set out in Section 0, we propose to ACC that the Directorate be divided between Technical Services and Operations. The reasons for the suggested division are the size of the Directorate; the ability to focus skills and to establish "asset owner" and "asset operator" units within ACC.

We envisage a continued separation between water production and water networks and between potable water and wastewater. We envisage also the establishment of a separate Customer Service Division that is responsible for all customer contacts. We accept that ACC may consider that the allocation of all customer service activities to a single department is not appropriate at this time. We do suggest that ACC considers the proposal in the longer term. It is generally accepted that the "one-stop-shop" approach is "best practice"

The current operational structure can be described as "structure by function". The alternative is a geographical based structure centred on dual-functional area managers.

The advantage of a "district" based structure is that it the decentralisation allows local managers to take greater initiative which should lead to quicker response times and greater sensitivity of ACC to local needs. The structure provides efficient coordination between the functions of ACC, at the local level. The disadvantages are that resources tend to me more scattered amongst the local offices, and it is more difficult to develop specialist skills. The latter can be mitigated by having central teams for specialist activities e.g. non revenue water reduction.

On balance, and in line with most modern service providers, our recommendation to ACC is for a geographical based operational structure based upon three areas:

- Riscani, Ciocana and settlements to the east of Chisinau;
- Centru, Buiucani and settlements to the north-west, and
- Botanica, Ialoveni and settlements to the south.

The area offices/depots would be supported by required operational head office staff for such as work planning, plant maintenance and non revenue water planning and analysis.

Network Maintenance Teams

Network maintenance gangs comprise, on average, eight people. In line with the size of gangs commonly seen elsewhere, the gang size could be reduced to three people, possibly two, as it is an efficient ration safety/efficiency/cost. However, the Moldovan situation does not allow yet implementing this recommendation as the law requires at least 4 people. A three-man gang would comprise a supervisor, an unskilled worker and a plant operator. Not all maintenance work requires excavation and for such tasks the gang size could be reduced to two people. Similarly, if plant was hired and not owned by ACC, the gang could comprise two ACC employees.

Equipment

As discussed in Section 3.3 of the Report:*"Network Operation Recommendations*", the existing plant and equipment is old - the average age of the plant is 16 years[10] and inefficient.

Accordingly, we have included within the PIP for an investment in new plant and equipment.

Repair Fittings

During the Leak Pilot Study, it was seen that the effectiveness of ACC to reduce leakage is disadvantaged by the lack of the correct fittings to be used for pipe repairs.

We have prepared a schedule of repair stock to be held by ACC in order to be able to respond effectively to bursts and leakage, and included an appropriate investment in the PIP.

The allocation is in addition to any requirements to effect a reduction in current levels of non-revenue water – Section 3.4.4.2.

3.2.3.2. Wastewater Network

Organisation

We recommend that the wastewater network maintenance teams be located in the same district offices as the potable water teams, with a common district manager for both functions.

The two teams will need to be separate, with separate equipment, in order to avoid cross-contamination of the water supply.

Recommended Equipment to be Purchased

[10] Table 8 of the Report: "*Network Operations Recommendations*.

As with the potable water network teams, gang members are skilled and dedicated to the task. The major issue is the lack of basic equipment and plant. The equipment available is estimated to have an average life of over twenty years.

Within the Report: "*Network Operation Recommendations*" the necessary plant and equipment is scheduled that we would consider necessary to fully equip the ACC wastewater network teams. An allocation has been made in the PIP for the required investment.

Equipment to be purchased includes the nozzles used for sewer cleaning and for cutting tree roots, currently done manually by ACC's teams. In a city like Chisinau with a lot of trees and plantations and with a worn-out network, roots can easily find their way into a sewer. They start very thin, passing through very small cracks; expand and eventually cracking and ultimately collapsing the pipe. Their main impact is that, when they grow inside the pipe they stop the floating matter and grease, and create obstructions.

The current trucks in ACC are flushing trucks, with the sludge removal by other vehicles. Most of the time, when sewers are flushed the sludge is not removed but washed down the sewer. For ease of operations in congested streets and quicker cleansing, we would recommend the purchase of a recycling truck within which the sludge is treated.

We also recommended ACC to implement night-time sewer flushing when the traffic is lighter and the pipes have less water.

CCTV Surveys

We have recommended in the Detail Report that ACC introduces a programme to CCTV survey its sewers, and that the required equipment is purchased within the PIP.

We also recommend the purchase of the video equipment known as "Quick View" which is cheaper than the full CCTV equipment. Only after sewers are shown by the "Quick View" equipment to be in need of maintenance, is a full CCTV survey made in order to understand the problem, and to derive the effective solution. With the "Quick-View" a preliminary survey of the sewers can be made quickly, without the need to first clean the sewer.

Sewer Preventative Maintenance

We suggest that ACC establishes specific teams dedicated to sewer preventive maintenance with a program of systematic CCTV inspection and cleaning of all the pipes of its network. Such a program will improve the knowledge of the system and eventually reduce the number of interventions.

Diagnosis of the structural condition of the sewers will lead to the classification of the pipes by remaining asset life. The most urgent rehabilitation work can be programmed and collapse risk will be avoided.

Illegal Wastewater Discharges

In the same way that stormwater may enter the sewer network; foul wastewater can enter the storm-water network and be discharged to a natural water course, as a pollutant.

During a period of dry weather, more than thirty pipes were actively discharging into the River Bic, suggestive of foul wastewater entering the stormwater network. Whilst, ACC made a preliminary check and reported that none of the discharge came from ACC wastewater network, there remains the risk and ACC, together with the Municipality and other authorities, should take necessary action to mitigate that risk.

3.2.4. WASTEWATER DISCHARGES TO ACC SEWERS

3.2.4.1. Industrial Sewer Discharges

Currently, when an ACC intervention team identifies a problem related to the quality of the flow collected by the wastewater network, a laboratory team is sent to investigate and to take samples for analysis. ACC does have the necessary powers to fine, take to court or, in extreme cases, terminate the water supply to the offender.

We recommend that ACC introduces a monitoring system using international best practice procedures that are based upon individual discharge consents, supported by industry self-certification and ACC monitoring.

3.2.4.2. Restaurants and Garages

There is a high risk of sewer blockages downstream of restaurants resulting from their grease-rich discharges. For each restaurant, a grease trap is compulsory, but not controlled. We recommend that, in conjunction with the Municipality, the requirement for grease traps and their regular maintenance is enforced.

We recommend similar enforcement for the hydrocarbons removal tank in car washing, parking or garage areas.

3.2.4.3. Septic tanks

ACC has an agreement with a private company called “Solutio Grup” which provides trucks to empty the septic tanks and discharge the sludge at the treatment plant. The septic tank emptying activity needs to be supervised by ACC to ensure that (i) no unregistered trucks perform the service; (ii) that the sludge is discharged at a special reception pit in the treatment works, and (iii) to gain the full income to which it is entitled.

3.2.4.4. Supervision of Separate Wastewater Systems

We recommend that ACC, together with the Municipality and Exdrupo, should seek to control storm water from entering the foul wastewater network, and should disconnect any connections that are found between the two systems. The control should extend to buildings where roof down-pipes and other surface drainage water is connected to the sewer system.

We recommend that the survey starts with the catchments with the highest ratio stormwater volume per hectare i.e. Sectors A and C.

3.2.4.5. Management of the Ingress Water

Intrusive water is permanent and we recommend that ACC methodically investigates the causes and takes appropriate action to reduce the flow.

From the measurement campaign, we have identified the areas with the highest levels of intrusive water, and priority should be given to these areas.

3.2.4.6. Continual Monitoring of Flows

We suggest that, through SCADA, ACC performs a permanent hydraulic diagnosis of the sewer system with permanent measuring points installed, and flows monitored, at strategic points on the network.

3.2.5. Geographical Information System

3.2.5.1. Digitalization of the Network

The new database structure which will be used in the ArcCis is almost completed.

Data for almost 3,700 km of the water and wastewater networks taken from the Chisinau Municipality RINEDAC has been digitised, at the time of this Report, together with over 7,500 ancillary items such as valves and manhole chambers. Some of the data provided has been poor, and will require to be perfected as subsequent information is collected and records revised.

There is lack of clarity of ownership of assets and a large section of the network has been input that is not the responsibility of ACC, but of private organisations and industry. Ownership must be clarified to ensure that ACC works only on assets for which it is responsible, and to ensure the correct valuation is placed upon ACC.

As the length of network digitised is greater than the original 2,700 km indicated to us, the entire network cannot be digitalized within the contract period and the task of completion will pass to ACC. We have trained ACC staff for the task.

In the GIS, only information related to the network and to the production installations has to be introduced. For example, information related to consumers or the volumes consumed is not included, but held in a separate commercial application. In order to access such information for the GIS application, an interface between the GIS and other applications must be provided e.g. for the example provided, linking a GIS location and the identity code of the building in the commercial application. The links can only be provided after the entire network has been digitised.

3.2.5.2. On-Going Improvement to GIS Data Collection & Its Application

For the on-going improvement in the accuracy of the data, the accessibility of the GIS and for the roll-out across the whole of ACC, we recommend ACC to:

- Implement a procedure whereby the O&M filed teams record their work and appropriate asset data for subsequent input/updating to the GIS;

- ACC IT specialists develop an application accessible online to draw a water and sewerage network without purchasing additional ArcEditor license;
- ArcGIS allows an easy development of web applications which shall allow the operational district offices to plan and report their activities;
- Digitise the networks operated by ACC, but outside of Chisinau, and
- ACC explore the various interfaces with other systems as recommended in the MIS Report.

3.2.6. Supervisory Control & Data Acquisition (SCADA)

The potable water system of Chisinau is complex. An analysis of possible SCADA solutions to supplement the existing partial SCADA and so better operate and monitor the water and wastewater systems has been made in the Detail Report: “*SCADA Report*”.

Our recommendation is to develop the existing SCADA, and to limit the number of maintenance/equipment providers used by ACC to a limited number for the telemetry equipment, and for the plant automation requirements.

Recommendations for the development of the SCADA apply also to:

- Data Storage – We support ACC’s intention to install a computer room where data will be received and stored on reliable and dedicated servers. Access to the data will enable and facilitate developments of specific analyses using common and easy computer languages (EXCEL, SQL…).
- Data processing – we recommend equipping the Dispatch Room with the means to process data rapidly and for reliable processing. The data sent from the pumping stations should be accessible and visible on a screen. The necessary software should be chosen to allow a future upgrading of the system, e.g. remote control and management of the system.

3.2.7. Emergency Response Planning

Emergency planning is contained within a risk management approach that sets out to reduce risk, and then to enable ACC to professionally tackle an emergency.

Where possible, the Feasibility Study will look to design risk out of the water and wastewater systems.

We have provided to ACC, an Emergency Response Plan the application of which during an emergency will mitigate the effects of the emergency for the benefit of the: (i) public; (ii) the customers of ACC and (iii) the business reputation of the company.

3.3. Socio Economic Analysis

3.3.1. Introduction

A socio-economic analysis has been made that included (i) collection and analysis on statistics on population, water consumption and on the local economy; (ii) household and large consumer surveys; and (iii) spatial development within the study area.

The objective of the analysis was to collect the required data to ascertain future water demand within each of the customer categories for infrastructure dimensioning, and for preparation of the financial Business Plan and tariff study. The outputs of the surveys included ascertaining customer “willingness to pay” and “affordability”, and for possible marketing purposes associated with meeting customer expectation of service.

The surveys were performed across the ACC service area i.e. within the Chisinau City area and outside of the City and Municipality areas.

The full results of the Survey and the methodology followed are provided in the Detail Report: “*Water Demand Assessment 2010-2035*”, of which the following is a summary of the pertinent details.

3.3.2. SOCIO-ECONOMIC SURVEY

3.3.2.1. Population

The population of the area fell rapidly between 1989 and 2004 but since has stabilised, as shown in the following table:

Table 4: Population Changes 1989-2010

Year	Population in the Study Area	Population within Chisinau City
1989	721,900	667,000
2004	712,218	589,445
2010	786,252	663,4009

Within the study area, 94% of the population are within the Chisinau Municipality administrative area; 4% within the surrounding small towns and 2% in the rural areas.

Population growth in Chisinau is influenced by a very low fertility rate, a very low rate of natural increase, and net migration.

The net effect is that within the potential ACC service area, the population is forecast to fall from 812,688 to 789,760 by 2035, around 0.1% per year.

3.3.2.2. Urban Development

The Municipality’s strategy for urban development is (i) to establish five new peripheral residential areas to enable people to move out of the city centre and free the former industrial land for commercial development. For example, industry is to move from sites adjacent the River Bic so as to provide recreational facilities along the river.

The water sector consequences are:

- Customers will be dispersed over a wider area with the need for new infrastructure to service the development areas, funded by the Municipality;

- Infrastructure will continue to be oversized within the city area, and
- A high standard of service will be required in the city centre if commercial organisations, particularly international businesses, are to be drawn to the city centre.

3.3.2.3. Economic Forecast

The national economy is considered to be recovering from the severe economic crisis of 2008/9. National GDP is forecast to grow at a rate of 4.5% per year, rising from 71.8billion Leu in 2010 to 279.3billion Leu by 2035[11]. The main driver is considered to be growth in the industrial sector, rather than agriculture.

The monthly wage is predicted to increase from 3,659Leu in 2012 to 20,218 by 2030, a real increase of 105%.

3.3.2.4. Household (Domestic Customers) Survey

A Household Survey was held during March and April 2011. The objective was to understand domestic water usage within differing socio-economic groups; gain knowledge of (i) customer satisfaction with ACC service and (ii) the issues seen as important to them, and their affordability and willingness to pay ACC charges. The survey also included for wastewater disposal facilities.

A total of 1,038 households were surveyed with 631 in Chisinau city, 125 in each of five districts, and 407 outside of the city.

The main outcomes related to the water sector[12] are provided within the following table:

[11] The forecast was prepared prior to the current international financial turmoil and is probably optimistic.

[12] Other findings are available within the Report on the Household Survey

Table 5: Main Findings of the Household Survey

Subject	Group	Findings
Household Size	Location	2.9 persons per household in Chisinau City, and 3.5 outside
	Affluence	Households are larger in poorer households varying between 3.8 people for the poorest households and 2.6 people within richest households
Housing	Type of housing	Apartments account for 71% of residences, and private houses 21%. Most apartments are in the city (85% of all apartments) and most houses (76%) outside of Chisinau. Richer households tend to live in the apartments (79% of richer households) than private houses (19%), with 56% of poorer households reside in houses and 43% in apartments.
	Status of property	87% of residences in Chisinau are privately owned; 95% outside of the city. Only 8% are rented in Chisinau and 3% outside. State ownership is marginal at 6% and 2%.
	Economic activity	Economic activity from residences is virtually non-existent. That which does exist is market gardening outside of the city.
Income	Per Household	Household income is 5,793Leu per month inside the city, and 4,439Leu outside. There was a variance from 2,241Leu in the poorest quintile[13] to 9,634Leu in the richest, with an average across the study area of 5,492Leu per month
Expenditure	Per Household	Household expenditure is 3,100Leu inside the city and 2,161Leu outside, varying between 975Leu in the poorest quintile to 5,492Leu in the richest, with a study area average of 2,892Leu.
Other considerations	Water using appliances	76% of households in Chisinau city have washing machines compared with 64% outside. Dishwashers are not common.
	Telephones & computers	Telephones - landlines (97%) and mobiles (83%) - are widespread in households inside and outside of the city. Computers are more common in the city (66%) than outside (45%).
	Cars	More households outside of Chisinau have a car than inside: 39% against an average of 35%.

[13] Those surveyed were collected into 5 quintiles each of 20% of the surveyed households.

3.3.3. WATER & WASTEWATER SERVICE PROVISION

3.3.3.1. Method of Water Supply

The method of water supply within the study area is summarised in the following table:

Table 6: Method of Water Supply

Location		ACC	Local networks	Wells
Chisinau city		100%	0%	
Outside of Chisinau but within Municipality limits	Towns	81%	19%	
	Villages	46%	37%	17%
Outside of Chisinau Municipality	Towns	47%	42%	11%
	Villages	10%	31%	59%

Within the various groups, up to 24% did not answer "if the water involves a health risk", showing a lack of understanding and knowledge of water quality. Of concern to ACC, of the people who did respond to the question, between 75% and 81% of ACC customers considered there to be a health risk with the water supplied by ACC, which is greater than those supplied from private networks or by another source. On the other hand, 93% of ACC customers drink the tap water but, of those 93%, almost half either use a filter or first boil the water.

33% of ACC customers purchase bottled water, spending an average 190Leu per month.

Generally, people supplied by private networks or have other means of supply also first treat the water before drinking, or buy bottled water.

3.3.3.2. Willingness to Pay for an ACC Water Connection

64% of those households without an ACC supply did not wish to become ACC customers. There was a significant variation between those outside and those inside of the Municipality area, 72% and 43% respectively. The indications are that this is due to the cost of the connection, rather than any fundamental objection to an ACC supply.

When asked if they were prepared to pay for a connection, 57% on average said they would pay, and considered a charge of around 1,200Leu as reasonable. Only 46% would accept the current charge of 3,300Leu; of the remaining 54%, all would accept a charge of 1,320Leu.

3.3.3.3. Evolution of ACC Customer Base

The assumption can be made that a significant number of people would wish to become customers of ACC, if (i) ACC were to take a commercial position concerning the cost of a connection, and (ii) there was a publicity campaign explaining the health benefits and other advantages of a professionally managed ACC supply.

For the purpose of determining future volumes of water into supply, the Feasibility Study has assumed that 100% of people within Chisinau city are customers of ACC and that the percentage of households outside of the city increases from 56% in 2010 to 71% in 2030, and continues at this level through to 2035.

3.3.3.4. Cost of Water

On average, households pay 84Leu per month for water and wastewater services. There are variances depending upon the locality - the tariff is lower for ACC customers at 9.40Leu per cubic meter than for those drawing from local networks at 10.60Leu. As to be expected, the quantity of water used is linked to affluence through ownership of water using appliances.

On average, there is little difference upon the percentage of the family budget that is expended upon the water service, between households inside or outside Chisinau: 1.9% and 1.8%, respectively.

3.3.3.5. Satisfaction & Importance Issues

When asked about their satisfaction with the service provided to them by ACC, the highest dissatisfaction was recorded for the cost (72%). This is of little consequence as customers gave little importance to the cost – see Figure 2. Dissatisfaction with cost might not necessarily be dissatisfaction with the cost per see, but the consequence of other dissatisfactions.

Within Chisinau City, dissatisfaction with taste (63%), colour (55%) and smell (61%) featured higher than the less tangible aspects of customer service (30%), meter reading and billing (17%). These high levels of dissatisfaction with the water quality tie in with the 75% of households who consider that ACC water involves a health risk. Outside of the City, dissatisfaction with taste and smell etc was much less at around 40%.

Within Chisinau City, dissatisfaction with pressure, duration and continuity of service were much lower at around 14%.

When dissatisfaction criteria is plotted against importance, Figure 2, encouraging for ACC, the company's response to customer complaints and colour/turbidity have both low levels of dissatisfaction, but are considered of importance to customers.

Interestingly, the criteria with least satisfaction – cost of water, taste and, most strangely, healthiness – are considered the least important.

Customer service featured as being of high importance and came midway in the satisfaction levels. Clearly as far as the perception of ACC service is concerned, on-going importance needs to be given to customer service.

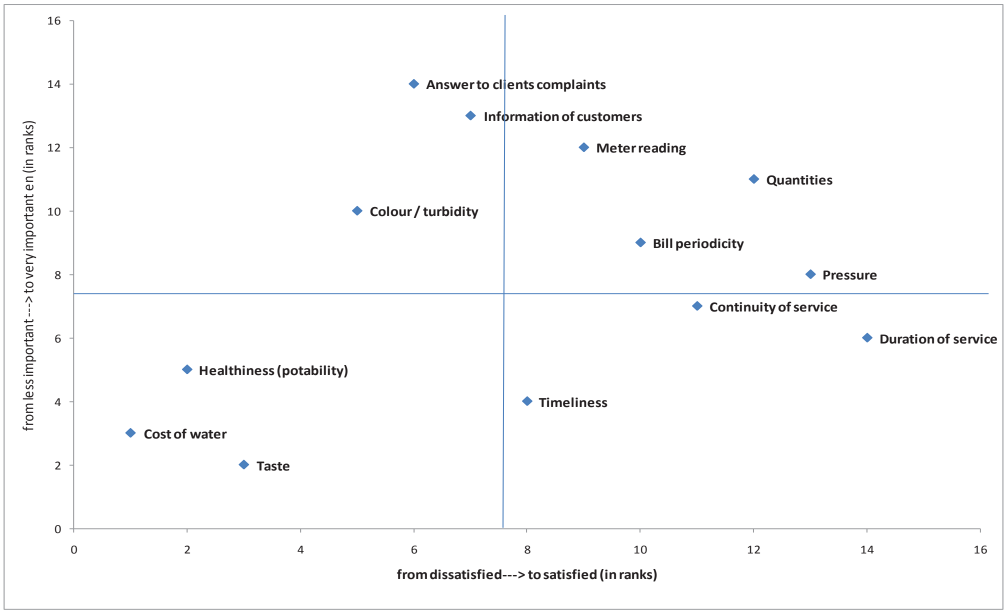


Figure 2: Customer Dissatisfaction and Importance

When asked about the improvements that people would like to see implemented, the biggest choice was for improved filtering (25%), followed by changing the pipes (18%). Water quality associated improvements in total amounted to over 50%, which contradicts the low importance given by customers to “healthiness” of the water, and their current low level of dissatisfaction shown in Figure 2.

The fact that 25% of people considered improved filtering to be the most important issue is interesting. Customers place a high level of importance upon poor colour/turbidity in their water supply, and many use filters in their homes. There is a misconception that improved filtration processes at the treatment works alone will improve the quality of water. The problem lies more with old pipes in the network, and replacing these will more effectively improve water quality. Pipe replacement will improve the continuity of service, also seen as important and with a high level of current dissatisfaction.

Overall within the city, satisfaction with the water service at 25% is comparable with the heating service, solid waste disposal both also at 25%. The satisfaction with the water service compares slightly less favourably with wastewater disposal – also an ACC service – at 21%.

Water service was the least important, at 19%, when customers within the city were asked to benchmark the importance of the water supply against other public utilities. The highest importance was given to roads at 53%. Wastewater disposal was fourth at 24%. A similar situation existed outside of the city, except that the lowest importance was placed upon the electricity supply at 21%; water was 24% and wastewater disposal 32%.

3.3.3.6. Wastewater Disposal

Within Chisinau City, 98% of people are connected to the sewer network. Outside of the city: 36% of people are connected, 50% use a septic tank or cess pit and 14% have some other disposal method. As to be expected, alternative disposal routes to piped sewer systems are more common in rural than urban locations: 27% and 12%, respectively.

Septic tanks are usually emptied by specialist companies in Chisinau City on average every 9 months and every 14 months outside. The average cost is 268Leu per event. The most common problem stated was smell.

Overall, people show concern for the environmental effects of unsatisfactory wastewater disposal with 88% feeling “concerned” or “very concerned”. About 50% of households are dissatisfied with the quality of the environment, but 75% are satisfied with the sanitation.

Households are not prepared to pay much for a wastewater collection service. The most desired improvement was for replacement of the sewers; only 8% responded with removal of smell, 2% with the cost. 28% replied with “Do not know”.

3.3.3.7. Willingness to Pay for Wastewater Connection

Of households questioned there was almost universal (94%) acceptance that a sewer connection was at least useful. The accepted price for a connection was 1,334Leu.

The percentage fell drastically to 18% of those willing to pay when told the current charge was 6,000Leu. Of those prepared to pay: 82% would be prepared to pay a charge of 1,625, on average.

With regard to paying a regular charge for the service, only 15% considered it “unjustified” and 10% as “unacceptable”. Whilst those without a septic tank and poorer households were more reluctant to pay, households outside of Chisinau City were marginally less reluctant than those within, 22% against 26%.

3.3.3.8. Affordability of Water & Wastewater Charges

Current water charges in Chisinau are well within the normally accepted “average household” level of 3% of income, but for the Chisinau city poorest group the percentage at 4.3% is close to the internationally accepted 5% for poorer households. Few people remembered the last ACC tariff increase in 2009 when the tariff almost doubled. ACC records show little change in the overall demand for water as a result of the increase.

From the data collected within the Household Survey, an indicative maximum affordable price for water and wastewater services can be determined.

Table 7: Maximum Affordable price for Water and Wastewater Service Provision

	Poorer Households	Average Household
Household size	3.77 persons	3.05 persons
Water consumption	76.3litres/head/day	119litres/head/day
Total household expenditure	2,241 Leu/month	5,492 Leu/month
Affordability as percentage of expenditure	5%	3%
Maximum affordable expenditure	112 Leu/month	165 Leu/month
Maximum affordable cost of water	12.5 Leu per cubic meter	15.0 Leu per cubic meter
Current tariff	8.06 Leu per cubic meter for water + 1.13 for wastewater	

3.3.3.9. Willingness to Pay

Within the survey, those questioned were first explained what was meant by an "improved service" i.e. clean water, good pressure and available 24hours a day/7 days a week.

A charge in the price band of 60 to 70Leu charge was generally accepted (71%) across all locations, and modes of supply. Such a cost is less than the current average monthly charge of 84Leu. Only, 31% would find a charge of 165Leu per month, as determined in Table 7, acceptable.

Again, there were variations between those inside and those outside of the city, and within those supplied by ACC and those with alternative supplies.

Noticeably, a charge of 100 Leu per month seems to be a psychological threshold with 62% of all households finding a cost of 90 to 100Leu per month acceptable, but only 45% finding a charge of 100 to 110Leu acceptable. All other things being equal, an increase in tariff of around 20% such that the average charge increases from 84 to 100Leu per month, with appropriate improved service; an awareness campaign and arrangements in the tariff mechanism for poorer people would find general, but not universal acceptance.

3.3.4. Future Water Demand

3.3.4.1. Domestic Per Capita Consumption

Current (2010) Consumption

Current domestic consumption within the study area varies between an average of 131litres/person/day in Chisinau City and 77litres/person/day, outside. The average across the study area was 119litres/person/day.

The consumption varied across the socio-economic groups with, as to be expected, the rate increasing with wealth and access to water using facilities such as shower/bath, washing machines and flush toilets.

Future Levels

Historically it is well documented that in geographical east European countries, and in some within the west, domestic per capita has fallen in recent years. Nevertheless, future consumption trends are difficult to predict.

Within the Household Survey, 92% of people consider that their supply is adequate and that their demand for water is met. Among ACC customers in Chisinau, only 11% wish to consume more water; 4% outside of Chisinau. Rather more, 24% of people who draw water from a private source wish to consume more. No person drawing from a private network wished to consume more.

On the basis of the Survey, there would seem to be little "restrained" demand. This belief of customers is based upon their current standard of life. The Survey results show clearly that as households become more affluent and customers began to install water using facilities, their consumption increases. The question about future water consumption is, therefore, directly linked to the likelihood of increased prosperity.

Experiences in Chisinau concerning the price to consumption ratio have been variable depending more on other external factors, than the tariff. Around 2000, consumption decreased drastically even though the tariff was low, probably due to the installation of meters; consumption then started to increase despite tariff increases only to recently decrease when the tariff was increased.

Conclusions concerning Future Domestic Consumption

Within the poorer areas of Chisinau and outside of the city, there is the likelihood of an increase in domestic consumption, with any increased affluence. Within the city, where residences have baths/showers, flushing toilets and many have washing machines there is no reason to consider, in the immediate future, that consumption will increase.

In fact, with any further increase in tariff, especially for the sewerage element, the assumption would be that consumption will decline in Chisinau, as has happened in other countries.

To what extent domestic consumption will increase or decrease is truly “crystal-ball gazing”. For this purpose, various scenarios are considered and the solutions tested for sensitivity against the chosen scenario.

Within the Feasibility Study, three scenarios are proposed – high, medium and low levels of consumption. The proposed domestic consumptions proposed, and accepted by ACC, are shown in the following table:

Table 8: Scenarios for Domestic Consumption

Location	Scenario	Domestic per capita as litres/head/day					
		2010	2015	2020	2025	2030	2035
Chisinau City	High	131	131	131	131	131	131
	Medium	131	128	125	118	112	112
	Low	131	121	112	107	101	96
Outside Chisinau City	High	81	89	97	105	109	111
	Medium	81	85	88	91	94	95
	Low	81	84	86	89	91	91

3.3.4.2. Domestic Customer Demand

Considering both the expected population levels discussed in Section 3.3.2 and the above future per capita consumption, future domestic water demands have been derived:

Table 9: Forecast for Domestic Water Demand

		Domestic Water Demand in m3/day					
Location	Scenario	2010	2015	2020	2025	2030	2035
Chisinau City	*Population*	*631,312*	*635,918*	*628,458*	*623,977*	*615,535*	*603,659*
	High	82,646	83,285	82,324	81,749	80,633	79,067
	Medium	**82,646**	**81,203**	**78,259**	**73,827**	**69,179**	**67,835**
	Low	82,646	77,081	70,515	66,521	62,333	58,066

		Domestic Water Demand in m3/day					
Location	**Scenario**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Outside of the City	*Population*	*181,376*	*185,629*	*186,101*	*186,462*	*186,254*	*186,101*
	High	14,725	16,534	18,068	19,666	20,363	20,719
	Medium	**14,725**	**15,762**	**16,324**	**16,957**	**17,431**	**17,743**
	Low	14,725	15,638	16,048	16,562	17,033	16,987
Study Area	*Population*	*812,688*	*821,547*	*814,559*	*810,438*	*801,789*	*789,760*
	High	97,371	99,819	100,392	101,415	100,996	99,786
	Medium	**97,371**	**96,965**	**94,583**	**90,784**	**86,610**	**85,578**
	Low	97,371	92,719	86,563	83,083	79,366	75,053

3.3.4.3. Non Domestic Customer Demand

ACC categorises non-domestic customers as:

- Administrative organisations, that is national and local government organisations or agencies who represent 5% of billed consumption, and
- Commercial and industrial customers (17%).

Industrial water usage is greater than billed by ACC as many concerns operate their own boreholes. Understandably, the lower cost of procuring their supplies is the major reason given. There are some indications that more current industrial customers intend to move towards their own supplies. Although cost is a driver, the most common dissatisfaction with ACC is with the quality of the water.

As a whole, non-domestic customers comprise two groups:

- 50 larger customers who consume 50% of non-domestic demand, and
- Around 5,000 smaller units.

Trends in future non-domestic water demand were considered within two separate surveys, targeted to each of these two groups. In many cases, future trends were unknown, as those questioned were not the decision makers. The following generalisations were found:

- Within the health sector, there will be a continuing decline in water consumption due to reducing number of hospital beds and the introduction of efficiencies in water usage;
- Water consumption will decline in schools due to improved water plumbing;
- A similar decline is expected in security and military establishments with the planned closure of one prison in 2015;
- Within industry as a whole, the expectation is for a continuing decline in water consumption due to improved efficiency in water usage and process changes. A slight increase is expected within the agro-industries;

- There will be a continuing increase in demand within the commercial and services sectors;
- In transport, little change is expected, and
- For other organisations directly linked to population numbers e.g. kindergartens, health centres, current ratios of demand to domestic demand can be expected to continue.

Considering all the above factors, future non-domestic demand is forecast as shown in Table 10.

Table 10: Forecast for Non-Domestic Demand

		Non-Domestic Water Demand in m3/day					
Location	**Scenario**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Chisinau City	*Population*	*631,312*	*635,918*	*628,458*	*623,977*	*615,535*	*603,659*
	High	29,370	29,754	29,764	29,977	30,200	30,382
	Medium	**29,370**	**28,615**	**27,698**	**26,485**	**25,391**	**24,963**
	Low	29,370	27,308	25,375	24,043	22,791	21,558
Outside of the City	*Population*	*181,376*	*185,629*	*186,101*	*186,462*	*186,254*	*186,101*
	High	3,936	4,419	4,810	5,216	5,384	5,454
	Medium	**3,936**	**4,203**	**4,335**	**4,484**	**4,591**	**4,648**
	Low	3,936	4,159	4,244	4,352	4,449	4,408
Study Area	*Population*	*812,688*	*821,547*	*814,559*	*810,438*	*801,789*	*789,760*
	High	33,307	34,173	34,573	35,193	35,584	35,836
	Medium	**33,307**	**32,818**	**32,033**	**30,969**	**29,982**	**29,611**
	Low	33,307	31,468	29,620	28,395	27,240	25,966

3.3.4.4. Total Water Demand of Customers

The forecast for total water demand of customers within each of the three scenarios is shown in Table 11.

Table 11: Total Water Demand of Customers by Scenarios

		Total Customer Water Demand in m3/day					
Location	**Scenario**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Chisinau City	*Population*	*631,312*	*635,918*	*628,458*	*623,977*	*615,535*	*603,659*
	High	112,016	113,039	112,088	111,726	110,833	109,449
	Medium	**112,016**	**109,818**	**105,957**	**100,312**	**94,570**	**92,798**
	Low	112,016	104,389	95,890	90,564	85,124	79,624
Outside of the City	*Population*	*181,376*	*185,629*	*186,101*	*186,462*	*186,254*	*186,101*
	High	18,661	20,953	22,878	24,882	25,747	26,173
	Medium	**18,661**	**19,964**	**20,659**	**21,441**	**22,022**	**22,391**
	Low	18,661	19,797	20,292	20,914	21,482	21,395

		Total Customer Water Demand in m3/day					
Location	**Scenario**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Study Area	*Population*	*812,688*	*821,547*	*814,559*	*810,438*	*801,789*	*789,760*
	High	130,677	133,991	134,965	136,608	136,580	135,622
	Medium	**130,677**	**129,783**	**126,616**	**121,753**	**116,592**	**115,189**
	Low	130,677	124,187	116,183	111,478	106,606	102,019

and in the following graph, Figure 3.

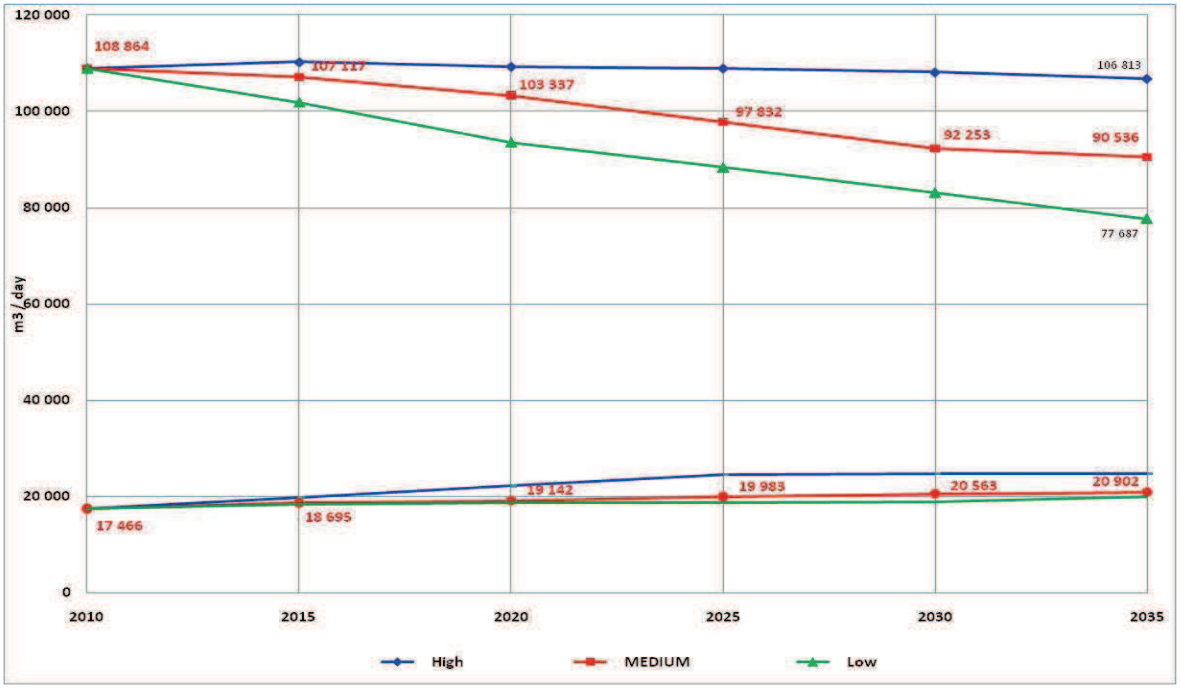


Figure 3: Forecast of Increase in Customer Demand

Total water into supply, that is customer demand and non-revenue water is discussed in Section 3.5.

3.3.5. Summary of Major Conclusions from the Socio-Economic Analysis

The following is a summary of the major conclusions of the Socio-Economic Analysis.

- Customer's perception of ACC would benefit from a public awareness campaign focused upon the importance to health of a professionally operated water and wastewater service. Water service came last at 19% when customers within the city were asked to benchmark the importance of the water supply against other public utilities. From the household survey, people would seem to lack knowledge of water quality and the issues associated with an inferior supply;
- Should ACC wish to increase its customer base, it should consider lowering the charge for a water connection to around 1300Leu, which cost would be more acceptable to potential customers. Similarly for a sewer connection, where a cost of 1800Leu would gain general acceptance;

- All other things being equal, an increase in tariff of around 20% such that the average charge increases from 84 to 100Leu per month, with appropriate improved service; an awareness campaign and arrangements in the tariff mechanism for poorer people would find general, but not universal acceptance;
- Within the customer satisfaction section of the Household Survey, customer service featured as being of high importance to customers. Replacement of pipes and improved filtration featured prominently as desirable;
- Future water consumption is directly linked to the likelihood of increased prosperity within the city and surrounding area, and
- Customer water demand across the whole study area, is forecast to increase from a current 130,677m^3/day to 135,622 m^3/day under the “high” demand scenario or fall to 115,189m^3/day or 101,019m^3/day under the “medium” and “low” demand scenarios.

3.4. WATER MEASUREMENT CAMPAIGN

3.4.1. INTRODUCTION TO THE SECTION

Two measurement campaigns have been performed within Phase B: one for potable water and the second for wastewater. The wastewater campaign is discussed in 3.9.2. Within this section the potable water campaign is discussed, as a prelude to, amongst other objectives, forecasting future non-revenue water levels as a component of demand.

The measurement campaign was performed between the 25th May and 7th September, 2011. Each of the six separate campaigns was of seven days duration.

Each campaign comprised the collection of pumping station pump delivery pressures and the inlet and outlet flows at the stations within a zone; water service reservoir levels and flows and pressures at strategic points in the distribution network. The data was collected from permanent ACC pressure and flow recorders or from temporary equipment provided by Seureca for the purposes of the measurement campaign.

The objectives of the campaign were to:

- Enable the calibration of the strategic network model;
- Provide information upon current customer demand and patterns of demand;
- Ascertain physical[14] water losses from the network, and
- Provide ACC with a prioritised non-revenue water detection programme.

In particular, the campaign enabled the following key determinations for each zone, and collectively for the distribution network of ACC:

- The annual average and peak day “water into supply” from the sources;
- Annual average customer demand, including operational water used by ACC;
- Performance Indictors of Linear Leakage Index and Network Efficiency, and
- Hydraulic energy supplied to each zone from which a prioritised leak detection programme based upon the cost of energy was produced.

3.4.2. DETERMINATION OF THE ANNUAL AVERAGE AND PEAK WATER INTO SUPPLY FLOWS

3.4.2.1. Definition of Terms

The following table provides the definitions of the terms used in this, and subsequent sections.

[14] But not commercial losses due to meter under-registration and unknown connections

Table 12: Definition of Terms Relevant to the Water Measurement Campaign

Source of Data	Term	Unit	Definition
Computed from ACC Production Records	Monthly production coefficient	Ratio	Total water into a supply during the month of the measurement campaign : 12th of the annual water into supply
	Monthly production peak coefficient	Ratio	Maximum water into supply during any month : 12th of the annual water into supply
Recorded during a Measurement Campaign	Average daily (water into supply) flow	m^3/day	The flow recorded into a supply zone for any 24 hour period of the measurement campaign in that zone
	Average weekly (water into supply) flow	m^3/day	One 7th of the total flow into a supply zone during the week of a measurement campaign in that zone
	Minimum night flow	m^3/hour	The lowest rate of flow recorded into a supply zone measured over an hour
Computed from the results of the Measurement Campaign, relevant to a supply zone	Daily coefficient (for water into supply)	Ratio	Average daily flow : the average weekly flow
	Weekly delivered flow coefficient	Ratio	Water into a supply zone during the “reference day” : the average weekly flow
	Weekly peak delivered flow coefficient	Ratio	The highest daily coefficient recorded during a measurement campaign in the subject zone
	Delivered flow coefficient	Ratio	Monthly production coefficient x Weekly delivered flow coefficient
	Annual average water into supply for a zone	m^3/day	The annual flow delivered into a supply zone averaged over 24 hours, computed from: Average daily flow / (Delivered flow coefficient x Weekly delivered flow coefficient)

Source of Data	Term	Unit	Definition
	Peak delivered flow coefficient	Ratio	Peak production coefficient x weekly peak delivered flow coefficient
	Peak (day) delivered flow	m^3/day	The peak quantity of water supplied in any 24 hour period, computed from: Average delivered flow X Peak delivered flow coefficient
	(Customer) demand coefficient	Ratio	Customer demand on the reference day : annual average customer demand In the context of this analysis, “customer demand” includes operational water used by ACC

3.4.2.2. Methodology

The above definitions can be elaborated by reference to the results obtained from Measurement Campaign No 1: Zone 1.

The flows recorded for each day of the measurement campaign are shown in the following table, as is the daily coefficient of water into supply computed for each day of the measurement campaign.

Table 13: Results of the Measurement Campaign No1: Zone 1

Day	Average Daily Flow into the zone	Daily Coefficient	Minimum Night Flow	Minimum Night Flow: Average Daily Flow
	m^3/day	Ratio	m^3/hour	Percentage
6th June	31,326	1.10	592	45%
7th June	29,947	1.05	622	50%
8th June	29,430	1.03	549	45%
9th June	28,528	1.00	795	67%
10th June	28,025	0.98	618	53%
11th June	26,390	0.93	508	46%
12th June	25,676	0.90	597	56%
Average	**28,475**		**508**	**52%**

From an examination of the flow and pressure data, the 7th June was selected[15] for the reference day because (i) the recordings on that day were representative for the whole of the campaign in that zone, and (ii) there were no operational events on that day to adversely influence the results.

From the production records of ACC, it was determined that:

- The June 2010 “water into supply” was 3% higher than the average monthly figure i.e. the “Monthly production coefficient” is 1.03, and
- The peak month for “water into supply” was August when the flow was 9% higher than the average monthly flow i.e. the “Monthly production peak coefficient” is 1.09.

Other ratios computed are shown in the following table:

Table 14: Computation of Measurement Campaign Indicators for Measurement Campaign No 1: Zone 1

	Indicator	Computation	Value
Reference day	Date		7th June 2011
	Average daily flow	As recorded	29,947m^3/day
	Weekly delivered flow coefficient (computed	=29,947 / 28,475	1.05

[15] A fuller explanation of why the 7th was selected is provided in the Measurement Campaign Report, Section 4.1.3.1

	Indicator	Computation	Value
	for the reference day)		
	Delivered flow coefficient	=1.03 x 1.05	1.08
Peak Day	Weekly peak delivered flow coefficient	The highest computed "daily coefficient" on 6th June	1.10
	Peak delivered flow coefficient	= 1.09 x 1.10	1.20

From the above: the annual average water[16] into supply was determined as 27,691m^3/day, and the peak flow into supply was found to be 33,206m^3/day

Within a reiterative process based upon the two variables of network efficiency and the percentage of the minimum night flow that can be considered as legitimate demand, the following key determinants were computed:

- The customer demand for the reference day was assessed to be 17,965m^3/day;
- Network efficiency is 57%, and
- 10% of the daily demand was shown to be legitimate night demand.

By deduction from the flow into the supply zone on the reference day of 29,948m^3/day, the losses are assessed to be 11,983m^3/day

Using the network efficiency (57%) and the delivered flow coefficient (1.08) for the reference day, an annual average customer demand of 15,708m^3/day, was derived.

3.4.2.3. Summary of Water into Supply and Customer Demand for ACC Area of Supply

A similar series of calculations were made for each of the 33 supply zones, and summed for the ACC area of supply as shown in the following table.

Table 15: Summary of Measurement Campaign for ACC Area of Supply

Item	Chisinau	Suburbs	Whole Area of Supply
Average delivered flow (m^3/day)	176,645	17,204	193,849
Average customer demand including ACC operational use	110,533	8,664	119,197
Peak customer demand coefficient	1.36	1.94	1.40
"Water into supply" peak coefficient	1.22	1.47	1.25

The "water into supply peak coefficient" is lower than the customer demand coefficient as the former is inclusive of physical losses, for which there is no "peaking".

[16] See the Detail Report: "*Measurement Campaign Report"* for the derivation of these flows and other determinants

3.4.2.4. Performance Indicators for Water Losses

Two water loss performance loss indicators are determined for each of the supply zones: network efficiency and the Linear Leakage Index.

- Network efficiency = annual average legitimate / annual average water into supply
- Linear Leakage Index[17] = annual average physical losses / length of the network

The derivation of the network efficiency for Zone 1 was determined as 57%, see above Section.

The Linear Leakage Index for the Zone 1 supply area was derived as 45m^3/km/day.

Such Indicators show that leakage is at unacceptable level with the Zone. The determination of the prioritised leak detection programme within which Zone 1 is ranked with the other Zones is discussed in the next Section.

The Indicators derived for the whole supply area are shown in the following table.

Table 16: Network Performance Indicators for ACC Area of Supply

Item	Chisinau	Suburbs	Whole Area of Supply
Network Efficiency	63%	50%	61%
Linear Leakage Index (m^3/km/day)	48	22	42

3.4.2.5. Prioritisation for Leak Detection

The Performance Indicators within Table 16, show that the ACC has a higher-than-acceptable level of physical losses from its network that requires to be tackled. As all zones cannot be surveyed at the same time, there requires prioritisation based upon:

- The need to "find" additional water to meet current and/or future demands with minimal capital expenditure on new source works, or
- Savings in operational costs.

For ACC, the need for leakage savings to meet additional demand is not applicable.

The prioritisation programme will be based upon savings in operational costs. Assuming that the cost of repairs is consistent across the service area and considering that the greater majority of water comes from the STA treatment works and has the same treatment costs, the only variable is the cost of pumping at the various booster stations.

An output of the measurement campaign is the energy cost per cubic meter required to pump water into supply and around the different supply zones, enabling prioritisation of the leak detection programme.

The measurement campaign data permitted:

- The efficiency of the pumping stations to be computed, and

[17] The Index applies only to physical losses; not to commercial losses

- The energy dissipated across flow control valves.

The determination of energy losses across flow control valves shows the locations where there could advantageously be investment to avoid the energy inefficiencies and where the energy losses are so great that the installation of a turbine might be cost beneficial – see Section 3.8.9 for the discussion about a turbine upstream of the Ciocana reservoir complex.

3.4.2.6. Determination of Energy Input to Water

The electrical energy imparted into the water at a pumping station, as kWh/m^3, is calculated from the electrical power consumed by the pumps, the delivered flow and the pressure difference across the pump i.e. the difference between the suction and delivery heads. The total energy input to a zone can be computed from the sum of the energy inputted at each of the pumping stations through which the water passes before it reaches a customer, including the high lift pumps at the treatment works.

3.4.2.7. Prioritised Physical Losses Reduction Programme

Based upon the total energy inputted to the water lost in a zone and the quantity of physical losses, a prioritised leak detection and repair programme can be produced, as shown in the following Table.

The Table also shows that by tackling physical losses in the top five zones, the total losses and power wasted can be reduced by around 46% and 43%, respectively or 16% of the current power consumed by ACC.

A work programme to achieve the target, based upon the results of the Pilot Leak Detection programme, is provided in Section 3.4.4.2.

Table 17: Prioritised Leak Detection Programme

		As Recorded in Measurement Campaign						With Reduction Campaign		
Zone		Linear Leakage Index	Physical losses		Energy Consumed	Energy Lost		Target	Leakage Saved	Power saved
Priority Ranking	Name		In Zone	Cumulative	in Zone	in Zone	Cumulative			
			m^3/day	m^3/day	kWh/m^3	kWh/day	kWh/day	LLI	m^3/day	kWh/day
1	Zone 2 - Tohatin,Vostoc & Independeta	68	18,744	18,744	0.49	9,185	9,185		13,231	6,483
2	Zone 1	45	11,983	30,727	0.38	4,554	13,738		6,657	2,530
3	Zone 3 – Ciocana	203	7,253	37,980	0.56	4,062	17,800	20	6,538	3,662
4	Zone 3 – Independenta	94	5,510	43,490	0.57	3,141	20,940		4,338	2,472
5	Zone 2 - Doina	71	5,226	48,716	0.48	2,508	23,449		3,754	1,802
6	Zone 2 – Otel	19	3,908	52,624	0.48	1,876	25,325	Total saving	34,518	16,949
7	Zone 4 – Independenta	63	2,579	55,203	0.69	1,780	27,104	Of Total Lost	46%	43%
8	Zone 4 – Buiucani	36	2,675	57,878	0.63	1,685	28,790			
9	Codru to Singera	37	1,845	59,723	0.61	1,125	29,915			
10	Zone 4 – Telecentru	52	1,359	61,082	0.78	1,060	30,975			
11	Zone 3 – Buiucani	20	1,974	63,056	0.52	1,026	32,002			
12	Zone 4a – Telecentru	11	1,095	64,151	0.83	909	32,910			
13	Vadul Lui Voda	17	1,569	65,720	0.52	816	33,726			
14	Zone 4a – Schinoasa	31	847	66,567	0.96	813	34,539			
15	Zone 3 - Valea Dicescu	15	907	67,474	0.68	617	35,156			
16	Codru to Contrereservoir	37	854	68,328	0.61	521	35,677			
17	Zone 4 – Ciocani	42	869	69,197	0.57	495	36,172			
18	Colonita	99	614	69,811	0.73	448	36,621			
19	Zone 3 – Riscani	39	679	70,490	0.56	380	37,001			
20	SAN to Tohatin	37	625	71,115	0.52	325	37,326			
21	Singera	37	521	71,636	0.61	318	37,644			
22	Cosernita	37	552	72,188	0.52	287	37,931			
23	Stauceni	37	349	72,537	0.71	248	38,178			
24	Zone 4a – Botanica	82	317	72,854	0.73	231	38,410			
25	Durlesti – Gribov	7	238	73,092	0.93	221	38,631			
26	Dobrogeah	37	247	73,339	0.77	190	38,821			
27	Tohatin	7	247	73,586	0.66	163	38,984			
28	Ialoveni	5	319	73,905	0.49	156	39,141			

Zone		As Recorded in Measurement Campaign						With Reduction Campaign		
		Linear Leakage Index	Physical losses		Energy Consumed in Zone	Energy Lost		Target	Leakage Saved	Power saved
Priority Ranking	Name		In Zone	Cumulative		in Zone	Cumulative			
			m^3/day	m^3/day	kWh/m^3	kWh/day	kWh/day	LLI	m^3/day	kWh/day
29	Codru to airport	37	168	74,073	0.61	102	39,243			
30	Zone 3 - University Agrara	70	186	74,259	0.53	99	39,342			
31	Airport	37	86	74,345	0.72	62	39,404			
32	Vatra	37	184	74,529	0.31	57	39,461			
33	Durlesti – Cartusa	7	53	74,582	0.98	52	39,513			

3.4.2.8. Commercial Losses

Not a part of the measurement campaign, an investigation has been made into commercial losses due to under-registration of customer revenue meters.

The assessment of metering under-registration consists of two main activities:

- Obtaining representative consumption profiles and histograms;
- Testing of water meters aiming to obtain representative metrological error curves;

It includes the two following steps:

- 50 domestic customers have been equipped with Class C water meters, with pulsating units connected to dataloggers to record real-time water consumption during two weeks;
- water meters of selected large customers been checked on-site over three days thanks to an external portable ultrasonic flowmeter with an integrated datalogger;

At the time of submission of the draft Phase B Report, the results of the investigation were not available.

3.4.2.9. Reservoir Usage

Service reservoirs within the distribution network have two functions:

- To smooth out peak customer demands, and
- To provide strategic storage to ensure the continuation of supply in an emergency.

Indicatively, for the first function, capacity of around 6 hours, or 25%, of annual average demand is generally required. For the second, the requirements are based upon the time taken to respond to an emergency, effect a repair and recharge the system. Again, indicatively around 12 to 15hour demand is commonly provided. It is also important that the water in reservoirs is "turned over" in order to ensure the water quality by preventing stagnation of the water. Usage should not be less than around 15% of capacity of the reservoir i.e. the water is "turned over" once every 6 to 7 days. It can also be assumed that the bottom 10% of a reservoir is either unusable due to silt collection, or cannot be drawn.

The results do show that consideration needs to be given to the capacity at Codru and Airport reservoirs due to their low turnover, and to Upper Vadul luiVoda, Codru MDK and Tohatin due inadequate capacity.

The reservoirs at the water treatment plant are almost used over the full range of their capacity. Whilst large quantities of water should not be stored at the treatment works[18],

[18] Water at a treatment works usually has to be pumped into supply whereas, ideally, capacity should be provided where the water can gravitate into supply to provide security against electricity failures.

the minimum stored capacity has been determined at 50% of the 2035 peak demand. On that basis, the current stored capacity at STA and Tohatin of 40,000m^3 and 16,000m^3 is deemed satisfactory. The storage capacity excludes the capacity of the chlorine contact tank that is considered as a part of the treatment process and needs to be retained at full capacity to provide the required contact time.

3.4.3. WATER NETWORK COMPUTER MODEL

A water network computer model has been constructed based on the data collected during the measurement campaign. After the calibration stage, the model has been used:

- To analyse the current condition of the network and to propose a diagnostic of the network operation;
- To design the future extensions of the network and to design the pipes which are to be rehabilitated;
- To simulate different configurations considered for the future operation of the system related to the emergency use of the ground water wells;
- To simulate the quality of the water in the network and the residence time in the reservoirs;
- To model the emergency response scenarios created by the unavailability of a water source, a pipe, a pumping station, and
- To optimize the investments and the operational costs.

3.4.3.1. Construction of the Hydraulic Model

Developed by EPA's Water Supply and Water Resources Division, EPANET has been used as the model software. It is a Windows 95/98/NT/XP program that performs extended-period simulation of the hydraulic and water quality behaviour within pressurised pipe networks.

EPANET provides a graphical environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include colour-coded network maps, data tables, time series graphs, and contour plots.

EPANET is public domain software and freely available to ACC after the completion of the project.

Hydraulic modelling is a very efficient operating tool for planning & emergency response, and we will train ACC staff on the use of the software. To remain of benefit to ACC, it will be necessary for ACC to “own” and continually update the model to ensure its currency.

3.4.3.2. Modelled Area

The network modelled concerns the primary drinking water network managed by ACC, and connected to the network supplied by the water treatment plants of Chisinau and Nistru.

3.4.3.3. Components of the Model

All the components of the network were modelled in accordance with conventional modelling practice.

The source network data for the model was the “Autocad” file, provided by ACC.

3.4.3.4. Allocation of Consumption

One of the most critical steps of the model construction is the allocation of water demand to each node, and the evolution of consumption throughout the day.

Geographical Distribution

Using the water demand study, Section 3.3, the geographical distribution of the demand for drinking water in Chisinau is known, and was allocated to the appropriate nodes of the model.

Consumption Pattern

Using the results of the measurement campaign, a consumption pattern has been defined for each supply zone, and has been attributed to each node.

3.4.3.5. Calibration of the Model

The measurement campaign measured the flow and the pressure at key locations of the network as well as the water level in the reservoirs in order to perform the calibration. The results from the measurement campaign were compared with the outputs of the model and the pipe model and flow parameters adjusted until a “match” was achieved against the site measurements.

The majority of the measured pressure and flows were recreated with an acceptable error margin and the model can be considered as “calibrated”:

- An average difference of less than 5m for the pressure points, and
- A mean error of less than 10% of the flow.

3.4.3.6. Analysis of Network Operation & Expansion

Following calibration, the model was used both for the analysis of the performance of the network and for optimum investment in new mains for expansion and for rehabilitation.

In Chisinau city, the most widespread problem was found to be the low velocity in the pipe: for most of the pipes, even the maximal velocity is below 0.2m/s, due to reduced flows in the network. Other areas for attention by ACC operational staff are provided in the Report: “*Calibration of the Water Network Model*”

3.4.4. FUTURE LEVELS OF NON REVENUE WATER AS A COMPONENT OF WATER DEMAND

3.4.4.1. Pilot Leak Detection Study

During the period July 2011 and September-December 2011, a Pilot Leakage Study was made over 300kms of ACC network.

The main objectives of the Study were:

- Familiarisation of ACC staff with acoustic correlation and acoustic ground listening for leak detection and location;
- Interaction of ACC staff with our experienced staff for all aspects of NRW activities in order to introduce best practise into ACC;
- Analysis of the Study results as indicators for an NRW reduction programme across the whole of the ACC service area, and
- To determine the most suitable organisational unit within ACC for NRW management.

The training aspect of the Study was particularly successful with the trained ACC staff able to perform unaided a proactive leak detection and location programme in Vadul-lui-Voda. For the purposes of the Study, acoustic leak detection and location equipment was brought to Chisinau and made available to ACC technicians. Special equipment to detect and locate metallic mains and accessories was also purchased.

From the Study, the number and location of leaks detected was as shown below, for the first five months of the campaign:

Table 18: Number and Location of Leaks Detected within the Pilot leakage Study

	No of leaks detected	Frequency	Percentage of total
Pipes	152	0.36 per km of main	45%
Services	32	0.076 per km of main	9%
Fittings e.g. hydrants & valves	155	0.37 per km of main	46%
Total	**339**	**0.81 per km of main**	**100%**

The team inspected 418km of inspected network (23% of the whole system), and found 339 hidden leaks during the 5 months of the Study. The ratios that can be deducted from these primary results are:

- 0.8 hidden leaks per kilometre were detected and located by the team;
- 5.2 kilometres of network per day were inspected by a team, and
- An average of 4 leaks per day was found by the team.

The percentage of detected and located leaks on valves is very high; higher when combined with those from fire hydrants. Both are in a poor condition, old and with high levels of corrosion. As a consequence they are very vulnerable to leakage and many cannot be operated, itself a network management concern.

The percentage of detected and located leaks on service connections is very low when compared to a more common 80% of leaks. In Chisinau, this could be explained by the fact that most of the Study was in areas that have predominantly high-rise apartments, with a consequential low number of service connections per kilometre of main. As the difference is significant and will affect the cost of an NRW programme, we suggest that ACC considers this topic further.

The Study confirmed the measurement campaign conclusions that the most critical areas in terms of hidden leaks are Ciocana and Independenta-Botanica, which should be given priority in any NRW reduction programme.

Other objectives of the Pilot Study were to gain an understanding of the effectiveness of the Pilot work in reducing leakage flows and to be able to estimate the cost in reducing leakage, as indicators for the whole ACC network. Unfortunately, no clear indication was shown as, although the leaks detected were promptly found, ACC did not have the appropriate repair fittings[19] to make an effective permanent repair. Too often repaired leaks were again found to be leaking. Also, in many locations the pipes are in an extremely poor condition and, as soon as a leak was repaired, the slight increase in pressure caused further leaks.

Following the completion of the Study, ACC allocated their trained operatives to Vadul-lui-Voda area, where the measurement campaign results showed that the network had an efficiency of 24% and a LLI of 17.3m^3/km/day. The team inspected 85 km on the water supply network, finding 31 leaks.

On this basis of the results of the Study, the following very indicative conclusions can be drawn with the assumed 1,844km total ACC network:

Table 19: Indicative Number of Leaks from ACC Network

Location	Frequency	Indicative Number of leaks
Pipes	0.36 per km of main	665
Services	0.076 per km of main	140
Fittings e.g. hydrants & valves	0.37 per km of main	680
Total	**0.81 per km of main**	**1,500**

It should also be borne in mind that:

- The indicative number is drawn from the first "sweep" of the network. There will remain undetected smaller leaks that are "hidden" by the noise of the larger detected leaks, and
- Even as leaks are detected, other new leaks will be occurring.

It is stressed that as the Pilot Study covered less than a quarter of the total network, the conclusions drawn regarding the number of potential leaks can only be considered as

[19] An allocation has been made in the PIP for a stock of pipe repair materials

extremely indicative, and are presented only to give an overall picture of the task facing ACC if it wishes to reduce current levels of leakage.

From our experience, we would consider that the apparent number of leaking service connections is much lower than the real situation. Based upon the more usual 80% of all leaks are from services, we would expect the number of leaking services to be in the “thousands”; not “hundreds”, even with due allowance for the number of high-rise apartments in Chisinau.

The Pilot Leakage Study has established that a future ACC leak detection unit comprising two teams[20], each comprising two technicians, will be able to fully inspect the whole network once a year. We recommend that the team be a part of a central asset rehabilitation unit comprising the four on-site technicians with a head office engineer and a technician for NRW activity planning and analysis – an effective team of six people. The team will require a NRW management computer system and a second set of detection equipment, which have been included within the PIP.

3.4.4.2. Leak Detection Work Programme – Action Plan

Within Table 17, it was suggested that ACC could beneficially tackle leakage within the top five supply zones and that reducing leakage in these zones would reduce losses by around 46%, and save around 16,949kWh/day of power.

Unfortunately, the Pilot Study was unable to provide any indication as to the cost of leak detection in terms of “Leu/cubic metre saved”.

Using the World Bank 2006 Report: *“The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries”*, with due allowance for inflation, the cost of NRW reduction can be considered to be around €500/cubic metre saved and the leakage from a “typical” leak can be in the order of 1.7m^3/day.

Using these “broad brush” indicators, the cost of a leak detection programme in these five zones to achieve the desired target is shown in the following Table.

The difference between the costs based upon €500 per cubic metre saved and that based upon the cost of repairs is that the “all-in” cost is fully inclusive of the establishment of district metering, mains rehabilitation and is based upon contractor rates.

Referring to Table 17, the cost of power saved would be €1,500/day. For the cost of repairs at €3.6m, the payback period would be around 6yrs, on the cost of power alone; probably around 3 to 4yrs for all costs.

[20] At 5.2kilometres/team/day, 2 teams will be required to sweep 1,844kms per year, assuming a 22 working day year.

Table 20: Effect of Leak Detection Programme in Top Five Zones

Zone	Length of Network Km	Current LLI m3/km/day	Current Losses m3/day	Target LLI m3/km/day	Target Leakage Reduction to be achieved m3/day	Cost based upon €500 per m3/day saved	Indicative Number of leaks to repair	Cost of Repairs[21] @2,800Leu/repair
Zone 2 - Tohatin,Vostoc & Independeta	274	68	18,744	20	13,231	€6.6m	7,783	€1.4m
Zone 1	265	45	11,983	20	6,657	€3.3m	3,916	€0.7m
Zone 3 – Ciocana	36	203	7,253	20	6,538	€3.3m	3,846	€0.7m
Zone 3 - Independenta	59	94	5,510	20	4,338	€2.2m	2,552	€0.5m
Zone 2 - Doina	73	71	5,226	20	3,754	€1.9m	2,208	€0.4m
Total	707	69	48,716	20	34,518	€17.3m	20,305	€3.6m

[21] At a budget price of a repair at 1,081Leu[21] plus a weighted cost of excavation of 1,714 Leu, i.e. a total weighted cost of 2,800Leu per repair.

3.4.4.3. Commercial Losses

In the long-term we would expect, commercial losses to be reduced to between 3% and 5% of water sold top customers.

3.4.4.4. Proposed Future Physical Loss Levels for ACC

We have determined conservative levels of physical loss levels for ACC based upon realistic Linear Leakage Index targets of:

- $3m^3$/km/day for new mains when first laid rising to 11 m^3/km/day as the new mains become older, and
- The LLI within the existing mains to be reduced from the current assessed $47m^3$/km/day to $25m^3$/km/day.

Overall we have allowed for an increase in network efficiency from the current 61% to 75% with a combination of active leak detection and repair, and mains replacement/rehabilitation. While this level of losses is satisfactory, it is not a particularly challenging level and ACC may wish to set themselves a higher target with consequential benefits in OPEX savings and levels of customer service.

3.5. Future Water Demand

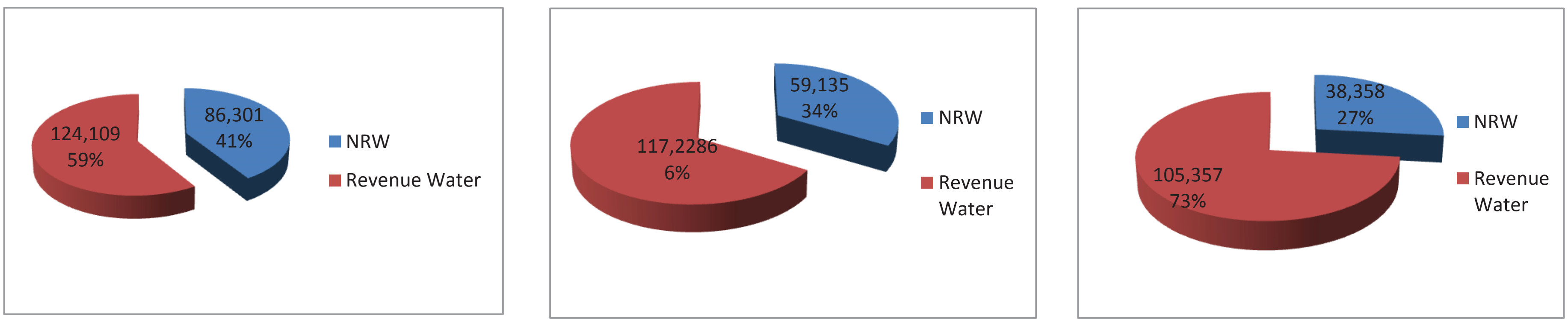
Considering all of the above i.e. the elements of customer demand and the levels of non revenue water – physical losses and commercial losses, the following water demand and resource balance has been prepared, and agreed with ACC, for the medium demand scenario.

The "Headroom" provided in the balance is the additional treatment capacity that needs to be provided to enable ACC to refill reservoirs and to recharge its system following an emergency event when the facilities will have been depleted. The capacity needs to be provided above that required to meet the peak demand.

Table 21: Future Water Demand Balance between Demand and Production

				2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Data	*Population*	*Chisinau*	*No*	631,312	632,233	633,154	634,076	634,997	635,918	628,458	623,977	615,535	603,959
		Outer area	*No*	181,376	182,227	183,077	183,928	184,778	185,629	186,101	186,462	186,254	186,101
	Coverage	*Chisinau*	*Percent*	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Outer area	*Percent*	56%	57%	58%	58%	59%	60%	65%	67%	70%	70%
	Domestic Customers	*Chisinau*	*No*	631,312	632,233	633,154	634,076	634,997	635,918	628,458	623,977	615,535	603,959
		Outer area	*No*	101,571	103,481	105,405	107,343	109,293	111,257	121,742	125,858	130,285	129,951
	Domestic Consumption	*Chisinau*	*l/hd/day*	137	136	134	132	130	128	125	118	112	112
		Outer area	*l/hd/day*	95	95	96	96	97	97	95	95	95	96
Demand	*Domestic Demand*	*Chisinau*	*m3/day*	86,789	85,672	84,555	83,438	82,320	81,203	78,259	73,827	69,179	67,835
		Outer area	*m3/day*	9,621	9,856	10,092	10,328	10,563	10,799	11,619	11,994	12,430	12,526
	Non-domestic Demand	*Chisinau*	*m3/day*	23,598	23,204	22,809	22,415	22,020	21,626	21,002	20,083	19,182	18,937
		Chisinau Tec	*m3/day*	4,981	4,911	4,840	4,770	4,700	4,629	4,391	4,178	3,975	3,782
		Outer area	*m3/day*	1,824	1,818	1,813	1,807	1,802	1,796	1,956	2,125	2,238	2,278
	Domestic: Non-domestic ratio	*Chisinau*	*%*	27%	27%	27%	27%	27%	27%	27%	27%	28%	28%
		Outer area	*%*	19%	18%	18%	17%	17%	17%	17%	18%	18%	18%
	Total Revenue Water	*Chisinau*	*m3/day*	115,368	113,786	112,204	110,622	109,041	107,459	103,653	98,087	92,336	90,553
		Outer area	*m3/day*	11,445	11,675	11,905	12,135	12,365	12,595	13,575	14,119	14,669	14,804
		Service area	***m3/day***	**126,813**	**125,461**	**124,109**	**122,757**	**121,406**	**120,054**	**117,228**	**112,206**	**107,004**	**105,357**
Unbilled authorised consumption	*ACC operational use*	*Potable water*	*m3/day*	3,902	3,562	3,562	3,562	3,474	3,386	2,922	2,566	2,210	1,854
		Technic water	*m3/day*	629	629	629	629	614	598	516	453	391	328
		Service area	***m3/day***	**4,531**	**4,191**	**4,191**	**4,191**	**4,088**	**3,984**	**3,439**	**3,020**	**2,600**	**2,181**
Mains Refurbishment	*Length of network*	*Service area*	*km*	1,789	1,788.60								
	Mains refurbished	*Service area*	*%/yr*			0.0%	0.0%	3.0%	3.0%	2.8%	2.0%	2.0%	2.0%
		Service area	*km*			0	0	54	54	250	179	179	179
	Existing mains to be connected to ACC network	*Service area*	*km*					10	19	37	37	37	37
	New mains for development/ service area expansion	*Service area*	*km*					43	86	138	225	320	390

				2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
	Total length new mains	*Service area*	*km*			0	0	97	193	495	762	1035	1285
	Total length old mains	*Service area*	*km*			1789	1,789	1,744	1,700	1,468	1,289	1,110	931
	Total length of network	*Service area*	*km*			1789	1,789	1,841	1,894	1,963	2,050	2,145	2,216
	LLI new mains	*Service area*	*m3/km/day*			3	4	4	5	6	8	10	10.0
	LLI old mains	*Service area*	*m3/km/day*	47	46	46	46	45	40	36	33	29	24
	NRW volume	*Service area*	*m3/day*	89,169	86,301	86,301	86,301	83,564	73,303	60,946	53,193	46,540	38,070
Analysis	***Production: Annual Average***	*Service area*	***m3/day***	**215,981**	**211,762**	**210,410**	**209,058**	**204,970**	**193,357**	**178,173**	**165,399**	**153,544**	**143,427**
	Network efficiency	*Service area*	*%*	61%	61%	61%	61%	61%	64%	68%	70%	71%	75%
	LLI total network	*Service area*	*m3/km/day*			46	46	43	37	29	24	20	16
Production capacity	*Peak consumption coefficient*	*Service area*	*%*		140%								
	Peak vol water into supply	*Service area*	*m3/day*		261,946	260,054	258,161	253,532	241,378	225,064	210,282	196,346	185,570
	Headroom factor	*Service area*	*%*			114%							
	Required prod. capacity	*Service area*	***m3/day***			**297,204**	**295,042**	**289,751**	**275,861**	**257,216**	**240,322**	**224,395**	**212,080**



2012 2020 2035

Figure 4: Reduction in NRW 2012 - 2020 - 2035

3.6. Water Resources

3.6.1. Geology of the Area

A full and detailed description of the geology of the area is presented in the Report: "*Underground Water Resources*", attached as an Appendix to this Report.

3.6.2. Water Bearing Aquifer

The water bearing strata in the vicinity of Chisinau are:

- Shallow aquifer - usually these strata are a few meters thick, and within 10m of the surface. The wells rarely become dry and they are widely used in rural areas surrounding Chisinau. Due to their shallow depth, the water is often polluted;
- Middle and lower Sarmatian aquifer - the aquifer is well used for water supply purposes, in particularly by ACC. Most of the wells are more than 100m deep;
- Cretaceous aquifer - the top of this aquifer is deeper than 150m and its thickness ranges between 20m and 40m. Yields from this aquifer are lower than for the Sarmatian aquifer, and the quality of the water is very poor, and
- Deep aquifers exist in the perimeter of the Study Area but the water is too much mineralized for potable purposes.

3.6.3. Groundwater Quality

As discussed in the previous section, the shallow, deep and cretaceous aquifers are not suitable for public water supply.

Sarmatian aquifer

Concentrations of sulphates and sodium are high. The fact that this aquifer is confined without oxygen is characterized by the following:

- Removal of nitrates at an average 4.9 mg/l compared to the 158mg/l observed in the shadow aquifer;
- Presence of ammonia generated by the reduction of nitrates, and
- Presence of H_2S generated by the reduction of sulphates.

Iron is present, also.

The aquifer does not suffer from bacteriological pollution as it is quite well protected from direct infiltration. Water from the aquifer is suitable for public water supply with appropriate treatment.

The Table below shows the limit values compliant with the Moldovan and the European legislation.

Table 22: Moldovan and European Potable Water Standards

Parameter	Moldovan Standard	European Standard
Sulphates	250 mg/l 500 mg/l acceptable	250 mg/l
Ammonia	0,5 mg/l	0,5 mg/l
Hydrogen Sulphide	100 µg/l	NA

Sulphates and ammonia are not considered as health risks factors. Below 500 mg/l, sulphates do not have any impact on the taste of the water, or on current uses of potable water. Ammonia is not toxic for humans. In the Sarmatian aquifer, the ammonia comes from the reduction of nitrates and cannot be used as an indicator of pollution from surface origins.

3.6.4. Current Use of Ground Water Resources

Several villages and localities in the Chisinau area rely on groundwater resources, which also contribute 3%[22] to the supply of Chisinau. Sixty wells have been drilled after the pollution of the Nistru River in 1983, although few are in service.

Water is abstracted from seven well fields operated by ACC, and from wells operated by industry. Six hundred wells have been counted.

The table below summarizes the current capacity of each ACC well field.

Table 23: Yield of ACC Well Fields

Name	Total number of wells	Nr of wells in operation	Max flow rate drawn (m^3/d)	Max current flow rate (m^3/d)	Comment
Ilaloveni	21	5	19,200	3,100	
Ghidigich	12	11	11,400	2,400	
Petricani	9	0	9,960	0	Stop in 2001
Balisevsc	6	5	9,800		
Gratiesti	4	0	1,000	0	Stop in 2002
Durlesti	6	0	1,500	0	Stop in 2005
Burcuta	2	0	700	0	Stop in 1990

In addition to the well fields located within the city, there is another one at Vadul lui Voda.

The total underground water production reached 23,000,000 m^3 per year in the 70s. Then the annual production has gradually decreased over the years to become more or less steady, around 3,000,000 m^3, since 2002 - about 3% of the total production of ACC.

[22] Prior to the construction of the water treatment plant (SAN) in 1958, Chisinau was exclusively supplied from groundwater resources.

The intensive exploitation of the aquifer within the study area is clearly evidenced by a continuous decrease of the groundwater levels. However, it seems that groundwater resources have not been exploited beyond the sustainability limits.

AGeoM have assessed the reliable yield from the different sites in Chişinău area.

Table 24: Assessed Well Filed Reliable Yield

Well field	m^3/d
Ghidighici	22,000
Ialoveni	37,000
Balişevsc	10,000
Petricani	13,000
Airport	5,600

3.6.5. EMERGENCY SUPPLY OF CHISINAU CITY

The main supply to Chisinau from the River Nistru supply is vulnerable to pollution, and an alternative supply is required to fully or partially meet demand. The underground water resources are the only feasible option.

To ensure their availability in an emergency, the wells to be used must be operated on a regular basis as a component of the Chisinau total production capacity. In order to ensure their suitability as sources of potable water, some additional treatment facilities will be required, as discussed fully in Section 3.7.4.

3.6.6. SUPPLY TO COMMUNITIES OUTSIDE ACC AREA OF SUPPLY

Several villages and cities around Chisinau are being supplied from underground water resources. Some of the wells fields are operated by ACC, others by the municipalities/localities.

We have visited all the localities not supplied from the ACC centralised system to assess the current situation and to determine the best option to supply potable water everywhere. The Appendix 3 of the Report *"Underground Water Resources"* includes a detailed description of the data gathered during our field visits.

A summary of our recommendations is shown in the following Table. The required CAPEX is not included into either the PIP or LTIP as these areas are currently outside of the ACC service area, and thus the study area.

Table 25: Long-Tern Water Supply Recommendations for Areas Outside of the ACC Service Area

Community	Recommendation
Truşeni, Cojuşna and Străşeni Bălăbăneşti Floreni Budeşti, Ceroborta Ghidighici	Connect to the ACC network
Oniţcani, Slobozia-Dusca and Coşerniţa	A new deep well solution for Onitcani and Slobozia-Dusca. For Cosernita, the priority is to replace the existing DN120 connection pipe to Chisinau network with DN180, and to increase the customer connection rate.
Băcioi and Cricova	Increase the current production capacity by drilling three new wells, and install chlorination equipment
Ciorescu	Maintain the current wells, and install chlorination equipment
Condriţa	Further study required
Maximovca	Community is connected to ACC network. Extension of the supply network is on-going and will allow supplying the entire city from this source.
Revaca	Supply from ACC network is to be implemented
Vatra Singera	These two communities already almost entirely supplied from Chisinau water works. We recommend also to connect the residential areas, currently supplied by wells, to the ACC network
Humuleşti	Drill a new well
Pruncul, Dumbrava, Vaduleni	Current production facilities are satisfactory

3.7. Water Treatment

3.7.1. Background

As set out in Section 3.6, the total potable water production facilities agreed with ACC to be provided are for 290,000m^3/d, including 9,700m^3/d of “technical water” for industrial uses.

The River Nistru water is satisfactory as a raw water source for drinking water production. Yet, because the River Nistru is vulnerable to accidental industrial pollution, any treatment plants using the River Nistru water as its source of raw water will require some provision against pollution of the raw water.

As discussed in the previous Section, the quality of the water from the wells fields operated by ACC is poor, with high concentrations of hydrogen sulphide, ammonia, total dissolved solids and sulphate. If the water from the wells is to be used continuously, full treatment must be implemented.

Treatment of hydrogen sulphide will be necessary if the ground water is used for emergency situation.

3.7.2. Standards for Potable Water

Water treatment processes have been designed to ensure compliance with Moldovan Standards for potable water, as a minimum.

3.7.3. Overview of the existing facilities

Currently, the water is produced in several sites:

- The treatment plant of Vadul Lui Voda, referred to as “SAN”, treating the water from the Nistru;
- The main water treatment plant, referred to as “STA”, also supplied with raw water from the Nistru, and
- Wells fields for the remote villages, not connected to the city network.

The Vadul Lui Voda WTP was built in the sixties with a design capacity of 50,000m^3/d. The current production is around 25,000m^3/d.

STA, the main water treatment plant for Chisinau, was built in three phases in 1972, 1977 and 1981. The current average production is around 200,000m^3/d, for an initial design capacity of 350,000m^3/d.

No significant investment has been made on either the Vadul Lui Voda or STA plants since 1981, with the consequence that the two plants are in a condition that requires complete rehabilitation, or reconstruction.

The well fields are not operated at their maximum capacity, because of their bad conditions or because of poor water quality and lack of appropriate treatment.

3.7.4. Options for Water Production Capacity

3.7.4.1. Vadul Lui Voda Plant

Our recommendation is for the Vadul Lui Voda (SAN) site to be decommissioned for the following reasons:

- As with the STA plant, Vadul Lui Voda draws water from the Nistru. The plant cannot be considered as a backup facility to STA, in case of accidental pollution of the River Nistru;
- It will be more cost efficient to retain one production site only for the Nistru water, and
- The area supplied by SAN can easily be connected to the main network.

The raw water pumping station will be retained to pump raw water to STA plant.

3.7.4.2. STA Plant and the Well Fields

Given the poor quality of the ground water in most of the wells fields, the continuous production of drinking water from the well fields will require the costly implementation of full-sale treatment facilities. With limited treatment facilities, the well fields can be made available for emergency use, in case of accidental pollution of the Nistru.

Due to the configuration of the STA plant and the several outlet mains from the plant, a total failure of STA, although feasible, is not considered to be risk against which ACC can be expected to mitigate fully.

We propose three options to be evaluated:

- Option 1: The Ialoveni well field is operated at full capacity with the difference in required capacity made up by (i) STA and by (ii) the other well fields operating at a minimal level consistent with their ability to be rapidly brought into full production during an emergency;
- Option 2: The output from the Ialoveni source is operated at a capacity that is suitable for treatment within a packaged treatment plant. The other wells fields would be decommissioned and not used in either normal or emergency scenarios, and
- Option 3: As option 1, except that Ialoveni would operate at the lower capacity of Option 2.

Option 2 is an alternative scenario that has been studied to assess the impact of the introduction of the emergency use of the underground water resources. The option provides no security against pollution of the River Nistru, and is not recommended for adoption.

The following Table summarises the treatment capacity at STA and the wells for normal and emergency scenarios.

Table 26: Options for "Normal" Operation Treatment Capacities

Site	Required Treatment Capacities (m3/day)		
	Option 1	**Option 2**	**Option 3**
Balsevskii	850	0	850
Ghidighici	790	0	790
Petricani	1,130	0	1,130
Singera, Sat. Ghidighici, Vatra, & Goianul	0	0	0
Ialoveni	15,000	5,000	5,000
STA: Potable water	262,494	275,264	272,494
STA: Technical water	9,737	9,737	9,737
Total	**290,000**	**290,000**	**290,000**

In addition, for emergency use, for option 1 & 3, the capacity of the wells fields will require to be increased as shown in the following table:

Table 27: Treatment Capacities for Emergency Plan

Site	Current Capacity	Total Site Capacity to be Available in an Emergency
Balsevskii	1,900	8,500
Ghidighici	4,400	7,900
Petricani	0	11,300
Ialoveni	3,120	20,900
Fantani Artizine Departementale	9,000	0
New well field near STA	0	15,000
Total	**18,420**	**63,600**

The necessary investments are shown in the following Table:

Table 28: Required Water Treatment Investment for Each Option

Option	Site	"Normal" Operations	Emergency Plan
Option 1	STA	Rehabilitate to a peak capacity of 263,000m^3/day	Powder Activated Carbon facility with a production capacity of 200,000 m^3/d.
	Ialoveni well field	Treatment plant with a capacity of 15,000m^3/d for the treatment of ammonia, turbidity and H_2S.	Aeration and chlorination facility for 20,900m^3/day
	Petricani well field	Rehabilitation of the existing well filed and treatment facilities	Disinfection facility for 11,300m3/day
	Ghidighici well filed	Rehabilitation of the existing well filed and treatment facilities	Aeration and chlorination facility for 7,900m^3/day
	Balsevskii well field	Aeration, filtration and Chlorination plant for 850m3/day	Aeration and Disinfection for 8,500m^3/day
	Rehabilitation and extension of the wells fields & new well field at STA		
Option 2	STA	Rehabilitate to a peak capacity of 276,000m^3/day	Powder Activated Carbon facility with a production capacity of 276,000 m^3/d.
	Ialoveni well field	Treatment plant with a capacity of 5,000m^3/d for the treatment of ammonia, turbidity and H_2S.	Nothing.
Option 3	STA	Rehabilitate to a peak capacity of 273,000m^3/day	Powder Activated Carbon facility with a production capacity of 200,000 m^3/d.
	Ialoveni well field	Treatment plant with a capacity of 5,000m^3/d for the treatment of ammonia, turbidity and H_2S.	Aeration and chlorination facility for 20,900m^3/day
	Petricani well field	Rehabilitation of the existing well filed and treatment facilities	Disinfection facility for 11,300m^3/day
	Ghidighici well field	Rehabilitation of the existing well filed and treatment facilities	Aeration and chlorination facility for 7,900m^3/day
	Balsevskii well field	Aeration, filtration and Chlorination plant for 850m3/day	Aeration and Disinfection for 8,500m^3/day
	Rehabilitation and extension of the wells fields & new well field at STA		

3.7.5. INVESTMENT PLAN FOR GROUND WATER TREATMENT

3.7.5.1. General

In Options 1 & 3, the wells will be used for water supply in normal situation, and as part of the emergency plan against pollution of the River Nistru.

In order to minimize the investment, we propose that the ACC discusses with the appropriate authorities, acceptance of temporary non-compliant water quality during, and only during, an emergency. This would concern mainly the total dissolved solids and the sulphate concentrations, which do not have any immediate effect on health when absorbed for short, infrequent periods. We believe that this would be a sensible and responsible position for ACC to take.

The strategy is detailed in the following table:

Table 29: Treatment for Emergency Groundwater Supplies

Parameters treated	Permanent (normal) Supply	Emergency Supply
H_2S & NH4	Full Treatment	Partial treatment[23] only of NH4 and H2S (by aeration and chlorination)
TDS & SO_4	Dilution of the water in the reservoirs with water from STA	No treatment² of TDS and SO4 for the emergency supply

In light of the above, the following facilities are proposed:

- Aeration for the emergency flow capacity
- Biological treatment of NH_4 and H_2S for the normal supply flow only
- Disinfection with break-point chlorine injection, based on emergency supply and average concentration of NH_4 and H_2S.

3.7.5.2. Proposed Ialoveni Treatment Plant

For Option 2 & 3, a package plant of 5,000m^3/d is to be provided at Ialoveni; for Option 1, the plant shall have a capacity of 15,000m^3/d.

Option 1: 15,000m^3/d Plant

The required treatment process will require:

- Acid injection, to assist, would be followed by aeration for removal of hydrogen sulphide;

[23] In order to minimize the investment within the PIP, a temporary non compliance of water quality during emergency as been assumed for mainly the TDS and the sulphate concentrations. Short term exceedences would have immediate effect on health. Approval would require to be ought before adoption of the strategy.

- Rapid sand filtration by a battery of four reinforced concrete filters, with a unitary surface of 27m²;
- A machine room with backwashing, air and water, plant, and
- The treated water stored in a 500m^3 tank; in which sodium hypochlorite or pure chlorine will be injected.

Option 2 & 3: 5000m^3/d Plant

For Option 2 & 3, a package plant can be installed that will include for aeration, rapid sand filtration and chlorination, as for Option 1 but of reduced treatment capacity.

3.7.5.3. Other Plants:

Packages plants similar to the one of Ialoveni Option 2 & 3, will be required for Baliveskii, Ghidighici and Petriciani.

3.7.5.4. Network Enhancements for Well Field Options

With regard to the network enhancements necessary to deliver the groundwater to the distribution network, for Option 2, no network enhancements are required.

For Options 1 and 3: new and/or upgraded pumping stations are necessary at Ialoveni and Schinoasa to transfer the increased water flows from the well fields to the distribution network.

3.7.5.5. Cost Comparison for the Well Field Options

CAPEX - Water Treatment

For the required treatment plants at the well fields, the investment costs are:

- Option 1: €1.78m;
- Option 2: €0.55m, and
- Option 3: €1.31m

CAPEX – Well Fields rehabilitation, creation or decomission

- Option 1&3 : €2.59m, and
- Option 2: €0.16m.

CAPEX - Network Enhancements

The investment costs for options 1 and 3 are:

- New pumps in Ialoveni pumping station to supply Schinoasa tank: €0.4m, and
- New pumps in Schinoasa pumping station to supply Zone 4a Telecentru and Botanica: €0.03m.
- New pumps in Buiucani pumping station to supply the Zone 4 Buiucani from the reservoirs: €0.04m.

- New pumps in Petricani pumping station to supply the Zone 2 Doina: €0.04m.
- Upgrade of the pumps in Petricani pumping station to supply the Zone 1: €0.02m.
- Upgrade of the pumps in Ghidighici pumping station to supply the Zone 1: €0.02m.
- Upgrade of the pumps in Balisevschi pumping station to supply the Zone 2: €0.04m.
- Connection pipe between Petricani pumping station and transfer pipe Doina: €0.3m.

OPEX

Option 2 has the highest pumping electric consumption. Option 1 is 1.1% lower and Option 3 is 0.4% lower. Considering Option 2 as the base case, Option 1 is approximately €0.04m lower and Option 3 is €0.014m lower.

3.7.5.6. Recommended Option

Option 2 is the cheapest when considering both capital investment and annual operating costs[24]. Nevertheless, we propose Option 3 to ACC for acceptance as the option provides security against pollution of the River Nistru, and is cheaper than Option 1.

3.7.5.7. Other Network Changes to Accommodate Production Changes

In order to accommodate the suggested changes in the operation of the well fields, other network modifications are required, detailed in the Report: "*Water Networks*" and included into the PIP:

- Decommissioning of the SAN plant;
- Dilution of water from the Petricani and Ghidighici well fields, and
- To provide a supply from the Schinoasa tank to Durleşti city.

3.7.6. Investment Plan for STA Plant

The technical proposals to meet the production enhancement objectives are described fully in the Detail Report: *"Water Production Treatment",* included as an Appendix. The following is a summary.

3.7.6.1. Water Treatment Strategy

Currently, the quantity of water produced by at STA meets current and future expected demand, and the quality complies with the Moldovan Quality Standards. The plant suffers from no major structural problems. In our opinion, the STA plant is suitable for rehabilitation, rather than the more expensive full reconstruction.

[24] See Section 3.3 of Water Network Report for a cost analysis.

However, there are several important issues with the facilities regarding the operability of the plant and the overall running costs that we consider do need to be addressed:

We propose investments to meet the following objectives:

- Improved treatment efficiency by decreasing the chlorine demand for pre-chlorination;
- Improved reliability of the plant operation and maintenance;
- Upgrade the plant for pollution of the River Nistru raw water, and
- Make the O&M less labour intensive, easier to perform, safer and more reliable.

To meet these objectives, we suggest that the investment programme be split into independent sub-projects:

- Retrofitting of the coagulation / flocculation / settling facility;
- Overhauling of the filters;
- Implementation of a powder activated carbon injection;
- Reconstruction of chemical preparation and dosing, and
- Upgrading of instrumentation and control system.

3.7.6.2. Retrofitting of Coagulation / Flocculation / Settling Facilities

The upgrading of the coagulation/flocculation/settling stage is a mandatory investment to be implemented before the overhauling of the filters as, in the current situation, the poor performance of the settling tanks are balanced by the under-loading of the filters.

The sub-project will increase the quality of settled water; permit the decrease in the continuous chlorine injection at pre-chlorination and remove the hard and unsafe operation of manual de-sludging.

The following modifications are required to achieve efficient settling:

- Mechanical flash mixing for coagulation, and
- Efficient sludge removal device in the settlers.

Chemical Flash Mixing

For the necessary retention time of 60 seconds to achieve coagulation, two tanks each of 102 m^3 are required, in two parallel lines.

Each tank will be fitted with one vertical flash mixer.

Flocculation Zone

We recommend a minimum retention time in the flocculation tank of 20 minutes, to allow for low temperatures and low turbidity. The renovation of 14 corridors minimum will be necessary to insure the correct flocculation time.

To improve the efficiency of the flocculation, mechanical stirring is required. The best solution we propose would be to remove the existing baffle walls, and install two vertical stirrers per corridor.

Settling Zone

We suggest two technical options to efficiently rehabilitate the settling zone:

- Implementation of lamellae in the existing settlers, and
- Implementation of dissolved air floatation (DAF) in the existing settlers

The CAPEX investment cost for both solutions is very similar.

The OPEX for the DAF option is higher, due to high energy consumption. The lamellae settling option is our recommended option.

The technical feasibility of a bottom de-sludging system must be confirmed by detailed investigation before selecting this solution.

Other Works

In addition, the following works must be done on the settling stage:

- Replacement of the steel inlet distribution troughs, which are corroded, and
- Rehabilitation or replacement of interconnecting pipes between the coagulation and flocculation zones and between the settlers and the filters.

3.7.6.3. Renovation of the filters

The renovation of the filters will result in an increase of treated water quality and its consistency, and in a decrease of water consumption for backwashing.

Improved water distribution on the filters and the implementation of an efficient control system will enable some of the existing filters to be de-commissioned with a reduction in the maintenance and equipment renewal costs.

Redesign of the Filters

The implementation of an efficient backwash system and the improvement of the hydraulic scheme will allow an increase of the surface loading on the filters.

With a total media depth of 180 cm, a maximum loading of 17 m/h could be accepted, with a targeted turbidity of 0.5 NTU for the filtrated water. To retain a safety margin, our suggestion is to overhaul 10 filters of 117 m², giving an hydraulic loading of 9.6 m/h to 10.5 m/h, depending upon the required flow through the works, as required for each of the three options for water production – Section 3.7.4.2.

Filter Under-Drain System

The increase of the hydraulic loading on the filters will require the implementation of an efficient under-drain system for good filtrated water distribution.

Two technologies are recommended:

- Construction of a nozzled false floor, or
- Implementation of prefabricated system in stainless steel.

The prefabricated system solution will be more expensive, but present the great advantage of being almost independent from the existing civil work. The construction of the false floor would require sealing and grouting of the supporting posts in the existing raft.

Filter Backwash System

The implementation of a combined air and water backwashing will allow savings in backwash water, and improve the quality of the backwash and thus the filtration cycle life.

We consider that this modification is not essential, and can be postponed outside of the PIP.

Automatic Filter Control System

In each filter, we suggest that level measurement be implemented to control the opening of the filtrated water outlet valve, in order to balance the progressive clogging of the filtration media.

Replacement of Equipment

Due to their age, control valves will require replacement as will the filter control panels.

Renovation of the civil work

In most of the filters, the civil work seems to be in good condition.

The apparent good structural condition of the filters will need to be confirmed by a detailed investigation. Some minor decorative and superficial works are suggested.

De-Commissioned Filters

We suggest that the ten filters which will not be renovated should be kept in working conditions as stand-by facility.

3.7.6.4. Contact Tank for Final Disinfection

The historical treated water analysis shows that the residual concentration of ammonia can be significant with concentrations of up to 0.7 mg/L. Such levels result in a high chlorine demand, with a significant reaction time. Other parameters may create also a slow chlorine demand.

A standard value of 30 minutes contact time is required for a full and reliable disinfection for which a contact tank capacity of 5,700m^3 is required.

3.7.6.5. Implementation of Powder Activated Carbon Injection

We do not think that the existing layer of activated carbon on the filters can be considered as a reliable barrier for micro-pollutants. Grain activated carbon requires frequent regeneration, because of progressive saturation.

As activated carbon shall be used for emergency purpose only, with the hypothesis of a progressive stop of the continuous pre-chlorination, we propose the more efficient temporarily injection of powder activated carbon into the coagulation tanks in case of pollution, than continuous filtration through grain activated carbon.

The PAC plant would include storage facility, slurry preparation and dosing equipment.

Due the risk of fire and explosion with powdered activated carbon, a fire safety system will be essential.

3.7.6.6. Renovation of the Chemical Storage, Preparation and Dosing Plant

For efficient and safe operation, the existing chemical storage and dosing facilities etc will require to be renovated. At the same time, old previously abandoned equipment can be removed.

3.7.6.7. Upgrading of the Control System

There is a lack of instrumentation and control within the plant, compared to modern plants. When the main rehabilitation works are implemented, we suggest that a upgrading of the instrumentation and control will be possible and relevant.

The benefits would be to make the operation less labour intensive, more reliable, and upgrade the operational data recording.

A specific SCADA system, dedicated to the treatment plant only, i.e. separate to the network control, would be preferable. Some automation sequences or loops must be implemented for flow and treatment control.

3.7.6.8. Other Rehabilitation

In addition to the investment described above, the full replacement of the electrical plant will be required in the medium-term future.

The retrofitting of the existing settlers is a provisory solution; it will most probably be necessary to built new settlers within 15 or 20years, depending on the actual condition of the existing civil works.

3.7.6.9. Electro-chlorination

Electro-chlorination enables an on-site generation of sodium hypochlorite, addressing thus the issue of liquid gas storage. The general principle of an on-site salt electrolyser system is to create a continuous electrical current through a solution of NaCl. Na+ is electrically attracted to the cathode and Cl- is electrically attracted to the anode. Chemical reactions take place at the electrodes and give:

- caustic Soda (NaOH) at the cathode
- chlorine Cl2 at the anode

Both of the chemical react together to produce sodium hypochlorite NaClO used for the chlorination.

3.8. Water Network

3.8.1. Introduction

The following recommendations are made concerning the water supply and distribution network in addition to those discussed in Section 3.7.5 as necessary to incorporate the recommended changes in the operation of the well fields, in particular to provide for an emergency supply in the event of a pollution incident in the River Nistru.

Our proposals are based upon the results of the measurement campaign, the use of the network model and from the detailed discussions with the ACC staff.

All new mains of diameter up to DN300 are assumed to be of HDPE pipe. Mains of greater DN would be assessed based upon the specific requirements of each pipeline.

The following is a summary of the recommendations made in the Detail Report: "*Water Supply*".

3.8.2. Objectives

The objectives for the Feasibility Study relating to the potable water netwrok are the following:

- To enable ACC to gain an improved knowledge of the water network by producing an inventory of the network assets;
- Improved awareness of how the system performs, its performance and efficiency;
- Proposals for extensions of the network for increased ACC customer base within the city, suburbs and development areas, and for any increase in customer demand;
- The preparation of a rehabilitation works programme for the network and pumping stations, and
- Preparation of a PIP and LTIP.

To reach the objectives, within the Phase B activities and in conjunction with ACC operational staff, we:

- Collected and input the data onto the GIS for the strategic network and facilities main collectors;
- Undertook a measurement campaign on the network, including at the major pumping stations, in order to both assess performance and to calibrate a hydraulic computer model, and
- Defined, assessed and cost evaluated scenarios for network expansion and rehabilitation.

3.8.3. Design criteria

3.8.3.1. Pressure

At each point of the network, the minimum pressure to be maintained has been taken to be 1 bar at the bottom of the buildings and of 0.4 bars for each floor e.g. the minimum pressure for the supply to a 5-floor building is 30m.

We would suggest that this places an unfair burden upon ACC and, in effect, customers in low-rise buildings are subsidising those in high-rise buildings. The higher pressures will also increase leakage losses. Our suggestion would be for ACC to be required to maintain an appropriate minimum pressure and for developers who require a higher pressure to install and maintain the necessary pumping equipment; not ACC. We suggest that ACC takes this into consideration when contracting supplies to any new high-risk buildings.

3.8.3.2. Peak Factors

The network is designed to meet the peak hour demand of the peak day.

The peak factors were obtained through the measurement campaign and are summarized in the Table 30: *Peak Factors Used*

Table 30: Peak Factors Used

Zone	Daily peak factor	Hourly peak factor
Chişinău	1.36	1.66
Outer area	1.94	2.01
Total	1.40	1.66

3.8.4. Improvement of the Operation of the Network

3.8.4.1. Problems Identified by Model

During the computer diagnosis of the water supply network using the hydraulic model, we found the existing network to have been well designed and appropriate to the needs and topography of the city.

A few locations where improvements to the network could be beneficially implemented to improve the flows within, and around the network, have been identified:

- Rehabilitation of the pipe in the street "Lomonosov" ;
- Rehabilitation of the pipe at the crossroad of the streets "Grenoble" and "Trajan", and
- Further on-site work is required to determine the reason for the high head losses in some pipes, especially the one on the street "Pogdorenilor"

3.8.4.2. Improvement of the Current Distribution System

Our investigative work supports the proposals of ACC for the improvements to the supply to Ialoveni City, Durleşti and South East distribution Zones

3.8.4.3. Pressure regulation

Methodology and Proposals

Pressure management in the network is an important means to reduce leakage.

As a means to reduce the pressure, several solutions were studied:

- Reduce the pump outlet pressures;
- Supply zones from one with a lower head than currently used, and
- Install a pressure reducing device.

As mentioned in Section 3.8.3.1, the requirement for ACC to be able to supply high-rise buildings is a hindrance to effective pressure reduction. Nevertheless, we propose that ACC considers pressure reduction in several areas by installing a total of sixteen pressure reducing valves and the bringing into operation of five small boosters.

Impact on reducing water losses

Reduction of the mains network pressure will lead to a reduction of the water loss, which we estimate to be 10%. A reduction of pressure will decrease the number of new leaks, especially in zones where the pipes are in a poor condition.

Full implementation of the pressure reduction recommendations represents an electrical energetic gain of around 2,000MWh/year or 3% of the total electrical consumption of all pumping stations.

3.8.5. Expansion of the network

3.8.5.1. Expansion of the Network in Currently Supplied Areas

Even though the population in Chişinău City is forecast to decrease during the next 25 years, some urban areas will continue to grow. The distribution network will need to be extended into these growth areas. We anticipate that the network will be increased by some 33km of new mains within the city area.

Similarly within currently supplied areas of the suburbs, where we estimate the extension to be around 37km.

3.8.5.2. Expansion of the Network to New Territories

The new territories correspond to 11 uninhabited areas in Chişinău that will be developed in the future.

Using the network model, we estimate that an additional 18kms of new main will be required to supply these areas. Four small new pumping stations will be required for zones 1A, 2A, 3A and 9A

3.8.5.3. Expansion of the Network to the Suburbs

We propose that ACC plans to connect the suburbs to its network, as shown in

Figure 5, with some 22km of new mains. Pumping stations will be required at Ghidighici (two sets), Cojuşna reservoir, Truşeni and at Balabaneşti.

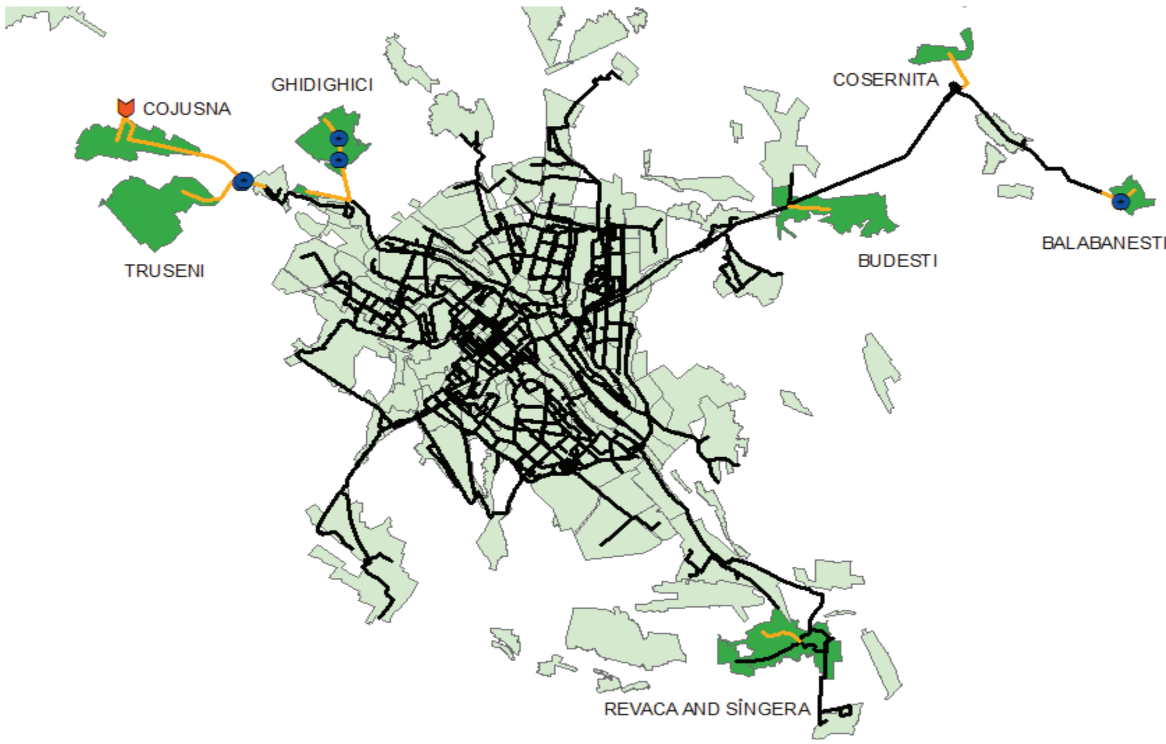


Figure 5: Expansion of the Network to Outer Suburbs

3.8.6. PIPE REHABILITATION

The assessment of the current situation based on ACC data showed that the network's efficiency is thought to be around 61% and the linear leakage index around 47m^3/day/km for the drinking water network and 84m^3/day/km for the technological water network.

Those values are very high and show that both networks are in poor condition. The seven most critical zones are shown in Table 31.

Table 31: Seven Most Critical Zones for Losses

Zone	Average delivered flow (m^3/d)	Water losses (m^3/d)	Network efficiency (%)	Length of the network (km)	Linear leakage index (m^3/d/km)
Zone 2 - Tohatin, Vostoc and Independenţa	38 788	18 744	52%	274	68
Zone 2 – Doina	11 446	5 226	54%	73	71
Zone 3 – Independenţa	14 985	5 510	63%	59	94
Zone 3 – Ciocana	15 378	7 253	53%	36	203
Zone 3 - U.Agrara	519	186	64%	3	70
Zone 4 – Independenţa	8 309	2 579	69%	41	63
Zone 4A – Botanica	938	317	66%	4	82
TOTAL	**90 364**	**39 816**	**56%**	**489**	**81**
% of the total Chişinău City	51%	60%		35%	

Such bad efficiencies are mainly due to the poor condition of the pipes in the network and of the service connections. Over the last 5 years, an average of 13,400 leaks were found and repaired every year. Around 68% occur on mains and 32% on service connections.

3.8.6.1. Replacement of the Pipelines

The technical performance of a potable water system is affected by the three variables of water losses, the continuity of service and the quality of the distributed water. In the short term, improved operating practices can reduce the number of leaks; in the long term, the aging of the network will deteriorate the performance.

ACC has identified 82km of pipelines which need to be rehabilitated because they are susceptible to failure, difficult to maintain or of strategic importance. Of the 82km, 50% are steel[25]. Most of the pipelines to be rehabilitated are oversized and can be replaced by new pipelines with a lower internal diameter, indicatively by at least one diameter size. For example, 82% of the DN600 existing pipelines can be replaced by HDPE pipe with DN400 and 18% by cast iron pipe with DN500. It is only in the diameters of 100mm and below that we suggest re-laying with a minimum DN110 to ensure satisfactory flows.

The following parameters have been taken into account in prioritising our recommended mains rehabilitation[26] programme:

- Failure history;
- Linear leakage index;
- If a main is considered as strategic by ACC;
- Consequences of a failure e.g. flooding or major traffic disruption;

[25] See Report: "Water Network for a full breakdown by diameter and material

[26] Some of the existing PS, irrespective to their efficiency, will be shut down to fit with the new water production scheme.

- If the pipeline is difficult to maintain due to its depth or location;
- If the rehabilitation represents an economical interest, or
- There is a “growth” requirement

To estimate the economical interest of the rehabilitation of a pipe, the cost of the pipeline under consideration was compared to the expected operational cost of the pipeline over the next 50[27] years. The operational cost corresponds to the cost of repairs and of the water losses due to the leakages, discounted at a rate of 5%.

The economical interest depends on the diameters of the existing and the projected pipeline; the marginal cost of the water which will vary with the supply zone to which the water is delivered, and the Linear Repair Index (LRI).

The figure below presents the minimum LRI that a pipe has to obtain to justify its replacement, on economical grounds. For example, for a DN100 pipeline located on Zone 3, replacement is economically viable only if more than 8 leaks occur per year and per km.

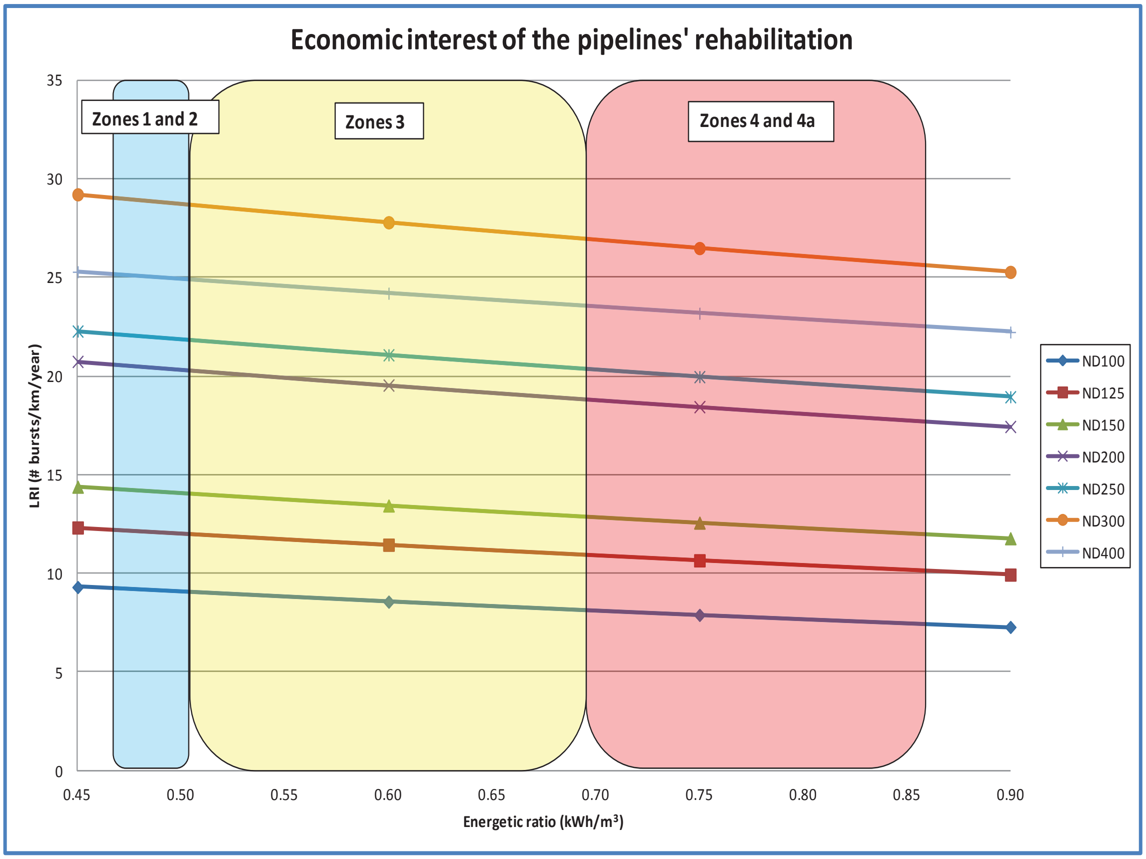


Figure 6: Economic Level for Pipe Replacement

Applying the principle to ACC’s current rehabilitation programme, would suggest that only 20% of the proposed programme is cost beneficial, as a high priority for replacement.

[27] Considered as the lifespan of a new pipeline

In order to derive a programme for rehabilitation of the next 25 years, we propose to add to the 20% of mains within the ACC's programme that are shown to be cost beneficial, additional pipelines which represent the highest economical benefit i.e. with the highest LRI.

The whole of ACC's programme is in our proposed rehabilitation programme, albeit some at a lower priority.

The Linear Repair Index, by diameter and material calculated from the number of repairs recorded between 2006 and 2010 is given in the following table:

Table 32: Linear Repair Index by Pipe Diameter and Material

Nominal Diameter	LRI (No of bursts / km / year)					
	Steel	cast iron	concrete	asbestos cement	PE	TOTAL
50	-	-	-	-	1.4	1.4
63	-	-	-	-	1.2	1.2
75	-	-	-	-	1.1	1.1
90	-	-	-	-	0.3	0.3
100	8.6	4.8	-	0.0	-	7.4
110	-	-	-	-	0.1	0.1
125	78.5	-	-	-	0.2	1.0
150	20.8	6.6	-	10.0	-	13.0
160	-	-	-	-	0.0	0.0
180	-	-	-	-	0.1	0.1
200	21.2	4.9	-	1.0	0.1	9.5
225	-	-	-	-	0.0	0.0
250	5.2	1.1	-	-	0.0	1.8
300	15.0	1.4	-	0.1	-	4.5
315	-	-	-	-	0.0	0.0
350	4.9	-	-	-	-	4.9
400	11.6	1.2	-	1.4	0.0	4.3
500	3.8	0.9	0.2	0.0	-	2.4
600	4.1	0.4	-	0.0	-	2.2
630	-	-	-	-	0.0	0.0
700	0.3	-	-	-	-	0.3
800	3.1	0.7	0.0	-	-	2.9
900	0.4	0.0	-	-	-	0.3
1000	0.9	3.3	0.0	-	-	0.5
1200	0.4	-	0.0	-	-	0.3
1400	0.0	-	-	-	-	0.0
TOTAL	**9.2**	**2.9**	**0.0**	**0.5**	**0.4**	**5.0**

The Table shows that the most beneficial pipes for rehabilitation are:

- Pipes made of steel with DN100 to DN400, especially DN150 and DN200, which represent 30% of the total network but account for 70% of all repairs, and

- Iron pipes between DN100 and DN200, which represent around 17% of total length and of total repairs.

57% of the pipelines proposed by ACC for rehabilitation are included in one of both categories shown to be suitable candidates for rehabilitation. The remaining 43% represents only 2% of the total network.

Considering that a lifespan of 50 years is a maximum[28], the annual rate of replacement of the current network should be at least 2% per annum. In the next 25 years, 922km, half of the current network should be rehabilitated. In reality, a replacement rate of 1%, probably 0.5%, would be a good achievement due to funding restrictions.

With a Linear Repair Index higher than 20repairs/km/year, we suggest the steel pipes DN150 and DN200 should have the highest priority. We estimate that about 35% of the steel pipes recommended for rehabilitation are located in the seven zones mentioned in Table 31.

Our Action Plan, recommended to ACC for consideration, is to start rehabilitating the oldest pipes located in the seven zones with the highest Linear Leakage Index, and the worst efficiency. The proposed rehabilitation programme of pipelines for the next 25 years is:

- Priority programme: the oldest steel pipes of DN150 and DN200 located in the seven distribution Zones with the highest Linear Leakage Index and the worst efficiency: 30 km;
- The remaining steel pipes with DN150 and DN200 and the steel pipes of DN100: 382 km;
- The steel pipes of DN250 to DN400: 122 km;
- The iron pipes of DN100 to DN200: 290 km;
- The remaining 43% of the ACC's rehabilitation pipelines programme not included in the four categories above: 36 km, and
- A complementary programme of strategic pipelines to be defined by ACC in 10 or 20 years: 62 km.

3.8.6.2. Replacement of the Service Connections

Around 4,250 repairs per year, 32% of all repairs, are on the service connections. The ratio of repair per connection at 3.5 repairs per 100 connections is high. An indicative figure is nearer to 1 repair/100 connections.

Around 90% of service connection bursts appear on steel service connections, and we recommend that they should be replaced, as a priority. Services should be replaced as part of the mains rehabilitation scheme. Around 2,000 connections would be replaced with the high priority steel mains replacement programme.

[28] 50yrs is a low life expectancy. Properly manufactured, laid and maintained pipes can expect to have a life of at least 50yrs, in the larger sizes up to 100yrs and longer judged by performance in many countries.

We understand that the service pipes are the property of the householder where the supply is to individual properties. Where the service is to a Municipality building or to apartment block, the service is owned by the utility or the Municipality. We respectfully suggest that nationally within Moldova, this is an anomaly that needs attention. The normal practice is for all services as far as the property boundary or meter to be owned by the utility. The inability of ACC to replace service pipes because they are not in their ownership will have a detrimental effect on their ability to reduce losses to acceptable levels.

3.8.6.3. Impact on Reducing Water Losses

Physical water losses will be impacted by the rehabilitation programme. The normative approach used by ACC to estimate losses shows that:

- 45% of water losses are due to hidden losses and
- 55% to repaired bursts, average estimated over the last 5 years.

It can be considered that half of the hidden losses of the current network will disappear when half of the current network is replaced by new pipes.

Around 87% of the notified bursts pipes are within steel pipes in the range DN100 to DN400 and within iron pipes of DN100 to DN200, which comprise the prioritised rehabilitation programme. Physical losses from these pipes and their connections can be assumed to be significantly reduced when they are replaced.

On the other hand, the remaining pipes will become older and will either start to leak or leak more significantly which will have a countering negative effect on leakage levels. Also, there will be leakage from the new pipes laid as part of the network expansion programme.

In conclusion, we would expect that the rehabilitation programme over the next 25 years should reduce the physical water losses due to the current network by around 60%, conservatively.

Within Table 21: Future Water Demand Balance between Demand and Production”, we have shown losses decreasing from current levels of 89,000m^3/day to 38,000m^3/day.

3.8.7. PUMPING STATION REHABILITATION

The measurement campaign revealed that a number of pumping stations operate with a poor efficiency. Some of the pumping stations that operate with low performance are small stations, with low flow rate. For this reason, they represent little potential for significant energy saving. On the contrary, pumping stations with a high efficiency and high flow may provide important sources of energy saving.

We propose that a pump rehabilitation programme[29] is prepared based upon the potential for improved efficiency, and on pay-back time of any investment, all represented within a Financial Gain Indicator. Within the Report: "*Water Network*", the Financial Gain Indicator for each pumping station has been determined from which we recommend the prioritised rehabilitation of the following stations:

- Treapta IIa raw water
- Buiucani Z4
- Independenta Z3
- Independenta Z4
- Buiucani Z3

In addition to the replacement of the pumps and associated control equipment, the operation of the pumps should be optimised to ensure that reservoirs are fully utilised.

3.8.8. Rehabilitation of water Storage Facilities

The major defects in the water storage facilities identified by ACC operational staff are:

- Poor hydraulic integrity with ensuing water losses;
- Deterioration of the reservoirs roofs' waterproofing that allows rain water to penetrate;
- Structural integrity, and
- Poor condition of the pipework and control valves

We concur with the opinion of the ACC staff that the condition of two reservoirs is very poor - Tohatin No1, STA No5 - and they require urgent, major rehabilitation works. STA No6 is in equally poor condition but it should not be necessary to rehabilitate tank STA No6 reservoir to maintain a sufficient level of stored volume and this tank will remain decommissioned.

A further seventeen reservoirs are in poor condition and need rehabilitation.

The Codru, reservoirs in Vadul Lui Voda are in poor condition. When the new well production scheme is adopted, they can be decommissioned as unnecessary (except for the tank "Upper Vadul Lui Voda"). In the same way, the Burcuta pumping station and Botanica tanks will be de-commissioned and no rehabilitation works are proposed. The scheme of water supply for Durlesti includes the reservoirs of Gribova and Cartusa, correspondingly these reservoirs cannot be ceased, but requires rehabilitation.

To optimize the rehabilitation costs of the reservoirs, we suggest that ACC rehabilitates the facilities only if they are necessary to maintain a total stored capacity higher than 50%

[29] Some of the existing pumping stations, irrespective to their efficiency, will be shut down to fit with the new water production scheme

of the peak demand for the next 25 years. On that basis, we suggest that ACC could decommission a further three reservoirs: Buiucani No1, Ghidighici No1 and Telecentru No2.

Some other reservoirs need to remain in service until specific mains have been replaced when the strategic importance of the reservoir will decline, e.g. Valea Dicescu PS tanks Nos 1 and 3, when the transmission main "Independenţa" coming from STA is replaced.

Other storage facilities identified for rehabilitation, we suggest should be rehabilitated in the next 10 years.

Following the suggested improvements to the storage facilities, Chişinău's water supply system will have storage capacity of 157,800m^3, representing 54% of the total targeted production capacity.

3.8.9. Potential for Hydro Power Generation

The potential for hydro power generation within the water network where there are high energy losses has been assessed based on the head loss reduction and associated averaged flow rate at various locations.

The only place where a power generator can be implemented beneficially is at Ciocana reservoir. To optimise the investment, we have developed a solution based on a centrifugal pump coupled with an asynchronous motor, operating in reverse.

Based on the flow measurements performed upstream of the Ciocana reservoirs and the future flows, we estimate that the generated power will be 33kW, assuming an efficiency of around 72%. After the four year payback period, we would expect a revenue of €20,500/year[30]. OPEX we estimate to be €5,000/year.

The production and selling electricity is subject to the approval of the authorities and to the technical feasibility of the connection to the grid. There is no guarantee that these two conditions can be fulfilled in a near future in Moldova, which makes the practical implementation of a hydro-generation facility uncertain.

3.9. Wastewater Collection

3.9.1. Objectives

The objectives for the Feasibility Study relating to the sewerage system are the following:

- To enable ACC to gain an improved knowledge of their wastewater collection system by producing an inventory of the wastewater network assets;
- Improved awareness of how the system performs, its performance and efficiency;

[30] Selling price of electricity has been taken equal to the current purchase price of electricity - 1.45 MDL/kWh

- Proposals for extensions of the network for increased ACC customer base within the city, suburbs and development areas, and for any increase in “return to sewer” flows;
- The preparation of a rehabilitation works programme for the network and pumping stations, and
- Preparation of a PIP and LTIP.

To reach the objectives, within the Phase B activities and in conjunction with ACC operational staff, we:

- Collected and input the data onto the GIS for the strategic network and facilities main collectors;
- Undertook a measurement campaign on the network, including at the major pumping stations, in order to both assess performance and to calibrate a hydraulic computer model, and
- Defined, assessed and cost evaluated scenarios for network expansion and rehabilitation.

3.9.2. WASTEWATER MEASUREMENT CAMPAIGN

The following is a summary of the wastewater measurement campaign only as far as is necessary to understand the rationale behind, and the methodology to prepare the Prioritised Investment Programme. Reference should be made to the Report: “*Wastewater Collection System”* attached as an Appendix to this Report, for full details of all activities and results.

3.9.2.1. General

The wastewater collection network operated by ACC was originally designed as a separate system for the collection of foul wastewater, only. However, as with many other separate sewer systems, stormwater and groundwater are collected through run-off and infiltration.

Five major hydraulic catchments cover the city of Chisinau and its surrounding communes. The latter are connected to the Chisinau city central collection network through pumping stations lifting the wastewater from one catchment into another.

Hydraulic measurements were made on the ACC network from mid-June 2011 to mid-October 2011, ensuring the availability of a high number of dry weather days.

From mid-October to early November, instantaneous flow, pressure and electrical measurements were recorded in twelve wastewater pumping stations accounting for 90% of the electrical power consumption, excluding the wastewater treatment plant inlet pumping station. The main objective of which was to assess pumping efficiency.

3.9.2.2. Methodology & Objectives of the Measurement Campaign

Each of the five major catchments that cover the city was sub-divided into five measurements campaigns, each one specifically dedicated to one of the major catchments. The wastewater flows were measured at key-locations, over a short period of time. The locations and time periods were chosen as adequate to gain an understanding of the flow regimes in each sub-catchment.

For practical reasons, some areas were not included into the measurement campaign, but were assessed from the performance in adjacent catchments.

The hydraulic measurements campaign was conducted jointly with ACC operational staff.

Besides the short term measurement points, which were equipped only during a specific measurement session, a long term measurement gauge was installed on the DN1500 collector that runs adjacent to the Bîc river, and which discharges into the treatment works.

Flow data recorded at the treatment plant by three permanent ultrasonic flow meters was collected as the input to the works i.e. the net summation of all the catchment flows.

The campaign objectives were, under dry weather conditions:

- The assessment of wastewater volumes within each sub-catchment;
- The definition of the daily wastewater discharge profiles;
- Determination of peak flow coefficients;
- The assessment of permanent ingress to the sewer network;
- The collection of data for the hydraulic model's calibration process, and
- The gathering of data for pump efficiency assessments.

While the main purpose of the campaign was to gather all the above data during dry weather days, a certain number of rainy days occurred during the campaign which allowed an assessment to be made of stormwater flows that entered the system.

3.9.2.3. Equipment Used in the Campaign

The equipment used for flow measurements on gravity wastewater collectors were five HYDREKA Mainstream IV and one HYDREKA Mainstream III flow meters. One meter remained at a fixed location within the DN1500 collector, as stated in Section 3.9.2.2, while the remaining five were installed at the short-term measurement points in each of the catchments.

Two rain gauges were installed to record rainfall in order to be able to extract dry weather days from the measurements session.

All the equipment was physically verified a few days after the installation and the accuracy of the collected data analysed. Between the install and the uninstall days, the equipment and the data was verified at least twice.

3.9.2.4. Results of the Measurement Campaign

The minimum, maximum dry weather flows and the peak factor determined within each of the catchments is shown in the following table.

Table 33: Results of the Wastewater Measurement Campaign

Dry Weather Flow	Catchment				
	A	B	C	D	E
Minimum flow (litres/second)	126	142	129	125	147
Maximum flow (litres/second)	309	347	308	319	348
Peak Factor	1.24	1.27	1.24	1.24	1.22

3.9.2.5. Wastewater Balance

The following wastewater balance was derived from the measurement campaign:

Table 34: Wastewater Balance

Parameter	Catchment						
	A	B	C	D	E	Unmeasured	All
Surface area (hectares)	3,851	2,410	2,336	2,191	1,956	4,035	16,779
Daily flow (m^3/day)	36,849	37,522	25,237	26,323	30,491	14,437	170,860
Wastewater flow (m^3/day)	17,301	19,791	15,606	15,013	14,274	8,825	90,809
Ingress (m^3/day)	19,549	17,731	9,631	11,310	16,217	5,613	80,050
Wastewater %	47%	53%	62%	57%	47%	61%	53%
Ingress %	53%	47%	38%	43%	53%	39%	47%

The reasons for the high ingress of water could be due to non-foul water entering the sewer system e.g. groundwater through cracked or damaged pipes.

The average flow rate arriving at the wastewater treatment plant varies between 150 and 160,000m^3/day. The results would suggest that around 20,000m^3/day does not reach the plant, due to:

- Losses occurring at siphons under the Bîc river, and other leakage;
- Unknown connections between the stormwater and the wastewater networks leading to untreated wastewater discharges into the environment, and
- Lower than considered “return to sewer flows”.

We intend to perform tests with fluorescein to better understand the problem.

3.9.2.6. Consequences of Rainfall

Inevitably during heavy rainfall, run-off enters the ACC wastewater network instead of the stormwater network. The rain water entering the foul sewer network (i) generates additional flows within the sewers; (ii) increases the cost for pumping and for treatment, and (iii) can cause sewers to exceed their flow capacity with consequential local flooding.

Debris entering the pipes can also contribute to silting of the sewers and blockages.

Following the heaviest rainfall, an additional 40,000m^3 was received at the treatment works - around 30% of the average dry weather flow.

The run-off volume reaching the treatment plant represents less than 3% of the total run-off volume from the Chisinau catchment, i.e. more than 97% of the run-off goes to the stormwater network or directly to the natural environment. Any cross connections, or reasons for the stormwater entering the foul sewer network should be investigated and, if possible, removed.

3.9.2.7. Pumping Station Efficiencies

Methodology

As part of the measurement campaign, records were taken of flow, pressure and power consumption at twelve pumping stations in order to assess the efficiency of the specific stations, and as an indicator of the efficiency of all stations. As the audit of all stations was not reasonably feasible, pumping stations were ranked according to their yearly average power consumption, and the twelve largest selected.

Excluding the treatment works inlet pumping station, the selected facilities each consume an average of 160 MWh/year, 90% of the total. The twelve pumping stations selected represent 80% of the flow pumped in the network.

The pumping station located at the inlet of the treatment has an electrical consumption higher[31] than the total of all the network pumping stations, and was included in the campaign.

Performance Indicators and Improvement Actions

The calculated specific energy measured on-site is compared to considered best practice. The difference allows the calculation of potential energy savings when replacing existing equipment by a new one. This analysis is a first step to performance improvement but is not sufficient enough to identify the actions to be implemented for energy savings; the payback time of investments is also required.

Pumps were considered for replacement based upon the criteria of:

- Potential gain of efficiency - the ratio between the current efficiency and the typical efficiency of new equipment;
- Payback time - the ratio between the yearly financial gain and the cost of investment;
- Investment Urgency Indicator - the- ratio between the payback time and the typical lifetime, and
- Financial Gain Indicator which is the product of the Investment Urgency Indicator and the average flow rate.

[31] 5.3 GWh/year against 2.1 GWh/year

As with the potable water pumping stations, the Financial Gain Indicator, as the combination of all other parameters, is the basis of our recommendations for pumping stations rehabilitation.

Conclusions of the Pumping Station Efficiency Study

For the treatment plant inlet pumping station, the specific energy of the pump set was determined as 7.1 Wh/m^3/mwc, with an efficiency of 38%. From discussions with the pump operators and from our study, it would seem that one third of the energy supplied to the pumps is lost across the control valves.

The pumping equipment within the network pumping stations is approaching twenty years old, on average. A reasonable assumption would be that some pumps have exceeded their expected asset lifetime, and are due for replacement. The performance of some stations was found to better than expected. The best performing stations had efficiencies of between 50% and 60%, and the worst performing between 30% and 40%.

In addition, there are several instances where pumps are throttled due to the pump being oversized. The worst instance seen was where there was 60% throttling on each pump outlet plus a further 90% throttling on the station rising main.

Our main conclusion of the study is that investment in pump replacement will be beneficial to the operational performance of ACC, as discussed in Section 3.9.6.1 where suggested pumps for replacement are scheduled.

3.9.3. WASTEWATER HYDRAULIC MODEL

3.9.3.1. The Hydraulic Modelling Tool

Hydraulic computer models are common tools used for simulating and predicting the performance of a network under various scenarios. The use of a model ensures that inefficiencies in the network can be readily identified and OPEX and CAPEX cost efficient solutions developed.

The software used to build the Chisinau model is INFOWORKS CS, one of the most common systems used. The software incorporates full interactive views of data using geographical plan views, long sections, spreadsheet and time varying graphical data.

After the completion of the project, the model will remain as a valuable operational and planning tool for ACC, provided that the model remains current.

3.9.3.2. Construction of the Model

The construction of the hydraulic model commenced with the preparation of a schematic of the strategic sewer network, including the pumping stations. The strategic network was then built on INFOWORKS CS.

The model includes (i) neighbouring villages that currently discharge partially or completely wastewater into the Chisinau collection system of ACC, and (ii) the thirteen main pumping stations of the thirty total.

Even though the hydraulic model is a simplification of the real wastewater collection system, some singular points have been inserted in the model as they create specific hydraulic conditions that impact directly on the quality of the calibration process e.g. siphons under the River Bic.

3.9.3.3. Calibration of the Model

Initially, customer "return to sewer" flows were assessed from the potable water demand data, and subsequently adjusted within the calibration process.

Calibration, essential to confirm that the model represents correctly the real network, consists in comparing the result of a model simulation with the observed performance of the network. The model parameters are modified until the observed and predicted results are comparable within an accepted level of accuracy.

The calibration process was based on the data collected during the hydraulic measurements campaign.

The calibration process was performed for twenty-six points in the model/network, each point being calibrated at peak and average values. The errors for peak and average modelled values are below or equal to 15% of measured values, and within an allowable margin of accuracy.

3.9.4. Hydraulic Performance of the Existing Sewer Network

3.9.4.1. Analysis for Potential Problems

Once calibrated, the model was used to identify locations of the following potential problems in the performance of the network:

- Adequacy of the slope of a sewer: Inadequate slope results in low velocities, increased water level in the sewer which can become a problem during sewer maintenance and which reduces the capacity of the pipe, creating a risk of flooding during heavy rain. Critically, the interceptors running alongside the River Bîc have either flat or very small slopes (below 1%);
- Velocity of flow: In a sewerage collection system, the wastewater carries suspended solids, sand and gravel. Obstruction to flow by deposits settling in a pipe is a major reason for malfunction of the system. Due to the reduced "return to sewer flows" and possible over-design of the sewers, less than self-cleansing velocities (0.6m/s) were found in several elements of the network;
- Adequacy of sewer capacity: The sewerage pipes should not be full during dry weather in order to maintain good aerobic conditions and to provide capacity for storm water that finds its way into a separate sewer system. According to the model results, even though there were no flooding events predicted during average dry weather conditions, there were situations where the water levels rose up inside the manholes due to inadequate sewer capacity;

- Maximum flow: The model gives the dry weather flow at any time and in any location in the sewerage system. Once determined the maximum flow indicates where there might be insufficient capacity to meet any increased demands or expansion of the network;
- Obstructions: Although obstructions were identified, the model shows that there is no flooding generated under average dry weather conditions. Obstructions are to be avoided because they can create anaerobic conditions leading to complaints of smell and adverse affects on the treatment process. For Chisinau network, disregarding the reverse slopes that also create bottleneck, two major obstructions were located due to too small diameters – between Transitrica and Mesterul Streets and in Calea Mosilor. These were considered for rectification in the PIP – see Section 3.9.6.5.
- Minimum water level: Sewer maintenance work is often performed at night when sewer flows are at a minimum. The model predicts low flow levels and thus the practicability of safe maintenance work.

3.9.4.2. Conclusions on the Hydraulic Performance of the Sewer Network

The full analysis with identification of sewer problems is presented in the Report: "*Wastewater Network*". The sewers identified are proposed for site investigations before taking any further decisions for a pipe renewal program.

The main conclusion is that under current conditions of flow, there are few obstructions to wastewater flow with minimal risk of flooding.

There is an important risk of deposition of silt due to the reduced flows. The sewers with the highest risks of deposit formation are located in the Centru sector, where the majority of pipes do not experience self-cleaning velocities during the day. A particularly serious problem is with the gravity collector running towards PS Petricani-27. The pipe was inspected during one of the site visits in the measurement campaign and appeared to be filled by sediments at more than 50% of its capacity, over a long stretch. The collector is included in the urgent rehabilitation program. In the meantime, we confirm the intention of ACC to include the sewer into its regular sewer maintenance programme.

The current pumping regime at the wastewater treatment plant inlet station has a significant impact on the water level in the interceptors located on both sides of the River Bîc. The pumping regime, combined with the inadequate slope, explains why the collectors are almost or completely full at the daily maximum water level.

3.9.4.3. Future Performance of the Existing Service Area Sewer Network

In order to assess the capacity of the current service area network to meet future flows, the worst case scenario was simulated. Sewer flows were assumed to be equal to current potable water consumption and with 100% of all households connected to the sewer system.

Flows were taken to include those from the surrounding areas, subsequently connected to the city network – see Section 3.9.7.

The results of the simulation show that no new problems are expected to occur in the existing network to those identified and discussed above. In conclusion, the capacity of the network to serve the existing service area is sufficient to cope with the next 25 years of flow.

The only investment required will be for rehabilitation, as discussed in Section 3.9.6.

3.9.5. FUTURE WASTEWATER COLLECTION

3.9.5.1. General Assumptions

The future connection of the different districts and villages to the central network is based on our following project criteria:

- ACC will be responsible for all the sewerage networks of all entities within Chisinau Municipality. Except Straseni and Cojusna, which are already connected, villages belonging to other municipalities are not considered within the design of the city network;
- The entities close to the main collection network will be connected to the network and treated at the main wastewater treatment plant;
- For some remote villages, there are two options: the connection to the main sewerage system or the construction of an independent system with its own treatment plant – see Section 3.9.7.2;
- Some settlements, including some in Chisinau municipality area, can stay with individual sewerage systems, albeit with a close supervision of the septic tanks emptying.

3.9.5.2. Assumptions for Connection, Discharge and Other Flow Rates in 2035

From 2010 to 2035, ACC coverage is taken to increase to 100%. It is assumed that the planned development areas of Chisinau will be connected fully.

The domestic “return to sewer flow” is assumed to be 80% of the water drawn as potable water. For non-domestic customers, the rate is taken to be 100%. At the time of a detailed design, these assumptions will need to be verified against data available at the time of the design, appropriate for the design area.

The analysis of the flows arriving at the treatment plant and of the measurements campaign results indicate that about 47% of the dry weather flow is due to intrusive water. We suggest that the volume will decrease by 1% per annum as ACC reduces infiltration, water leakage, wrong connections, etc.

The measurement campaign indicates that the wastewater hourly peak coefficient for flows arriving at the treatment plant is about 1.4, with a daily peak of 1.1. We have used these factors in the Feasibility Study.

The following table summarises the volumes, estimated for 2010 and projected until 2035, reaching the Chisinau wastewater treatment plant.

Table 35: Estimated Average Daily Flows Arriving at the Chisinau Wastewater Treatment Works

Category	Flows arriving at the works (m3/day)					
	2010	2015	2020	2025	2030	2035
Foul wastewater	73,600	85,700	101,200	96,600	91,800	91,100
Ingress	65,000	61,800	58,700	55,700	52,900	50,300
Total	138,600	147,500	159,900	152,300	144,700	141,400

The maximum flow is shown to occur around 2020. The 2020yr flow of 160,000m^3/day has been agreed with ACC to be the works design flow.

3.9.6. Network and Pumping Station Rehabilitation Programmes

3.9.6.1. Pumping Stations

Wastewater Treatment Plant Inlet Pumping Station

The pumps installed at the treatment plant inlet pumping station are oversized for the duty delivery head and could be replaced beneficially with pumps sized to a dry weather flow of between 5,400 and 6,800m^3/h and with a peak flow of 12,000 m^3/h. The estimated cost is €400,000, inclusive of associated equipment[32].

The revised yearly consumption of power at the station we estimate would be 2.5 GWh/year compared to the current 5.1 GWh/year: an energy savings of 51% valued at €218,000/year i.e. the pay-back period is less than 2 years.

Network Stations

The first step for reducing energy consumption is to limit head loss created by valve throttling to maintain a lower pressure at pump discharge, achieved most advantageously by replacement of the most inefficient pumping sets, identified as those at the Vatar, Codru, Vieru and Lupu pumping stations.

3.9.6.2. Network Rehabilitation

ACC operations have a list of required sewer rehabilitation works. The majority of these rehabilitation works have remained at the initial state of planned works as no substantial funding has been available. We have discussed the reasons for replacement with all operation sectors chiefs to allocate the priority of replacement into one of three priority levels: very urgent, urgent and the remainder of the network.

The way ACC staff had chosen the pipes to be rehabilitated is not systematic, as no CCTV inspection has been performed. ACC does have a very good operational

[32] The cost is included into the Wastewater Treatment element of the PIP; not that of the wastewater collection.

knowledge of its system and the justifications were observed during the measurement campaigns.

Without a comprehensive CCTV survey performed[33] within the preparation of the Feasibility Study, we have based our proposed sewer rehabilitation programme upon ACC's schedule with the proviso that the need for the rehabilitation works is confirmed by a CCTV inspection. A summary of the programme is provided below:

Table 36: Sewer Network Rehabilitation Programme

Catchment	No of Schemes in Catchment	Length to be replaced	Cost
Ciocana	20	16.13km	€2.06m
Riscani	24	20.38km	€3.18m
Buiucani	31	19.98km	€3.36m
Centru	18	23.38km	€4.76m
Botanica	25	42.58km	€7.29m
Ialoveni	4	7.6km	€1.18m
Total	**122**	**130.05km**	**€21.83**

3.9.6.3. Interceptor Rehabilitation

Two rehabilitation projects for the interceptors adjacent to the River Bic have been identified, totalling 26.2km at a cost of €9.16m.

3.9.6.4. Prioritised Programme

Of the total identified cost of €31m, €0.8m has been identified as priority 1; €3.3m as priority 2 and €26.9m as priority 3.

Almost all works to be undertaken under priority levels 1 and 2, about 25 km, are located within Centru (10 projects), Buiucani (9 projects) and Riscani (7 projects).

3.9.6.5. Obstructions

Two locations have been identified where there are obstructions within the sewer network due to inadequate capacity:

- Between the streets Transitriea and Mesterul: a 74m length of DN300 sewer. We recommend ACC to lay a DN800 pipe, the same as the upstream pipe, and
- In Calea Mosilor at the intersection with street Nagresteni: currently, a 700m length of DN700 sewer. We recommend a DN1200 replacement.

Our suggestion to ACC is to rehabilitate the first in the PIP, and to rehabilitate the second as a part of the whole BIC collector rehabilitation to solve the structural problem, referred to in Section 3.9.6.3.

[33] Funding transferred to the procurement of the CCTV equipment and training of ACC staff

3.9.7. NETWORK EXTENSIONS

3.9.7.1. Introduction

Sewer network extension will be required:

- To connect most villages of Chisinau Municipality and some neighbouring ones to the ACC central network, and
- To extend the sewer network to include the development areas in Chisinau – see Section 3.3.2.

For wastewater service provision, in conjunction with ACC, we have assessed:

- If the village can remain with a non-collective sewerage system, with a strict control and maintenance of septic tanks;
- If the village can be connected by gravity to the existing ACC system and if not, the infrastructure needed to convey collected wastewater towards the central network;
- If the remote areas of Zones W, N and E should treat the collected wastewater at a dedicated new wastewater treatment plant or convey the collected wastewater to Chisinau central system.

The final selection of service modality will require to be agreed between ACC and the respective Municipality.

3.9.7.2. Proposed Extensions

Chisinau City and the Suburbs

A total of 836km of new sewers and 14 pumping stations are considered necessary to service the expansion areas of Chisinau and the suburbs. The cost is high, €120m the source of the required funding will need to be given special attention and consideration in the overall cost planning of the developments.

Extensions inside the City

Inside Chisinau city, there remain some areas within which there is no wastewater collection system. At the moment, these areas are not fully defined and will be known only once the GIS input has been completed.

Although 100% sewer coverage within the city must have a high importance, due to PIP funding limitations, these are not considered a high priority for inclusion within the PIP.

Remote Areas of Zones W, N and E.

For the remote areas of Zones W, N and E, there are two options to service the areas:

- Decentralised strategy : whereby the wastewater is collected and transferred to an independent wastewater treatment plant, or
- Centralised strategy: all wastewater goes to the main collection system and to Chisinau treatment plant.

The most cost beneficial option for all areas, taking into account OPEX and CAPEX, is for the centralised strategy within which the wastewater is transferred to the main Chisinau treatment plant. Accordingly, this is our recommendation.

3.10. WASTEWATER TREATMENT

The following is a brief summary of our proposals for wastewater treatment. Full details are to be found in the Detail Report: "Wastewater Treatment" to which reference should be made.

3.10.1. EXISTING FACILITIES

The existing Chisinau treatment plant is 40yrs old and was built in several stages. Only about 50 % of the works are currently being used. The wastewater treatment process is a conventional medium load contact-stabilization activated sludge. Final effluent is discharged to the River Bic, adjacent to the works.

The sludge treatment line initially included static thickeners and digesters and drying beds before final disposal. The digesters have never been commissioned due to construction defaults and the treatment line has never been in operation. The mixture of primary and biological sludge has been directly disposed onto drying beds instead, which caused serious odour problems. Geotubes have recently been installed to reduce these problems. The dehydrated sludge is currently disposed of in a dumping site nearby the plant.

A special feature of the plant is the excess sludge management. Because it is not possible to thicken the excess biological sludge, the latter is transferred to the inlet chamber where it is mixed with raw wastewater. The biological sludge settles down in the primary settling tanks from where both sludge types are pumped together to the Geotubes. The current sludge management is dictated by practical reasons but is not recommended. The process is shown in Figure 7.

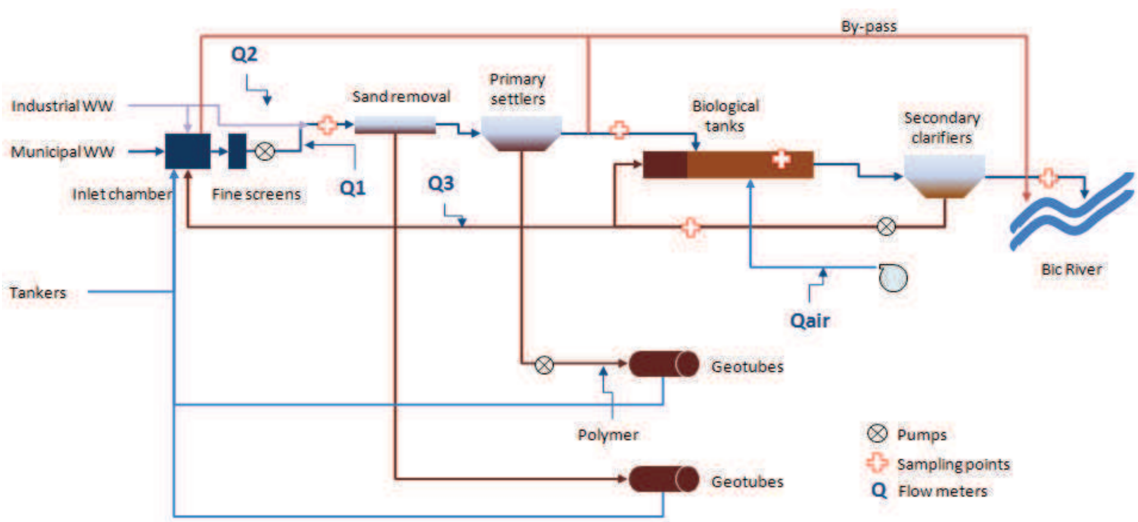


Figure 7: Process flow diagram of Chisinau WWTP

3.10.2. Wastewater Loads for Treatment

3.10.2.1. Analysis

The sampling point used by ACC to monitor the quality of the incoming wastewater is located just upstream the sand removal tanks (Figure 7). The recorded data corresponds to the stream that enters the treatment process; not the incoming wastewater

Within the Feasibility Study, a series of sampling campaigns were held in order to analyse the water for treatment. The results of all the campaigns are summarized in Table 37.

Table 37: Summary table of the raw wastewater composition as measured in various measurement campaigns.

		Routine monitoring by ACC	Exceptional monitoring by ACC	Exceptional monitoring by ACC	Preliminary specific campaign	Specific campaign by Seureca and ACC	Specific campaign by ACC
		Upstream the sand removal tanks	"Municipal" only	Without sludge recirculation	Without sludge recirculation	"Municipal" only	"Municipal" only
		01/01/2010 - 30/09/2010	26/09/2005 - 30/09/2005	01/06/2009 - 24/06/2009	19/01/2011 - 20/01/2011	25/04/2011 - 19/05/2011	28/11/2011 - 16/12/2011
Average flow rate	m3/d	151 400	-	141 300	156 000	145 000	-
COD	mg/L	739	678	500	539	528	535
BOD5	mg/L	338	264	208	162	180	222
TSS	mg/L	542	525	278	362	208	288
NK	mg/L	56	NA	NA	56	53	45
NH4	mg/L	46	40	NA	37	38	40
TP	mg/L	9	7	NA	10	6	4
Temperature	°C	10 - 25	NA	19	-	16 - 19	-
pH	-	7,3	NA	NA	7,1	7,7	7,4
Alkalinity	mgCaCO3/L					136	224
		PO4	*PO4*			*TN*	*TN*

The different conditions affecting each of these measurement campaigns make difficult the direct comparisons of the results. However, they show that the two most recent measurement campaigns are fairly consistent, especially for COD concentration, while significantly differing from the measurements recorded in the ACC routine monitoring in 2010. This observation confirms that the way ACC monitors the quality of the raw wastewater leads to the overestimation of the pollutants' concentration.

Based on the results presented in Table 37, the average water composition of the inlet to Chisinau WWTP presented in Table 38 has been proposed to serve as a basis for future design activities.

Table 38: Proposed current composition of the inlet to Chisinau WWTP

Parameter	Unit	Current values
COD	mg/L	530
BOD5	mg/L	200
TSS	mg/L	280
TN	mg/L	55
NH4	mg/L	40
TP	mg/L	6
Temperature	°C	10 - 25
pH	-	7.5
Alkalinity	mgCaCO3/L	200

The absolute pollutant concentrations of the influent show that the influent is classed as "moderate" to "dilute". The associated ratios indicate the probable presence of some organic matter that is difficult to degrade and a future possible de-nitrification without the addition of an external carbon source.

The change in consumption habits within the population of Chisinau is highly uncertain both in terms of content and evolution rate. This evolution is likely to lead to the increase of the pollutant concentration in the wastewater, all the more since intrusive water (IW) flow rates will progressively be reduced through the improvement of the sewerage network conditions.

On the other hand, the pollution load originating from industrial customers is likely to decrease in the near future due to the stricter regulation and associated controls that should be implemented[34].

In our opinion, the high uncertainty affecting the economic development of Chisinau and the implementation of stricter regulations do not permit a meaningful evolution of the future industrial discharge load to the municipal wastewater network. In conclusion, we consider it reasonable to discard the marginal effect of the future evolution of the industrial pollution load when evaluating the future concentrations in the wastewater.

3.10.2.2. Cyanide

Of concern is the probable presence in the raw wastewater of cyanide which has a detrimental effect upon the nitrification process. The stricter discharge limits, presented in Section 3.10.5, especially the limit values for TN and NH4, make it necessary to ensure good nitrification at the future works, and hence the elimination of the cyanide.

We strongly recommend that ACC further investigates the origin of the cyanide pollution in the sewer network, and possibly also in the River Bic. Once identified, these pollution sources should be removed and the wastewater composition carefully monitored to ensure that the cyanide concentrations go down to a level compatible with nitrification.

[34] See the Detail Report: "Assessment of Industrial Discharges", August 2011"

3.10.3. WASTEWATER FLOW RATES

The wastewater flow rates at the inlet of Chisinau WWTP are recorded by flow meters that are located downstream the junction of the raw wastewater stream with the return streams, especially with the excess sludge return stream (Figure 7).

The estimated excess sludge flow rate has been subtracted to the measurements provided by the flow meters in order to get a more accurate picture of the raw wastewater flow rates. The excess biological sludge flow rate has been assumed equal to 250 m^3/h, in standard operating conditions according to the plant operators.

The flow rates of other return streams have been considered negligible.

The main results are summarized in Table 39.

Table 39: Main results of the statistical analysis of the wastewater flow rates at Chisinau WWTP.

	Unit	Period 2008-2010
Average daily flow rate	m3/d	145,798
50%-fractile daily flow rate	m3/d	144,894
95%-fractile daily flow rate	m3/d	165,701
Average hourly flow rate	m3/h	6,083
50%-fractile hourly flow rate	m3/h	6,185
95%-fractile hourly flow rate	m3/h	7,573

The wastewater flow rates projections for the period 2010 – 2035, as provided in the Detail Report: "Wastewater Network", indicate a maximum average daily flow rate (ADWF) of approximately 160,000m^3/d in 2020[35] with an associated daily peak coefficient of 1.1 and an hourly peak coefficient of 1.4. The corresponding flow rates are presented in Table 40.

Table 40: Design figures for wastewater flow rates

		Unit	Maximum in the period 2010 - 2035
ADWF	Average Dry Weather Flow	m3/d	160,000
PDWF	Peak Dry Weather Flow	m3/d	176,000
PDWF	Peak Dry Weather Flow	m3/h	10,266

3.10.4. QUALITY OBJECTIVES

The current allowed discharge limits set by the ecological department significantly differ from the European Urban Waste Water Treatment Directive (UWWTD, 91/271/EEC).

In conjunction with ACC, we have defined the quality objectives for the treated wastewater at Chisinau WWTP to be compliant with EU regulation and such that the local environmental constraints are fulfilled.

[35]Considerd to be the year when maximum flows can be expected at the works

3.10.5. ENVIRONMENTAL CONSTRAINTS

The final effluent from the Chisinau WWTP is to the Bic River. The flow rate of the river is controlled at the Ghidigici dam located upstream Chisinau city and, since 2005, has always been equal to or lower than the outlet flow rate of the works.

The quality of the Bic River just upstream the junction with the WWTP outlet is not good due to uncontrolled pollution by domestic and industrial discharges during its course through Chisinau city. It has been assumed that,through improved monitoring and control, the situation is likely to improve.

Even then, it is clear that the dilution of the outlet of Chisinau WWTP with the natural surface water of the River Bicwill remain very low. Consequently, and in addition to carbon removal, we consider that nitrogen and phosphorus removal is necessary to avoid high concentrations of these in the River Bic downstream the discharge point.Presence of the pollutants would prevent the development of aquatic life in the Bic River and would also affect the surface water quality further downstream in the Dniester River, eventually also in the Black Sea.

We suggest that the Bic River be identified as a “sensitive area” and the corresponding EU effluent quality[36] requirements,be applied, as

Considering the low dilution factor and the vulnerability of aquatic life to the toxicity of ammonium, we proposethat ACC impose a maximum outlet concentration of 3 mg/L for NH4, which would make the final NH4 concentration in the River Bic, downstream of the discharge point, lower than 1.5 mg/L, which is acceptable for the development of aquatic life.

The River Bic is notintended to be used as a recreational area, nor for irrigation downstream of the works. We do notconsider disinfection of the final effluent to be necessary.

Considering the EU regulation and the environmental constraints presented above, the final quality objectives for the wastewater treated at Chisinau WWTP are summarized in Table 41.

Table 41: Discharge limits for Chisinau WWTP

	Max. concentration (mg/L)	Min. removal rate (%)
BOD5	25	80
COD	125	75
TSS	35	90
TN	10	70
N-NH4	3	-
TP	1	80

3.10.6. FUTURE WORKS

[36] TN < 10 mg/L and TP < 1 mg/L , for WWTPs larger than 100,000 PE

3.10.6.1. Introduction and Process Selection

In addition to the characteristics of the wastewater and to the quality requirements and local conditions, the design of a new WWTP shall also take into consideration the following elements:

1. The existing facilities.
2. The strong interaction between the water treatment line and the sludge treatment line.

The implementation of a low load conventional activated sludge process (CAS) is the most adapted to the wastewater characteristics and quality requirements and local conditions due to the main following reasons:

- There is no space constraint (land is available on the premises of the existing WWTP and old drying beds).
- The operators already know the activated sludge process and the associated O&M procedures.
- The activated sludge process is robust.

3.10.6.2. Process Design

Process Elements

A low load activated sludge includes the following elements:

- Reception platform and equalization/storage tank for night soils and other wastewater brought to the plant by trucks
- Coarse screening (30 mm)
- Pumping station
- Fine screening (6 mm)
- Sand and grease removal tanks
- Biological tank featuring a contact zone followed by a strict anaerobic zone (intended for biological P removal) and a large tankwith intermittent aeration (to account for anoxic and aerated periods) and injection of $FeCl3$ (for physico-chemical P removal)
- Secondary clarifier

Calculations

The calculations regarding the biological treatment are presented in the Detail Report for Wastewater Treatment.

Energy consumption

The energy consumption due to aeration of the whole future WWTP is estimated at around 50,000 kWh/d. The total energy consumption of the plant is estimated at around 70,000 kWh/d.

Land Requirement

Land on the existing site is adequate but its availability shall be further investigated. Indeed a part of the proposed land for the new WWTP does not belong to ACC and it is today not clear whether there will be any possibility for ACC to use this land in the future.

3.10.6.3. Phasing

The BOD load that was treated in 2010 at Chisinau WWTP is around 29,200 kgBOD/d while the maximum future load (in 2020) is estimated at 44,000 kgBOD/d.

It is recommended to phase the future works in order to deal with the uncertainties of the predictions and to be able to adjust the works when more precise information are available.

We recommend to divide the future WWTP into three independent treatment trains - each of them being able to treat about15,000 kgBOD/d and 53,000 m3/d. Two trains would correspond to the current (2010) pollution and hydraulic load treated at Chisinau WWTP, while the third train would allow to treat the additional load expected in 2020.

The first phase includes the necessary first stages of sludge treatment, and the works associated with odour reduction, such as biological air filters for the pre-treatment works and chemical scrubbers for the dewatering and intermediate sludge storage facility.

3.10.6.4. Priority investment program (PIP)

Considering the high CAPEX required to upgrade the WWTP in order to achieve nitrogen and phosphorus removal and the implementation time to get the funding and commission the new plant, it is proposed to do the necessary rehabilitation works on the existing wastewater treatment line in order to secure good performances of the plant without changing its current objective, carbon removal only, and to include anaerobic sludge digestion into the PIP. The main reasons for including anaerobic sludge digestion are the following:

- It would allow ACC to decrease the sludge volume by reducing by 1/3 the amount of dry solids and by reaching higher dryness. Considering the 4 yrs limited storage capacity for sludge at the WWTP, priority should be given to reduce the volume of sludge in the PIP.
- Anaerobic sludge digestion would provide a stabilized sludge. Today the sludge is not stabilized which is one of the source of odour. Stabilization with lime is possible but the risk is that it would not be acceptable for sludge use in agriculture since the soils are said to be already alkaline. Anaerobic sludge digestion is compatible with sludge use in agriculture and will reduce the volume and cost of transportation.

- The production of biogas and the associated energy recovery would cover more than 50% of the energy production of the WWTP, inclusive of the raw pumping station. Part of the investment concerning energy recovery has already been done since the existing co-generation facility could be reused.
- Lastly the production of biogas from sludge would make the project a green investment more likely to be supported by the international funding agencies.

It must be noticed that the implementation of sludge digestion requires making priority investment on the water treatment works of the WWTP in order to secure the treatment process, i.e. the quality of treated water and a steady production of sludge.

Before a complete renewal, Chisinau WWTP would work under the current medium load activated sludge process. However renewal of air blowers –to increase energy efficiency – but also the renovation of existing primary settlers, aeration tanks and secondary clarifiers are necessary to yield the expected sludge and send it for digestion.

It must be stated that the PIP does not include the investment required to treat nitrogen and phosphorus. The WWTP will only treat carbon pollution. The full compliance of the WWTP with EU standards for nitrogen and phosphorus exceeds by far the current investment capacity of ACC.

The implementation of sludge digestion is compatible with a future complete rehabilitation of the wastewater treatment, to achieve nitrogen and phosphorus treatment.

3.10.7. LONG-TERM PROPOSALS FOR TREATMENT

3.10.7.1. Treatment schemes

The following sections present a comparison between three alternatives for the renewal of Chisinau WWTP, i.e. the long-term proposals. The alternatives feature a low load activated sludge process as the main treatment process for wastewater treatment but differ from each other through the targeted treated water quality and the addition of anaerobic sludge digestion. A brief description of the three options is provided below:

- Option 1 features a low load activated sludge process without primary settling tank and without anaerobic sludge digestion; the targeted water quality being 10 mg/L for TN and 1 mg/L for TP;
- Option 2 features a low load activated sludge process with primary settling tank and with anaerobic sludge digestion; the targeted water quality being 10 mg/L for TN and 1 mg/L for TP, and
- Option 3 features a low load activated sludge process with primary settling tank and with anaerobic sludge digestion; the targeted water quality being 15 mg/L for TN and 2 mg/L for TP.

3.10.7.2. CAPEX and OPEX estimations

Comparison between the options shows that:

- The CAPEX of Option 2 and Option 3 is very similar and approximately 350 million MDL higher than the CAPEX of Option 1 due to the extra facilities to be constructed in comparison to Option 1. These facilities include the primary settling tanks, the digesters and the associated CHP unit.
- The OPEX of Option 2 and Option 3 is approximately 28 million MDL per year lower than in Option 1.

3.10.7.3. Suitability with final sludge disposal option

There is a strong correlation between the final sludge disposal scheme and the wastewater and sludge treatment:

- It is not relevant to implement a sludge incineration plant downstream a sludge treatment line featuring an anaerobic digestion step since the fraction of organic matter will be reduced at the inlet of the incineration. Thermal oxidation of sludge will then require additional fuel, and
- Organic matter and nutrients are valuable contents of the sludge for the plants and both digested and non-digested sludge contain these constituents although digested sludge will have less organic matter. In addition, digested sludge does not require further hygienisation whereas non digested sludge may require additional liming that could also bring some mineral material to the soils if needed.

3.10.7.4. Recommendations

Considering the priorities which have been taken into account to derive the recommended PIP featuring anaerobic digestion and the fact that it is cost efficient to reuse the maximum of available structures in good conditions – the new anaerobic digesters will be the only ones - Option 2 is our preferred proposal for the future design of the new WWTP to be built.

The final disposal sludge option will preferably be landfilling or agriculture use. The latter will be advantageously applied when all local conditions for its implementation are met.

3.11. Sludge Disposal

3.11.1. Overview of possible final disposal routes

Wastewater treatment shall not be envisaged without thinking about the way of handling the sludge that is produced during the wastewater treatment process. The following features should be investigated when setting up sludge management plans.

- The quantity and the quality of the sludge, which differ depending on the processes implemented at the WWTP.
- The local regulatory framework related to sludge management and disposal.

- The possibilities of considering sludge as a product and not only as a waste, through adapted treatment and/or monitoring procedures.

The Moldovan regulation related to waste management and sludge is weak in some aspects and it was decided to apply the EU regulation when appropriate.

The main final sludge disposal routes, as can be experienced worldwide, are further detailed in the following sections.

Final sludge disposal appears to be an issue in Chisinau where no sustainable solution has yet been identified. The most common final disposal options are presented below with a preliminary assessment of their respective technical feasibility and some financial elements.

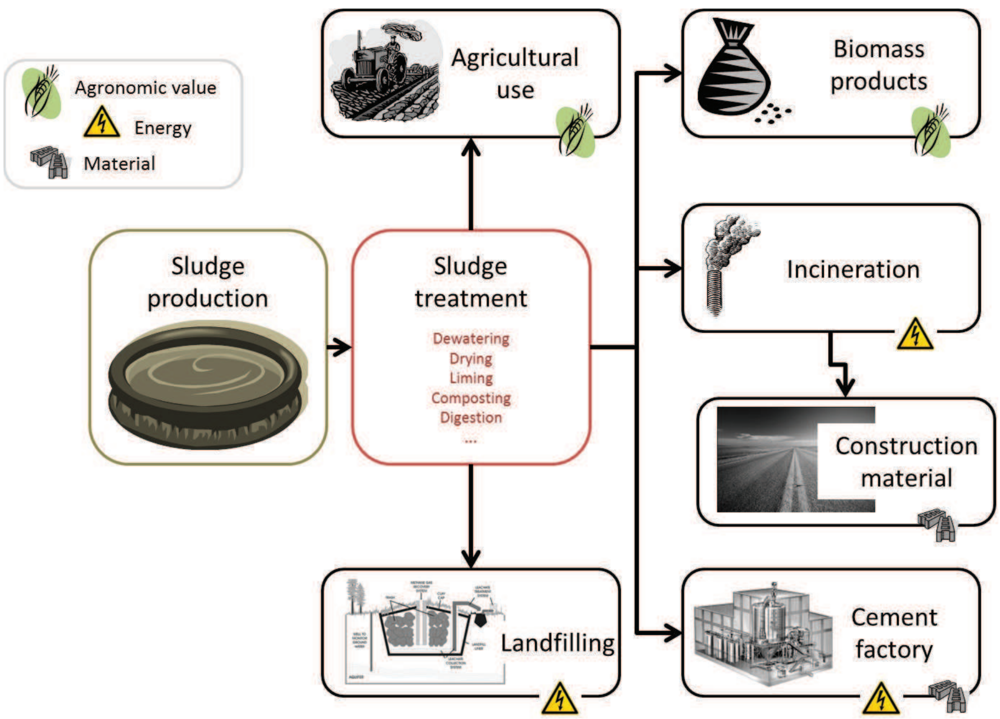


Figure 8: Final sludge disposal routes

3.11.2. COMPARISONS OF FINAL SLUDGE DISPOSAL OPTIONS

Within the Detail Report, the disposal routes – their advantages and disadvantages and cost – are fully detailed. The following comprises a summary of the Report's findings.

Five alternatives for final sludge disposal options were compared in terms of CAPEX and OPEX, cumulated over a 20 year period without financial adjustment. The results show that incineration on the Chisinau WWTP site, and agricultural use are the most economical options. **If the PIP we propose is approved by the stakeholders and implemented, the incineration option will have to be ruled out.** Indeed sludge incineration becomes less relevant after sludge digestion due to the lower calorific value of the digested sludge.

We would recommend having at least two alternative disposal routes to limit the risk of failure of the selected option. Barriers to the final disposal options

The lack of adequate legal framework related to the incineration of waste in Moldova poses a threat to the acceptability of this technical solution by the Municipality. The risk would be reduced if an EU compliant regulation is adopted in Moldova, as is expected. There could also be significant public opposition.

Although a legal framework does exist in Moldova to rule the use of sludge in agricultural activities, and despite the positive opinion expressed by a local specialized agronomical institute, no practical implementation of this sludge disposal option has been reported in the country. This status likely originates from the reluctance of farmers to use the sludge produced by WWTPs, which is seen as a waste rather than a valuable product for soil fertilizing. This situation is common in many countries and the difficulties to overcome this barrier should not be underrated. A lot of efforts and time are generally needed to inform the stakeholders, to demonstrate the technical feasibility and to finally convince the farmers.

3.11.3. CONCLUSION

We recommend ACC to start to develop the necessary legal and commercial framework, accompanied by a public relations campaign in order to start as soon as possible the implementation of the agricultural use of digested and dewatered sludge. A pilot project with the use of sludge on a small area should be envisaged.

As a fall-back disposal option, we recommend ACC to plan for the construction of a small landfill facility that could advantageously couple to a solid waste landfill and supplement the existing storage capacity in the future..

3.12. STAKEHOLDER INVOLVEMENT PLAN

The Stakeholder Involvement Plan that we have prepared within Phase B, complies fully with the Moldovan legal requirements to inform and consult with the public, and with the provisions of the Environmental and Social Policy of EBRD, adopted in 2008.

The Plan sets out:

- How the public will be informed about project in order that members of the public may consult with ACC and the stakeholders concerning the provisions of the project;
- The manner of the consultations that will take place with potentially affected parties, and
- A procedure through which people may be able to make compensatory claims if they consider that they have been, in some way, prejudiced or affected.

The Plan that we have produced presents the requirements, the content and the form of dissemination of information about the project, and the methods and procedures for stakeholders' consultation. The Plan includes, as part of consultation methods, the provisions to be made for stakeholders' involvement through complaints and petitions.

The Plan will be available to the public on ACC's web page and copies will be made available to the public as part of the activity to disseminate information about the project.

The provisions of the Plan will be applied from the initial stage of the planning of project implementation, and will continue throughout all the life of the project. In this way, it will provide to stakeholders and to the public transparency about the project activities and about making any compensatory claims arising from the project.

3.13. Capacity of Local Construction Companies

We sent a questionnaire to ten local construction companies who we considered suitable for the works likely to be required within the project and who we considered to be both technically competent and financially sound.

The following was found:

- Turnover of companies varies between €1.65 and €5.5 million;
- Number of staff is between 15 and 100;
- Companies had between 12 and 45 items of machinery and equipment;
- On average, the companies had been in business for over 10 years.

In conclusion, whilst local companies could not perform some of the specialist work, unless in association with a larger experienced contractor, local companies would seem, and in the past have proved themselves to be, fully competent to tender for many of the pipe and sewer laying contracts, and for the general civil engineering and building works.

3.14. Financial Feasibility of PIP

3.14.1. Overall Objective

The global capacity of the water authority ACC to support the Priority Investment Programme has to be assessed, as well as the relevant funding mechanisms. This is the purpose of the chapter.

This assessment is mainly based on a model (under Excel®) gathering and connecting the main variables determining the evolution of technical, economical and financial drivers describing the situation of the Company and its evolution over a long period. These variables are interconnected as they have mutual interactions (e.g. the budget for repairs, the resulting reduction of water losses, then the reduction of energy consumption, and decrease of energy budget over the period). This includes the main elements discussed through the present study, and particularly:

- The investments identified under the Priority Investment Plan, and complementary investment programme

- The impact of PIP on the operation and maintenance costs, especially energy and leak repairs
- Estimated gains regarding technical efficiency
- The funding structure for supporting PIP, and more generally all investments
- The resulting tariff grids, and the affordability for the population of Chisinau
- The projected financial statements and key evaluation ratios

This section describes key elements of the financial analysis, including the main assumptions, and the main results of analysis

3.14.2. Projection Period

The projection period for the financial analysis covers a period from 2013 to 2037 (25 years); past years 2010 and 2011, as well as current year 2012 are also included for ensuring the full consistency of future evolution modelling with the existing and past evolution of technical and financial elements describing ACC activities. Year 2012 figures are based on the best estimate collected through investigation and discussions with ACC staff.

3.14.3. Macroeconomic Assumptions

The financial projections have been based on forecast figures collected from local economic institutions as well as discussions with EBRD. They include descriptions of evolution over the whole period (25 years) for Customer Price Index (CPI), salaries, energy, and exchange rates between Leu and Euro/USD, with, for each of them, a “base case” scenario, completed by a worst case and optimistic scenario.

Inflation (Customer Price Index) is expected, as a base case, to remain at a relatively low level over the whole period, steadily decreasing from 6% per year at the beginning of the period to 2% in the long term horizon, supported by the progressive integration of Moldovan economy into European Union environment. This control over inflation is, nevertheless, balanced by the weaknesses of the national currency towards Euro and USD, with an expected significant depreciation of Leu compared with these two international currencies, its relative value being halved within 15 years.

Inflation on average salaries is anticipated at a higher rate than customer prices, with an additional 3% per year over the whole period.

Table 42: Macroeconomic Hypotheses

Macroeconomic hypotheses	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Inflation Moldova	7.0%	6.5%	6.0%	5.5%	5.0%	4.5%	4.0%	3.5%	2.0%	2.0%	2.0%	2.0%
CPI	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.4	1.6	1.7	1.9	2.1
Salary growth without inflation	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
*Salary Index**	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.4	1.7	1.9	2.2
Exchange rates												

MDL/EURO rate	**16.0**	**16.0**	**17.0**	**18.0**	**19.0**	**20.0**	**21.0**	**22.0**	**27.0**	**32.0**	35.0	35.0
EURO/USD rate	**1.40**	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

** salary index / 2010 level*

Energy costs would grow significantly faster than CPI (+5% over inflation per year for the base case, +12% per year for the pessimistic scenario).

The model enables easy comparisons and sensitivity analysis of the impact of macroeconomic changes – together with other technical drivers

3.14.4. Water and Wastewater Coverage

The model, aiming at describing the technical and economical of the municipal entity in charge of water and wastewater services for Chisinau, is logically based, in priority, on the evolution of population and other customers served, and the corresponding volumes.

As already described in other parts of this report, ACC delivers services to the population of the Municipality of Chisinau, and to several urban entities and villages located nearby. Both populations have been studied, and their evolution over the period anticipated.

The main elements are an expected stability of the whole population served; the main change should occur through the significant evolution of connection rates for individual housing to water and wastewater central systems.

Table 43: Hypotheses on Water & Wastewater Coverage

Population per location (Thsd)	**2010 -2**	**2011 -1**	**2012 0**	**2013 1**	**2014 2**	**2015 3**	**2016 4**	**2017 5**	**2022 10**	**2027 15**	**2032 20**	**2037 25**
Chisinau city	**631**	632	633	634	635	**636**	634	633	626	621	611	604
Outside Chisinau	**181**	182	183	184	185	**186**	186	186	186	186	186	186
Total	**812**	**814**	**816**	**818**	**820**	**822**	**820**	**819**	**812**	**807**	**797**	**790**
Population per type of housing												
% living in houses	**25%**	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Blocks	609	611	612	614	615	617	615	614	609	605	598	593
Houses	203	204	204	205	205	206	205	205	203	202	199	198
Allocation of blocks per housing agency												
IMGFL	**53%**	53%	53%	53%	53%	53%	53%	53%	53%	53%	53%	53%
APLP	**24%**	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
CCL	**12%**	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Others	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Connection rate to the drinking water system												
Blocks	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Houses	**56%**	**56%**	**56%**	**57%**	**59%**	**60%**	**61%**	**62%**	**66%**	**68%**	**70%**	**70%**
Connection rate to the waste water system												
Blocks	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Houses	**36%**	**36%**	**36%**	**36%**	**36%**	**36%**	**36%**	**36%**	**41%**	**52%**	**63%**	**70%**
Population served by												

ACC (Thsd)												
With drinking water	723	724	726	731	735	740	740	741	743	741	737	731
With wastewater	682	684	685	687	689	690	689	688	692	710	724	731

3.14.5. WATER CONSUMPTION AND WASTEWATER DISCHARGE

The evolution of volumes consumed will result from several components, each of them being the transcription in the local context of Chisinau of international trends already identified in other similar large water systems in Central and Eastern Europe:

- a global decrease of industrial consumptions, due to a reducing industrial production, on one hand, and mainly on more efficient production processes, consuming less water (or producing less wastewater) per unit produced
- a larger equipment rate of individual customers, essentially in collective housing, with individual meters, allowing the generalization of billing based on measured volumes rather than on norms (estimated consumption per inhabitant, or per square meter of housing)
- the modernization of domestic equipment (e.g. washing machines) resulting in reduced consumption of water
- the extension of areas served in peripheral sections of large towns, connecting new individual housing to centralized water and wastewater networks and services

As a consequence, the global consumption for both domestic and non-domestic categories will significantly decrease during the studied period, from 44 (in 2012) to 36 $M.m^3$ per year (in 2032) for domestics, and from 10.5 to 8.6 $M.m^3$ per year, over the same period, for non-domestic.

Table 44: Hypotheses on Water Consumption and Wastewater Discharge

Consumption		2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Consumption - domestic	1000 m3												
Blocks IMGFL		17,729	17,773	17,816	17,021	16,221	14,203	13,940	13,677	13,055	13,430	13,775	13,650
Blocks APLP		8,099	8,109	8,129	7,766	7,401	6,481	6,360	6,240	5,957	6,128	6,285	6,228
Blocks CCL		3,924	3,919	3,929	3,754	3,577	3,132	3,074	3,016	2,879	2,962	3,038	3,010
Blocks other		3,957	3,987	3,997	3,818	3,639	3,186	3,127	3,068	2,929	3,013	3,090	3,062
Houses		10,108	10,133	10,158	9,935	9,688	8,676	8,657	8,633	8,746	9,243	9,817	9,728
Total domestic		**43,817**	**43,921**	**44,029**	**42,293**	**40,526**	**35,679**	**35,158**	**34,634**	**33,565**	**34,774**	**36,005**	**35,680**
Consumption - non domestic	1000 m3												
Public institutions		2,708	2,708	2,572	2,545	2,518	2,491	2,464	2,437	2,302	2,132	2,031	2,031
Companies		6,908	6,908	6,562	6,493	6,424	6,355	6,286	6,217	5,872	5,440	5,181	5,181
ACC operational	use	1,424	1,424	1,424	1,424	1,424	1,424	1,424	1,424	1,424	1,424	1,424	1,424
Total non domestic		**11,040**	**11,040**	**10,559**	**10,463**	**10,366**	**10,270**	**10,174**	**10,078**	**9,597**	**8,996**	**8,636**	**8,636**
Consumption - total	1000 m3												
Domestic		43,817	43,921	44,029	42,293	40,526	35,679	35,158	34,634	33,565	34,774	36,005	35,680
Non domestic		11,040	11,040	10,559	10,463	10,366	10,270	10,174	10,078	9,597	8,996	8,636	8,636
Total		**54,857**	**54,960**	**54,587**	**52,756**	**50,893**	**45,949**	**45,332**	**44,712**	**43,162**	**43,770**	**44,641**	**44,315**

Effective water consumption is one component, but the most important for the economical cycle of activity of ACC is of course the quantities measured and billed by the Company to its customers; the quantities billed already are, and will remain significantly lower than those effectively consumed – especially when individual metering with low metrological quality is used for determination of the volumes to be billed.

Table 45: Billed Volumes of Drinking Water & wastewater

	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Billing of drinking water												
Billing domestic – meter												
1,000 m3												
Blocks IMGFL	15,589	15,627	15,666	15,037	14,397	12,665	12,488	12,309	11,749	12,087	12,397	12,285
Blocks APLP	7,122	7,130	7,148	6,861	6,569	5,779	5,698	5,616	5,361	5,515	5,657	5,606
Blocks CCL	3,451	3,446	3,455	3,316	3,175	2,793	2,754	2,715	2,591	2,665	2,734	2,709
Blocks other	3,479	3,506	3,514	3,373	3,230	2,841	2,801	2,761	2,636	2,711	2,781	2,756
Houses	4,379	4,390	4,401	4,338	4,262	3,846	3,867	3,885	4,154	4,390	4,663	4,621
Total domestic	**34,020**	**34,100**	**34,184**	**32,924**	**31,633**	**27,925**	**27,608**	**27,286**	**26,491**	**27,369**	**28,232**	**27,977**
Billing domestic – norm												
1,000 m3												
Blocks IMGFL	362	539	540	433	326	218	109	0	0	0	0	0
Blocks APLP	165	246	247	198	149	99	50	0	0	0	0	0
Blocks CCL	80	119	119	96	72	48	24	0	0	0	0	0
Blocks other	81	121	121	97	73	49	24	0	0	0	0	0
Houses	1,108	1,111	1,113	1,085	1,054	1,021	975	926	488	498	509	505
Total domestic	**1,797**	**2,136**	**2,141**	**1,909**	**1,674**	**1,435**	**1,181**	**926**	**488**	**498**	**509**	**505**
Billing domestic - norm + meter												
1,000 m3												
Blocks IMGFL	15,951	16,167	16,206	15,470	14,723	12,883	12,597	12,309	11,749	12,087	12,397	12,285
Blocks APLP	7,287	7,376	7,394	7,059	6,718	5,878	5,747	5,616	5,361	5,515	5,657	5,606
Blocks CCL	3,531	3,565	3,574	3,412	3,247	2,841	2,778	2,715	2,591	2,665	2,734	2,709
Blocks other	3,560	3,627	3,636	3,470	3,303	2,890	2,826	2,761	2,636	2,711	2,781	2,756
Houses	5,487	5,501	5,514	5,423	5,317	4,867	4,841	4,811	4,642	4,888	5,172	5,125
Total domestic	**35,817**	**36,235**	**36,324**	**34,834**	**33,307**	**29,360**	**28,789**	**28,212**	**26,979**	**27,866**	**28,741**	**28,482**
Billing - non domestic												
1,000 m3												
Public institutions	2,437	2,437	2,315	2,291	2,266	2,242	2,218	2,193	2,071	1,919	1,828	1,828
Industries	6,217	6,217	5,906	5,844	5,782	5,720	5,657	5,595	5,284	4,896	4,663	4,663
Total non domestic	**8,654**	**8,654**	**8,221**	**8,135**	**8,048**	**7,962**	**7,875**	**7,789**	**7,356**	**6,815**	**6,491**	**6,491**
Billing – total												
1,000 m3												
Domestic	35,817	36,235	36,324	34,834	33,307	29,360	28,789	28,212	26,979	27,866	28,741	28,482
Non domestic	8,654	8,654	8,221	8,135	8,048	7,962	7,875	7,789	7,356	6,815	6,491	6,491
Total	**44,471**	**44,889**	**44,546**	**42,968**	**41,356**	**37,321**	**36,664**	**36,001**	**34,335**	**34,681**	**35,232**	**34,972**

	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Billing of Wastewater												
Billing domestic – meter												
1,000 m3												
Blocks IMGFL	15,589	15,627	15,666	15,037	14,397	12,665	12,488	12,309	11,749	12,087	12,397	12,285
Blocks APLP	7,122	7,130	7,148	6,861	6,569	5,779	5,698	5,616	5,361	5,515	5,657	5,606
Blocks CCL	3,451	3,446	3,455	3,316	3,175	2,793	2,754	2,715	2,591	2,665	2,734	2,709
Blocks other	3,479	3,506	3,514	3,373	3,230	2,841	2,801	2,761	2,636	2,711	2,781	2,756
Houses	2,815	2,822	2,829	2,724	2,616	2,308	2,282	2,256	2,559	3,368	4,210	4,621

	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Total	**32,456**	**32,532**	**32,612**	**31,310**	**29,987**	**26,387**	**26,023**	**25,657**	**24,896**	**26,347**	**27,779**	**27,977**
Billing domestic – norm 1,000 m3												
Blocks IMGFL	362	539	540	433	326	218	109	0	0	0	0	0
Blocks APLP	165	246	247	198	149	99	50	0	0	0	0	0
Blocks CCL	80	119	119	96	72	48	24	0	0	0	0	0
Blocks other	81	121	121	97	73	49	24	0	0	0	0	0
Houses	712	714	716	681	647	612	575	538	300	382	460	505
Total	**1,401**	**1,739**	**1,743**	**1,506**	**1,267**	**1,026**	**782**	**538**	**300**	**382**	**460**	**505**
Billing domestic - norm + meter 1,000 m3												
Blocks IMGFL	15,951	16,167	16,206	15,470	14,723	12,883	12,597	12,309	11,749	12,087	12,397	12,285
Blocks APLP	7,287	7,376	7,394	7,059	6,718	5,878	5,747	5,616	5,361	5,515	5,657	5,606
Blocks CCL	3,531	3,565	3,574	3,412	3,247	2,841	2,778	2,715	2,591	2,665	2,734	2,709
Blocks other	3,560	3,627	3,636	3,470	3,303	2,890	2,826	2,761	2,636	2,711	2,781	2,756
Houses	3,527	3,536	3,545	3,405	3,263	2,920	2,857	2,794	2,859	3,750	4,670	5,125
Total	**33,857**	**34,271**	**34,355**	**32,816**	**31,253**	**27,413**	**26,805**	**26,195**	**25,197**	**26,729**	**28,239**	**28,482**
Billing - non domestic 1,000 m3												
Public institutions	2,559	2,559	2,431	2,405	2,380	2,354	2,329	2,303	2,175	2,015	1,919	1,919
Industries	6,528	6,528	6,201	6,136	6,071	6,006	5,940	5,875	5,549	5,141	4,896	4,896
From Technological Water	419	419	419	419	419	419	419	419	419	419	419	419
Total	**9,506**	**9,506**	**9,051**	**8,960**	**8,870**	**8,779**	**8,688**	**8,597**	**8,143**	**7,575**	**7,234**	**7,234**

It must be reminded that the impact of inaccuracy (i.e. underestimation) of volumes billed on the economical equilibrium of ACC can be mitigated if the unit price per cubic meter can be adjusted accordingly, in order to ensure that ACC will issue appropriate global bills to the customers, and collect relevant revenues to cover its needs of funding.

3.14.6. Water Balance, Production

The global volumes of drinking water to be produced by ACC depends directly from the evolution of volumes consumed by customers, with addition of own consumptions (technical needs) of ACC, and the technical losses during the distribution process, due to leaks on network and connections. This level is significant (over 40%) and is expected to be maintained at an acceptable level, similar to the existing, thanks to limited – but selective – actions for leak reduction, through repairs and replacement of ruined parts of network, which will balance the mechanical increase of percentage resulting from the reduction of volumes consumed by customers.

Table 46: Water Balance

	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Water balance (drinking water) 1,000 m3												
Production	**76,234**	**76,214**	**85,858**	**84,026**	**82,047**	**72,768**	**71,598**	**70,424**	**66,992**	**67,131**	**67,531**	**67,151**
ACC operational use	1,424	**1,300**	**1,300**	**1,300**	**1,279**	**1,259**	1,242	1,225	1,163	1,130	1,098	1,424
Technical losses	19,953	19,953	**29,970**	29,970	**29,875**	**25,561**	25,024	24,487	22,667	22,231	21,793	21,412
Consumption of potable water	54,857	54,960	54,587	52,756	50,893	45,949	45,332	44,712	43,162	43,770	44,641	44,315
Commercial losses	10,386	10,071	10,042	9,788	9,537	8,628	8,668	8,711	8,827	9,089	9,409	9,343
Billing	44,471	44,889	44,546	42,968	41,356	37,321	36,664	36,001	34,335	34,681	35,232	34,972

NRW	40%	39%	47%	47%	48%	47%	47%	47%	47%	47%	46%	46%

3.14.7. Operation Costs

The repartition of operation costs has been based on a detailed analysis of historical costs supported by ACC for recent years, from official accounting documents and discussions with operation departments of ACC. This exercise results in an analytical breakdown of operation costs linked with physical consumption units corresponding to technical needs (e.g. the quantity of kWh for production and distribution of 1 cubic meter of drinking water). Such ratio evolves, during the period modeled, according to technical drivers resulting from anticipated investments, gains of productivity and reorganization; they generate, together with the expected evolution of quantities produced, and the evolution of unit prices, a yearly budget for each component of operation costs.

Staff costs: the base case estimates that the number of employees of ACC will significantly decrease over the period, decreasing from a ratio of 2,7 employees per 1,000 people served, to 1,5 within 10 years. The salaries will grow faster that CPI (+3% per year) during the period. As a consequence, staff costs, in constant Leu, value 2012, will decrease from 160 to 126 M.Leu within 10 years, then climb again, up to 193 M.Leu by the end of the 25-year period

Energy costs: significant improvements in energetic efficiency are expected from the PIP programme, and they partly balance the negative impact of strong energy prices increase over inflation during the period; as a result, the budget for energy doubles in 25 years (in constant Leu), when the unit cost per kWh is multiplied by 2,4.

Material / consumable: the reduction of unplanned interventions on networks, due to selective replacement and modernization programme on water and wastewater networks, allows a division by 2 of corresponding budget over the period.

VAT not refundable: the base case scenario includes a pessimistic scenario regarding VAT, considering that water services to domestic customers will continue not to be subject to VAT, which means that corresponding VAT paid on external services will not be refunded by the tax administration.

Table 47: Opex Summary

Millions MDL constant	2010	2011	2012	2013	2014	2015	2016	2017	2022	2027	2032	2037
	-2	-1	0	1	2	3	4	5	10	15	20	25
Staff	153	158	162	152	149	146	141	136	126	145	168	193
Electricity	119	118	122	127	123	122	128	141	176	234	261	244
Material / consumable	67	67	67	62	57	51	49	47	38	35	32	31
External services	39	39	39	39	39	39	39	39	39	39	39	39
Taxes / fees	38	38	38	38	38	38	38	38	38	38	38	38
VAT not refundable		25	26	25	23	21	22	23	25	32	35	33
Other opex	9	9	9	9	9	9	9	9	9	9	9	9
Losses due to exchange rate	0	0	3	2	1	13	24	27	15	5	0	0
Total	**425**	**454**	**464**	**453**	**439**	**426**	**426**	**432**	**451**	**532**	**582**	**587**

3.14.8. COLLECTION OF BILLED QUANTITIES, WORKING CAPITAL NEEDS

The major part of revenues for ACC will provide, for the whole period, from domestic customers living in collective housing, even if they should face a significant shrink in their respective part of volumes billed in the short-term horizon.

Table 48: Bill Collection

Millions MDL constant	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Domestic	260	257	368	368	394	434	479	504	514	634	755	824
Non domestic	244	243	276	283	312	380	423	448	452	505	558	611
Technologic water	13	13	15	16	17	20	22	23	24	29	33	36
Other	47	45	48	51	53	56	58	60	67	74	82	91
Total	**563**	**558**	**708**	**717**	**777**	**889**	**981**	**1,035**	**1,057**	**1,242**	**1,428**	**1,562**

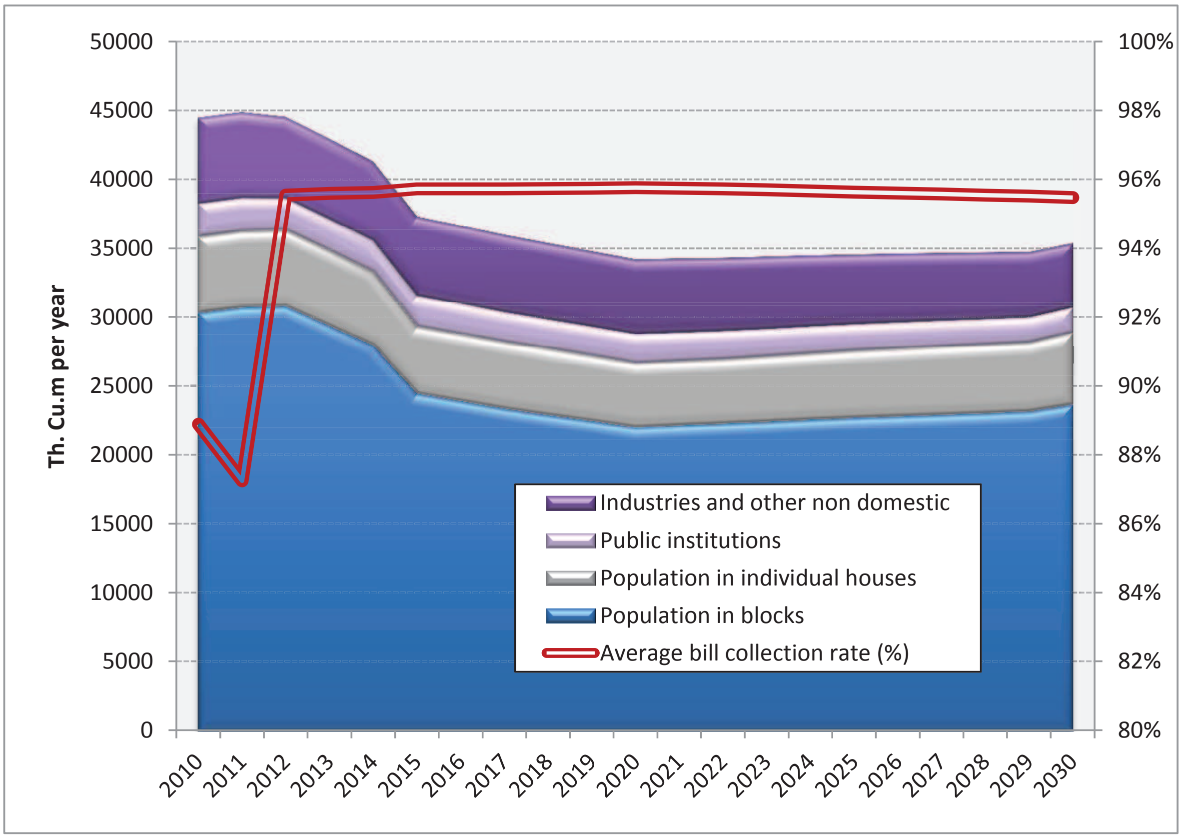


Figure 9: Breakdown of billed volumes per category of consumers

Collection of billed amount has a direct and very significant impact on cash position of ACC – and therefore on its capability to face its commitments for paying its providers and its investments.

The base case is rather conservative, with a negative evolution of receivables amounts, accounted for as days of turn-over, increasing from 288 days as per 2012 up to 336 days in 2022, and 438 days by the end of the period – this is partly due to the fact that no write-off policy has been considered in the model. On the other hand, the collection rate is globally kept over 95% over the period, which can be considered as a relatively efficient rate.

Table 49: Cumulated Receivables Net

days of turnover	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2022 10	2027 15	2032 20	2037 25
Blocks IMGFL	145	172	153	156	149	134	126	124	143	143	146	156
Blocks IMGFL - debt population	11	14	16	19	21	21	22	24	39	48	57	68
Blocks IMGFL - debt block	134	158	138	137	128	113	104	100	104	95	89	88
Blocks APLP	47	56	51	53	52	48	46	46	58	61	66	73
Blocks APLP - debt population	11	13	13	16	17	17	17	19	29	35	41	49
Blocks APLP - debt block	36	43	38	37	35	31	28	27	29	26	25	25
Blocks CCL	7	8	8	10	10	10	11	12	18	22	26	31
Blocks CCL - debt population	6	8	8	10	10	10	11	12	18	22	26	31
Blocks CCL - debt block	0	0	0	0	0	0	0	0	0	0	0	0
Blocks other	3	5	6	8	10	10	11	12	21	26	32	38
Houses	4	5	5	6	6	6	6	7	11	14	17	20
Public institutions	2	2	2	2	2	1	1	1	1	1	1	1
Companies	54	54	47	47	44	39	36	35	36	33	31	31
Technologic water	2	6	9	13	16	18	21	24	44	57	70	85
Energy sales	3	3	3	3	3	2	2	2	2	2	1	1
Studies / construction	3	3	3	3	3	2	2	2	2	2	1	1
Total	**271**	**315**	**288**	**301**	**294**	**272**	**262**	**264**	**336**	**360**	**392**	**438**

3.14.9. DEPRECIATION, FIXED ASSETS

Existing and future assets have been sorted into various categories according to their funding origin:

- Those older than 2004
- Those having been funded (or transferred to ACC) between 2004 and now

(both categories are considered separately for the calculation of admissible margin in the price of water – according to a justified remuneration of investments made)

- The assets to be funded under the Priority Investment Programme (with subdivision according to the origin of funding)
- Additional assets funded in addition to PIP over the period

Table 50: Residual value eoy

Millions MDL current	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2018 6	2022 10	2027 15	2037 25
Assets < 2004	620	599	579	558	537	517	496	475	455	372	269	62
Assets 2004-2010	200	193	187	180	173	167	160	153	147	120	87	20
Assets PIP - EBRD	-	-	-	-	115	208	254	244	233	171	145	94
Assets PIP - EIB	-	-	-	-	115	208	254	244	233	171	145	94
Assets PIP - KfW	-	-	-	-	115	208	254	244	233	171	145	94
Assets PIP - NIF	-	-	-	-	84	153	187	179	171	126	107	69
Assets PIP - City of Chisinau	-	-	-	-	23	42	51	49	47	34	29	19
Assets PIP - From cash flow	-	-	-	-	-	-	-	-	-	-	-	-

Millions MDL current	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2018 6	2022 10	2027 15	2037 25
Assets CIP - City of Chisinau	-	-	-	-	-	-	-	-	-	-	-	-
Assets CIP - From cash flow	-	21	34	48	44	41	37	36	60	225	300	522
Total	820	814	799	786	1,207	1,542	1,694	1,623	1,577	1,392	1,227	973

A detailed calculation of depreciation is made after repartition of each type of investment into 6 categories of assets for depreciation (Civil works – Pipes – Electromechanical (pumps) – instrumentation (meters) – operation equipments (vehicles) – engineering studies), each of them having its own average rate of depreciation.

It allows calculate the generation of depreciation by each group of assets, and the global amount of justified depreciation, which represents a significant part added to operation costs (12 to 25% in addition);

Table 51: Depreciation

Millions MDL current	2010 -2	2011 -1	2012 0	2013 1	2014 2	2015 3	2016 4	2017 5	2018 6	2022 10	2027 15	2037 25
Assets < 2004	21	21	21	21	21	21	21	21	21	21	21	21
Assets 2004-2010	7	7	7	7	7	7	7	7	7	7	7	7
Assets PIP - EBRD	-	-	-	-	-	11	20	26	27	6	5	5
Assets PIP - EIB	-	-	-	-	-	11	20	26	27	6	5	5
Assets PIP - KfW	-	-	-	-	-	11	20	26	27	6	5	5
Assets PIP - NIF	-	-	-	-	-	8	15	19	20	4	4	4
Assets PIP - City of Chisinau	-	-	-	-	-	2	4	5	5	1	1	1
Assets PIP - From cash flow	-	-	-	-	-	-	-	-	-	-	-	-
Assets CIP - City of Chisinau	-	-	-	-	-	-	-	-	-	-	-	-
Assets CIP - From cash flow	-	-	1	3	5	5	5	4	4	29	30	45
Total	27	27	29	30	32	76	112	134	136	79	78	93

3.14.10. TAXES

The model considers VAT rate at 20% on all purchased goods and services, and no VAT refund for expenses (including investments) corresponding to domestic services – as these services are not subject to VAT.

The Corporate Tax rate, on net margin, has been taken at 20% over the whole period.

3.14.11. INVESTMENT POLICY, PIP COSTS AND FINANCING

The Priority Investment Plan will take place during the 6 first years of the programme, i.e. from 2012 to 2018. It is detailed in Chapter 4.6.

Funding of this programme is based on a balanced repartition of loans agreed for with EBRD, EIB and KfW, as follows:

Table 52: Breakdown of Funding Sources of the PIP

Millions MDL current	2013	2014	2015	2016	2017	2018
	1	2	3	4	5	6
PIP - EBRD						
PIP - EIB	0	109	100	64	15	16
PIP - KFW	0	109	100	64	15	16
PIP - NIF grant	0	109	100	64	15	16
PIP - grant from the City	0	80	73	47	11	11
PIP - EBRD	0	22	20	13	3	3
PIP - EIB	0	0	0	0	0	0
PIP - From cash flow	0	429	392	254	59	61
Total	**0**	**429**	**392**	**254**	**59**	**61**

Detailed conditions of loans have been detailed as follows in the model:

Table 53: Hypotheses on Loan Conditions

Loan interest rates	
Euribor	**1.6%**
Interest rate on long term loan - EBRD existing	**1.4%**
New EBRD loan conditions	
Interest rate	**5.6%**
EBRD loan conditions (margin)	**400**
Maturity (years)	**10**
Grace period (years)	**3**
Loan amount (M.Eur)	**15.2**
EIB loan conditions	
Interest rate	**4.1%**
EIB loan conditions (margin)	**250**
Maturity (years)	**15**
Grace period (years)	**3**
Loan amount (M.Eur)	**15.2**
KfW loan conditions	
Interest rate	**4.1%**
KfW loan conditions (margin)	**250**
Maturity (years)	**15**
Grace period (years)	**3**
Loan amount (M.Eur)	**15.2**

3.14.12. FUNDING SUPPORT FROM THE MUNICIPALITY

As mentioned during the workshop organized in May 2011 at ACC premises, the Municipality must be considered as a possible support to the Water Company for completing the funding scenario in water and wastewater, as the Municipality remains the sole owner of the water company, and as such, bears a direct responsibility in the quality of services rendered to the population and areas covered.

The capacity of the Municipality to contract loans and to provide guarantees is bound by Moldovan legislation on public bodies, which prevents Municipalities from getting financial commitments which would result in annual debt services (=repayment of capital + payment of interests) representing more than 20% of the whole annual budget.

In recent years, the budget of the Municipality of Chisinau has raised from 1,6 billion Leu to around 2,4 billion for 2012. This amount can be considered as an indication of budgets for years to come.

Existing loans and commitments of the Municipality will result in the following debt service scenario for coming years:

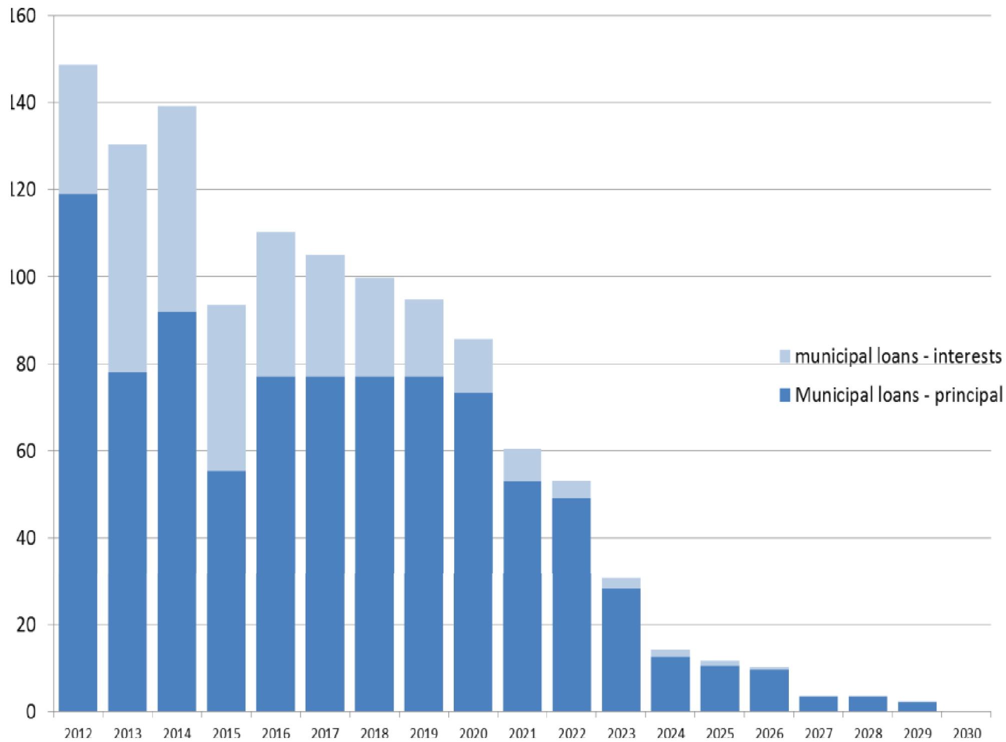


Figure 10: Debt Service of Municipality, in M. Leu Current

It can be seen that the yearly amounts remain far below the threshold of 20%, the maximum percentage, considering a yearly budget of 2.4 billion Leu, being less than 7% between years 2012 and 2014, and much lower after. This indicates that the Municipality keeps a very significant capacity of loan contracting for the years to come.

Event considering a case when the Municipality would have to fully counter-guarantee the loans contracted by ACC with EBRD, EIB and KfW, the resulting addition of commitments in the accounting books of the Municipality would be as follows:

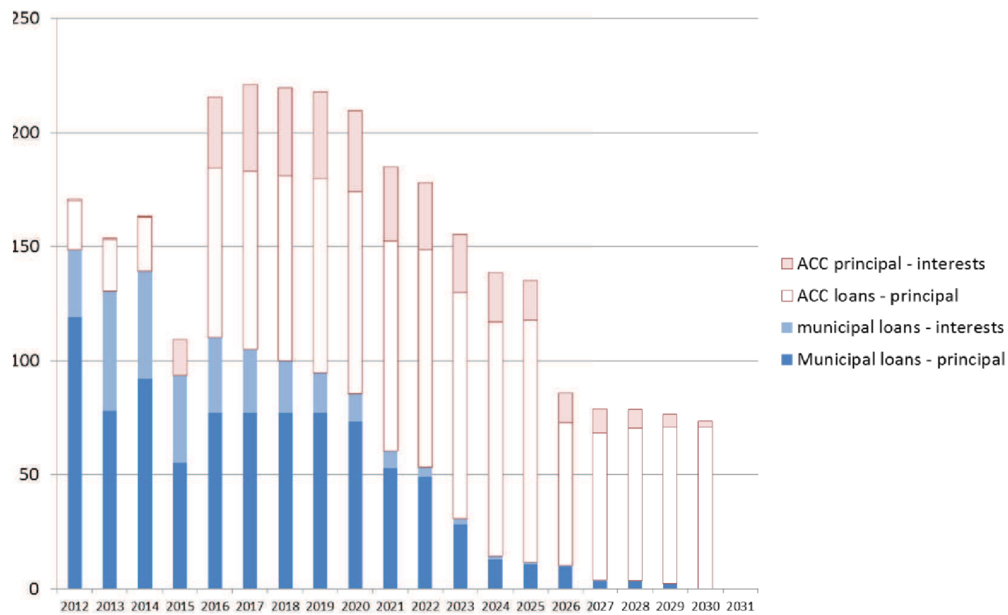


Figure 11: Debt Service of Municipality + for ACC loans, in M. Leu Current

Which remains in any case under the limit of 10% of the municipal budget for the whole period.

This confirms that the Municipality will keep, over the whole period, a strong capacity for intervention in complementary funding of ACC needs, through direct participation or through providing guarantees to additional loans to be contracted by ACC.

3.14.13. Financial Sustainability of PIP, Ratios

The sustainability of the programme has been challenged through the following calculation cycle:

- Investments included in the PIP are implemented, and are funded by the corresponding loans to be contracted
- Operation costs (including savings resulting from improvement of infrastructure allowed by the PIP) and depreciation are estimated by the model, as well as volumes produced and billed, and are entered into a calculation of yearly justified tariff grids, according to the tariff setting methodology defined by the national regulator
- Estimate of billing collection efficiency and working capital needs define the evolution of cash position of ACC
- If the cash position is positive by the end of year, then this situation is used as the cash starting point for next year; if the position becomes negative, then a short-term loan is activated, generating addition debt service on following year.

The aim of this model is to make sure that the PIP scenario remains sustainable for the Company without excessive recourse to short-term debts.

Global sustainability are estimated, in addition, through classical ratios such as Debt Service Current Ratio (DSCR), reflecting the capacity of ACC to face its financial commitments (debt service) with a sufficient margin of security, and Current Ratio.

The following curves show that, with the base case scenario, ACC can face the reimbursement of loans contracted from EBRD, EIB and KfW under satisfactory financial conditions.

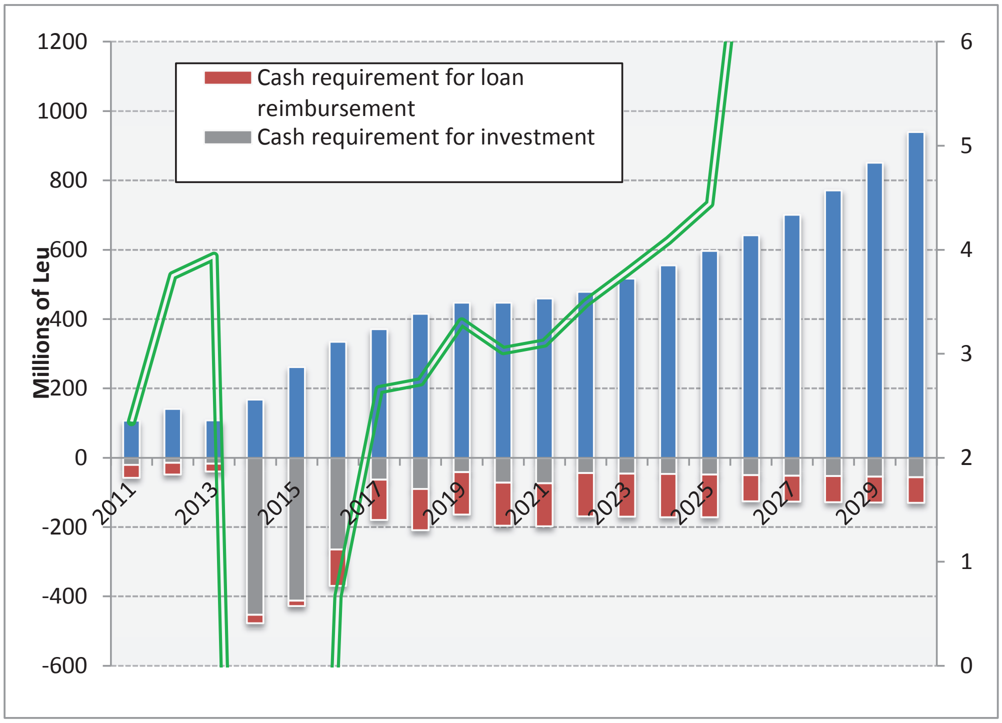


Figure 12: Cash flows

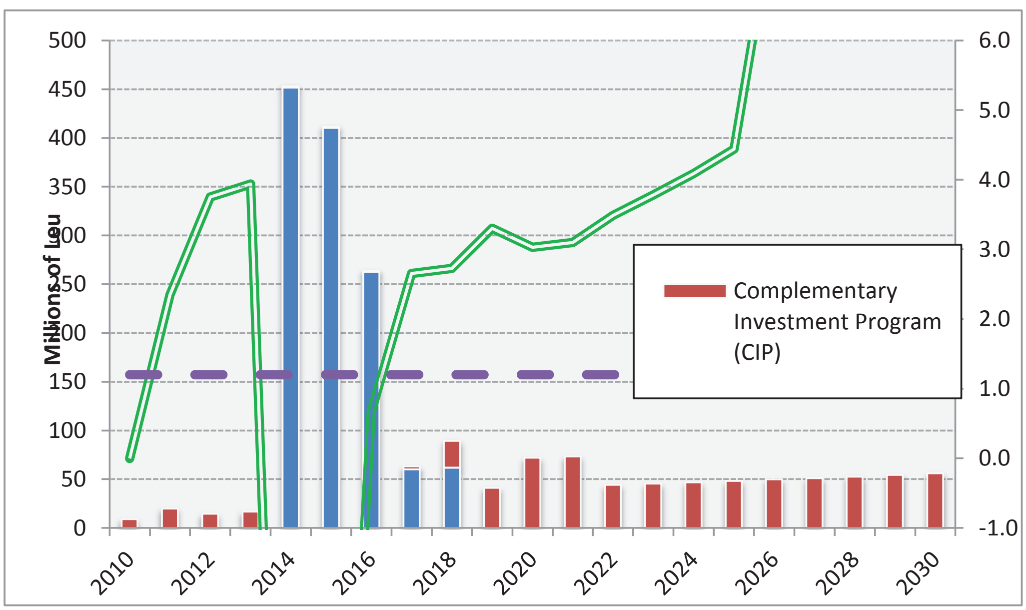


Figure 13: Capacity of investment (DSCR)

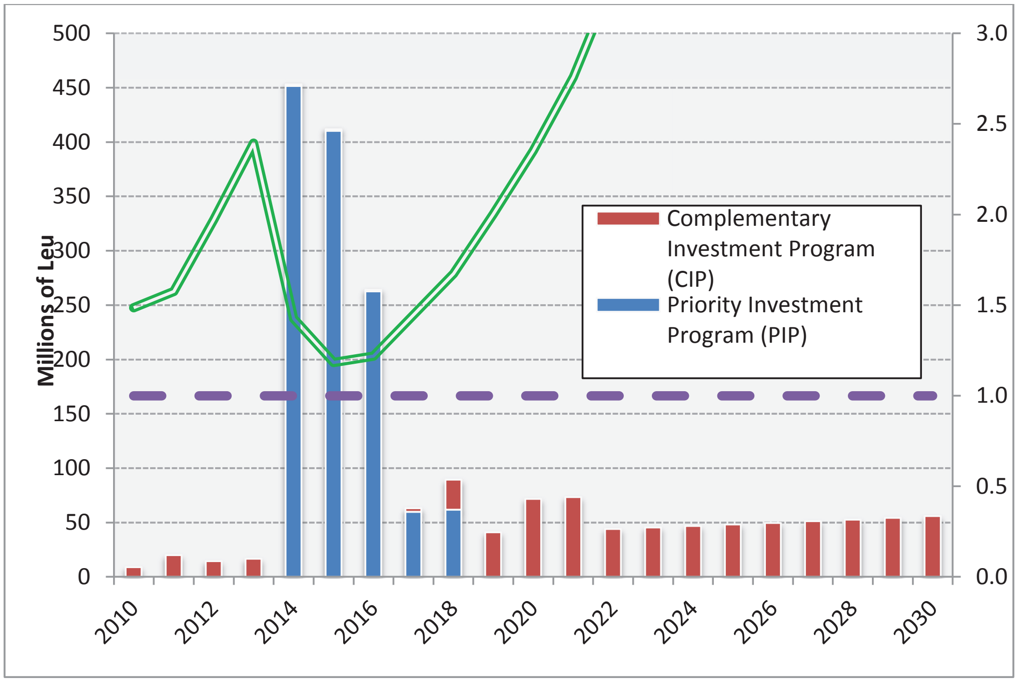


Figure 14: Capacity of investment (Current ratio)

3.14.14. AFFORDABILITY

It is essential to measure the capacity, for the poorest part of the population, to face the evolution of tariff, and corresponding yearly bill. It is commonly agreed that acceptable budget for poor domestic customers should not excess 5% of their revenues.

One solution for covering a possible gap (i.e. part of the bill exceeding the limit of 5%) is to mobilize subsidies from the Municipality, which is already the case in Chisinau. The model indicates that this subsidization would remain significant for the first years of the period (until year 2017) with an average budget of 5 to 6 Million Leu per year, then after would decrease under 0.5 M.Leu for the rest of the period.

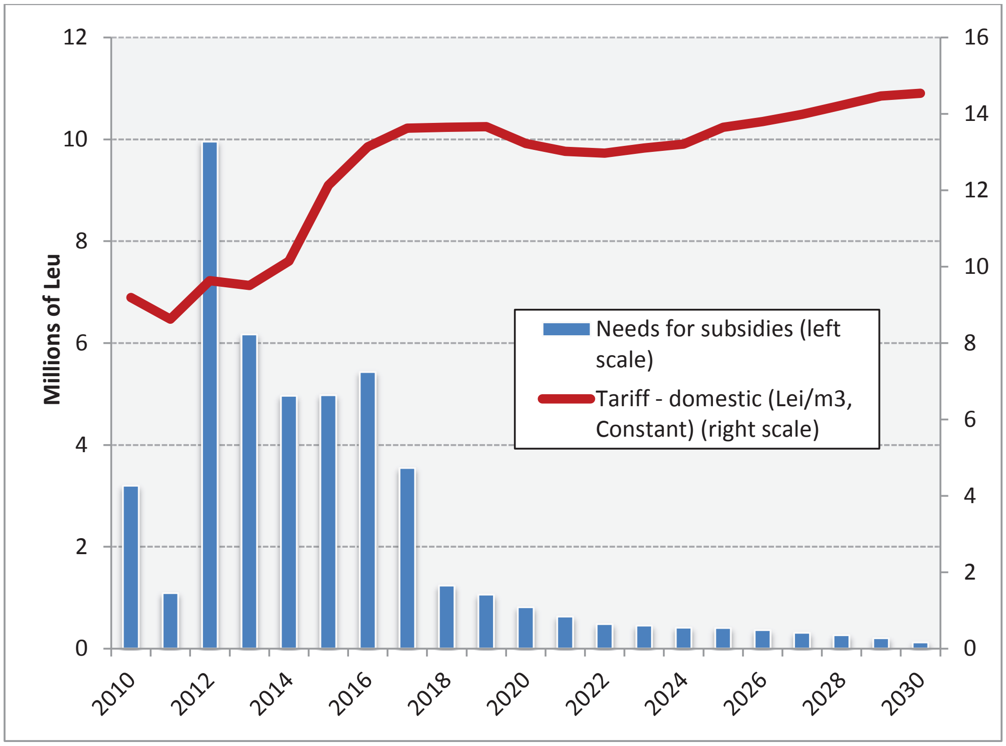


Figure 15: Tariff levels and subsidies for the poorest 10% of population

The following graph shows (curve in yellow) the constant decrease of weight of an average bill for water and wastewater in the global income of households, over the period, resulting from:

- The nearly stable tariff per m3, starting from 2017, in constant Leu
- The reduction of volumes consumed and billed to customers
- The increase of revenues (salaries) over inflation

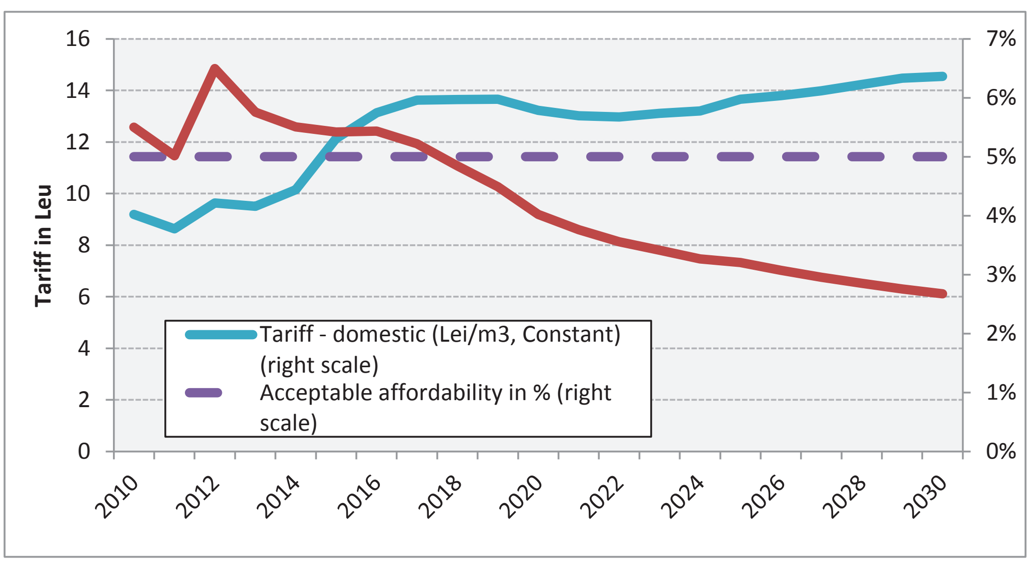


Figure 16: Affordability

3.14.15. IRR, EIRR

The global justification of the Project can be evaluated by the model, through a comparison of with / without scenarios, comparing the expected evolution of ACC accounts and cash flows in situations where the PIP is implemented vs. nothing is done. For comparison, EBITDA in both cases are compared, as well as mobilization of cash by investments; the resulting net flows are cumulated (negative during the first years, as investment funding exceeds the own resources of the Company, then positive by the end of the period), and the Internal Rate of Return of the Project (IRR) is the discount rate that makes the sum of discounted flows equal to zero.

With the base case, the IRR equals 11,6%, and the payback period (number of years in which the cumulated flows become positive) is around 10 years.

It must be considered that the relevance of this calculation is limited by the impact of cost+fee regime, and tariff setting regulation in Moldova:

- Cost + Fee regime implies that any saving on operation costs resulting from the implementation of PIP will be deducted from justified costs for the calculation of tariff next year – this means that corresponding savings beneficiate directly to the customers, through decrease, or limited increase, in yearly tariffs, but cannot be identified through the calculation of EBITDA, and therefore not reflected in the IRR
- tariff setting methodology officially states that the authorized margin is based on the remuneration of investments in assets; as a consequence, a purely financial consideration of IRR will be directly linked with the authorized remuneration rate, whatever technical scenario is implemented .

Table 54: IRR of PIP

Millions MDL current	2010	2011	2012	2013	2014	2015	2016	2017	2018	2022	2027	2037
	-2	-1	0	1	2	3	4	5	6	10	15	25
EBITDA with PIP	149	105	155	149	197	276	328	345	345	277	261	264
EBITDA without PIP	140	94	154	148	150	150	149	146	147	181	181	207
Difference in EBITDA	**9**	**10**	**2**	**1**	**47**	**126**	**179**	**198**	**199**	**96**	**81**	**58**
CAPEX with PIP	9	20	14	17	453	412	264	63	89	44	51	68
CAPEX without PIP	9	20	14	17	1	1	2	3	28	44	51	68
Difference in CAPEX	**0**	**0**	**0**	**0**	**-452**	**-410**	**-263**	**-60**	**-62**	**0**	**0**	**0**
Net flow	**9**	**10**	**2**	**1**	**-405**	**-284**	**-84**	**138**	**137**	**96**	**80**	**57**
Cumulated flow	**9**	**19**	**21**	**21**	**-384**	**-668**	**-751**	**-613**	**-476**	**76**	**507**	**1,182**

Payback period	**10**	YR
IRR=	**11.6**	**%**

A more appropriate way to estimate the real impact of the Project would be to re-introduce the savings rendered to the customers in the global evaluation; such evaluation has been made, by identifying the net savings generated by the Project on energy expenses (through a better efficiency of new pumps) and repairs (through a decrease of unplanned repairs resulting from selective replacement of critical parts of water and wastewater networks and connections). This leads to the identification of an additional "shadow" flow of cash to be added to EBITDA for the calculation of the rate of return. With this additional component, the Economical Rate of Return of PIP Project climbs up to 22,8%, with a payback period of 8 years.

This confirms the economical interest and justification of the PIP Project.

3.15. DETAILED REVIEW OF PROGRESS ON PHASE B

Phase B contains the following specific tasks:

- Phase B.1: Continuation and Conclusion of Measurement Programme;
- Phase B.2: General Information;
- Phase B.3: Water Supply;
- Phase B.4: Wastewater Collection;
- Phase B.5: Wastewater Treatment, including sludge disposal;
- Phase B.6: Institutional and Economic Operation (of ACC);
- Phase B.7: Summary of Investment Programme;
- Phase B.8: Definition of Criteria for Priority Setting for Implementation, and
- Phase B.9: Phasing of Project Implementation.

The work of the Phase B tasks has been reported in the previous chapters.

For ease of reading, the Phase B progress has been set out in the following Table.

Table 55: Schedule of work completed against each of the Phase B tasks

Task	Progress Achieved	% of Progress Achieved	Ref. Section of the Report
Phase B.1 Continuation and Conclusion of Measurement Programme			
Analyze & Summarize the data after 12 months of operation	The on-site Measurement Campaigns have been completed satisfactorily. Models have been calibrated and used for further analysis.	**100%**	3.4 3.9.2 & 3.9.3
Phase B.2 General Information			
Analysis of capacities of construction companies to handle the proposed project during "operation stage" (both in technical and financial terms).	An assessment of the capacity of local constructors is provided. It summarized the main figures describing the major companies in the Republic of Moldova.	**100%**	3.13
Phase B.3 Water Supply			
Present and summarise the investment measures proposed for improving the water supply system, including SCADA system	A set of investments are proposed to improve the existing system, reduce the losses, secure the water supply, …	**100%**	3.8
Water resources: indicate preventive measures to guarantee security of supply in case of accidental pollution	An emergency plan mobilizing underground water resources has been defined.	**100%**	3.6
Phase B.4 Waste Water collection			
Present and summarise the investment measures proposed for improving the waste water collection system	A set of investments are proposed to improve the existing system, channel the pollution, reduce the illegal discharges, …	**100%**	3.9
Phase B.5 Wastewater Treatment including Sludge Disposal			
Present and summarise the investment measures proposed for improving Wastewater Treatment including Sludge Disposal	A set of investments are proposed to improve the existing system, respect the EU norms. A long term strategy for sustainable sludge disposal is proposed and must be agreed by the stakeholders	**90%**	3.10 & 3.11
Phase B.6 Institutional and Economic Operation			
Assess the economic cost-benefits of the proposed components to be financed via the Programme		**100%**	3.14.15
Propose a new tariff structure		**50%**	
Financial Analysis of the Municipality			

Task	Progress Achieved	% of Progress Achieved	Ref. Section of the Report
Analyze the current conditions for subventions and/or subsidies or any other financial support paid from the local budget to cover water and wastewater services. Provide the relevant amounts since 2007.		100%	3.14.12
Carry out a detailed financial analysis of the Municipality including current indebtedness and debt capacity.		100%	3.14.12
Environmental and Social due diligence			
Review any relevant environmental studies undertaken to date.	Presented in the Inception Report	100%	
Assessment of the future potential impacts of the proposed PIP and the ability of the future operations to comply with Moldovan and EU environmental, health and safety standards and regulations	The environmental analysis cannot be finalised until the PIP is approved. However we already started to work to avoid any delay.	50%	
Potential for Carbon Trade Identify expected emission reductions from the proposed investments compared with the baseline scenario and quantify roughly the related CO2 equivalent (COre) emission reductions	Investigations have been made and a report is to be submitted by end of April. It is not on the critical path.	75%	
Environmental and Social Action Plan ("ESAP")			
Prepare an ESAP taht will outline the mitigation measures needed to prevent or mitigate any adverse environmental and social impacts arising from the implementation of the PIP as well as the key steps to be taken to improve the Company's environmental performance so as to achieve, within a reasonable time frame, compliance with Moldovan and EU environmental, health and safety standards.	A preparatory report for the Environmental and Social Action Plan (ESAP) has been submitted. It focusesd on the current environmental and health and safety (EHS) management practices. The ESAP Report will be prepared further to the environmental and social analysis.	40%	
Validation of the ESAP	Majority of outstanding work e.g. budget and tariff determination cannot be completed until the PIP has been finalised during January	0%	
Stakeholder Engagement Plan (SEP) Prepare a draft Stakeholder Engagement Plan for the Municipality in accordance with the EBRD Performance Requirement, providing information on identified key stakeholders, how communication with the identified stakeholders will be handled throughout project preparation and implementation, including the type of grievance procedure.	The draft SEP presnted in the report must be disucssed with the stakeholders bedore finalisation	70%	3.12

Task	Progress Achieved	% of Progress Achieved	Ref. Section of the Report
Phase B.7 Summary of Investment Programme			
Presentation of main expected impacts of the investment measures	A series of Fact Sheets present the physical components of the subprojects constituting the PIP (cost estimates and overviews of benefits expected)	**100%**	Ex. Summary 4
Phase B.8 Definition of Criteria for priority setting for implementation			
Criteria shall be proposed for discussion with and decision by stakeholders	Criteria have been discussed with ACC and presented to the stakeholders during the meetinghel on February 16th	**100%**	4.3
Phase B.9 Phasing of project implementation			
Presentation of proposals for phasing the Long Term Investment Plan of the Company for discussion with and decision by stakeholders	The phasing of the LTIP has been done taking into account the overall strategy. It is shown in the Business Plan. After the approval of the Phase B Report, a detailed phasing for the PIP is to be prepared.	**50%**	5.3

4. PRIORITY INVESTMENT PROGRAMME

4.1. Definition & Objectives

The Priority Investment Programme ("PIP") can be considered as a short term programme (5 years) and constitutes more or less the first phase of the LTIP. It aims to meet the first and most urgent needs of ACC. The PIP must be tailored for the benefit to the wider community and in accordance with ACC and co-funders policy and objectives.

The definition of criteria used for Priority Setting is detailed in Section 4.3.

The Section acts also as a summary of our capital investment proposals.

4.2. Methodology

The elaboration of the PIP has been based on the following methodology:

- Technical assessment of the current situation, including operational performance of ACC (performed in Phase A);
- Proposal of projects aiming to improve the current situation and meet the urgent needs defined in the first phase (Phase B);
- Design of the above mentioned projects based on hypotheses discussed and agreed with ACC (water demand, …) (Phase B);
- Identification of projects eligible for PIP based on a multi criteria analysis and after formal and informal meetings and discussions with the management and technical staff of ACC (Phase B).

4.3. Definition of Criteria for Priority Setting for the PIP

4.3.1. Strategic Basis

Priorities may be perceived differently depending on who is looking at, as shown on the following figure.

The strategy we propose must consider:

- the business needs and objectives of ACC – legal and regulatory compliance; improved customer service and efficiency;
- the objectives of the funding organisations - improvement of the environment. Indeed, in considering the criteria, it should be borne in mind that the Feasibility Study will be used as the basis for funding applications;
- The improvement of the level of services for the customers.

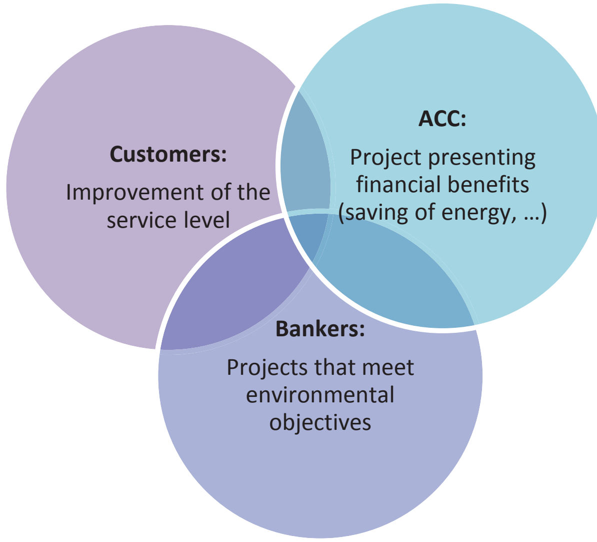


Figure 17: Priorities in the Selection of the PIP

Although it appears that there are no specific levels of service clearly defined either by the Moldovan legislation or in ACC statutes, customers have some expectations and wish some improvements of the water and wastewater systems. This has been evidenced during the households survey that has been performed in the frame of our Study (1,000 households have been interviewed during spring 2011).

The graph below, abstracted from the Report “Water Demand Assessment” shows the overall satisfaction on levels of service. Hence it takes into consideration both the level of satisfaction and the importance of the feature given by the household. For instance taste and cost of water have least importance; information of customers as well as answer to clients’ complaints has most importance.

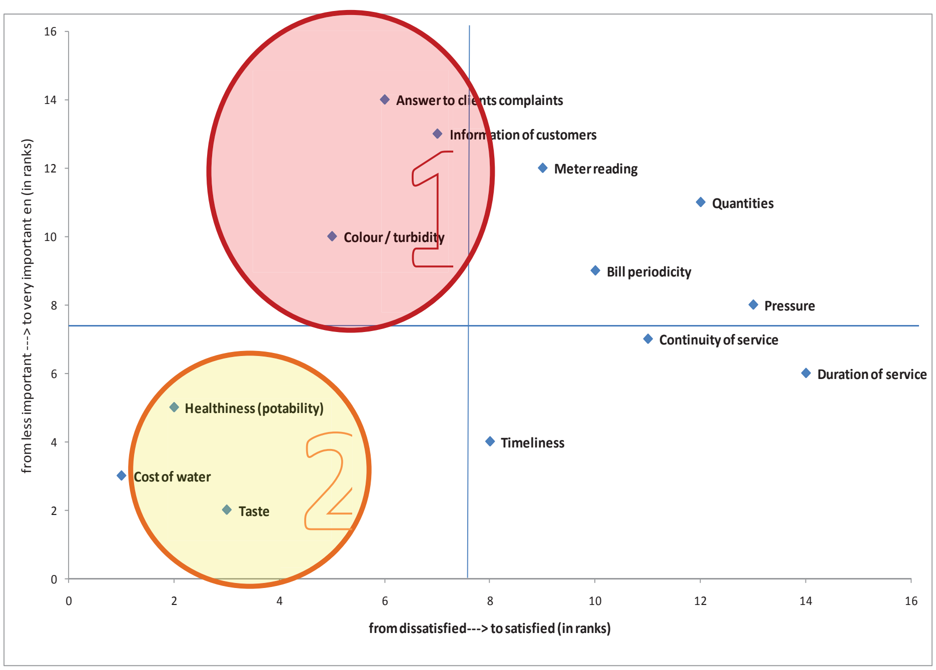


Figure 18: Customer Satisfaction Map

The most important quadrant is the *top left* that cumulates maximum importance with maximum dissatisfaction (highlighted in pink). In this quadrant, 3 features are found:

- Answer to clients complaints and information of customers that are considered as very important, but that involve a reasonably low dissatisfaction
- Colour/turbidity is less important but involves more dissatisfaction

Improvement must be made regarding the healthiness and taste (yellow zone), which are not considered as very important, but are still far to be satisfactory, from the customers' point of view.

The improvements for the existing water service that are expected by the dissatisfied households are mainly the filtering of water and the replacement of water pipes.

It is worth noticing that the serious situation with sludge treatment, responsible of odour problems encountered near the WWTP is one of the major concerns for both Chisinau Municipality and ACC. Solving this issue would probably not be perceived by the major party of the population as an improvement component of the level of service.

4.3.2. MULTI-CRITERIA GRID FOR PIP RANKING

The following main criteria have been adopted in the process of identification and selection of the subprojects included in the PIP:

- Compliance with Moldovan and EU norms & standards;
- Enhancement of the operational efficiency & customer service, resulting from any or a combination of the following: i) substitution of obsolete pumps and electromechanical equipment with energy-efficient alternative equipment, ii) overall improvement of operation and maintenance (O&M) efficiency including safety of workers, iii) reduction of leakage and black spots, all the above resulting in operational cost reduction, and iv) improvement of reliability of equipment;
- Anticipated environmental benefits, mainly consisting of: i) introduction of "International Best Practice", ii) reduction of pollution load in surface water, iii) energy savings and reduction of water wastage, iv) improved quality of water supply;

It has to be noted that the PIP we propose shall be entirely consistent with the LTIP since it constitutes its first stage implementation.

Based on the main principles listed before, we have defined a set of criteria to rank the sub-projects and select those which present the more benefits.

Table 56: Criteria for Prioritisation

Criteria for Priority Setting for Implementation	Score
Compliance with the Moldovan Regulation/Law	15
Secure the sustainability of the drinking water supply and its quality	
At a very large scale (all the service area of ACC)	15
At a medium scale (district, villages or street)	5

Criteria for Priority Setting for Implementation	Score
At a small scale (block)	2
Improvement of Customer Service and reliability of the service	
At a very large scale (all the service area of ACC)	5
At a medium scale (district, villages or street)	2
At a small scale (block)	1
Operational expenditures savings	
ROI < 2 years	8
2 years < ROI < 5 years	4
5 years < ROI < 10 years	1
Improvement of the operational efficiency	
Safety of the employees	15
Improvement of quality of the work	3
Increase of efficiency	2
Improvement of the environment	
Reduction of pollution of natural water courses	6
Significant saving of water	5
Significant saving of energy	3
Reduction of GHG	3

Each of the criteria has a “score” between 15 and 3, depending on the importance of the criteria.

All subprojects have been ranked. The subprojects with the highest score have the highest priority.

The prioritised list derived as above has been then presented to a panel of ACC and adjustments have been made integrating their local expertise and perception.

4.4. Proposal and Justification of the Short-Term Investment Programme

As explained before, the LTIP has been prioritised into a PIP that would fit an assumed level of funding, here about 60 MEUR.

The most urgent needs both within water supply and wastewater have been addressed in the PIP. The overall short-term strategy is reminded hereafter. Most of the technical elements have been already detailed in the previous chapters. However we believe it is important to remind some items in order to understand the structure and the content of the proposed PIP.

4.4.1. Water Production

Decommissioning of SAN

The two existing plants (SAN & STA) treating the water from the Nistru River (97% of the current productions) are globally in poor condition. No significant investment has been made on the two plants since the construction of the third phase of the main plant (STA), with the consequence that the two plants should be completely rehabilitated or reconstructed.

The first step we propose to consider in the PIP is the decommissioning of SAN. Indeed, maintaining in operation the 2 sites (SAN & STA) has two drawbacks:

- It does not secure the supply since both plants treat the water coming from the same source, the Nistru River. SAN cannot be considered as a backup facility in case of accidental pollution;
- It is more expensive than operating 1 solely site.

Furthermore, the water produced at SAN and supplied to Chisinau is as expensive as the water produced at STA (electricity and chemical expenditures are more or less equivalent for 1 cubic metre of water produced).

Regarding the CAPEX, rehabilitating two plants is also much more expensive that focusing the investment on one site only.

It is worth noticing that the whole area supplied by SAN is already connected to the main network and the hydraulic system can easily be adapted. Only the raw water pumping station located at SAN, and feeding STA, will be kept in operation.

The full rehabilitation of STA is planned in the LTIP. Within the PIP we propose to limit the investments to perform:

- Some urgent general rehabilitation works in the WTP (rehabilitation of the roof of the building where are located the filters, renewal of some hydraulic fittings, …);
- Construction of an electro-chlorination Plant to produce sodium hypochlorite used for the water disinfection. Bulk supply of sodium hypochlorite is the current method. Producing on site hypochlorite production by electrolysis will reduce the operating costs and secure the treatment.

Rehabilitation of the well fields

As already stressed several times in the frame of this Study, the security of supply within Chisinau is very vulnerable since the main and almost solely source of water for Chisinau is the River Nistru.

As detailed in a specific report on the water resources, mobilizing underground water resources appears to be a reliable alternative to mitigate the risk of pollution or flooding. It implies to:

- Rehabilitate the existing well fields of Ialoveni, Ghidighici, Petricani and Balisevsc;
- Create a new well field near STA.

The cumulated estimated capacity production is expected to be about 63,600m^3/d. This will provides adequate water to supply Chisinau and meet about 34% of the current volume into supply and 50% of the estimated volume into supply in 2035 thanks to a reduction of water losses and a decrease of the demand.

Given the poor quality of the ground water in most of the wells fields, the production of drinking water from these sources will require the implementation of treatment facilities.

4.4.2. DRINKING WATER NETWORK

All the population living in the Study Area is not fully supplied with potable water. However the extension of the drinking water network operated by ACC is not included in the PIP because such investments are not the responsibility of ACC. Investing into new facilities (treatment works, pipes, PS, reservoirs) to connect new areas should be supported directly by local authorities.

Adaptation to the new scheme of production

The new production scheme with the decommissioning of SAN and the mobilization of underground water resources imply some modifications in the existing water supply system.

New pumps have to be installed in existing facilities (Tohatin for example) and new pipes must be laid. These investments are mainly due to:

- the water distribution between Vadul Lui Voda and Tohatin has to be adapted: by-pass of SAN, new pumping stations;
- The dilution in the reservoirs of Petricani and Ghidighici: underground water produced from Balişevschi, Ghidighici and Petricani well fields must be diluted with the water produced at STA in the storage tanks before being supplied to customers.

Pipes

Although the current network efficiency is acceptable (about 60%), taking into consideration the present economical conditions of ACC, the estimated volume of NRW represents still 89,000 m^3/d, i.e. 32.5 Mm^3/year. This must be improved. Furthermore, as already stressed in the assessment of the current network, the LLI is around 47m^3/day/km and the mean LRI about 8repair/km/year. Those values are very high and evidence the poor condition of the network. In Western Europe, Veolia ranks urban network within the "Very Poor" category when the linear leakage index is higher than 16m^3/day/km and in Bucharest the LRI observed is 5.2repair/km/year.

A programme of pipe and HSC renewals is required in order to achieve sustainable leakage reduction and to alleviate service problems for customers.

The targeted programme of pipe rehabilitation we propose to include in the PIP is based on pipe bursts analysis. Renewal usually takes precedence over repair when it represents the least cost option assessed on the whole lifespan. Our analysis shows that the most brittle pipes are: i) pipes made of steel with a Nominal Diameter between 100 and 400 mm (especially ND150 and ND200); and ii) pipes made of iron with a Nominal Diameter between 100 and 200 mm (around 17% of total length and of total repairs).

In order to significantly and quickly reduce the physical losses, we propose an ambitious programme, particularly during the next five years, with the replacement of 190 km of pipes (mainly steel pipes with ND between 100 and 200). The exact location of the pipes to be replaced will be based on the statistical analysis of the georeferenced leakages, using the GIS.

It has to be noted that the programme should be adapted taking into consideration other parameters, as the programme of road rehabilitation undertaken by the Municipality. When renovating a road, it might be interesting to replace the pipes as well. Strategic pipes might be also added to our programme because of the consequences a burst may cause (see photo below).

Figure 19: Burst on a ND1200 cement pipe threatening the road

When renewing the pipe, we propose to rehabilitate also the HSC. We include about 3,270 connections in the PIP, which correspond to the connections for blocks. HSC for individual houses or industrials should be replaced at the same time but it will be charged to the customer as those connections are not ACC property.

The implementation of this PIP will result in a drop of the number of intervention, from 14,000 to 8,600 (-39%). The volume of water wasted by losses will also decrease by 30%.

In addition, we expect energy savings (less water to pump) and also an improvement of the water quality (the risk of contamination will be reduced).

Pressure reduction

Another mean to reduce the physical water losses is to optimize the management of the pressure. By reducing the pressure, the water lost for each existing leak is reduced, and the number of new leaks drops. Several solutions have been studied:

- Change the pressure set at the outlet of the pumping stations;
- Isolate a part of the network and supply it by a pressure Zone with a lower piezometry;
- Isolate a part of the network and install a pressure reducer.

The implementation of a EUR 302,000 capital investment programme, mainly consisting in installing some pressure reducers, new valves, pressure sensors, flow meters and boosters, will reduce the physical losses by 10%.

Reservoirs

We assessed the cumulated storage capacity of the existing reservoirs sufficient to secure the supply against emergency situation. It represents about 168,000 m^3; i.e. 70% of the daily peak water demand.

Although there is no need to increase this storage capacity by constructing new service reservoirs, some of the existing reservoirs must be rehabilitated within the PIP because of their poor structural condition. It concerns 17 sites.

In addition, we propose also to decommission 3 reservoirs (cumulated capacity ~8,000 m^3). They are too expensive to rehabilitate and do not contribute to the objective: maintaining a storage capacity higher than 50% of the peak demand over the next 25 years per hydraulic entity.

Operating mode of reservoirs must be optimized (flow balancing) to take into account the new tariff structure for electricity, which should result in energy savings.

Pumping Stations

The current pumping stations are rather well operated by ACC, but some of them are proposed to be rehabilitated. New pumps with better efficiency will lead to significant energy savings.

The first step of our analysis consisted in identifying the PS worth rehabilitating.

Then we have looked which PS should be shutdown to fit with the new production scheme (decommission of STA, …).

The PS proposed to be rehabilitated within the PIP are listed in the table below.

Table 57: Water Pumping Stations to be Rehabilitated

Pumping Station	% of the total current consumption of energy	Energy savings per year	Estimated savings per year
Treapta II a raw water	20.0 %	1,021,343 kWh/y	1,370,000 MDL
Buiucani Z3 & Z4 PS	2.6 %	615,622 kWh/y	822,000 MDL
Independenta Z3 & Z4 PS	4.4 %	640,964 kWh/y	856,000 MDL
Total	**27.0%**	**2,277,929 kWh/y**	**3,048,000 MDL**

As shown on the above table, these subprojects result not only in operational expenditures savings for ACC but also in reduction of energy consumption, which is in benefit to the Environment.

Telemetry System and Control

Introducing a phased programme for telemetry monitoring and control is part of the PIP.

The existing SCADA systems used by ACC are operational and work properly. We recommend to develop it. ACC should pursue their investments for the equipment of remote transmission.

To significantly improve the current situation, we advise ACC to choose a unique tool for data processing.

4.4.3. WASTEWATER COLLECTION NETWORK

In the wastewater field, sewage collection is only available in parts of the study area.

However, extension of the wastewater collection network is not included in the PIP for the following reasons:

- Investing into new facilities to connect new areas are not under the direct responsibility of ACC, but should be supported by local authorities;
- Inside Chisinau city, some areas are missing the wastewater collection system, but these areas will be known only once the GIS is finished.

The investment considered in the PIP are the ones that

- Improve the operational efficiency of ACC, and guaranty the safety of the workers
- With a small investment have a high return rate and lead to energy savings
- Channel the pollution to the WWTP

Sewers

The wastewater collection system is known to be in a poor condition with blockages, broken pipe and other deficiencies. However, over the past few years, a very few rehabilitation works have been done as no substantial funding has been available for their launch.

But the need for rehabilitation and/or replacement is evident. It will improve the structural stability of the network and limit the risks of breakage or collapse.

While the overall requirements exceed the financing of the first phase, an allocation is essential to initiate improvements in the most pressing sections of the network. In close collaboration with the operation sectors chiefs a list of “urgent rehabilitation” has been defined. ACC staff had chosen the pipes to be rehabilitated based on their detailed knowledge and expertise only (no thorough CCTV inspection has been performed). However, ACC has a very good empirical knowledge of its system. Many operational and structural reasons confirm the rehabilitation choices.

In the PIP, replacement of about 15 km of sewers is considered.

Pumping Stations

The investments for the WW PS we propose within the PIP aim to reduce the energy consumption, therefore realise savings by replacing some existing pumps.

The 9 pumps concerned are listed in the table below.

Table 58: Wastewater Pumping Stations for Rehabilitation

Pumping Station	Pump No.	Estimated energy savings	Estimated savings per year
Vatra	1	52,993 kWh/y	70,967 MDL
Vatra	2	40,259 kWh/y	53,914 MDL
Codru	2	29,935 kWh/y	40,088 MDL
Codru	1	21,413 kWh/y	28,675 MDL
Codru	3	21,413 kWh/y	28,675 MDL
Vieru	2	32,991 kWh/y	44,181 MDL
Vieru	1	26,381 kWh/y	35,329 MDL
V. Lupu	1	13,816 kWh/y	18,502 MDL
Vatra	3	23,832 kWh/y	31,915 MDL
Total		**263,033 kWh/y**	**352,246 MDL**

In addition to the above stations that are installed on the sewerage network, we also propose to include in the PIP the replacement of the pumps installed at the inlet pumping station of the WWTP. They are oversized and should be replaced by equipment adapted to the actual needs. It is worth reminding that these pumps consume about 70% of the total consumption of the wastewater collection system. The saving expected is about 3.5 MLeu/year (218,000€/year) and the consumption of electricity should decrease by 60%. The time of return on investment is lower than 2 years, which is very low considering the forecasted lifetime of this type of equipment (20-30 years).

Telemetry System and Control

Proposals for WW PS are the same as for the drinking water: development of the remote control system (SCADA) and upgrade of data storage and processing, utilizing the same system for both DW and WW.

4.4.4. Wastewater treatment and sludge management

Chisinau WWTP suffers from the lack of investment over the past decades. The major issue at the works is the odour that emanates from the site, due mainly to poor sludge management. In addition to this odours issue, the structural condition of the plant is very poor and the process performance and quality of the final effluent should be improved.

The full rehabilitation of the existing structures of Chisinau WWTP is not a good option either economically or technically due to the advanced damage of the works and to the future treatment requirements (compliance with the EU standards on N<10 mg/L and P<1 mg/L for a sensitive receiving body as the Bic River and expected increase of the load received in the future).

Therefore a new plant will have to be built. But this requires massive investments (more than 50 M€). This cannot be included in the PIP but will be considered in the long-term strategy for wastewater treatment and sludge disposal.

However solutions must be found in order to secure the good operation of the existing WWTP in the medium term horizon until the construction of the new WWTP. Particular efforts should be made to reduce odours.

The new facilities we propose to construct during the PIP must be designed in such a way that they can be easily integrated into the future WWTP. Actually, the PIP component for the WWTP constitutes the first step of the long-term implementation. It includes the following:

- Construction of new pre-treatment facilities:
  - New pump building (inlet chamber, by-pass, coarse screens, pumps)
  - Fine screens
  - Sand and grease removal tanks
- Light rehabilitation of primary settling, biological tanks and secondary clarification;
- Implementation of separated thickening for biological excess sludge
- Implementation of sludge dewatering: installation of centrifuges
- Construction of digesters for an anaerobic digestion with energy generation
- Upgrading of the electrical works

Optimizing the pre-treatment, dewatering and anaerobic digestion of the sludge are efficient solutions to reduce significantly the unacceptable odour emanating from the site.

Dewatering and digesting the sludge will allow to: i) achieve higher reduction in sludge volume by eliminating 1/3 of the dry solids; ii) stabilize the sludge (today the sludge are not stabilized which is one of the source of odour); iii) to produce biogas that would cover more than 50% of the energy production of the WWTP (inclusive of the upstream pumping station).

Before implementing a long-term and sustainable sludge disposal strategy (agriculture use or landfilling), we propose to continue to store dehydrated sludge in the recently built dumping site nearby the plant. It is worth pointing out that installing centrifuges will extend its lifetime from 4 years to 6 years.

4.4.5. INVESTMENTS AIMED AT IMPROVING OPERATION PERFORMANCE

It is important, with the improvement of the water supply and wastewater systems, to consider appropriate investments aimed at improving the ACC operational performance.

Together with the introduction within ACC of best practices for network operation, investments for the modernization of the O&M equipment should be done. Currently, ACC is poorly equipped: the overall fleet of vehicles is old and not very efficient. Their productivity is low compared with modern vehicles. Their maintenance costs are high due in particular to a very high consumption of fuel.

The provision of operation and maintenance equipment provides vital support to the company in undertaking maintenance and repair work and must be included in the PIP. The needs have been identified jointly with ACC.

O&M investments for drinking water supply system:

Considering the age of the current equipment within ACC, and their inadequacy to a performing service, we recommend a massive investment in new equipment including small Truck 5-10T, public works machinery and equipment, safety equipment, excavators, trucks and leak detection equipment for 2 teams.

O&M investments for wastewater collection system:

We propose to equip ACC with operating equipment for preventive actions in order to reduce significantly the number of interventions. Today, there are about 30interventions/km/year. In comparison this KPI is about 7int/km/y today in Bucharest.

It will also make the daily intervention on the network simpler and safer.

Our proposal includes vehicles, 2 big hydro-cleaning trucks and 5 small jet units on trailer (1 per team), 1 CCTV truck and 5 quick view, 1 smoke generator and general intervention equipment.

O&M investments for the improvement of ACC operational staff safety

By international standards, there are some aspects within ACC that should be improved regarding the safety issues. That is considered as a top priority.

Therefore, the PIP we propose includes some measures aiming to improve security for ACC staff:

- Installation of Plexiglas protection in front of the electrical panel of all WW PS
- Electrical optimization : installation of new electrical panels for all the WW PS
- Purchase safety equipment for ACC operating staff (gas detectors, road signalisation, etc.),

4.5. COST ESTIMATES OF THE PIP

The estimates of quantities and costs of the components in the short-term investment programme have been based on recent experience of works executed in Moldova, whenever available, and on international costs for import items. The cost level is as of2011.

The total cost of the proposed short-term investment programme is 59.7 M€ including basic implementation costs as well as allowances for physical and price contingencies. No taxes have been included.

In the PIP we propose, the priority is slightly given to wastewater which concentrates 55% of the investments.

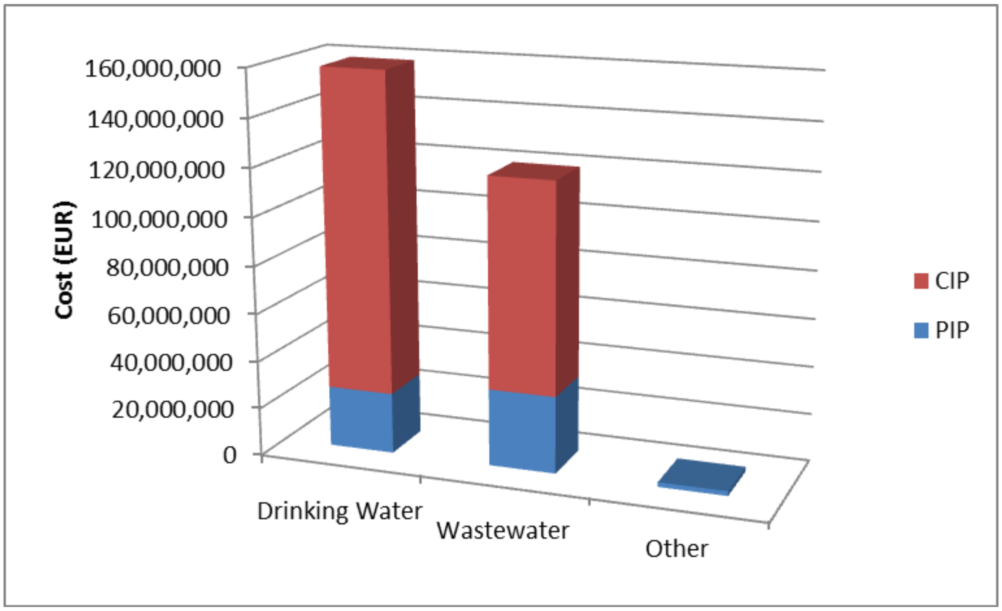


Figure 20: PIP & LTIP

The following figure shows the main components of the proposed PIP. It clearly appears that the PIP contains two major items:

- Wastewater Treatment (44%), which includes the first phase of upgrading the WWTP: new pretreatment, light rehabilitation of primary settling, biological tanks and secondary clarification, separated thickening for biological excess sludge, anaerobic digestion with energy generation and sludge dewatering for reducing the volumes produced before landfilling.
- Drinking Water Network (25%), which includes the renewal of pipes, replacement of HSC (for blocks only) and rehabilitation of reservoirs.

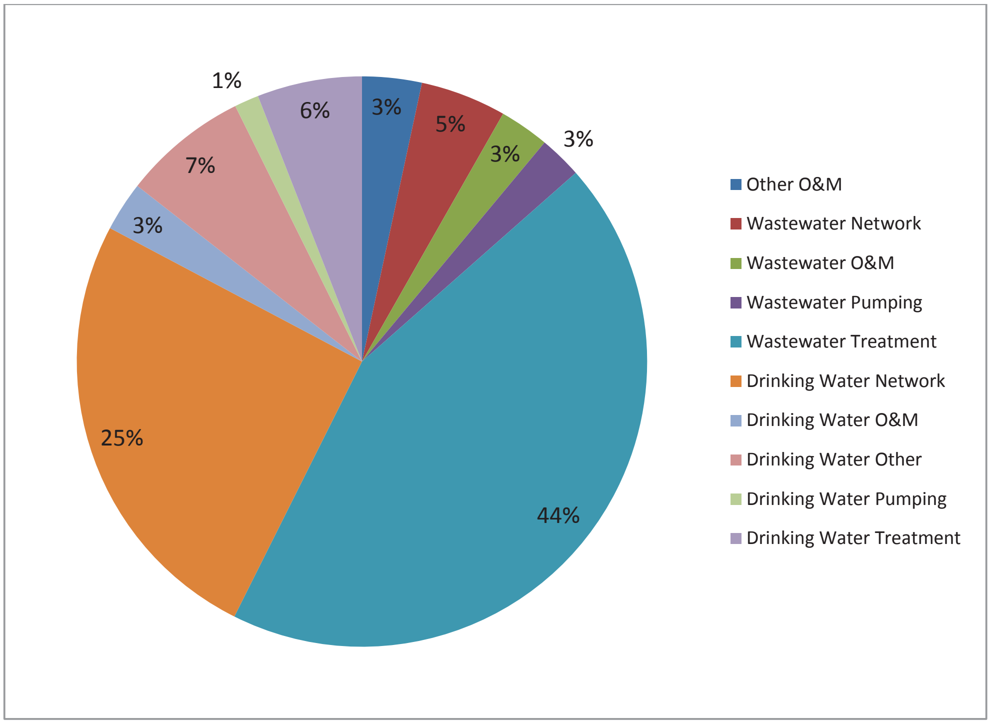


Figure 21: Main Components of the Proposed PIP

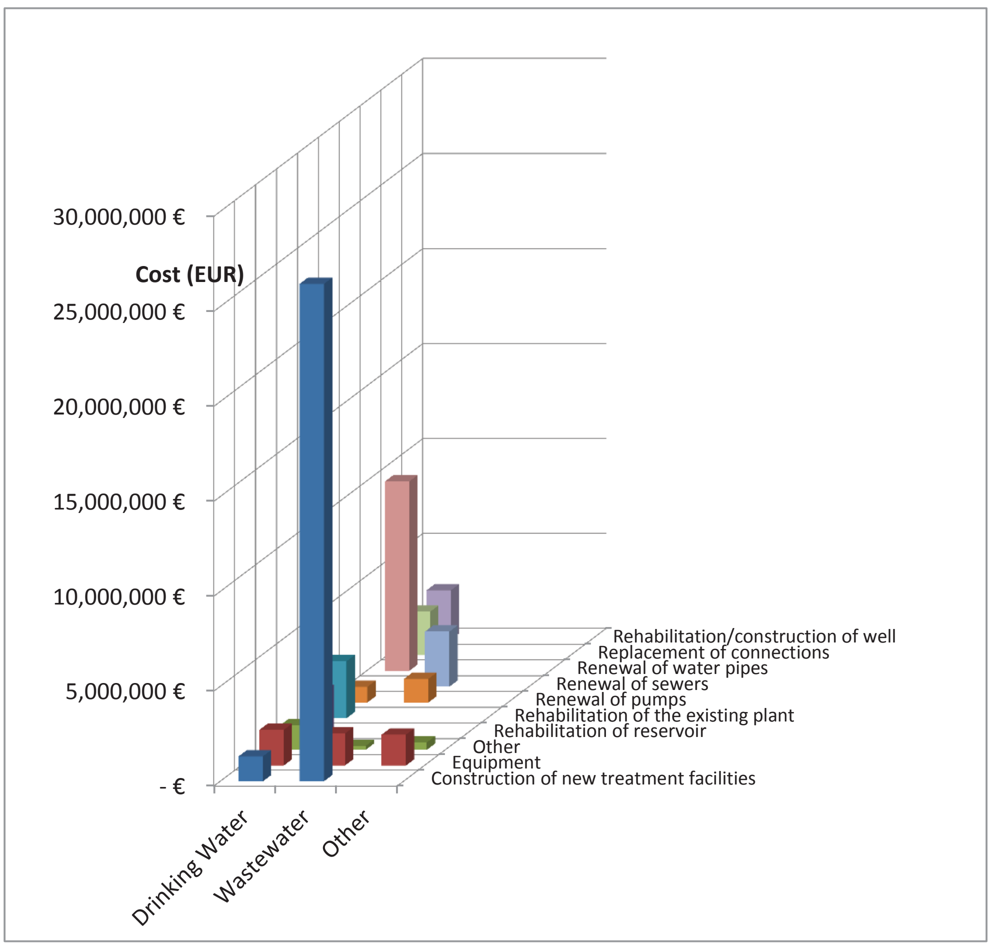


Figure 22: Components of the Proposed PIP

4.6. DESCRIPTION OF THE COMPONENTS OF THE PIP

Descriptions of the physical components of the subprojects constituting the PIP, as well as cost estimates and overviews of benefits expected after implementation of each subproject are provided a series of Fact Sheets ranked by priority (ref the end of this Executive Summary).

Each subproject has been labelled as following:

- DW or WW or O for Drinking Water or Wastewater or Other;
- Nor P or Tor O&M or O for Network or Pumping or Treatment or O&M or Other.

It is worth pointing out that some subprojects are linked: rehabilitation of pipes and of connections for example, or rehabilitation of wells and treatment of the water produced from the wells.

In light of the above, we have grouped some subprojects in order to obtain coherent and consistent sets.

Irrespective to the priority rank of each subproject, we have defined “global priority” for each set, taking into account the following strategy of implementation:

1. Wastewater investments first,
2. Then O&M
3. And finally drinking water investments.

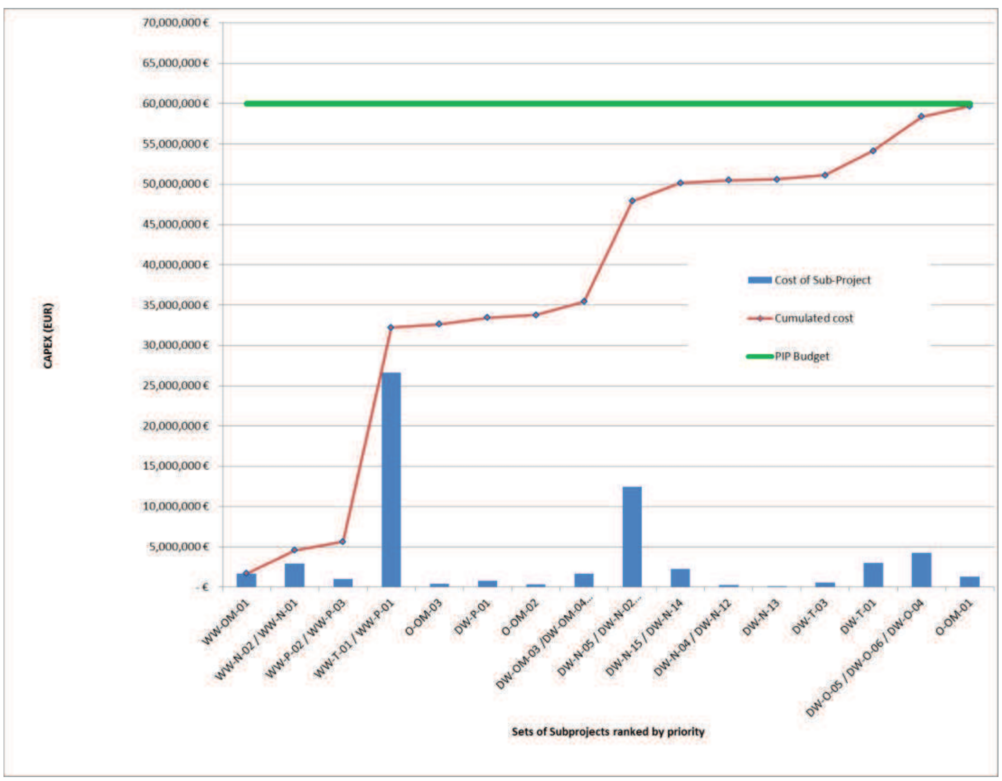


Figure 23: Sets of subprojects ranked by priority

Table 59: PIP Projects

Field	Sub-Category	% of PIP	Cost	Rank	Description	% of PIP	Code
Drinking Water	Treatment	6%	3,000,000 €	14	Urgent rehabilitation works including Electro chlorination plant	5.0%	DW-T-01
			548,000 €	13	Treatment of the water produced from Ialoveni well field	0.9%	DW-T-03
	Network	25%	12,468,000 €	9	Rehabilitation of 190 km of water pipes and 3,270 block service connections+ hydraulic fittings	20.9%	DW-N-05 / DW-N-02 DW-N-04 / DW-N-01
			2,256,000 €	10	Rehabilitation of reservoirs	3.8%	DW-N-15 / DW-N-14
			303,000 €	11	Pressure reduction on the network	0.5%	DW-N-04 / DW-N-12
			108,000 €	12	Adaptation of the water distribution system to the new production scheme: By-pass of SAN facilitiesNew PS from Zone 2 to TohatinNew PS from Tohatin tanks to VdVGhidighici dilution	0.2%	DW-N-13
	Pumping	1%	825,000 €	6	Rehabilitation of the existing PS	1.4%	DW-P-01
	O&M	3%	1,678,000 €	8	Equipment for operating the drinking water network	2.8%	DW-OM-03 /DW-OM-04 DW-OM-01 /DW-OM-05 / DW-OM-02
	Other	7%	4,244,000 €	15	EMERGENCY PLAN (Rehabilitation of the wells + treatment facilities + adaptation of distribution system)	7.1%	DW-O-05 / DW-O-06 / DW-O-04
Wastewater	Treatment	45%	26,595,000 €	4	First phase of upgrading the WWTP for Chisinau (New pretreatment, light rehabilitation of primary settling, biological tanks and secondary clarification, separated thickening for biological excess sludge, anaerobic digestion with energy generation, sludge dewatering)	44.6%	WW-T-01 / WW-P-01
	Network	5%	2,903,000 €	2	Renewal of sewers (15 km)	4.9%	WW-N-02 / WW-N-01
	Pumping	2%	1,051,000 €	3	Rehabilitation of PS	1.8%	WW-P-02 / WW-P-03
	O&M	3%	1,683,000 €	1	Equipent for operating the wastewater network	2.8%	WW-OM-01
Other	O&M	3%	1,300,000 €	16	Purchase of MIS equipment	2.2%	O-OM-01
			389,000 €	5	Replacement of the electrical lines in STA, SAN, SESE, SSP	0.7%	O-OM-03
			325,000 €	7	SCADA: Upgrading or renewal of the equipment for drinking & wastewater PS + Data Storage + Implement a unique tool for data processing	0.5%	O-OM-02
SUB-TOTAL for DRINKING WATER			25,430,000 €				
SUB-TOTAL for WASTEWATER			32,232,000 €				
SUB-TOTAL for OTHER			2,014,000 €				
TOTAL			**59,676,000 €**			**100.0%**	

This draft PIP has been presented to both ACC and the main stakeholder (EBRD, EU, Chisinau Municipality, …) during the "Phase B 2nd Quarterly Report – Stakeholder Meeting" held on February 16th, 2012 at ACC office.

Some minor adjustments have been made (integration of digester for the sludge, …).

5. LONG TERM INVESTMENTS PROGRAMME

5.1. DEFINITION

The Long-term Investment Programme ("LTIP") consists in a strategic long-term investment plan for ACC, which aims to achieve maximum improved operational efficiency with sustainable service reliability for both water supply and wastewater systems over a 25 year period.

To make easier the understanding of the investments programme, we propose to introduce a third definition: the Complementary Investments Programme –CIP. The definition is as follows:

LTIP = PIP + CIP

Based on the technical assessment we made, the LTIP we propose include all CAPEX that we consider as necessary to bring ACC in line with other utilities for the next 25years (see Chapter 3), irrespective of affordability and financing capacity of ACC.

It is worth pointing out that:

- Construction of new assets into developing areas (networks, treatment works, …)are not included in the LTIP because outside of ACC perimeter. Indeed expansion must be funded by the Municipalities, not ACC;
- the financial model we have built (see next chapter) does not include all the LTIP but only the part which is economically sustainable for the own resources of ACC together with the PIP;
- funding the whole LTIP in the long-term horizon will require a specific study and funding strategy.

5.2. DESCRIPTION OF THE LTIP

The total cost of the proposed LTIP is 280.5 M€, as shown in the following table.

Table 60: Summary of PIP, CIP & LTIP

	PIP	CIP	LTIP
Drinking Water	25,430,000 €	133,314,000 €	158,744,000 €
Wastewater	32,232,000 €	87,466,000 €	119,698,000 €
Other	2,014,000 €		2,014,000 €
TOTAL	**59,676,000 €**	**220,780,000 €**	**280,456,000 €**

A significant part of the programme is dedicated to the rehabilitation of pipes:

- 53% of the CIP for water pipes renewal
- 21% of the CIP for sewers renewal

The LTIP also includes heavy investments to comply with the EU norms regarding water treatment. Indeed we propose to:

- Construct a new WWTP;
- Fully rehabilitate the WTP STA.

Both plants are in poor conditions. Investments made in the PIP are the minimum to ensure a partial treatment for the next coming years, assuming the civil works will allow to operate the plants until the implementation of the CIP.

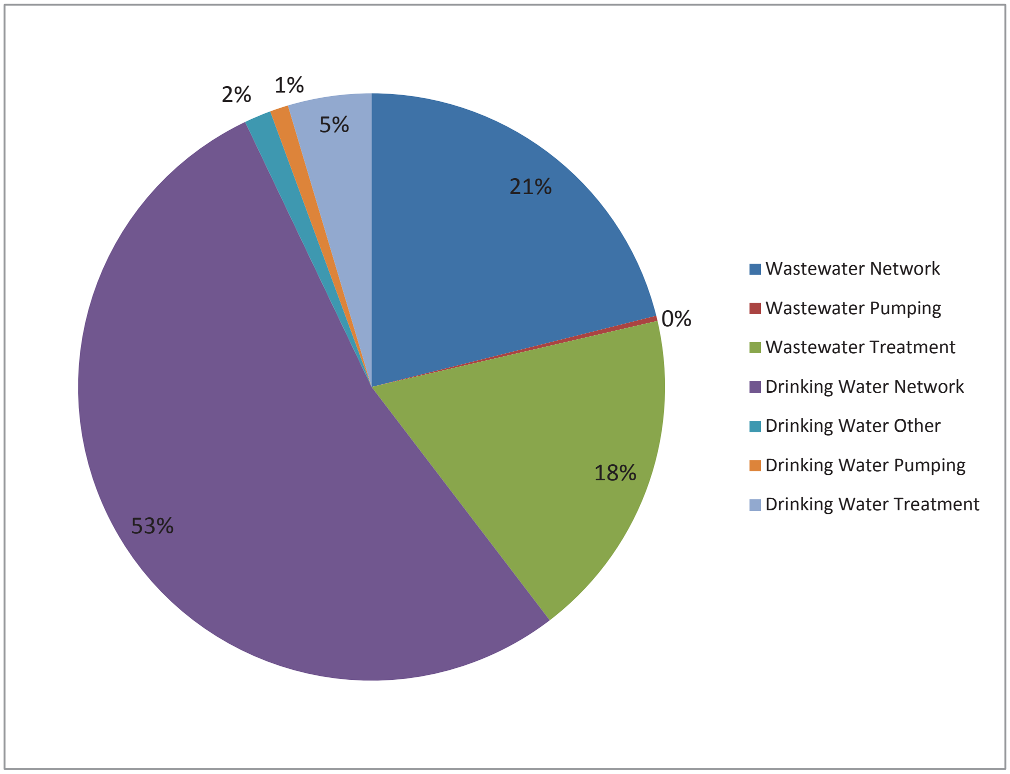


Table 61 & Figure 24: Main Components of the Proposed CIP

	Drinking Water	Wastewater	Total
Network	117,661,000 €	46,589,000 €	164,250,000 €
Renewal of sewers		46,589,000 €	46,589,000 €
Renew of pipes	83,349,000 €		83,349,000 €
Replacement HSC	34,312,000 €		34,312,000 €
Other	3,260,000 €		3,260,000 €
Block water meters	3,260,000 €		3,260,000 €
Pumping	2,236,000 €	630,000 €	2,866,000 €
Renewal of pumps	2,236,000 €	630,000 €	2,866,000 €
Treatment	10,157,000 €	40,247,000 €	50,404,000 €
New Plant		40,247,000 €	40,247,000 €
Rehabilitation	10,157,000 €		10,157,000 €
Total	**133,314,000 €**	**87,466,000 €**	**220,780,000 €**

5.3. PHASING OF THE LTIP

The phasing of the LTIP has been done taking into account the overall strategy. It is shown in the Business Plan.

After the approval of the Phase B Report, a detailed phasing for the PIP is to be prepared.

Annexes

LIST OF ANNEXES

Annex 1 Description of the LTIP irrespective financing capacity of ACC

LONG TERM INVESTMENT PROGRAMME - LTIP

No.	Colonne1	Field	Sub-Cat	Type of operation	Quantity	Unit	Unit Cost	Cost	Rank	PIP or LTIP	Description
1	WW-P-01	Wastewater	Pumping	Renewal of pumps	1	u	400,000 €	400,000 €	26	PIP	Renewal of the pumps at the inlet f the WWTP: 4 pumping groups
2	WW-P-02	Wastewater	Pumping	Other	1	ls	204,000 €	204,000 €	7	PIP	Installation of electrical panel plexiglas in the big PS+ Installation of electrical panel plexiglas in the small PS + New electrical panels in big PS + New electrical panels in small PS
3	WW-P-03	Wastewater	Pumping	Renewal of pumps	1	ls	847,000 €	847,000 €	17	PIP	Rehabilitation of PS where odour issues are obsrevedReplacement of the pumps of Vatra 1, Vatra 2 and Codru 2 + Replacement of the pumps of Codru 1 & 3, Vieru 1 & 2, V.Lupu 1 and Vatra 3
4	WW-P-04	Wastewater	Pumping	Renewal of pumps	1	ls	630,000 €	630,000 €	42	LTIP	Renewal of pump (5 pumps per year)
5	WW-N-01	Wastewater	Network	Renewal of sewers	4,800	m	202 €	968,000 €	19	PIP	Urgent pipe rehabilitation defined by ACC
6	WW-N-02	Wastewater	Network	Renewal of sewers	9,600	m	202 €	1,935,000 €	30	PIP	Rehabilitation of the 2nd priority pipes selected by ACC
7	WW-N-03	Wastewater	Network	Renewal of sewers	141,900	m	252 €	35,758,800 €	39	LTIP	Rehabilitation of the pipes selected by ACC
8	WW-N-04	Wastewater	Network	Renewal of sewers	57,300	m	189 €	10,829,700 €	38	LTIP	Renewal of the sewerage network based on 1% after the completion of the rehabilitation programme
9	WW-OM-01	Wastewater	O&M	Equipment	1	ls	1,683,000 €	1,683,000 €	16	PIP	Hydrocleaning trucks + Jet units on trailer + CCTV Equipment + Quick View equipment for sewers inspection: 5 equipment for 5 teams + Safety Equipment (gaz detector, scale, harness, protection clothes, safety signs, road signalisation, …) + General intervention equipment + Smoke generator + “basa de produtie” ?A CONFIRMER AVEC CAMILLE
10	DW-OM-01	Drinking Water	O&M	Equipment	2	ls	41,000 €	82,000 €	4	PIP	Necessary equipment for 2 leak detection teams, inlcuding 2 light commercial vehicles
11	DW-OM-02	Drinking Water	O&M	Equipment	19	ls	34,000 €	646,000 €	10	PIP	Vehicles for the transport of team: 19 Small Truck 5-10T and 19 Trailer for mini excavator

LONG TERM INVESTMENT PROGRAMME - LTIP

No.	Colonne1	Field	Sub-Cat	Type of operation	Quantity	Unit	Unit Cost	Cost	Rank	PIP or LTIP	Description
12	DW-OM-03	Drinking Water	O&M	Equipment	19	ls	31,000 €	589,000 €	21	PIP	Public works machinery and equipment (Mini-excavator 3T, Generator, Compressor and Ram down machinery)
13	DW-OM-04	Drinking Water	O&M	Equipment	1	ls	101,000 €	101,000 €	2	PIP	Automated tools (Sawing machinery, Jack hammer, Drill, …) + Manual tools (General tool box, Specific spanners and tools for cleaning, Specific tools to work on HDPE pipes, Wheel barrow, shovel, pickaxe, hammer, broom, …) + Safety Equipment (gaz detector, individual and collective, …)
14	DW-OM-05	Drinking Water	O&M	Equipment	1	ls	260,000 €	260,000 €	15	PIP	JCB (backhoe loader) + Excavator on wheel 14T + Dump truck 4X6 26T
15	DW-N-01	Drinking Water	Network	Replacement of connections	1,000	u	700 €	700,000 €	14	PIP	Replacement of steel connections (for blocks) when replacing pipes during the PIP
16	DW-N-02	Drinking Water	Network	Replacement of connections	2,270	u	700 €	1,589,000 €	9	PIP	Rehabilitation of steel connections (blocks) in line with the percentage of pipes replaced
17	DW-N-03	Drinking Water	Network	Replacement of connections	49,017	u	700 €	34,312,103 €	40	LTIP	Rehabilitation of steel connections in line with the percentage of pipes replaced
18	DW-N-04	Drinking Water	Network	Other	1	ls	303,000 €	303,000 €	6	PIP	Pressure reduction on the network:Pressure reduction on Zone 1 + Pressure reduction on Zone 2 in Botanica + Pressure reduction on Zone 2 in Ciocana + Pressure reduction on Zone 2 Doina + Pressure reduction on Zone 2 Oţel + Pressure reduction on Zone 3 Valea Dicescu + Pressure reduction on Zone 3 Ciocana + Pressure reduction on Zone 4 Ciocana + Pressure reduction on Zone 4A Schinoasa + Critical points on the network
19	DW-O-01	Drinking Water	Other	Supply and installation of water meters	2,717	u	400 €	1,086,667 €	34	LTIP	1st renewal of block waters for domestic customers (1/3 of the existing stock)
20	DW-O-02	Drinking Water	Other	Supply and installation of water meters	2,717	u	400 €	1,086,667 €	34	LTIP	2nd renewal of block waters for domestic customers (2/3 of the existing stock)
21	DW-O-03	Drinking Water	Other	Supply and installation of water meters	2,717	u	400 €	1,086,667 €	34	LTIP	3rd renewal of block waters for domestic customers (3/3 of the existing stock)
22	DW-N-05	Drinking Water	Network	Renewal of water pipes	1	ls	2,232,000 €	2,232,000 €	29	PIP	Rehabilitation of the current network: 1 - Priority programme (ND150 existing steel pipes=17800m & ND200 existing steel pipes=12200m)

LONG TERM INVESTMENT PROGRAMME - LTIP

No.	Colonne1	Field	Sub-Cat	Type of operation	Quantity	Unit	Unit Cost	Cost	Rank	PIP or LTIP	Description
23	DW-N-06	Drinking Water	Network	Renewal of water pipes	1	ls	7,747,000 €	7,747,000 €	22	PIP	42% of Rehabilitation of the current network: 2 - Steel Pipes ND 100 to 200 (ND100 existing steel pipes=290500m & ND150 existing steel pipes=54600m & ND200 existing steel pipes=37300m)
24	DW-N-07	Drinking Water	Network	Renewal of water pipes	1	ls	10,749,000 €	10,749,000 €	37	LTIP	68% of Rehabilitation of the current network: 2 - Steel Pipes ND 100 to 200 (ND100 existing steel pipes=290500m & ND150 existing steel pipes=54600m & ND200 existing steel pipes=37300m)
25	DW-N-08	Drinking Water	Network	Renewal of water pipes	1	ls	16,409,000 €	16,409,000 €	42	LTIP	Rehabilitation of the current network: 3 - Steel Pipes ND 250 to 400 (ND250 existing steel pipes=26600m & ND300 existing steel pipes=64000m & ND350 existing steel pipes=3800m & ND400 existing steel pipes=27400m
26	DW-N-09	Drinking Water	Network	Renewal of water pipes	1	ls	17,435,000 €	17,435,000 €	42	LTIP	Rehabilitation of the current network: 4 - Iron Pipes ND 100 to 200 (ND100 existing cast iron pipes=126300m & ND150 existing cast iron pipes=89900m & ND200 existing cast iron pipes=73400m
27	DW-N-10	Drinking Water	Network	Renewal of water pipes	1	ls	14,114,000 €	14,114,000 €	42	LTIP	Rehabilitation of the current network: 5 - ACC's programme not included in the four categories above (Existing pipes with diameter between 100 and 1200 mm=35800m)
28	DW-N-11	Drinking Water	Network	Renewal of water pipes	1	ls	24,642,000 €	24,642,000 €	42	LTIP	Rehabilitation of the current network: 6 - Strategic pipes to be defined (Existing pipes with diameter between 100 and 1200 mm=62500m)
29	O-OM-03	Other	O&M	Other	1	ls	389,000 €	389,000 €	13	PIP	Replacement of the electrical lines in STA, SAN, SESE, SSP
30	DW-N-12	Drinking Water	Network	Equipment	1	ls	200,000 €	200,000 €	25	PIP	Hydraulic fittings for the repairs (stainless steel pipe repair clamps, couplings large tolerance, other fittings, ...)
31	DW-P-01	Drinking Water	Pumping	Renewal of pumps	1	ls	825,000 €	825,000 €	20	PIP	Rehabilitation of the existing pumps (Emergency Plan)Buiucani Z3 PS + Buiucani Z4 PS + Independenta Z3 PS + Independenta Z4 PS + Treapta II a raw water
32	DW-P-02	Drinking Water	Pumping	Renewal of pumps	1	ls	1,904,000 €	1,904,000 €	41	LTIP	Rehabilitation of the existing pumps (stage 1):Ialoveni PS to Ialoveni City + U. Agrara PS + Valea Dicescu PS + Botanica PS + Telecentru Z4 PS + Telecentru Z4a PS + Schinoasa PS + STA Z3 PS + STA Z4 PS + Tohatin PS to Tohatin + Tohatin PS to Colonita + Aeroport PS + Singera PS + Stauceni PS + Treapta I raw water + Treapta II raw water
33	DW-P-03	Drinking Water	Pumping	Renewal of pumps	1	ls	297,000 €	297,000 €	42	LTIP	Rehabilitation of the existing pumps (stage 2):Ialoveni PS to Ialoveni City + Buiucani Z3 PS + Buiucani Z4 PS + U. Agrara PS + Independenta Z3 PS + Independenta Z4 PS + Botanica PS + Telecentru Z4 PS + Telecentru Z4a PS + Schinoasa PS + Tohatin PS to Tohatin + Tohatin PS to Colonita + Aeroport PS + Singera PS + Stauceni PS

LONG TERM INVESTMENT PROGRAMME - LTIP

No.	Colonne1	Field	Sub-Cat	Type of operation	Quantity	Unit	Unit Cost	Cost	Rank	PIP or LTIP	Description
34	DW-P-04	Drinking Water	Pumping	Renewal of pumps	1	ls	35,000 €	35,000 €	42	LTIP	Rehabilitation of the existing pumps (stage 3):Buiucani Z3 PS + Telecentru Z4 PS + Schinoasa PS
35	DW-T-01	Drinking Water	Treatment	Rehabilitation of the existing plant	1	ls	3,000,000 €	3,000,000 €	27	PIP	Urgent rehabilitation works including Electrochlorination plant
36	DW-T-02	Drinking Water	Treatment	Rehabilitation of the existing plant	1	ls	10,157,000 €	10,157,000 €	31	LTIP	Rehabilitation of STA: overhauling of coagulation, retroffiting of settlers, overhauling of filters and chemical plant
37	DW-T-03	Drinking Water	Treatment	Construction of new treatment facilities	1	ls	548,000 €	548,000 €	5	PIP	Treatment of the water produced from Ialoveni well field
38	DW-O-04	Drinking Water	Other	Construction of new treatment facilities	1	ls	764,000 €	764,000 €	8	PIP	Emergency Plan: Treatment of the water produced from the wells: Petrucani, Ghidighici and Baliveskii
39	DW-O-05	Drinking Water	Other	Rehabilitation/construction of well	1	ls	2,592,000 €	2,592,000 €	23	PIP	Rehabilitation of the wells for the Emergency Plan: Ialoveni(Rehab 21 wells), Ghidighici(Rehab 11 wells), Petricani(Réhab 9 wells), Balisevsc(Réhab 6 wells), New wells field(Realization 15 wells)
40	DW-O-06	Drinking Water	Other	Other	1	ls	888,000 €	888,000 €	11	PIP	Emergency plan: distribution of the water produced from the wells: Petricani PS to Zone 1 + Petricani PS to Zone 2 + Ghidighici PS + Balsevsc PS + Buiucani Z4 PS from Buiucani tanks + Ialoveni PS to Chisinau + Schinoasa PS to Z4a Telecentru + Connection Petricani PS to Transfer pipe of Doina (Zone 2)
41	DW-N-13	Drinking Water	Network	Other	1	ls	108,000 €	108,000 €	1	PIP	Adaptation of the water distribution system to the new production scheme: By-pass of SAN facilitiesNew PS from Zone 2 to TohatinNew PS from Tohatin tanks to VdVGhidighici dilution
42	DW-N-14	Drinking Water	Network	Rehabilitation of reservoir	1	ls	840,000 €	840,000 €	12	PIP	Rehabilitation of the tanks of STA Chisinau
43	DW-N-15	Drinking Water	Network	Rehabilitation of reservoir	1	ls	1,416,000 €	1,416,000 €	18	PIP	Rehabilitation of the tanks of Ialoveni + Rehabilitation of the tanks of Tohatin + Rehabilitation of the tanks of Valea Dicescu + Rehabilitation of the tanks of Ghidighici + Rehabilitation of the tanks of Telecentru + Rehabilitation of the tanks of Buiucani + Rehabilitation of the tanks of Ciocana + Rehabilitation of the tanks of Schinoasa + Rehabilitation of the tanks of Airport + Rehabilitation of the tanks of Balsevsc + Rehabilitation of the tanks of Petricani + Rehabilitation of the tanks of Codru MDK + Rehabilitation of the tanks of Colonita + Rehabilitation of the tanks of Independenta + Rehabilitation of the tanks of Sîngera + Rehabilitation of the tanks of Stauceni

LONG TERM INVESTMENT PROGRAMME - LTIP

No.	Colonne1	Field	Sub-Cat	Type of operation	Quantity	Unit	Unit Cost	Cost	Rank	PIP or LTIP	Description
44	WW-T-01	Wastewater	Treatment	Construction of new treatment facilities	1	ls	26,195,000 €	26,195,000 €	28	**PIP**	First phase of upgrading the WWTP for Chisinau (New pretreatment, light rehabilitation of primary settling, biological tanks and secondary clarification, separated thickening for biological excess sludge, anaerobic digestion with energy generation, sludge dewatering)
45	WW-T-02	Wastewater	Treatment	Construction of new treatment facilities	1	ls	24,046,000 €	24,046,000 €	33	LTIP	Second phase of the new WWTP for Chisinau (Biological tanks+Secondary clarifiers+Thickeners+Electrical works+Administrative building and miscellaneous works)
46	WW-T-03	Wastewater	Treatment	Construction of new treatment facilities	1	ls	16,201,000 €	16,201,000 €	32	LTIP	Third phase of the new WWTP for Chisinau (Pretreatment+Biological tanks+Secondary clarifiers+Thickeners+Sludge dewatering facility+Electrical works)
47	O-OM-01	Other	O&M	Equipment	1	ls	1,300,000 €	1,300,000 €	24	**PIP**	Puchase of MIS equipment
48	O-OM-02	Other	O&M	Equipment	1	ls	325,000 €	325,000 €	3	**PIP**	SCADA: Upgrading or renewal of the equipment for wastewater PS + SADA: Data Storage + SCADA: Implement a unique tool for data processing (Development of a specific tool or adaptation of an existing tool)
Total								**280,455,603 €**			**48**