REPUBLIC OF MOLDOVA

APA CANAL CHISINAU

CHISINAU WATER SUPPLY & SEWAGE TREATMENT - FEASIBILITY STUDY

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



Environmental Analysis Report - DRAFT

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seureca

A Subsidiary of VEOLIA ENVIRONNEMENT

In association with and Business Consulting Institute

European Bank for Reconstruction and Development and EU Neighbourhood Investment Facility

ABBREVIATIONS AND ACRONYMS

ACC	Apa Canal Chisinau
AP	Affected Persons
BOD	Biochemical Oxygen Demand (5 days unless otherwise stated)
CAPEX	Capital Expenses
CAS	Conventional Activated Sludge
CHP	Combined Heat and Power
COD	Chemical Oxygen Demand
dBA	Decibel A
DO	Dissolved Oxygen
DW	Drinking Water
DWTP	Drinking Water Treatment Plant
EAP	Environmental Action Plan (task force of OECD)
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
ESSO	Environmental and Safety Supervision Officer
EU	European Union
GHG	Greenhouse Gases
GU	Grievance Unit
IEEP	Institute for European Environmental Policy
KN	Kjeldahl Nitrogen
LEP	Law of Environmental Protection
MAC	Maximum Allowable Concentration
MoE	Ministry of Environment
MoH	Ministry of Healthcare
NH4	Ammonium
NO2	Nitrite
NO3	Nitrate
OECD	Organisation for Economic Co-operation and Development
OPEX	Operation Expenses
PE	People Equivalent
PIP	Prioritary Investment Programme
POP	Persistent Organic Pollutants
PPE	Personnel Protection Equipment
SEA	Strategic Environmental Assessment
SEHSO	Site Environment Health and Safety Officer
SEI	State Ecological Inspectorate
SGA	State Geological Agency
SHMS	State Hydro-Meteorological Service
TDS	Total Dissolved Solids
TN	Total Nitrogen
ToR	Terms of Reference
TP	Total Phosphorus
TS	Total Solids
TSS	Total Suspended Solids
UN	United Nations
VS	Volatile Solids
VSS	Volatile Suspended Solids
WHO	World Health Organ,isation
WW	Wastewater
WWTP	Wastewater Treatment Plant

TABLE OF CONTENTS

1. OPERATIONAL CONTEXT

1.1. STUDY BACKGROUND

The City of Chisinau, Capital of the Republic of Moldova intends to implement a programme to rehabilitate the City's water supply and sewage collection system and to improve the sewage treatment in order to improve living conditions and to reduce health risks for the population, to prevent excessive exploitation of natural resources and environmental pollution.

The programme is justified by the existing problems as follows:

- High leakages within the water supply system and frequent interruptions of water supply;
- Poor quality of potable water;
- Insufficient level of collection and treatment of wastewater due to malfunctioning of existing wastewater treatment plant;
- Insufficient level of sludge disposal and management, causing negative environmental impacts and emitting odour;
- Lacking technical and economic sustainability of operation.

The main expected objectives of the programme would be:

- Identifying and introducing much-needed technical, environmental and efficiency improvements in the provision of municipal water and sanitation services in line with the national and EU environmental standards;
- Introduction of an incentive based service contract, tariff increases, introduction of appropriate incentives for efficiency improvement at the level of the operating company, and encouraging outsourcing of certain activities (where appropriate);
- Improvement of the Company's financial transparency and the quality of financial information;
- Optimizing technical and economic sustainability of operation;
- Development and implementation of an Environmental Analysis (EA) and Environmental and Social Action Plan ("ESAP") which shall improve the Company's environmental management practices and overall performance in line with the national and EU standards;
- High demonstration effects which could be seen as a model for other smaller municipalities in Moldova with similar problems in the municipal infrastructure sector.

Chisinau water supply and sewage system is being operated by S.A. Apa Canal Chisinau (ACC), a joint stock company created in 1993 out a former state company. ACC is fully owned by the Chisinau Municipal Council and its operations are supervised by means of a Supervisory Board with representation from the City.

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 Neighborhood Initiative, the European Bank for Reconstruction and Development, together with co-founders: KfW Entwicklungsbank and the European Investment Bank, supports the initiative through a phased investment programme, provided within the European Union Neighborhood 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 programme components identified and described by the Consulting team will be divided into two sets:

- A Priority Investment Program (PIP) to be implemented to the short term in order to solve the more urgent problems affecting both water supply and wastewater collection and treatment. The PIP should be implemented on a 5 years period for a capital cost not exceeding Euro 56 Million.
- A Long Term Investment Program, to be implemented to the middle and long term in order to fully meet EU standards.

One of the tasks of the Consulting team is to carry out an Environmental and Social Due Diligence to ensure that PIP fully complies with EBRD's Performance Requirements, including preparation of an Environmental Analysis an Environmental and Social Action Plan for the Company based on the mitigation measures identified. The present report set out the results of the environmental analysis.

1.2. LEGAL AND INSTITUTIONAL FRAMEWORK

1.2.1. ENVIRONMENTAL INSTITUTIONAL FRAMEWORK

The main administrative bodies which are involved in the environmental sector are the following:

- The **Ministry of the Environment** (MoE, former Ministry of the Ecology and Natural Resources) is responsible for the development and promotion of the State policy in the field of environment. MoE initiates drafts environmental laws and regulations and issues relevant instructions and decisions, ensures coordination and control over the implementation of environmental laws and policies, issues permits on natural resources uses and licenses for polluting emissions, elaborates environmental standards and normative documents. MoE is also responsible for environmental monitoring and rules national environmental institutions as State Ecological Inspectorate; State Hydro-Meteorological Service, and the State Geological Agency.
- The **State Ecological Inspectorate** (SEI) is an environmental protection regulatory and enforcement agency which controls the implementation of environmental legislation and performs the State control over the rational use and protection/conservation of the natural resources. SEI has a wide network of Territorial Agencies and District (Rayon) Inspections which monitors industrial facilities impacting on environment. It issues permits on use of natural resources and environmental pollution in admissible limits, enforces the application of ecological norms and requirements on use of natural resources, hazardous substances and wastes. The SEI is fully involved in the state ecological expertise (SEE), and establishes emission limit values and maximum allowable concentrations for pollutants. The SEI performs environmental pollution monitoring. The SEI can levies fines or close down a facility in case of noncompliance with environmental protection requirements.
- The **State Hydro-Meteorological Service** (SHMS) performs through the Monitoring Centre on Environmental Quality, regular monitoring of the air, water and soil quality as well as atmospheric radiation background level. Among other task the SHMS is responsible for monitoring of Prut and Dniester Rivers' water flow, for the weather

hydrological and agro-meteorological forecasts, monitoring data recording and management.

- The **State Geological Agency** (SGA) is responsible for promoting of State policy in the field of management and monitoring of underground resources, including underground water resources (deep underground water). It is responsible for, monitoring (flows and quality), protection and management of underground water resource at the national level.

- State Agency "**Apele Moldovei**" (AM, Waters of Moldavia) is directly subordinated to the Government of Moldova. AM is the central technical and administrative organization dealing with surface water resources, and is responsible for management of water resources used for irrigation, domestic and industrial water supply purposes as follows: development of long-term programs concerning river basins and water administration works throughout the country, including centralized water supply facilities, irrigation and drainage, protection against floods or other damage, coordinating of construction, design, and operation activities in the field of water. Design of water resource projects and for land reclamation works such as irrigation, drainage or soil erosion control is the mission of **Acvaproject Design Institute** subordinated to "Apelei Moldovei".

- The **Ministry of Healthcare** (MoH) is the central authority responsible for population health protection, and sanitary and epidemiological supervision. Ministerial sub-division **National Scientific and Practical Centre for Preventive Medicine** performs regular sampling and analysing water quality in water bodies and groundwater used for drinking water supply (tap water, artesian and shallow wells), and those used for recreation purposes.

1.2.2. LEGISLATIVE FRAMEWORK OF THE WATER CYCLE

1.2.2.1. Water Resource Protection

The protection of water resource is addressed by laws:

- The 1993 **Law on Environmental Protection** (LEP) establishes the general framework for the protection of all water resources and aquatic ecosystems. It mainly focuses on water pollution sources. LEP prohibits the discharge to surface water of untreated wastewater, hot waters, waters contaminated, radioactive materials, pathogens and parasites, petroleum products or residues and other pollutants. It forbids also the discharge into surface water and storage in the water beds of any kind of waste, debris resulted from construction works, of other residues and pesticides as well as the introduction of explosive materials, poisons, drugs and other such substances.

- the 1997 **Law on Natural Resources** (LNR) declares that all surface waters and deep groundwater are national water resources, while shallow groundwater (above the shallowest impermeable layer) are classified as local resources. LNR stipulates that the rivers Dniester and Prut as well as the Cahul and Lalpug lakes are transboundary water bodies.

- the 1995 **Law on protected zones and belts of rivers and water basins** requires the creation of protection zones and belts along rivers and water bodies and establishes a regulatory framework for activities within these zones. For Dniester and Prut rivers, the width of the protection belt is at least of 1000 m from the riverbed (on both sides). The protection strip of other main rivers is 500m wide (within the water catchment area) while the protection strip for smaller streams is at least 15m wide. According to the Law, use of pesticides is restricted on the strip of 300 m width along the river bank. Setting of livestock farms, septic tanks and solid waste from livestock farms, location of technical services stations, machinery and transport wash, location

of municipal and industrial waste disposals, and irrigation by sewage is to be controlled with respect to distance from river bank.

- as far as the dams are concerned, the 1995 **Regulations on state dams for protection against flood** in the Republic of Moldova stipulates that, within the area of the dam the following activities are prohibited: (i) carrying out excavating, construction, geological exploration, mining works, (ii) establishing of crossing over dams paths, use of the dam crown for roads, (iii) establishing cattle paths and grazing, (iv) removal of furrows and (v) using the dam area for agricultural crop production.
- As regards pollution to surface or ground water by nitrates or pesticides, a **Code of Good Agricultural Practices** (CGAP) was developed in 2007 in the framework of the Agricultural Pollution Control GEF Project, financed by the World Bank. The CGAP was distributed to farmers all over the country but is generally considered to be too technical or scientific to be effective and informative for farmers. It is noteworthy that national legislation does not provide currently for the identification of surface waters and groundwater affected or likely to be affected by nitrate pollution as the sensitive area defined by the EU legislation.

1.2.2.2. Water quality standards

The 1993 **Water Code** (see above) stipulates that discharge of wastewater is allowed only if it does not increase the concentration of pollutants in ambient water to the levels higher than the maximum allowable concentrations (MACs) defined in implementing regulations. This conception of water quality standards is an inheritance of the former soviet regime

The surface water quality standards used in Moldova were stipulated in Rules for protection of surface waters (dated 1991) and Hygienic regulation on protection of water bodies against pollution (dated 1997). This later act set a standard of 50 mg NO_3/L in surface water bodies used for drinking, household and recreational purposes. Formally, these standards are no longer valid since 2004 but new standards on surface waters are still in development process.

In practice, most standards and other normative technical requirements in the field of environmental protection used during project planning and design and during project expertise are based on standards developed during the Soviet time (e.g. GOST sanitary standard are still used for water monitoring by Apa Canal) and/or Romanian standards (i.e. STAS).

The 2007 Government Decision on the establishment of the automated information system "**State register of natural mineral waters, drinking water and bottled soft drinks**" establishes the sanitary requirements for groundwater used for drinking purposes and for natural mineral water.

1.2.2.3. Management of Water Resources

The 1993 **Water Code** is the more specific framework law establishing the major principles and mechanisms for surface and groundwater management. It mainly aims at (i) ensuring the rational use of water and its protection against pollution and depletion, (ii) preventing flooding and other water-related disasters and (iii) strengthening the legality of relations in the water sector.

Other **relevant legislation** on water resources management also includes: Regulations on State Water Cadastre (dated 1994), Regulations on integrated environmental monitoring system (dated 1998), Law on the fund for state protected natural areas (dated 1998), Framework regulations on wetlands of international importance (dated 2007).

The new **draft Water Law**, planned by 2011, will includes: (i) provisions on river basin districts, (ii) administrative arrangements for international waters, (ii) analysis of river basin district characteristics, (iv) provisions for preliminary flood assessment with flood hazards and flood risks maps, as well as flood risk management plans, (v) establishment

of water quality monitoring programmes, and (vi) river basin management programmes and public consultation. Ancillary regulations of the Water Law under preparation include: draft Regulation on Identification, delimitation and classification of water bodies, draft Regulations on Surface Water Protection, Regulations on development and approval of management programme and action plan and Regulations on procedures for the development and updating of water resources monitoring programmes, Regulations on river basin committees. The new draft Water Law also incorporates provisions on management objectives for groundwater with respect to quantitative and chemical status, concentration of pollutants and balance between abstraction and discharge.

Groundwater is also addressed in the Subsoil (Mining) Code (dated 2009).

1.2.2.4. Drinking Water Quality

The 1999 **Law on drinking water** (LDW) establishes the legal framework regarding drinking water supply and sets requirements for natural and legal persons to ensure the safe operation of drinking water systems as well as liability for violations in this area. It stipulates that only materials, reagents, equipment and facilities which are certificated according to legal requirements may be used for drinking water supply and that the quality of drinking water must meet the standards established by the regulations in force. LDW states that consumers of water are entitled to access information about the authentic quality of drinking water, which shall be published in mass-media. Information on drinking water quality is to be periodically provided free of charge by companies operating the water supply systems and state authorities in charge of supervision of the compliance of drinking water with the quality standards.

The 2009 **Law on state surveillance of public health** stipulates that the drinking water supplied to the population shall not present a risk to human health and shall meet the physiological needs of the population.

Drinking water quality requirements are stipulated in the 2007 Government Decision on the establishment of the automated information system "**State register of natural mineral waters, drinking water and bottled soft drinks**". This normative act incorporates the quality standards for water intended for human consumption, points of quality compliance, monitoring sampling point requirements, derogations, quality assurance of treatment, equipment and materials, information and reporting requirements.

In addition, the Government Decision sets 31 December 2012 as the deadline to ensure the capacity to conduct the monitoring of drinking water quality by the Ministry of Health to prevent risks to public health and 2015 as the deadline for full compliance with the quality standards.

The current legislation incorporates standards for drinking water, requirements for the establishment of a monitoring system and of a mechanism to provide information to consumers.

1.2.2.5. Discharge of Wastewater

The 2007 **Regulations on conditions for urban wastewater discharge into natural receiving waters** aim to ensure environmental protection against pollution caused by wastewater discharges. The Regulations establish the general conditions of wastewater treatment and discharge into natural receiving waters as well as the requirements for discharges from urban waste water treatment plants for key water quality indicators. The **Government Decision No 1141 dated 10-10-2008** is in accordance with the UE Directive 91/271/EEC: the standards for wastewater discharged into natural water bodies is as follows:

- BOD5: 25 mg O2/L and minimal reduction rate of 70-90%
- COD: 125 mgO2/L and minimal reduction rate of 75%
- TSS: 35 mg/L and minimal reduction rate of 90%

For *sensitive areas*, the discharge of treated wastewater shall meet the following standards:

- Total N: 15 mg/L (10,000 – 100,000 PE), 10 mg/L (> 100,000 PE) and minimal reduction rate of 70-80%
- Total P: 2 mg/L (10,000 – 100,000 PE), 1 mg/L (> 100,000 PE) and minimal reduction rate of 80%

The Decision also gives the frequency of sampling and the methodology of analyses.

1.2.2.6. Solid Waste and Sludge Management

The legislation relating to the solid waste management will be outlined in the following paragraphs mainly to the extent that the sewage and drinking water sludge may be concerned.

The 1993 LEP establishes state policy with respect to waste management on the basis of awareness measures aimed at the reduction of waste accumulation, energy production and recyclable portions of production and household waste, disposal and efficient isolation of non-recyclable waste. According to LEP, the Government has competences to

- establish annual limits for the accumulation of household and production waste, supervise the compliance with those limits
- impose charges for storage and processing of household and production waste and establish technical standards for transport, landfill, incineration and burying of non-recyclable waste in order to minimise harmful effects on human health and environmental quality
- create conditions to facilitate and encourage the collection and recycling of metal, textile, leather, timber, rubber, oil wastes as well as the energy production from waste.

According to LEP the authorities of local public administration together with the environmental and health authorities are required to:

- permit the storage of any waste (i.e. domestic, industrial, agricultural, ***sludge resulted from industrial, urban and agricultural activities***, construction waste) on specially assigned and equipped sites only with the consent of landowners, taking into consideration the protection of surface and groundwater, human settlements, tourist and landscape areas, as well as land re-cultivation after exhausting its capacity for waste storage
- set annual limits for the disposal of waste in the village, city, district, municipality, and monitor compliance with the storage site regime and technical standards for waste storage processing, combustion and burial
- control compliance with environmental legislation

The 1997 **Law on Production Waste and Household Waste** (LPWHW) provides a framework for the regulation, record keeping, planning, control, supervision and monitoring in the field of waste management. It regulates the management of waste generated *inter-alia* from manufacture, transportation and storage consumer goods, from construction, agricultural, mining and other works, from service delivery, and from industrial and food products consumption.

LPWHW incorporates ecological security requirements related to:

- landfills and storage of waste
- prohibitions on waste disposal in water drainage systems and water, their storage and processing in the protection zones of water bodies, sanitary protection zones of

drinking water supply sources and aqueducts, in recreational areas, natural protected areas and parks and protection belts of railways and roads

- prohibitions on landfill and processing of waste in urban and rural areas, underground aquifer, recreation areas and other places where it would endanger the environment and human health
- landfill of waste in underground sites may be permitted in exceptional circumstances and only after special investigations, in compliance with specific rules and regulations

In addition, LPWHW includes provisions on financing sources and economic stimulation measures in the field of waste management.

The **new draft Law on Waste** provides for a five-step waste hierarchy, waste management plans, waste prevention programmes, specific obligations on hazardous waste management, permitting system etc. It includes requirements on packaging and packaging waste, the management of end-of-life vehicles, electrical and electronic equipment, and waste incineration. No specific mentione to sewage or drinking water sludge is cited in the draft Law.

A draft Regulation on **waste incineration** is under development. In addition, a draft Government Decision defining the List of waste, including hazardous wastes, is being prepared by the Ministry for Environment in the context of the new draft Law on Waste.

As regards nitrates pollution from agricultural sources, Article 17(1) of the 2004 Law on phyto-sanitary products and fertilisers stipulates that the regime regulating the use of fertilisers is to be developed by scientific and other institutions. According to Article 10(6), the competent authority is the State Centre of Phyto-sanitary Products and Fertilisers Testing and Approbation. This Centre issues certificates of approval which includes information on the amounts of substances to be used. Following the testing and approval procedure, the fertilisers are listed in the State Register of phyto-sanitary products and fertilisers, after which their commercialisation is allowed on the territory of the country.

There is no specific Moldovan regulation on the use of sludge in agriculture or other outlets. However, the quite recent document called "*Hotarîre cu privire la aprobarea Reglementarii tehnice "Masurile de protectie a solului în cadrul practicilor agricole*" Nr. 1157 din 13.10.2008" (Decision of Approval of Technical Regulation" Measures of soil protection in the framework of agricultural practices") indicates in its Article 11, that municipal sludge can be used in agriculture under the condition that maximum values indicated for heavy metal as regards concentrations in sludge and in receiving soils as well as the 10 years-cumulated loads to the same plot are not exceeded. Referenced methods are provided for analysis of sludge and soils. Furthermore, spreading of sludge is prohibited onto:

- Pastures and fodder crops less than three weeks before livestock grazing or harvest of fodder crops
- Plots cultivated with fruits and vegetable crops during the period of vegetation, except the fruit trees
- Land dedicated to fruits and vegetable crops, less than 10 month before the harvesting period

However, this Decision does not described the responsibilities and duties of stakeholders involved in the sewage sludge management

1.2.3. ENVIRONMENTAL ASSESSMENT FRAMEWORK

1.2.3.1. Environmental Impact Assessment

Environmental Impact Assessment (EIA) procedures for individual projects are mainly ruled by the **1996 Law on Ecological Expertise and Environment Impact Assessment**

which was issued with the view of integrating the existing system of ecological expertise inherited from the Soviet regime with the more "western" model of environmental impact assessment (such as EU Directive on EIA). The Law provides for a State Ecological Expertise (SEE) for design and planning documents of all planned economic facilities and activities that affect or may affect the environment and/or require the use of natural resources. The main goal of the SEE is to determine whether the project documentation complies with environmental protection requirements and to check whether all environmental standards are adhered, and the environmental protection measures are addressed. The decision of the ecological expertise is the basis for further approval or refusal of the project documentation.

The by-law **Instruction on Order of Organization and Conduction of the State Ecological Expertise**, dated 2002, stipulates that SEE is applied for any new construction, its modernization and up-grading. All design documents should be presented to the State Ecological Expertise units (MoE for major projects, headquarters of the State Ecological Inspection and district Ecological Inspectorates). Technical solutions, reflected in the project documentation have to be sufficiently substantiated in relation to reduction/mitigation of impact on environment.

According to the procedure, the projects firstly undergo a screening which classes them into three categories:

- the projects of **first category** (listed by the Law) are likely to impact significantly the environment and are subject to a (full) Environmental Impact Assessment (EIA), the report of which undergoes a State Ecological Expertise
- the projects of **second category** may have less significant impact on the environment and require ecological substantiation of project activities described in a special Environmental Chapter of the project documentation, which has to contain information on potentially affected environment as well as outline main potential environmental impacts and mitigation measures. These projects are subject to a State Ecological Expertise (SEE).
- the projects of the **third category** have only minor or no impact on the environment and do not require EIA or SEE.

As far as the water and sanitation sector is concerned, the following projects are subject to EIA (first category):

- *construction of municipal sewerage systems*,
- *supply of* heat, *water*, gas, electricity;
- construction, expansion, rebuilding, retooling, upgrading and redesign, conservation, demolition or liquidation of *all economic and social facilities which might affect the environment*, and those which may affect the state of environment in neighbouring countries;
- *underground exploration and exploitation*, including in areas with a water protection regime;
- setting and upgrading of *landfills for industrial*, *municipal* or agricultural *waste*, toxic residues, construction or setting of plants for wastes and residues processing, neutralisation or destruction;

The Ministry of Environment (MoE) may also require a full EIA for other types and scales of projects on the case-by-case screening.

Based on the EIA report, a Statement on the EIA (SEIA) is prepared to be subject to the MoE review and approval. The SEIA is also a subject of public consultation, according to the following procedure: the beneficiary submits the SEIA to the competent ministries and departments, in conformity with a profile of the object or activities, and to concerned local public authorities. Within next 5 days, local public authorities have to disseminate through mass media the information about the place and time one can get access to the SEIA. The public access to the SEIA shall be open within 30 days. During this term, the objections on the respective documents may be submitted in written to the person

specially appointed by the local public authorities. Within next 14 days after a 30-day public access to the SEIA, concerned local public authorities shall submit the objections formulated within the public debates on the SEIA as well as their own objections to the beneficiary, and to copy these to the central environment authorities The ministries and departments shall submit to the beneficiary, within 50 days from the receipt of the SEIA, their own objections, and also to copy these to the central environment authority. Should the beneficiary and the central environment authority not receive objections on the SEIA within 50 days it shall be considered that such do not exist.

The EIA procedure is depicted in Figure 1.

The ecological expertise is carried out by the central authority for environment (MoE), other central bodies of the public administration or public associations depending on the types of projects examined. The State Ecological Expertise (SEE) is the exclusive task of the central authority for environment which may ask its structural subdivisions and/or subordinate organisations, constituting the system of state ecological expertise, to undertake it. The departmental ecological expertise is undertaken by ministries and departments within their subordinate public organisations and enterprises. There is also a public evaluation, which can be undertaken by registered local associations. These can be NGOs or groups of local people who form an association to implement a public evaluation.

The procedure of state ecological expertise is described in the **2002 Instruction on the order of organising and conducting state ecological expertise**. It determines the scope, tasks, principles, objects and subjects of ecological expertise, order of ecological expertise organisation and undertaking, requested urban and spatial planning documents and the procedure for their presentation for review.

The **new draft Environment Protection Law** establishes the scope, objective, tasks and procedure of EIA for which specific legislation has to be developed aiming to establish the framework requirements of the EIA procedure compatible with the European EIA Directive 85/337/EEC. In addition, the **draft EIA law**, currently under preparation, should provide a good basis for implementing the EIA Directive in Moldova.

As regards existing polluting facilities, the 1998 **Regulation on Conducting of Ecological Audit of Enterprises** was enacted under the 1993 LEP. This text establishes that Ecological Audit aims at controlling compliance of the enterprises activities with the requirements stipulated in the Law on Environment Protection, Law on Sanitary-Epidemiological Protection of the Population and other environmental protection regulatory documents.

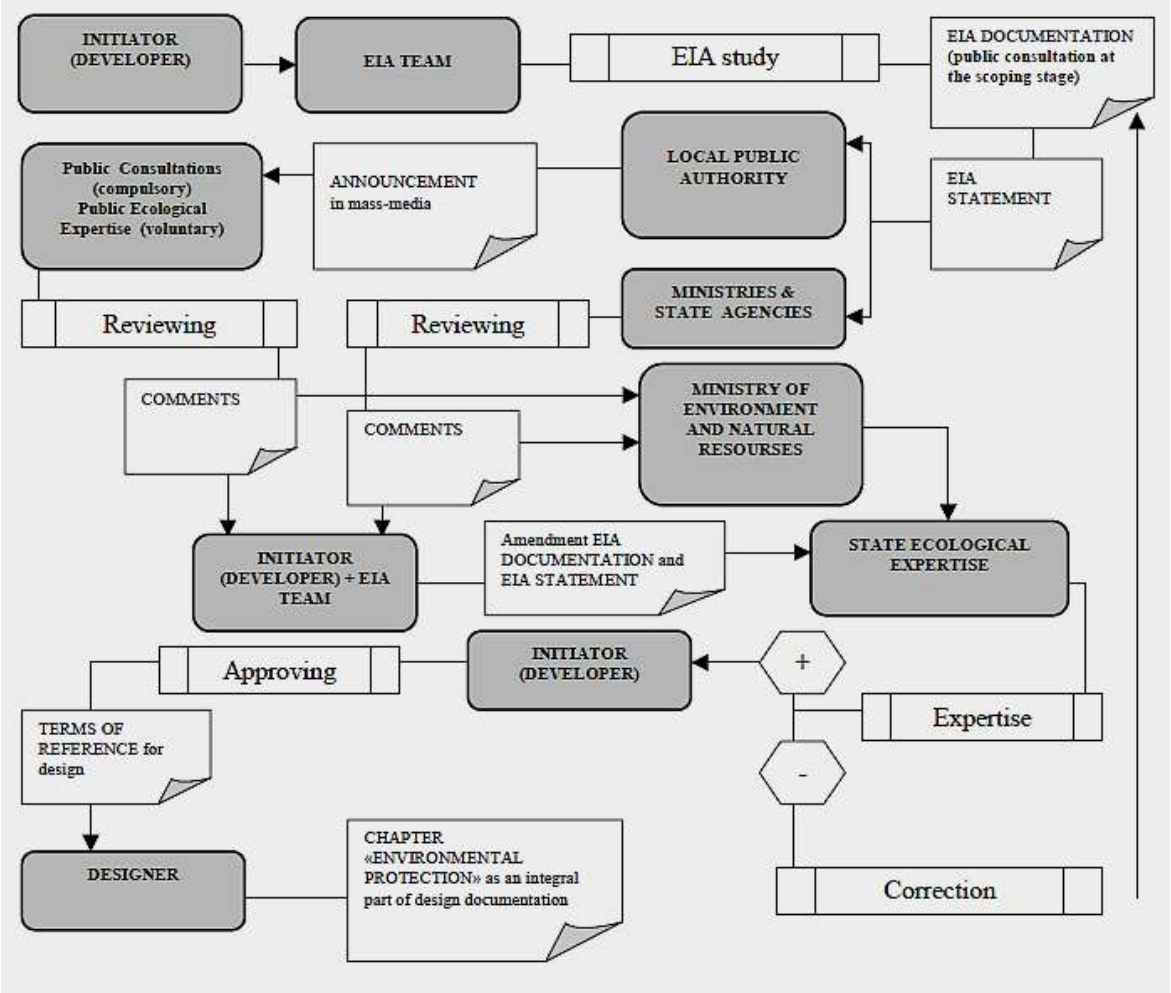

Figure 1 General flowchart of full EIA procedure (according to Belous, *"Competitiveness Enhancement Project Additional Financing - Environment Management Framework"* 2009)

1.2.3.2. Strategic Environmental Impact Assessment

The above mentioned **1996 Law on Ecological Expertise and Environment Impact Assessment** requires the assessment of environmental impacts of "programmes, plans, schemes, strategies and concepts" but these have not been really implemented to date. This lack of implementation is due to the fact that the Law does not provide for procedures to decide when and how which plans or programmes require strategic environmental assessment or arrangements with neighbouring countries for exchange of information and consultation.

The new draft EPL establishes the SEA scope, objectives and stages as well as responsibilities to conduct SEA. Based on the provisions of the new draft EPL, specific SEA legislation will have to be prepared by 2013.

1.2.4. FUTURE TRENDS: APPROXIMATION WITH EU ENVIRONMENTAL ACQUIS

The Institute for European Environmental Policy (IEEP) is engaged in a major 18-month EU funded study which will assess the benefits for the 16 countries including Moldova. The study will identify, quantify and where possible calculate in monetary terms the economic and social benefits of improved environmental legislation in these countries. It will also investigate challenges and needs for capacity building. The findings of the study are expected to be published in mid-2011.

It is now estimated that some 41 environmental legal acts need to be approximate in Moldova. First of them, the new draft Environmental Protection Law will replace the existing 1993 Law on Environmental Protection, but also to abolish, change or determine the entire future system of environmental protection in Moldova in line with the objective of approximation with EU environmental policy, norms and standards. The draft EPL includes framework provisions for environmental governance, air quality, water quality and resource management, waste management, nature protection, industrial pollution control, chemicals and Genetically Modified Organisms (GMOs).

With particular regard to the water and sanitation sector, five Directives are proposed for transposition in 2011-2015:

- Directive 98/83/EC on quality of water intended for human consumption,
- Directive 91/271/EEC on urban waste water treatment,
- Directive 91/676/EC concerning the protection of waters against pollution caused by nitrates from agricultural sources,
- Directive 2006/7/EC concerning the quality of bathing water,
- Directive 2008/105/EC on environmental quality standards in the field of water policy.

The two following Directives are proposed from 2016 onwards:

- Directive 2007/60/EC on the assessment and management of flood risks, and
- Directive 2006/118/EC on the protection of groundwater against pollution and deterioration.

Three directives on waste are proposed for transposition in 2011-2015: Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste, and Directive 1999/31/EC on the landfill of waste. EU legislation of use of sewage sludge seems not of first priority for transposition.

1.2.5. APPLICABLE STANDARDS FOR FRESH WATER QUALITY

In absence of official regulation on natural fresh water quality, it is proposed to use for the study purpose two sets of standards:

- The water quality standard issues by Romania which is the nearest UE country, which experiences similar climatic and physical features as Moldova and shares with Moldova an important watercourse: the Prut River (see Table 2.1).
- The standards which have been proposed for surface water quality in Moldova as a result of a study conducted in 2007 by the Environmental Action Plan Task Force (EAP Task Force) of OECD. These standards have however not yet been included in an offical text (see Table 2.2).

Table 2.1 Standards for assessment of ecological status of surface water in Romania (2006, GD 161)

Parameter	Unit	Class				
		I	II	III	IV	V
		Limit values				
Thermal and acidification regime						
Temperature	°C	Not regulated				
pH	unit	6.5 – 8.5				
Oxygen/Nutrient regime						
Dissolved oxygen	$mg.l^{-1}$	9	7	5	4	<4
Dissolved oxygen epilimninion (stratified waters)	%	90-110	70-90	50-70	30-50	<30
Dissolved oxygen hypolimnion (stratified waters)	%	90-70	70-50	50-30	30-10	<10
Dissolved oxygen for non stratif waters	%	90-70	70-50	50-30	30-10	<10
BOD_5	$mg.l^{-1}$	3	5	7	20	>20
COD_{Mn}	$mg.l^{-1}$	5	10	20	50	>50
COD_{Cr}	$mg.l^{-1}$	10	25	50	125	>125
Nutrients						
Ammonium-N	$mg.l^{-1}$	0,4	0,8	1.2	3.2	>3.2
Nitrite-N	$mg.l^{-1}$	0,01	0,03	0,06	0,3	>0,3
Nitrate-N	$mg.l^{-1}$	1	3	5.6	11.2	>11.2
Total-N	$mg.l^{-1}$	1,5	7	12	16	>16
Orthophosphate-P	$mg.l^{-1}$	0,1	0,2	0,4	0,9	>0,9
Total P	$mg.l^{-1}$	0,15	0,4	0,75	1.2	>1.2
Chlorophyll-a	$\mu g.l^{-1}$	25	50	100	250	>250
Salinity						
Conductivity	µS/cm					
Total residue 105°C	$mg.l^{-1}$	500	750	1000	1300	>1300
Chloride (Cl-)	$mg.l^{-1}$	25	50	250	300	>300
Sulphate (SO4--)	$mg.l^{-1}$	60	120	250	300	>300
Calcium (Ca++)	$mg.l^{-1}$	50	100	200	300	>300
Magnesium (Mg++)	$mg.l^{-1}$	12	50	100	200	>200
Sodium (Na+)	$mg.l^{-1}$	25	50	100	200	>200
Metals (total)						
Chromium (total) - Cr	$\mu g.l^{-1}$	25	50	100	250	>250
Copper – Cu	$\mu g.l^{-1}$	20	30	50	100	>100
Zinc – Zn	$\mu g.l^{-1}$	100	200	500	1000	>1000
Arsenic – As	$\mu g.l^{-1}$	10	20	50	100	>100
Barium – Ba	$\mu g.l^{-1}$	50	100	500	1000	>1000
Selenium – Se	$\mu g.l^{-1}$	1	2	5	10	>10
Cobalt – Co	$\mu g.l^{-1}$	10	20	50	100	>100
Lead –Pb	$\mu g.l^{-1}$	5	10	25	50	>50
Cadmium – Cd	$\mu g.l^{-1}$	0.5	1	2	5	>5
Iron - Fe	$\mu g.l^{-1}$	300	500	1000	2000	>2000
Mercury – Hg	$\mu g.l^{-1}$	0,1	0,3	0,5	1	>1
Manganese - Mn	$\mu g.l^{-1}$	50	100	500	1000	>1000
Nickel – Ni	$\mu g.l^{-1}$	10	25	50	100	>100
Other relevant toxics						
Total phenol (phenol index)	$\mu g.l^{-1}$	1	5	20	50	>50
Non ionic detergents	$\mu g.l^{-1}$	100	200	300	500	>500
AOX	$\mu g.l^{-1}$	10	50	100	250	>250

Table 2.2 Standards suggested for Surface Waters in Moldova (standards for pesticides and other organic micro-pollutants are not set out)

Parameter	Unit	Class				
		I (*)	II	III	IV	V
		Limit values				
Oxygen/Nutrient regime						
Dissolved oxygen *	$mg.l^{-1}$	>=7	>=7	>=5	>=4	>4
BOD_5	$mg.l^{-1}$	3	5	6	7	>7
COD_{Mn}	$mg.l^{-1}$	<7	7	15	20	>20
pH		6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	<6.5 >8.5
Ammonium-N	$mg.l^{-1}$	0.2	0.4	0.8	3.1	>3.1
Nitrite-N	$mg.l^{-1}$	0.01	0,06	0,12	0,3	>0,3
Nitrate-N	$mg.l^{-1}$	1	3	5.6	11.3	>11.3
Total-N	$mg.l^{-1}$	1.5	4	8	20	>20
Orthophosphate-P	$mg.l^{-1}$	0.05	0,1	0,2	0,5	>0,5
Total P	$mg.l^{-1}$	0,1	0,2	0,4	1	>1
Chlorophyll-a	$\mu g.l^{-1}$	25	50	100	250	>250
Metals (dissolved)**						
Zinc – Zn	$\mu g.l^{-1}$	<70	70	233	1163	>1163
Copper – Cu	$\mu g.l^{-1}$	<20	20	40	400	>400
Chromium (total) - Cr	$\mu g.l^{-1}$					
Lead –Pb	$\mu g.l^{-1}$	<2.5	2.5	2.5	2.5	>2.5
Cadmium – Cd	$\mu g.l^{-1}$	<0.2	0.2	1	1	>1
Mercury – Hg	$\mu g.l^{-1}$	<0.2	0.2	0.2	0.2	>0.2
Nickel – Ni	$\mu g.l^{-1}$	8	20	40	-	-
Arsenic – As	$\mu g.l^{-1}$					
Metals (total)						
Zinc – Zn	$\mu g.l^{-1}$	<300	300	1000	5000	>5000
Copper – Cu	$\mu g.l^{-1}$	<50	50	100	1000	>1000
Chromium (total) - Cr	$\mu g.l^{-1}$					
Lead –Pb	$\mu g.l^{-1}$	<50	50	50	50	>50
Cadmium – Cd	$\mu g.l^{-1}$	<1	1	5	5	>5
Mercury – Hg	$\mu g.l^{-1}$	<1	1	1	1	>1
Nickel – Ni	$\mu g.l^{-1}$	10	25	50	100	>100
Arsenic – As	$\mu g.l^{-1}$					
Other chemicals						
Phenols	$\mu g.l^{-1}$	<1	1	5	10	>10
Microbiological indicators						
Total coliforms	/100 ml	500	5000	10000	50000	>50000
Fecal coliforms	/100 ml	100	2000	10000	20000	>20000
Fecal steptococcus	/100 ml	20	1000	5000	10000	>10000
Escherichia coli	/100 ml	<500	500	1000	>1000	>1000

(*) for all natural substances, concentrations not exceeding the background level correspond to Category 1.

2. DESCRIPTION OF THE PRORITY INVESTMENT PROGRAMME

The Priority Investment Programme (PIP) is a set of 30 projects (sub-components or operations) to be implemented within the next five years (short-term programme) within a total budget not exceeding 60 million Euros. The programme has been elaborated subsequently to a diagnosis phase aiming at identifying the must concerning problem to the worked out as soon as possible. A list of projects was so provided and the projects were then ranked according different criteria falling into the following categories:

- Improvement of customer service and reliability of the service (size of the improved service area)
- Operational expenditures saving (return on investment)
- Improvement of the operational efficiency (safety of employees, improvement of quality of work, increase of efficiency)
- Improvement of the environment (reduction of pollution of natural water courses, saving of water, saving of energy, reduction of greenhouse gases)

Table 3.1a to 3.1 e describes summarily the 30 operations of the PIP.

The operations of pipes address 3 different fields:

- Drinking water (code: DW)
- Wastewater (code: WW)
- Other (code: O), i.e. general management of the APA CANAL Company (ACC).

Within each field, sub-categories have been defined according to the process/infrastructure affected by the project:

- Drinking water network (code DW-N-)
- Drinking water pumping (code DW-P-)
- Drinking water treatment (code DW-T-)
- Drinking water operation & maintenance (code DW-OM-)
- Drinking water emergency plan (code DW-O-), i.e. mobilization of groundwater resource in case of pollution of Dniester River or flooding of the water intake station
- Wastewater network (code WW-N-)
- Wastewater pumping (code WW-P-)
- Wastewater treatment (code WW-T-)
- Wastewater operation & maintenance (code WW-OM-)
- Other: operation & maintenance (code O-OM-)

The nature of operations is of 11 different types:

- Purchase of non-stationary, hard equipment and stationary soft equipment
- Renewal of water pipes and their connections
- Rehabilitation of water tanks and reservoirs
- Rehabilitation of well fields

- Creation of new well fields
- Construction of new water treatment facilities (DWTP, pumping station).
- Construction/upgrade of large size wastewater treatment works
- Construction of large size water treatment works (chlorination)
- Renewal of sewers
- Renewal of small size equipment of existing works (pumps, electric lines
- Purchase and rehabilitation of safety equipment (electrical panels, personal protection equipments)

Table 3.1a Projects selected for the Priority Investment Programme

Rank	Field	Code	Type of operation	Objective	Description
1	Drinking water Network	DW-N-13	Adaptation of network operation	Adapt the current water distribution system to the one recommended, with the decommissioning of the water treatment plant in Vadul Lui Voda(SAN) Dilute the water produced in the well fields to achieve potable water standards	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 building) 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 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,: a pipe (ND 225 HDPE 17) to dilute the water produced by the wells and ensure the quality and a check valve (ND300)
2	Drinking water Operation & Maintenance	DW-OM-4	Purchase of Equipment	Implement the best practices in the operation of the Drinking Water Network in order to increase the efficiency of the interventions	Purchase of equipments for the maintenance of the Water Supply Network for each team (19 in total) Automated tools working with a generator or a heat motor (as sawing machinery, jack hammer, drill…) Safety equipment (gas detector, protection clothes, road signalization) Manual tools (specific tools to work on HDPE pipes, specific spanners and tools for cleaning…)
3	Other (automatization) Operation & Maintenance	O-OM-02	Purchase of Equipment	Improve the operational efficiency by automazing the monitoring and the regulations of the water supply and wastewater collection system	Extension of the existing systems in the Water and Wastewater Pumping Stations Implementation of a Data Storage room with dedicated servers. The existing data (water and wastewater PS, Termocom, Water Treatment Plant…) should be redirected Implementation of a unique tool for data processing
4	Drinking water Operation & Maintenance	DW-OM-01	Purchase of Equipment	Implement the best practices for the leak detection on the Water Distribution Network	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…
5	Drinking water Treatment	DW-T-03	Construction of new treatment facilities	Ensure a potable quality of the water abstracted from the wells for the daily use	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)
6	Drinking water Network	DW-N-04	Adaptation of network operation	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 ensured to the last floor of the high buildings)	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
7	Wastewater Pumping	WW-P-02	Other	Improve the safety of the electrical installations in the all the wastewater pumping stations and improve the electrical maintenance	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

Table 3.1b Projects selected for the Priority Investment Programme (following)

Rank	Field	Code	Type of operation	Objective	Description
8	Drinking water Other (Emergency Plan)	DW-O-04	Construction of new treatment facilities (well field)	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	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 of7,110m3/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
9	Drinking water Network	DW-N-02	Replacement of connections	The rehabilitation of the connections made of steel will lead to decrease the number of repairs and decrease the Water Losses	Replacement of 2,270 connections made of steel when replacing the steel pipes of the group 2 (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
10	Drinking water Operation & Maintenance	DW-OM-02	Purchase of Equipment	Implement the best practices in the operation of the Drinking Water Network in order to increase the efficiency of the interventions	Purchase of equipments for the maintenance of the Water Supply Network for each team (19 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
11	Drinking water Other (Emergency Plan)	DW-O-06	Adaptation of network operation	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	Implementation of new pumps for emergency purpose in the pumping stations of : Ialoveni: 2 pumping groups (installed power 542 kW), Schinoasa: 2 pumping groups (94 kW), Bucani for the Zone 4: 2 pumping groups (221 kW), Petricani for the Zone 2: 2 pumping groups (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 (64kW), Ghidighici: 2 pumping groups (74kW), Balisevschi for Zone 2: 2 pumping groups (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)
12	Drinking water Network	DW-N-14	Rehabilitation of reservoir	Secure a storage capacity superior to 50% of the peak demand per hydraulic entity.	Rehabilitation of the tank n°5 (10,000m3 in concrete, rectangular) in the Water Treatmant Plant in Chisinau (STA): roof waterproofing elements, prefabricated panels, partition walls, fittings, access scale 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

Table 3.1c Projects selected for the Priority Investment Programme (following)

Rank	Field	Code	Type of operation	Objective	Description
13	Other (power supply) Operation & Maintenance	O-OM-03	Rehabilitation of electric lines	Rehabilitate electrical lines for important facilities in order to ensure electrical supply and therefore comply with Moldovan regulations	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, rehabilitation of electrical lines to ensure 2 independent sources of electricity to facilities (250m three-phase cable 3x70mm, 480m three-phase cable 3x240mm, 1280m three-phase cable 3x240mm Installation of 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)
14	Drinking water Network	DW-N-01	Replacement of connections	In the seven most leaking zones of the city, rehabilitate the connections made of steel to decrease the Water Losses	Replacement of around 1,000 connections made of steel when replacing the pipes of the PIP (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
15		DW-OM-05	Purchase of Equipment	Implement the best practices in the operation of the DW Network in order to increase the efficiency of interventions	Purchase of equipments for the maintenance of the Water Supply Network for the interventions on the big pipes: a JCB (backhoe loader), an excavator on wheel (14T) and a dump truck 4x6 (26T)
16	Drinking water Operation & Maintenance	WW-OM-01	Purchase of Equipment	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	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, ...)
17	Wastewater Pumping	WW-P-03	Renewal of pumps	Rehabilitate the pumping stations for which the efficiency is not optimum and where significant savings can be made Remediate odour problems	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 in Vatra and Pump n°2 in Codru Phase 2: Pumps n°1 and 3 in Codru, Pumps n°1 and 2 in Vieru and Pump n°1 in Codru V. Lupu, Pump n°3 in Vatra Complete rehabilitation of two wastewater pumping stations :
18	Drinking water Network	DW-N-15	Rehabilitation of reservoirs	Secure a storage capacity superior to 50% of the peak demand per hydraulic entity	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),17 reservoirs in a bad condition (requiring a investment superior to 0.5M MDL),16 reservoirs in a correct conditions and requiring the rehabilitation of a few fittings. Works will consist in rehabilitating the prefabricated panels from the roofs, the partition walls and replacement of the fittings and access scales which are dangerous for ACC staff Rehabilitation or installation of a chlorination system for the tanks in the PS of Telecentru, Tohatin, Valea Dicescu, Buiucani, Ciocana, Schinoasa, Airport, Codru MDK, Colonita, Independenta,Sîngera andStauceni

Table 3.1d Projects selected for the Priority Investment Programme (following)

Rank	Field	Code	Type of operation	Objective	Description
19	Wastewater Network	WW-N-01	Renewal of sewers	Rehabilitation of the pipes, to increase the efficiency of the collection system and reduce the leakage of wastewater to the soil	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)
20	Drinking water Pumping	DW-P-01	Renewal of pumps	Rehabilitate the pumping stations where the efficiency can be increased or where important energy savings can be made	Prioritary rehabilitation of the existing pumps in the pumping Stations: Treapta IIA Raw Water: 2 pumping groups (1747 kW), Buiucani towards the Zone 3: 2 pumping groups (52 kW), Buiucani towards the zone 4: 2 pumping groups (187 kW), Independenta towards the Zone 3: 2 pumping groups (198 kW), Independenta towards the zone 4: 2 pumping groups (233 kW)
21	Drinking water Operation & Maintenance	DW-OM-03	Purchase of Equipment	Implement the best practices in the operation of the DW Network in order to increase the efficiency of the interventions	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)
22	Drinking water Network	DW-N-06	Renewal of water pipes	Rehabilitate the pipes with the highest linear repair index in order to reduce the number of repairs and the water losses	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
23	Drinking water Other (emergency plan)	DW-O-05	Rehabilitation and construction of wells	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	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 (capacity: 7,900m3/day – production: 790m3/day) Rehabilitation of 9 wells in Petricani Well Field (capacity: 11,300m3/day – production: 1,130m3/day) Rehabilitation of 6 wells in Balisevschi Well Field (capacity: 8,500m3/day – production: 850m3/day) Creation of 15 new wells in the vicinity of the Water Treatment Plant (STA) (total capacity: 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.
24	Other (standardization) Operation & Maintenance	O-OM-01	Purchase of Equipment	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.	Implementation of a full ERP system (Enterprise Resource Planning) Licences for the software Technical assistance to implement the system Purchase of hardwares
25	Drinking water Network	DW-N-12	Purchase of Equipment	Improve the quality of reparation on the network in order to decrease the number of leaks and increase the efficiency of ACC's reparations	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 fittings for the new connections (using a all-in-one solution to prevent future leaks)

Table 3.1e Projects selected for the Priority Investment Programme (end)

Rank	Field	Code	Type of operation	Objective	Description
26	Wastewater Pumping	WW-P-01	Renewal of pumps	Rehabilitate the pumping stations for which the efficiency is not optimum and where significant savings can be made	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; Additional pumps for rain events: 2 pumping groups of 6,000 m3/h each; Hydraulic equipment and ancillaries.
27	Drinking water Pumping	DW-T-01	Rehabilitation of the existing plant	Implement a safe disinfection unit to comply with Moldova regulations regarding the storage of hazardous chemicals	Implementation of an Electro-chlorination Plant, that produces NaClO, in order to disinfect the water produced in STA Urgent general rehabilitation works in the DWTP
28	Wastewater Pumping	WW-T-01	Construction of new treatment facilities	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	Implementation of the first phase of construction for the Wastewater Treatment Plant Construction of new pretreatment facilities: 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 Rehabilitation of the air blowers, the primary settlers, aeration tanks and secondary clarifiers
29	Drinking water Network	DW-N-05	Renewal of water pipes	In the seven most leaking zones of the city, rehabilitate the pipes with the highest linear repair index to reduce the number of repairs and the water losses	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 of 150mm with an average LRI of 20 burst/km/year 12,200m of the existing steel pipes 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
30	Wastewater Network	WW-N-02	Renewal of sewers	Rehabilitation of the pipes, assess as very urgent rehabilitation works to increase the efficiency of the collection system and reduce the leakage of wastewater to the soil	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

3. EXISTING ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

3.1. CLIMATIC CONDITIONS

The climate of Chisinau is of moderate continental type. The average yearly temperature is around 9 °C. January is the coldest month of the year (-4°C on average), while July is the warmest (21°C on average). The maximum daily temperature is around 28°C as the coldest absolute temperature can reach less than -30°C. Within the city of Chisinau, the temperature are generally 2°C higher than in surrounding rural areas, this being often observed in large cities.

The climate is rather dry with an average yearly rainfall of 475 mm but inter-annual variation can be significant (see Fig. 2).

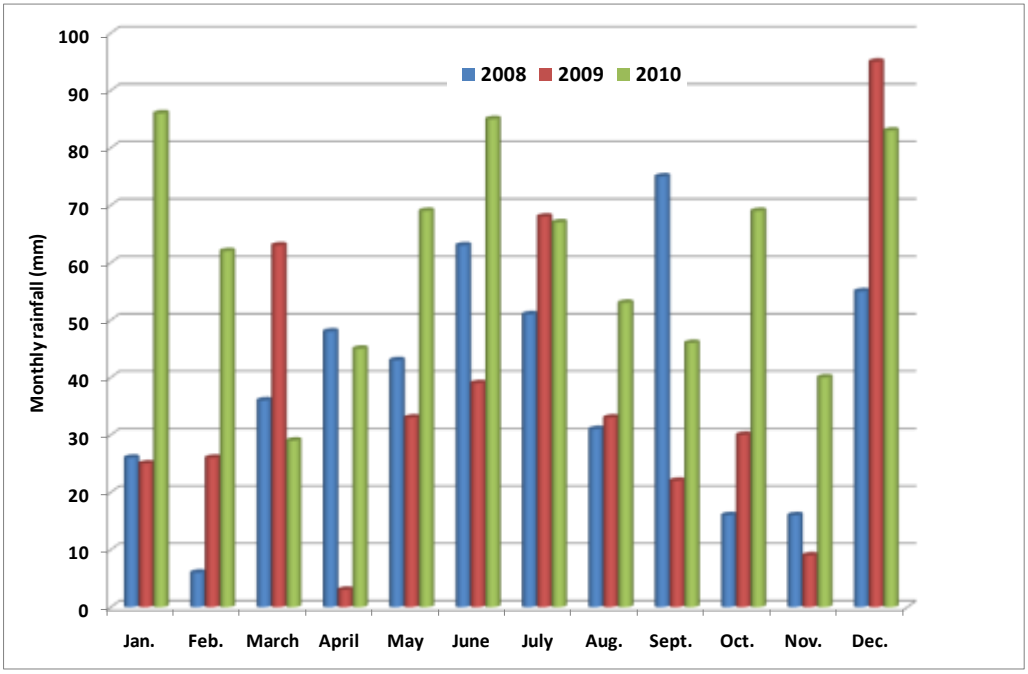

Figure 2 Monthly rainfalls over the 2008-2010 period

The rainfall events unevenly occur during the year. Generally autumn and winter are the driest seasons. The highest daily rainfall can reach 40 m (recorded in June 2010). Summer rains are often of torrential nature.

Snowfalls are very frequent in winter time: generally from 40 to 60 snowing days per year. The snow cover reaches most often from 15 to 25 cm. During the winter, the soil may freeze down to 30-45 cm depth.

The relative humidity varies from 61% in summer to 81-84% in wintertime and the ratio of rainfall to evaporation-transpiration oscillates between 0.8 and 1.1.

In Chisinau, the prevailing winds are from North-East, followed by those from South-East, and from North. The number of days with strong wind (over 15 m/sec) range from 10 and 40 in a year.

3.2. GEOLOGY AND LANDSCAPE

Basement rocks of the Chisinau area are constituted by crystalline, metamorphic rocks of Archean, Proterozoïc period overlaid by dolomite and limestone of Silurian age also overlaid by limestone of Cretaceous age. All these old rocks cannot be observed less than 200 m below the soil surface and do not play a significant role with respect to geomorphology, soil genesis and groundwater circulation. This is not the case of the Miocene sedimentary rocks, of marine origin, which are found at depth from 50 to 250 m below the soil surface. These rocks actually form discontinuous layers (strata) of pervious material such as sand or limestone and impervious material such as clay. Actually, the different rocks are often mixed inside a same layer but the prevailing rock(s) impose their porosity and then their capacity to transport and store groundwater (aquifer) or not (aquitard or aquiclude). During glacial periods of Pleistocene (early Quaternary) age, these rocks layers have been covered by several metres thick deposits of loess, originating from Aeolian transport of loamy particles. Loess deposits gave rise to the so fertile, deep Chernozem soils. During the most recent Quaternary, alluvial deposits carried by rivers, lakes or wind forming thin, piled layers of sand, gravel, silt and clays covered a large part of the existing rocks of Neogene period (i.e. Miocene and Pliocene).

The Municipality of Chisinau is located at the place where the Moldavian plateau is crossed by the wide and deep meadow of Bic River, right affluent of Dniester River. The actual “city” stretches on the valley of the Bic River and its tributaries. The plateau shows a gently rolling topography due to the network of streams and little rivers. The height of most hills is around 40 m above the bed of Bic River that is nearly 230 m above the mean sea level.

3.3. HYDROGEOLOGY AND GROUNDWATER QUALITY

According to gelogical formations, the groundwater can be found in severa water bearing layers (aquifers) which can be classified into three categories, from te surface ownwards:

- Shallow (phreatic) aquifer (less than 20 m deep), located in Quaternary alluvial and upper Neogen formatons, exploited from wells and boreholes generally dug by local population and equiped by manual pumps
- Deep aquifers constituted by pervious layers of Neogen formations and filled by freshwater, exploited by deep wells or drillings equipe with electrical pumps
- Very deep aquifers constitued by pervious layers of Cretaceous formations and often filled by brackish water, which is not compliant with health standards and hence generally prevents its exploitation.

An hyrgelogical study has been performed in the framework of the Master Plan, the main part of the following chapters is drawn from the hydrogeological rport.

3.3.1. SHALLOW GROUNWATER

Shallow (phreatic) groudwater is widely used in rural areas where almost every house has its own well(s) in the yard with diameters ranging from 0.5 to 2 m. Groundwater tables are usually within 10 m and do not show significant variations of level during the years so that the wells never become dry. The dug wells are generally very well constructed with good quality brickwork or concrete ring linings an also well maintained by owners. The water bearing layers are of sand or gravel, often mixed with clay. The yield of wells ranges is generally less than 0.5 L/s and the drawdown from 1 to 1.5 m. The phreatic aquifer is unconfined and recharged by infiltration of rainwater through the soil, the surrounding hills acting as natural water towers and discharges into the local, small size rivers and streams. The vulnerability of this aquifer to a surface pollution is deemed rather low but it can however be threatened either by chronic, diffuse pollution, such as that from fertilizer application or deep pollution, such as that from informal septic tanks or cesspits.

Basically, the shallow groundwater shows a natural chemical composition fully compliant with health and organoleptic standards. However, nitrate levels far higher than usual guideline (50 µg/L NO_3) are frequently observed. Nitrate contamination is most likely caused by nitrogen fertilization of intensive crops as well as migration and nitrification of organic nitrogen released by on-site, unconfined sanitation systems (septic tanks, cesspits, etc.) located in the vicinity of wells. Informal and low standard sanitation systems such as cesspits or soak-away pits located too close to the wells are also responsible for microbiological contamination, indicated by indicators such as total and fecal coliforms as well as streptococcus. As a result, many water samples from shallow wells and analyzed by the National Scientific and Practical Centre for Preventive Medicine (NSPCPM) do not meet health standards for drinking waters. As an example, a recent report of the PNUE (*Children health and Environment in Moldova, 2010*) shows a share of drinking water samples not complying with microbiological standards ranging from 11 to 38% in administrative units neighboring Chisinau. In Chisinau, the share is only 2.2%, buts this is due to the fact that almost the totality of drinking water comes from public network (treated and disinfected water). As regards the pollution by nitrate, the same report indicates shares of incompliant samples from 11 to 47% in the neighboring administrative units and of 1.7% for Chisinau.

3.3.2. DEEP GROUNDWATER

Dreep, freshwater aquifer is mainly located within Neogen (mre precisely Samartian) formation which is absically comprised of an impervious, clayey top layer with athickness of 30 to 110 m which covers a water bearing layer of limestone from 50 to 100 m thick. This aquifer is protected by the overlying clay layer and confined with a variable hydraulic head and hence not vulnerable to pollution. The deep groudwater is abstracted by a batteries of depp wells (drillings) such as those of the Chisinau well field operated by Apa Canal. In Chisinau, the yield of the wells is between 0.1 to 2.5 L/s. The hydraulic conductivity ranges from 2 to 10 m/day, transmissivity from 110 to 230 m^2/day and water storage coefficient from 0.001 to 0.003. The aquifer discharges into the main rivers Dniester and Prut River.

In some places, the top of Cretaceous aquifer is exploited for supply of technical water by drilling down to 150 to 160 m. The aquifer is comprised of 20 of 30 thick layer of chalky limestones or marl. The hydraulic conductivity of its uncnfined aquifer ranges from 0.1 to 3 m/day and transmissivity from 10 to 120 m^2/day.

Water from confined (Neogen) aquifer is not containated from external source but some of its natural elements can meet levels uncomliant with drinking water standards. The elemnts of concern are mainly fluorine, ammonium (NH4) and sulfides (H2S). As ammonium and sulfure give mainly bad taste and bad odour to water, fluorine in excess can be harmful for publich health by its averse effects on teeth and bones (fluorosis).

3.4. RIVERS AND SURFACE WATER QUALITY

3.4.1. RIVER NETWORK AND CATCHMENT BASINS OF THE STUDY AREA

The entire study area is included in the catment area of the Dniester River, the largest river of Moldava. The Dniester River rises in the northern part of the Carpathian Mountains in Ukraine and has a total length of 1,352 km out of which 630 km within Moldovan territory. The area of the Dniester Basin is 72,100 km^2 out of which 19,400 km^2 (27%) are in the territory of Moldova. The catchment basin is actually rather narrow and the Dniester River has only 15 tributaries of more than 100 km long i.e. from North to South: the Raut River, the Bic River and the Botna River. Within the Moldovan part of Dniester River Basin, the density of river network is 0.46 km/km^2, which is rather low.

The course of the Dniester River is regulated by two major hydropower dams located respectively called the Dniestrovsky dam in Ukraine and the Dubossary dam in Moldova,.

The Dniestrovsky dam was constructed in Ukraine in the 1980s around 15 km upstream of the Moldovan border to regulate the Dniester flow, first on a yearly basis, with subsequent transition to a multi-year flow regulation pattern. The drainage basin area upstream of the Dniestrovsky dam is 40,500 km^2, with a mean annual flow discharge rate of 274 m^3/s. The reservoir has a length of 204 km, an average depth of 21 m (55 m at maximum) and an effective storage capacity of 2 km^3. Downstream of the dam, when one enters into Moldovan territory, the river channel is 100-120 m wide and up to 3-4 m deep.

The 128 km long Dubossary dam has been constructed in the 1950s (hydropower plant operating from 1954) in Moldova, between the village of Camenca and the town of Dubossary. It has an area of 67.5 km^2, with a full storage capacity of 0.486 km^3 and effective storage capacity of 0.214 km^3. Within the reservoir, river flow velocities are in the range of 0.05 m/s to 0.15 m/s, with the average velocity being as low as 0.1 m/s. It is noteworthy that the Dubossary is located upstream of the water intake of Vadul Lui Voda and upstream the mouths of the main tributaries that are the Raut, and the Bic rivers. At Bendery (Tighina), i.e. nearly 10 km downstream of the discharge of the Bic River, the catchment area of Dniester River is 66,100 km^2 and its normal annual discharge (probability 50 %) is 10.4 km^3 (330 m^3/s) while the annual discharge with a probability of 95% is 6.56 km^3 (208 m^3/s).

3.4.2. BIC RIVER

The Bic River is a medium size tributary of the lower course of Dniester River. The Bic river is 155km long with a catchment area of nearly 2000 km^2. With a theroritical, average water runoff of 90,000,000 m^3/year arriving to the river bed, the mean flow would be of 246,575 m^3/d i.e 2.85 m^3/s. However, along its course, the Bic River experiences to major anthropic, antagonist factors which deeply modify its stream flow:

- Its higher course is impounded by the Gidighici dam upstream of the agglomeration of Chisinau
- Its bed receives the vast majority of wastewater discharged by the the city of Chisinau and all the tows located within its catchment basin.

The Ghidighici dam was build in 1957 for agricutural purpose (irrigation). Its 850 ha large lake is also used for recreational activities including swimming and boating and sevral restaurant are set up on its banks. The Ghidighici dam and reservoir are under the management of the Apele Moldove public company. At the beginning, an environemental flow of 250 l/s all over the year would have been provided for but, according to Ape Moldove, since many years ago, the discharge of the lake into the bed of the Bic River only occurs when the capacity of the reservoir is reached (overflow). This results in very irregular streamflow of the Bic River measured at the Pruncul hydrometric station (nearly 4 km downstream of the dam) as shown Table 4.1 and Figure 3. Even if water measured at the Pruncul station may also be brought by small tributaries, it appears that the realease of water into the river bed dramatically dereased after 2006.

Table 4.1 Monthly streamflows of the Bic River (in m3/s) measured at the Pruncul hydrometric station from 2005 to 2010

Month	2005	2006	2007	2008	2009	2010
Monthly values						
January	0.58	1.06	0.07	0.05	0.06	0.04
February	0.92	0.91	0.09	0.06	0.09	0.05
March	2.68	2.81	0.18	0.06	0.38	0.07
April	1.11	3.26	0.17	0.14	0.44	0.07
May	3.02	1.89	0.18	0.37	0.32	0.47
June	1.95	2.66	0.10	0.38	0.09	1.09
July	0.91	2.76	0.07	0.07	0.06	0.72
August	1.36	1.17	0.05	0.04	0.04	0.46
September	0.78	0.26	0.02	0.05	0.05	0.08
October	0.53	0.08	0.03	0.08	0.11	0.10
November	0.63	0.06	0.05	0.07	0.03	0.10
Annual values						
Minimimal	0.53	0.06	0.02	0.04	0.03	0.04
Average	1.31	1.44	0.09	0.12	0.14	0.31
Maximal	3.02	3.26	0.18	0.38	0.44	1.09

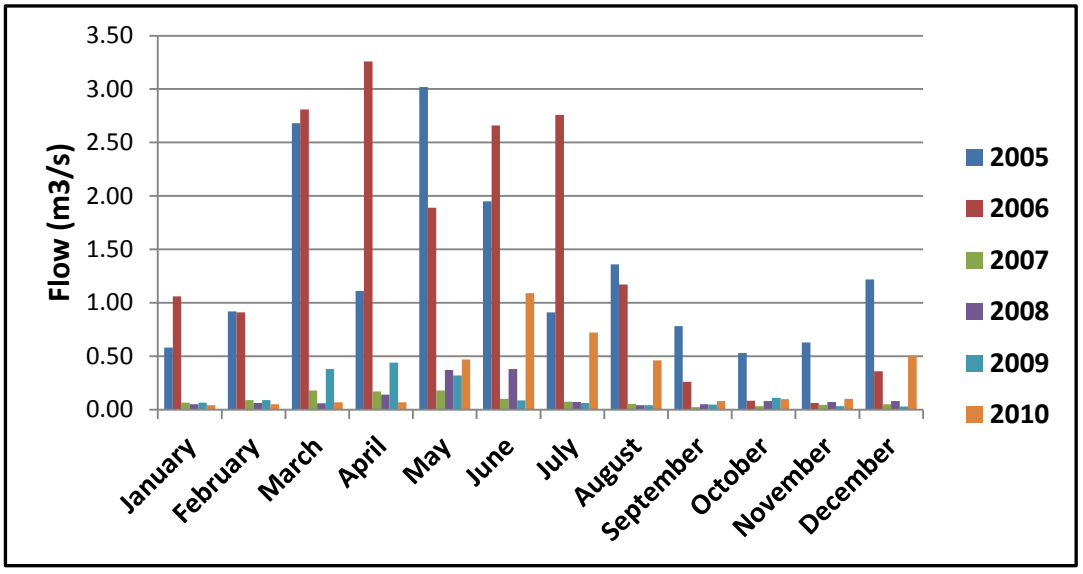

Figure 3 Monthly mean flow discharge (m3/s) of Bic River at Pruncul station (4 km downstream of Ghidighici Lake)

The discharge of wastewater into the Bic River starts probably upstream of the Ghidighici lake but becomes really significant, and measurable by physical (color and odors), chemical (organic and toxic compounds) and biological (fecal germs) features when it enters the agglomeration of Chisinau:

- Between the dam and the exit of Chisinau city (around 18 km), many unformal discharge points from industrial facilities not connected to the ACC sewage network

can be observed and the effluent discharged are very likely untreated. A study made in the framework of this Master Plan identified not less than 28 discharge points between the dam and the Chisinau WWTP (see Figure 4). The industrial wastewater probably adds to municipal wastewater of some housings. No measurment campaign have been do to determine the rande of discharge flow of wastewater on this river stretch.

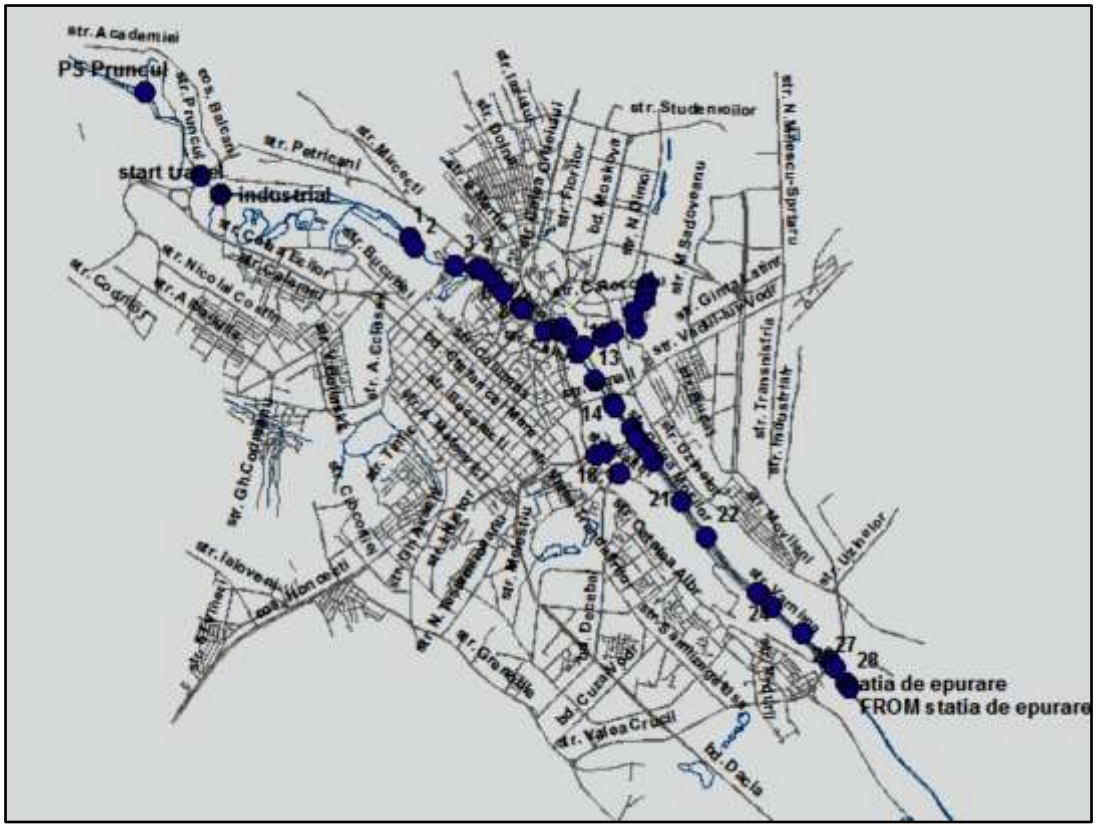

Figure 4 Informal industrial discharge points into the Bic River between the Ghidighici dam and the Chisinau WWTP (2011)

- At the exit of Chisinau city, the main discharge point is the one of the Chisinau WWTP, which releases on average 150,000 m3/d (1.7 m3/s) of treated wastewater into the Bic River, which results in a permanent and significant streamflow of the river downstream of this point and prevents the river from freezing even in the most cold periods down to its mouth to Dniester.
- From Chisinau to the discharge point into the Dniester River (around 45 km) which is located downstream of the small town of Gura Bicului, the Bic River keeps receiving through small tributary and man-made channels (see Picture 1) untreated municipal and industrial wastewater from small size towns located on its banks, such as, on the left bank, Floreni, Mereni, Chirca, Botnaresti, Socoleni and, on the right bank, Chetrosu, Todiresti, Tintareni, Anenii, Calfa. These towns are included in the District of Anenii Noi, which counts less than 80,000 inhabitants. Accordingly, the total volume of wastewater discharged by these towns stay far lower than the one of the Chisinau city, however, the leavel of treatment, in particular carbon treatment, must be also lower.

Picture 1 Man-made channel conveying urbancwastewater to the Bic Rived downstream of the WWTP (Floreni)

Data on the Bic River quality and discharge flow donstream of the Chisinau WWT are not available because of the lack of monitoring stations. However, direct, visual observations made by the consultant in late October 2011 at the Gura Bicului bridge, located less than 800 m usptream of the confluence, gave a flow estimate ranging closed to 3 m^3/s, wich is consistent with the theoritical estimate of 2.85 m^3/s (see § 4.4.2). At this observation point, the Bic water showed a brown color and a bad odor (see Picture 2).

Picture 2 Bic River just upstream of its discharge into Dniester River at Gura Bicului

However, the pollution load of the Bic River is no loger visible downstream it discharge into the Dniester River (see Picture 3).

Picture 3 Dniester River just downstream of the discharge of Bic River at Gura Bicului

The average concentrations of the main pollutants measured in the Bic River donwstream of the discharge point of the Chisinau WWTP are showed Table 4.2 for the year 2010. These results demonstrate the very bad status of the river water in terms of both ecological and health aspects. The high levels in phosphorus and nitrogen favour eutrophication and restrict the development of aquatic life to very resistant species, thereby sharply lowering the biodiversity. Moreover, the high level of ammonium (NH4+) in quite alkaline water is likely to generate free ammonia (NH_3) which is highly toxic for fises. As per classification of river waters proposed for Moldova (OEDC-EAP, 2007) and issued more recently by the Romanian legislation (2006), the Bic River is already deemed polluted to extremely polluted before receiving the effluent of the WWTP. The discharge of effluent significantly increases the concentration of pollutants such as BOD_5, COD, ammonium and phosphate but does not rellay change the (very low) status of the Bic River.

Table 4.2 Average yearly concentration of pollutants measured in Bic River usptream and downstream of the Chisinau WWTP in 2010. Rivers of Class I and II are satisfactory for the development of aquatic life. Rivers of Class III to V are deemed polluted to extremely polluted.

Parameters	Unit	Upstream of WWTP discharge			Downstream of WWTP discharge		
		Content	Quality class		Content	Quality class	
			Moldova (proposed)	Romania (2006)		Moldova (proposed)	Romania (2006)
Dissolved oxygen	$mg.l^{-1}$	5.50	**III**	**III**	6.09	III	**III**
BOD_5	$mg.l^{-1}$	5.98	II	II	21.67	**IV**	**IV**
COD_{Mn}	$mg.l^{-1}$	60.58	**V**	IV	112.75	**V**	**IV**
pH	unit	8.22	II	I	8.06	II	I
Ammonium-N	$mg.l^{-1}$	3.26	**V**	**V**	20.70	**V**	**V**
Nitrite-N	$mg.l^{-1}$	0.36	**V**	**V**	0.16	**III**	**III**
Nitrate-N	$mg.l^{-1}$	5.15	**III**	**III**	2.66	**II**	II
Total-N	$mg.l^{-1}$	7.54	II	**III**	27.20	**V**	**V**
Orthophosphate-P	$mg.l^{-1}$	1.07	**V**	**V**	2.79	**V**	**V**
Zinc – Zn	$mg.l^{-1}$	0.0085	I	I	0.0098	I	I
Copper – Cu	$mg.l^{-1}$	0.0184	I	n.d.	0.0204	II	n.d.
Chromium (total)	$mg.l^{-1}$	0.0582	n.d.	III	0.0612	n.d.	III
Nickel – Ni	$mg.l^{-1}$	0.0237	II	II	0.0211	II	II
Suspended Solids	$mg.l^{-1}$	21.58	n.d.	n.d.	24.57	n.d.	n.d.
Cyanide (total)	$mg.l^{-1}$	0.418	n.d.	n.d.	0.429	n.d.	n.d.
Petroleum products	$mg.l^{-1}$	0.135	III	n.d.	0.163	III	n.d.
Phenol	$mg.l^{-1}$	0.014	**V**	**IV**	0.024	**V**	**IV**
Coliforms	(/100mL)	$2.5\ 10^5$	**V**	n.d.	$1.0\ 10^6$	**V**	n.d.

The presence of a rather high level of total cyanide in Bic River is noteworthy. Actually, the cyanide contmaination affects both the Bic water upstream of the WTTP and the effluent of the plant. As a results, the concentration of cyanide stay significant at the exit of Chisinau city and most probably down to the junction with the Dniester. At this point however, the impact on the surface water quality becomes probably unsignificant due to dilution by the volume of Dniester River, nearly 100 times bigger than Bic River.

The cyanide found in water most likely originates in cyanide containing waste (mainly complex cyanides such as potassium ferri- and ferrocyanide) produced mainly by surface treament plants, but also by some other industrial activities. This very soluble product has been disposed indiscriminately and unadequatly in dumping sites without prevention from leaching and runoff transport to water courses, drainage system, shallow groundwater and also to sewage network with intrusive waters. To a lesser extent, direct discharge of cyanide containing waste into the sewerage cannot be excluded. A total of more than 1000 tons of ferrocyanide waste would be disposed in the territory of the Chisinau agglomeration. The cyanide measured by the laboratory of ACC is actually total cyanide, i.e. comprised of very toxic, free cyanide (dissociated CN^-) and far less toxic metal complexed cyanides (ferri- and ferrocyanide). Moreover, the protocol used still dates from the soviet period and is not ISO certified, which is of concern given that the protocol is rather complex with the use of many chemicals and several steps including distillation. The industrial waste are mostly made of complexed cyanide but during water transport, under proper conditions, this ferrocyanide may quickly generate free cyanide by photolysis. On the other hand, the free cyanide may alos be removed from water by volatilization of gaseous cyanhydric acid. So the resulting proportion between complexed

and free cyanide is impossible to estimate in water without appropriate analysis. If all or the most part of total cyanide measured in Bic River was actually made of free cyanide, the water would be toxic (chronic toxicity) for many fishes and aquatic invertebrates. It is also worth noting that the WHO guideline value for free cyanide in drinking water is of 70 µg/L, i.e. 6 times less than the average concentration of total cyanide in the Bic River in 2010.

Whatever is actually the proportion between free and complexed cyanide in the Bic River, the management of the cyanide containing waste within the Chisinau agglomeration and the entire Moldova is of highest concern, but out of the scope of this study. Nevertheless, it is warmly recommened that the laboratory of ACC acquires both equipment and skill necessary to measure both total and free cyanide according to a certified, appropriate methodology.

As a conclusion, the contribution of both treated and untreated municipal wastewater and industrial effluent to the water flow of the Bic River is estimated to range from 50% to nearly 100% according to the season. In these conditions, the quality of the Bic River cannot significantly improve without:

- increasing the connection rate to sewage network with the Chisinau agglomeration
- discharging an environemental flow from the Ghidighici lake into the Bic River all over the year
- improving the wastewater treatment at Chisinau WWTP with tertiary treatment aiming at both phosphorus and nitrogen removal
- removing and adequately disposing the cyanide containing waste which contaminate both Bic River and wastewater
- improving the collection and treatment of wastewater discharged by small towns downstream of Chisinau

With the implementation of these measures, it can be expected a real rise of both chemical and ecological status of the river, in accordance to the European Water Framework Directive.

3.4.3. DNIESTER RIVER

The Dniester River is a critical waterbody for the water supply and sanitation of the Chisinau agglmeration because:

- It supplies a very large part (97% in 2010) of the raw water for drinking water production at the level of the off-take station loacted close to Vado Lui Voda, more than 18 km east of Chisinau city.
- It receives the wastewater and effluent, treated and untreated, of the Municipality through its tibutary the Bic River.

The off-take of raw water from the Dniester River at the off-take station amouts to an average of 220,000 m^3/d, i.e. less than 1,5 % of the average stream flow, which is without significant quantitative impact on the river flow, even in low water season. In spite of its high pollution load, the discharge of the Bic River into the Dniester River does not seems to modfify the state of the latter, which falls into quality class II (clean) from Dubossary Dam down to the mouth at the Black Sea (see Figure 4). This is due to the self purification of the Bic River and, to a far most extent, to the dilution, the streamflow of the Dniester being nearly 100 times higher that the one of the Bic River.

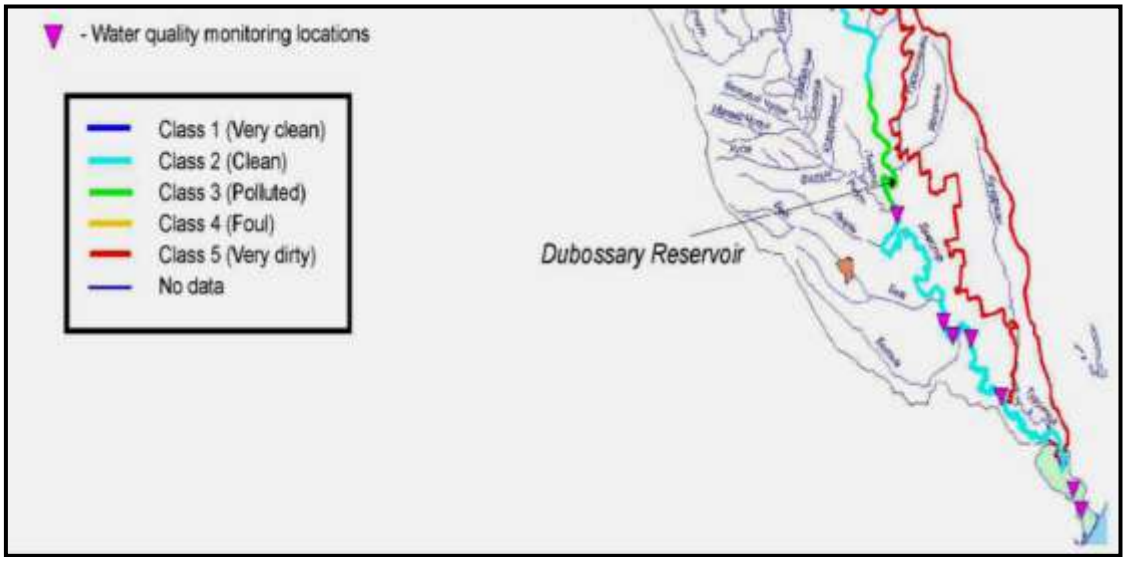

Figure 4 Quality of water in the lower basin of the Dniester River (the orange area shows Chisinau city). From "*Transboundary Cooperation and Sustainable Management of the Dniester River", 2005*.

3.5. ECOLOGY AND BIOTIC RESOURCES

From an ecological point of view, the territory of the Chisinau Municipality stretches on the border of the forest steppe zone (forested highlands to the west) and steppe zone (Dniester terrace to the east).

The Chisinau agglomeration is firstly a densely populated urban area without any natural zones within which the wildlife may develop quietly. Density of human population, movements of cars, emission of noise and air pollutants together with discharge of untreated wastewaters and industrial effluents into the watercourses, in particular the Bic River (see § 4.4.2) are very harmful for animal life and biodiversity. The Ghidighici impoundment lake, which is located upstream of the city (see § 4.4.2), can however be considered of suitable quality for the development of aquatic life. Birds, more or less adapted to urban conditions can also breed in the numerous parks and green areas scattered over the Chisinau city which contribute to the improvement of air quality as well as the urban aesthetic and population welfare. Many of these parks are protected by the State, among which the Institute Botanical Garden of Chisinau, the Dendrological Garden, the Denfrologic Park of the National Museum of Ethnography and Natural History and the Park "Valea Morilor". Actually, not less than 77 secular trees of different neighborhoods of the city have been put under the protection of the State. It should be mentioned that I the vicinity of the off-take station of Vadul lui Vodă, on the west bank of the Dniester, there is a 540 ha large green area called "Parcul Nistrean", which offers a large number of sanatoria, rest houses, sport and leisure camps very frequently visited by the population of Chisinau.

The main large-scale protected area is the Codrii Scientific Reserve located 30 km North-West of Chisinau.

The Chisinau municipality also comprises 33 "suburban" settlements a large part of which is actually made of rural areas mostly cultivated with cereals and vineyard or left in pasture for livestock. Forests actually cover 4,700 ha of the municipality territory. The most forested part is the North-West with nearly 30% of wooded areas whereas the South-East of municipality only comprises less than 10% of woods and forests.

Forests in this area are mainly formed of the common oak (*Quercus robur*), which may reach over 30 m in height. The trees forming the first stratum are the lime (*Tilia cordata*), the ash (*Fraxinus exelsior*), the maple (*Acer platanoides*), the cherry tree (*Cerasus avium*). The second stratum is frequently dominated by the hornbeam (*Carpinus betulus*). On this level there are also growing species of maple (*Acer campestre*), elm (*Ulmus carpinofolia*), forest-pear (*Pyrus pyraster*), forest-apple (*Malus silvestris*), Tatar mapple (*Acer tataricum*) and corn coppice (*Cornus mas*). The most frequent herbaceous

plants are the Bridal veil (*Stipa capillata*), the fescue (*Festuca valesiata*), the Narrow-leaved Meadow-grass (*Poa angustifolia*), the Hungarian brome (*Bromopsis inermis*), the sedges (*Carex pilosa*, *C. brevicollis*), the Goat's-foot (*Aegopodium podagraria*), the wood spurge (*Euphorbia amygdaloides*) and the Dog's Mercury (*Mercurialis perenis*).

Among rare or endangered species of plants which may grow in forests and steppes in the vicinity of the Chisinau municipality, there are: the service tree (*Sorbus domestica*), the gymnosperm ash (*Dictannus gimnostylis*), wild wines (*Vitis silvestris*), forest peony (*Paeonia peregrina*), Larkspur torn (*Delphinium fissum*), Marsh Fern (*Thelypteris palustris*), Pasque Flower (*Pulsatilla grandis*), Rigid Usnea (*Usnea hirta*), Stipa Grass (*Stipa lessingiana*), snowdrop (*Galanthus nivalis*), variegated tulip (*Fritillaria meleagroides*), Lady's Slipper (*Cypripedium colceolis*), Purple Orchis (*Orchis purpurea*), Burning Bush (*Euonimus nana*), Hoary Rockrose (*Helianheemum canum*), Pasque Flower (*Pulsatilla grandis*), Sinister plant (*Scopolia corniolica*), White Helleborine (*Sephalanthera damasonium*), Violet Helleborine (*Epipatus purpurata*) and Hart's-Tongue Fern (*Phyletis scolopendrium*).

The banks of the Bic River, of the Ghidighici Lake and other water bodies, are occupied by riparian vegetation such as reed (*Phragmites australis*), bulrush (*Thipha latifolia*, *T. angustifolia*), Frog Bit (*Hydrocharis morsus-ranae*), Horsetail (*Equisetum telmatea*), Water plantain (*Alisma plantago-aquatica*), duckweed (*Lemna minor*) and pondweed (*Patomogeton pectinatus* and *P. perfoliatus*).

3.6. AIR QUALITY

The monitoring of atmospheric air quality in Moldova is undertaken by the State Hydro-meteorological Service (SHS) and the State Ecological Inspectorate (SEI). The SHS monitoring network includes nineteen stationary stations located in 7 industrialized centres including Chisinau (6 stations). The level of air pollution is assessed by comparison of the annual average concentrations of pollutants with to the maximum admitted concentration (MAC), and air quality is estimated based on the complex indicator of atmosphere pollution (IAP). The monitored pollutants are: particulate matter (PM_{10}), CO, NO_2, SO_2, soluble sulphates, phenol, formaldehyde and benzo(a)pyrène. Moreover, wet deposits of ions such as $NO2^-$, $NO3^-$, $PO4^{3-}$, $NH4^+$, $SO4^{2-}$, etc. have been measured in rain and snow in order to assess the potential acidification of waters and soils. In Chisinau, among the monitored air pollutants only nitrogen dioxide (NO_2) showed in 2010 concentrations above MAC (40 µg/m^3, i.e. European standard for long term exposure). Actually NO_2 is typically associated with the transport sector and natural gas-fuelled power plants. The average annual concentration reached by NO_2 that is 2.3 MAC, i.e. 92 µg/m^3 in 2010 is high as compared to other European large cities but if there are monitoring stations set up in the vicinity of highways or power plants then such high concentrations are not surprising. In fact, only "background" stations, located within cities but in sites quite far away from the main emission sources, which are more representative of the quality of the air breathed by most of the population can be used or comparison with EU cities and health standards.

The use of natural gas for power production in Chisinau causes far less emissions of particulate matter into air than the use of coal or heavy fuel oil for the same purpose would do. Although the Moldovan car fleet is quite old (65% of cars of over 15 years in 2007), the emissions of particles do not seem to be of concern, but it is noteworthy that the standards for particulate matter is not really clear in the Moldovan legislation because based on origin (wood, soot, cement factory, gypsum) or chemical constitution (inorganic, as per silica content) of dust and not on their size. However, the MAC for soot, which is quite close to the particulate emitted by gasoline/diesel oil vehicles, is of 50 µg/m^3, which is the European standard.

3.7. NOISE

The most important sources of noise are monitored in Moldova. Nowadays, the transport sector (highways and roads, airports, railways) is the most impacting source of noise (responsible for 42.3% of noise emissions), followed by industrial activities (29% of noise emissions) and general urban activities (restaurants, disco clubs, bars, cafes, sports facilities, etc.).

Between 2005 and 2008, for example, nearly 5000 noise measurements have been performed in residential buildings/dwellings, schools, kindergartens and other places within the Chisinau municipality, out of which 930 have, i.e. 19% had not met the standards. Actually, the proportion of measurements exceeding the standard hade sharply increased from 2005 (6%) to 2008 (34%) because of the rise of number of cars circulating in the capital city.

3.8. GROUND CONDITIONS

3.8.1. GENERAL CONDITIONS

The soils prevailing in the territory of Chisinau Municipality are of clayey-illuvial Chernozem types more or less rich in humus, which can be locally modified by erosion due to slope, land clearing and intensive cultivation. These soils are very thick and basically of good quality for crop production albeit the erosion has lowered their natural fertility. On high locations there may be found portions of grey forest soils.

Table 4.3 shows typical chemical features of the prevailing soils of the study area (clayey Chernozem)

Table 4.3 Analysis of the different horizons of a typical soil of a clayey Chernozem

Horizon	Depth (cm)	Organic matter (%)	$CaCO_3$ (%)	pH	Exchangeable Ca (me/100 g)	Exch. Mg (me/100 g)
A_0	0-10	7,5	5,45	8.25	21,27	20,85
A_1	20-30	4,2	1,17	8,30	13,84	23,90
A	35-45	4,8	0,57	8,5	12,99	23,47
B_1	55-65	3,3	0,66	8,8	10,48	19, 29
BC	75-85	1,9	1,30	8.8	9,52	17.15
C	90-100	1.0	21,27	8,7	7,87	14,49

It is clear that within the urban area the soils have been deeply modified by excavation, earth filling, surfacing and so on. Moreover, during the former Soviet period, soils of industrial areas have been polluted by many kind of hazardous waste such as heavy metal and cyanide containing slurries and sludge. During the same period, pollution of agricultural land by pesticides (chlordane, heptachlor, DDT residues and other) and other Persistent Organic Pollutants (POPs) has been widespread all over the country. Fortunately, due to the practice of cleaner agriculture for the last 20 years the soil concentrations of POPs progressively decreased by self-cleaning down to quite acceptable levels in many areas. However, copper which is heavily applied on orchards and vineyards still shows high levels in soils cultivated with these crops as well as in the nearby watercourses. According to the Report of the National State of the Environment 2000-2010, the proportion of soil samples exceeding 50 mg/kg of POPs in the Chisinau Municipality is over the national average of 16 %.

Alkaline, calcareous soils are known for strongly fixing heavy metals (except arsenic, which, actually, is not a metal but often included into this category) and so hinder their migration down to the groundwater. A negative consequence of this may the shortage of microelements such as iron and cobalt which are necessary to the plant growth. Phosphate ions can be also made unavailable for plants in calcareous soils. In contrast, the nitrate soils are very mobile in these so that if nitrogen fertilizer is applied in excess, nitrate can easily contaminate shallow and may be deep groundwater.

3.9. SOCIO-ECONOMIC AND CULTURAL ISSUES

3.9.1. EMPLOYMENT, INCOME AND STANDARDS OF LEAVING

The study area encompasses:

- The Municipality of Chisinau, comprised of the city of Chisinau with five urban districts (about 631,000 inhabitants in 2009), and, around the city limits, six small towns (about 56,000 inh. in total) and 28 rural villages (about 70,000 inh. in total)
- Two small towns (about 33,000 inh. in total in 2009) and seven villages (about 21,000 inh. in total) located in the close vicinity of the limits of the Chisinau Municipality.

The total population of the study area is thus of around 811,000 inhabitants (2009) out of which 89% dwelling in urban zones and 94% in the Municipality of Chisinau.

Because of the rather low fertility rate and the growing net out-migration, the population of Municipality of Chisinau is supposed to decrease for the few next decades.

According to the results of the 2009 Household Budget Survey, in the Chisinau Municipality, 97.8% of households are supplied with piped water, 90.4% with a bathroom, 95.8% with sewage system, 87.8% with water closet, 85.8% with hot water and 70.4 with central heating system. The average size of households is of 2.7 persons, the average monthly income amounts to 4,617 Lei (around Euro 300).

According to the National Bureau of Statistics in 2008, 87.6% of Moldova population had a medium or high educational level. The employment level among people 15-64 years was of 47.3% (46.0% for women). Both data should be higher in Chisinau Municipality. Services (tertiary sector) gave work to nearly 50% of the employed population, agriculture 31% and manufacture 13%. It is clear that he tertiary sector is yet more developed in Chisinau Municipality. The Demographic and Health Survey in Moldova carried out in 2005 (Moldova-DHS 2005) showed that at this period in Chisinau nearly 40% of women and 36% of men had reached higher level of education against national averages of respectively 21% and 16%.

3.9.2. PUBLIC HEALTH CONCERNS

Basic indicators of public health have significantly improved during the last past decade in Moldova as it can be observed from by data issued by WHO (Table 4.4.) and those issued by the National Bureau of Statistics Moldova (Table 4.5).

Table 4.4 Evolution of basic public health indicators in Moldova (from World Health Statistics, WHO, 2010).

Health indicator	1990	2000	2008
Life expectancy at birth (years)	68	68	69
Under five (<5 years) per 1000 live birth	37	24	17
Infant mortality rate (<1 year) per 1000 live birth	30	21	15
Adult mortality rate (15-65 years) per 1000 populations	228	232	227
Prevalence of tuberculosis	n.d.	130	90

Table 4.4 Evolution of basic public health indicators in Moldova (from National Bureau of Statistics).

Public Health Indicators	1999	2008
Life expectancy at birth (years)	67.4	69.4
Infant mortality (<1 year) per 1000 live birth	18.2	12.2
Under five mortality (<5 years) per 1000 live birth	23.9	14.0
Mortality by circulatory system disease, per 100,000 persons	623	657
Mortality by cancer, per 100,000 persons	127	157
Mortality by respiratory disease, per 100,000 persons	71	69

From WHO data, which are slightly different from those given by the Statistical Bureau of Statistics (probably because of use of different definitions), the public health situation of Moldova can be compared to both Romania and Russian Federation (see Table 4.5).

Table 4.5 Public health data issued by WHO for Moldova, Romania and Russian Federation (year 2008 unless otherwise specified)

Health indicator	Moldova	Romania	Russia
Life expectancy at birth (years)	69	73	68
Healthy life expectancy (2007) (years)	61	65	60
Under five (<5 years) per 1000 live birth	17	13	11
Infant mortality rate (<1 year) per 1000 live birth	15	11	9
Adult mortality rate (15-65 years) per 1000 populations	227	156	273
Maternal mortality in 2005 per 100,000 live births	22	24	28
Prevalence of HIV in 15-49 years persons in 2005 (%)	0.4	0.1	1.1
Mortality by tuberculosis in HIV-negative people per 100,000	4.6	7.7	15

More specifically for the Municipality Chisinau, the Moldova Demographic and Health and Survey 2005[1] (Moldova-DHS 2005) gave an infant mortality rate of 18 per 1000 live births and an under-five mortality rate of 19 per 1000 live birth during the 2000-2004 period.

According to the Moldova-DHS 2005, infant and under-five mortality rates had dramatically risen during the few year following the soviet period (1995-1999), and have dropped since then without yet joining the level observed in western Europe (average under-five mortality of 4 per 100 live births).

Relation between the water quality and health are well known for both microbiological and chemical features. With a view to protect public health, water quality standards are applied by water companies under the aegis of health institution. According to the quality of raw water, these standards are met through appropriate treatment and proper transport and distribution systems. As water treatment is neither free of cost nor 100% effective, and as transport and distribution pipes may deteriorate with the time, standards may be not met at the tap. Table 4.6 shows the proportion of drinking water samples non-compliant to Moldovan standards in the Chisinau Municipality.

Table.4.6 Proportion of drinking water sample non-compliant with health standards in Health outcome associated with water quality in Chisinau Municipality in 2007. From „*Children Health and Environment in Republic of Moldova, UNPE 2010*"

Water quality parameter	% of non-compliant samples	% of exposed schoolchildren
Microbiology	2.2	0.8
Fluorine	0.0	0.0
Nitrate	1.7	0.4

As the decreasing trends showed by the basic health indicators for the last decades cannot be questioned, the toll of respiratory diseases among children does not seem to follow the same pattern, in particular as regards asthma. However, the same increase of asthma disease is also observed in UE western countries such as France.

Table 4.7 Health outcomes in under-five children associated with air quality in Chisinau Municipality (incidence rate in cases per 10,000 inhabitants). From „*Children Health and Environment in Republic of Moldova, UNPE 2010*"

Health outcome	2003	2004	2005	2006
Respiratory disease	3678	3737	4096	4053
Chronic bronchitis	6.0	7.8	6.6	5.0
Bronchial asthma	3.6	3.9	4.4	5.4

3.9.3. ARCHITECTURAL AND CULTURAL ISSUES

In spite of its very rich and ancient cultural past, the architecture of the 600 years old city of Chisinau was deeply marked by the Soviet domination which, particularly during the 1960-1980 period, has imposed industrialization and Soviet-style urbanization. This

[1] The Demographic and Health Survey has been carried out in 2005 by National Center for Preventive Medicine on a nationally representative sample of 7440 women aged 15-49 and 1408 men aged 15-59, one third of these women and men was living in Chisinau Municipality. This study was sponsored by the United States Government through the Agency for International Development (USAID) and cosponsored by the United Nations Children's Fund (UNICEF) and the United Nations Population Fund (UNFPA).

caused the loss of the unique centre and the dominance of uniform blocks of flats. Some olds buildings and monuments still subsist however, mostly along and n he vicinity of the main avenue (Stephan cel Mare).

As a capital city, Chisinau is populated by people coming from all parts of the country and there is no particular community claiming special status or different rights than the other ones.

Activities associated with drinking water treatment and supply and collection and treatment of wastewater are known and accepted by the population for several decades. Few years ago, a part of Chisinau people really suffered during the warm season from noxious odours produced by the sludge of the WWTP and now they will no longer stand it again. Accordingly, no cultural issue is likely to rise from implementation of a program for improvement of water services.

3.10. LAND USE AND SETTLEMENT PATTERNS

The city of Chisinau covers a total area of 12,301 hectares of which:

- 4,584 ha, i.e. 37% are covered by housing, commercial areas and social infrastructures
- 3,453 ha, i.e. 28% are covered by green areas including small urban agriculture areas (652 ha in total)
- 2,778 ha, i.e. 23% are covered by industrial, transport and communication infrastructures
- 940 ha, i.e. 8% are covered by land reserves dedicated to the protection of nature, health and water resources.

The agglomeration of Chisinau is expected to follow a polycentric development strategy, aiming at:

- a de-concentration of the commercial and social functions from the city center to suburban development residential areas towards: airport rayon, Budesti-2,Colonita, Buiucani, Ghidighici, Stauceni
- a de-industrialization within the city and evacuation of industrial functions: the Bic river area is targeting the transformation of old industrial areas into diverse recreation and leisure functions

The present population density of the city is of 51.7 inh./ha but is expected to decline slightly over the next 30 years (less than 50 inh./ha in 2034) due to:

- Densification in areas within the city limits the North West, and especially in the South West
- Movement of population from the city center towards new zones located in the peripheral outside the present city limits, especially in the North East and South

4. EXPECTED POSITIVE ENVIRONMENTAL IMPACTS OF THE PIP IMPLEMENTATION

4.1. DURING THE CONSTRUCTION STAGE

The construction stage will create job opportunities for both unskilled and skill manpower mainly recruited in the Chisinau agglomeration. Laying water pipes will be likely the main staff-demanding activity.

Replacement of water pipes and construction of new facilities will require local and imported materials and equipment which are likely to be provided by local retailers or wholesalers which will enhance local economy for a short period.

4.2. DURING THE OPERATION STAGE

Reduction of physical loss of water

The ACC's water network is in very bad state, causing a large amount of physical loss of water due to the leaks. The cumulative physical water loss has been estimated to nearly 74,600 m^3/day, i.e. 27 Mm^3/year. The corresponding Linear Leakage Index (LLI) is 43 m^3/km/day. To reduce this water loss, a set of project are proposed within the PIP, which consist of:

- Rehabilitating the water pipes (DW-N-05, DW-N-06)
- Reducing the water pressure in the network (DW-N-04)
- Replacing the pipe connections (DW-N-01, DW-N-02)
- Purchasing adequate, efficient equipment for pipe repair (DW-OM-12)
- Purchasing adequate, efficient equipment for leak detection (DW-OM-01)

This set of project, which will count for 22.4% of the total cost of the PIP, is supposed to reduce the physical loss by 10%, i.e. 7,500 m^3/day or 2.7 Mm^3/day. This will mostly result in a decrease of water abstraction from the Dniester by ACC, which currently amounts to 79 Mm^3/year (around 220,000 m^3/day). The abstraction rate, which averages 1.5% of the Dniester flow, will be reduced by 3.5% and the flow of the Dniester River downstream of the abstraction point will be increased by a not significant rate (1.5% * 3.5% = 0.05%).

Reduction of wastewater released by the sewage network

The sewage network is known to be in very bad state with blockages, broken and leaking pipes releasing wastewater into the ground. Moreover, the ingress of rainwater during the heavy rain events may cause flooding with diluted wastewater standing or running in the streets. This release of untreated wastewater is difficult to estimate quantitatively. The PIP, through replacement of 15 km of wastewater pipes in the most pressing areas (WW-N-01), as well as purchase of adequate, efficient equipment for the maintenance of sewerage (WW-OM-01) will significantly improve the structural stability of the network and reduce the risk of breakage. As a result, the rate of wastewater treated in Chisinau WWTP is expected to increase. Indirect impacts of this project are mainly associated with improvement of public health and welfare (odours, contact with wastewater, and possible contamination of drinking water with pathogens) and protection of soils, ground and surface waters against chemical and microbiological pollution.

Energy saving

Most of the PIP project will result in energy saving in both drinking water and wastewater sub-sectors.

As for the drinking water network, energy saving will be made due to the reduction of water flow, caused by the reduction of water loss (see previous chapter). Decrease of the number of interventions for repairing the network will also impact the energy consumption (use of vehicles and equipment).

As for the wastewater network, the rehabilitation of pumping stations (WW-P-01, WW-P-02, WW-P-03) is expected to result in saving 263,000 kWh/year, i.e. a 60% decrease in the consumption of electricity of pumping stations.

Implementation of anaerobic sludge digestion and biogas recovery and valorisation will result in an energy production of around 35,000 kWh/day (13 MWh/year), that is more than 50% of the energy required by all the treatment works.

Reduction of sludge volume and improvement of sludge quality

The implementation of the anaerobic digestion of sludge will result in a reduction by 25 to 30% of the sludge dry mass by degradation of organic (volatile) matters. Moreover, the digested sludge will be almost free of faecal bacteria and virus (but not of helminth eggs) and without bad odours.

After dewatering, the sludge will reach 20 to 25% Dry Solids (DS), and therefore more easy to handle, transport and spread onto the soil by usual agricultural machinery such as muck spreader. It should be remembered that currently the sludge processed in “Geotubes” can only reach 15 to 20% DS.

Improvement of the quality of treated wastewater

The implementation of the anaerobic digestion of sludge requires securing the wastewater treatment in order to produce steady quantities of sewage sludge. To this aim, the PIP (WW-T-01) provides for renewal of air blowers – to increase energy efficiency – but also the renovation of existing primary settlers, aeration tanks and secondary clarifiers. This will results in a more effective removal of final particles and carbon (BOD5) enabling the compliance with EU standards for wastewater treatment in terms of carbon removal.

Occupational safety

Occupational safety was one of the heaviest criteria used for the selection of PIP projects. Not less than 5 PIP projects comprise measures improving significantly the safety of ACC’s and subcontractor’s workers, namely:

- Purchase of safety equipment in maintenance activities of the drinking water network(DW-OM-04)
- Purchase of safety equipment in leak detection on the drinking water network(DW-OM-01)
- Installation of new electrical boards in the 30 wastewater pumping stations on the network and in the WWTP (WW-P-02)
- Purchase of adequate and necessary safety equipments for WW network maintenance such as gas detector, portable ladders, ropes and harnesses, protection clothes, road signalisation, etc. (WW-OM-01)
- Implementation of an Electro-chlorination Plant (DW-T-01), that produces NaClO – a safe disinfection unit to comply with Moldova regulations regarding the storage of hazardous chemicals – instead of the existing unit using chlorine gas – a very toxic compound.

These measures will significantly enhance the occupational safety level of the personnel, which have been subject to a series of potential hazards when working on the network and in the facilities.

Security of water supply to Chisinau

The PIP provides for the implementation an Emergency Plan ensuring the supply of water to Chisinau in case of pollution of the Dniester River through the mobilisation of groundwater abstracted in Ialoveni, Ghidighici, Balisevshi and Petriciani well fields. To this aim, the following three projects will be implemented

- Rehabilitation of 47 existing wells and construction of 15 new wells (DW-O-05)
- Rehabilitation of 6 existing pumping groups and installation of 8 new pumping groups (DW-O-06)
- Installation of 3 package treatment plants ensuring the compliance of the produced drinking water with the Moldovan water quality standards (DW-O-04)

Once these project implemented, if a critical pollution event threatens the health quality of the raw water abstracted at the main off-intake station (Vadul Lui Voda), the well fields will provide drinking water to the Chisinau agglomeration until the quality of Dniester water becomes compliant with health standards for raw water.

The implementation of the emergency plan will therefore prevent shortage of potable water to the Chisinau population and the unavoidable health adverse effect which will result thereby.

Public safety, health and welfare

Chlorine gas (Cl_2) is a very toxic compound which affects the respiratory tract even at a very low concentration. Currently, the chlorine storage building of the main drinking water plan of Chisinau (STA) is located only within 500 m of the nearest housings. In case of accident, the pressurized chlorine contained in bottle may be quickly released into air and according to the wind direction, reach concentrations exceeding the minimal risk level for the DWTP's staff and the riparian population. Accordingly, the replacement of the current chlorination unit based of chlorine gas by an electro-chlorination plant (DW-T-01) producing weakly volatile sodium hypochlorite (NaClO in water solution) from salt (NaCl), without need of storage of hazardous matters, will result in an actual elimination of this risk.

The reduction of wastewater released by the sewage network in urban area (WW-N-01 and WW-OM-01, see above) will positively impact the welfare of population by the elimination of odour sources and sites of standing dirty water along the streets.

More generally, it is clear that the improvement of water supply and wastewater treatment will have a positive impact on health of the general population, and particularly the children which are particularly vulnerable to waterborne disease. According to a WHO study (Valent et al., 2004), the attributable fraction of diarrhoea deaths due to water sanitation and hygiene in children under 15 years age is of 86% in the former soviet countries against 60% in western Europe. However, as the current situation of water supply and sanitation in Chisinau is not of real concern in terms of population coverage, the health impact of the PIP is not expected to be very high. On the other hand, emergence of new waterborne diseases, mainly due to protozoa like Cryptosporidium, Giardia, etc. has been observed in western countries and need to be controlled by an improved water supply and sanitation system.

5. EXPECTED NEGATIVE ENVIRONMENTAL IMPACTS OF THE PIP IMPLEMENTATION

5.1. ENVIRONMENTAL TYPOLOGY AND SCOPING OF PIP PROJECTS

A described in Chapter 3, the individual projects (operations) of the PIP are very diverse in nature, activities, dimensions and costs, and obviously in terms of expected environmental and social impacts. Consequently, it would not be reasonable to conduct assess environmental impact of the PIP without considering its individual projects. On the other hand, it would be fastidious and needless to consider the 30 PIP projects individually because many of them are expected to cause quite similar environmental impacts from both qualitative and quantitative point of view. The following typology is proposed for the project components with respect to their expected environmental impacts during both construction and operation phases:

- Purchase of equipment the use of which will be without or of insignificant effect on the environment software, safety equipment, etc.)
- Purchase of equipment the use of which may be of significant effect on the environment vehicles, machinery, etc.)
- Installation, replacement, rehabilitation of buried pipes transporting raw or drinking water
- Installation, replacement, rehabilitation of buried pipes transporting wastewater
- Installation, replacement, rehabilitation of equipments in small size infrastructures (well, pumping stations)
- Construction of new small size infrastructures (well field)
- Installation, replacement, rehabilitation of equipment in large size infrastructures (drinking water treatment plant, wastewater treatment plant)
- Decommissioning of infrastructures (drinking water treatment plant)

Tables 6.1a and 6.1b show how the individual projects of the PIP are classified according this typology. Some PIP projects have several components falling into different categories but most of them fall into only one category.

This typology results in nine PIP projects which are not likely to cause any significant negative impact on the environment neither in the construction nor in the operation phases. These projects consist of purchasing soft or hard equipment to ease the operational management of ACC and the maintenance activities. Actually, as these projects will contribute to a better management of water supply and wastewater in the agglomeration of Chisinau, their impacts on the environment are only expected to be indirect and positive and thus do not need for mitigation.

Rehabilitation works within existing small-size infrastructures such as water tanks, pumping stations wells, electric lines and package drinking water treatment stations may impact negatively, but to a limited extent, the environment during the construction phase but the operation phase is not expected to cause more impact that at present.

Other projects such as those consisting in installation, replacement or rehabilitation of buried pipes may cause significant negative impact during the construction phase, but far less during the operation phase. Construction of small-size infrastructures like pumping stations wells, electric lines and package drinking water treatment stations may impact negatively the environment during both construction and operation phase.

Works within the main DWTP and the WWTP are likely to cause negative impacts but not to the general population because occurring within the premises of the plants. After works, the operation of the new equipment may cause impacts to environment.

Eventually, the decommissioning of an infrastructure is not without effects or threatens to the environment, which may originate from the derelict buildings and equipments as well as the remaining, stored chemicals if they are not removed or secured carefully.

Once the environmental typology of projects is completed, the environmental scoping process will make it possible to list the expected negative impacts, direct or indirect, on the different components of the environment, biophysical and human during both phases of PIP: construction and operation. These negative impacts are described in Tables 6.2a and 6.2b.

Table 6.1a Typology of the PIP projects with respect of their environmental impacts

Components	Project Codes	Main features	Activities likely impacting negatively the environment	
			Construction phase	Operation phase
Purchase of equipment the use of which will not impact the environment	DW-OM-04 O-OM-02 DW-OM-01 DW-N-04 WW-OM-01 O-OM-01	Tools Automatization Tools and safety equipment 16 Pressure reducers (*) CCTV, safety equip., vans,.. Computers and soft wares	No impacting activities	No impacting activities
Purchase of equipment the use of which may impact the environment	DW-OM-02 DW-OM-05 D-OM-03	Excavator, truck, etc. Excavator, truck, etc. Mini excavators	No impacting activities	Activities restricted to maintenance works at very small scale (repairs, cleaning, etc.), considered as not impacting negatively the environment
Drinking water pipes	DW-N-13 DW-N-02 DW-N-01 DW-N-06 DW-N-12 DW-N-05	By pass (100 m) pipe Connections Connections made in steel 160 km water pipes Hydraulic fitting repairs 30 km water pipes	Movement and work of vehicles and machinery Earthworks (scouring, excavation, backfilling) Extraction of suitable material (sand, aggregate) in remote quarries and borrow pits Reinstatement of carriage way Encroachment on the carriage way	Drinking water transport (no negative environmental impact as compared to the present situation)
Wastewater pipes	WW-N-01 WW-N-02	Around 4 km Around 10 km	Movement and work of vehicles and machinery Earthworks (scouring, excavation, backfilling) Extraction of suitable material (sand, aggregate) in remote quarries and borrow pits Reinstatement of carriage way Encroachment on the carriage way	Wastewater transport

(*) pressure reducers will be installed on the network without opening any trench.

Table 6.1b Typology of the PIP projects with respect of their environmental impacts (following and end)

Components	Project Codes	Main features	Activities likely impacting negatively the environment	
			Construction phase	Operation phase
Works in existing small-size infrastructure	DW-N-13 WW-P-02 DW-N-14 O-OM-03 WW-P-03 DW-N-15 DW-P-01 DW-O-05	Pumping groups Electrical boards an panels Water tanks Electrical lines WW Pumping station Water tanks DW pumping stations 47 (existing) wells	Movement of vehicles Encroachment on the carriage way	Operation of infrastructures (pumping station, water tanks and wells)
Construction/installation of small-size infrastructures	DW-N-13 DW-T-03 DW-O-04 DW-O-06 O-OM-03 DW-O-05 WW-P-01	Pumping stations 1 Package DW treatment plant 3 Package DW treatment plants Pumps Electrical lines 15 new wells Pumping stations	Movement and work of vehicles and machinery Earthworks (scouring, excavation, backfilling Extraction of suitable material (sand, aggregate) in remote quarries and borrow pits Encroachment on the carriage way	Operation of infrastructures (pumping station, water tanks and wells)
Works within DWTP	DW-T-01	Chlorination system in STA DWTP	Movement and work of vehicles and machinery	Operation of the equipment (drinking water disinfection)
Works within WWTP	W-T-01	New preliminary treatment, new sludge treatment including a digester	Movement and work of vehicles and machinery Earthworks (scouring, excavation, backfilling Extraction of suitable material (sand, aggregate) in remote quarries and borrow pits	Operation of the equipment (wastewater and sludge treatment) Sludge treatment and disposal.
Decommissioning	DW-N-13	SAN DWTP (Vadul Lui Voda)	Existence of the derelict infrastructure and its ancillary equipments	

Table 6.2a Results of environmental scoping of the implementation of the PIP during the construction stage

Component	Potential direct adverse impacts	Impact Sources	Generating Activities	Indirect potential impacts induced
Air	Rise of noise and vibration level	Engines	Movement and work of heavy machinery	Disturbance of fauna
	Air pollutant emissions	Emission of exhaust gases	Movement and work of heavy machinery	Adverse effects on public health and welfare
		Emission of dust	Movement and work of heavy machinery, transport of spoil material	Adverse effects on public health and welfare
Soil	Loss of natural soil	Soil excavation	Trench digging, earthworks on WTP sites	Destruction of flora and fauna
	Pollution of soil	Spillage of lubricant, fuel and solid waste	Movement and work of heavy machinery, fueling operation	Pollution on surface and ground waters
Fresh water	Pollution of surface and ground waters	Spillage of lubricant and fuel , discharge of spoil material	Movement and work of heavy machinery, fueling operation	Pollution of Dniester River Decrease of freshwater biodiversity
Terrestrial flora and fauna	Destruction of terrestrial vegetation	Scouring, soil excavation	Site preparation, trench digging	Increase of soil erosion Loss of biodiversity
	Destruction and disturbance of terrestrial fauna	Soil excavation	Site preparation, trench digging and backfilling	Loss of biodiversity
Human and socio-economic environment	Unforeseen damage to private goods and public goods	Soil excavation	Trench digging	Adverse effect on population standard of living
	Disruption to road traffic	Encroachment on the carriage ways	Trench digging *Particularly of concern during laying/ rehabilitation of drinking water and sewage pipes*	Loss of time and its consequence on local economy
	Disruption to public services	Cutting power and water, damage to the networks	Movement and work of heavy machinery, trench digging and backfilling *Particularly of concern during laying/ rehabilitation of drinking water and sewage pipes*	Adverse effect on population standard of living
	Increased accidental risk for local population	Encroachment on the carriage ways, excavations, disposal of spoil material,	Movement and work of heavy machinery and contractors vehicles, trench digging *Particularly of concern during laying/ rehabilitation of drinking water and sewage pipes*	Accidents and injuries
	Nuisances to health and welfare of the nearby population	Emission of noise, vibration, dust and air pollutants	Movement and work of heavy machinery, fueling operation, trench digging and backfilling	Adverse effects on public health and welfare

Table 6.2b Results of environmental scoping of the implementation of of the PIP during operation stage

Component	Potential direct adverse impacts	Impact Sources	Generating Activities	Indirect potential impacts induced
Air	Rise of noise and vibration level	Pumps of new facilities	Wastewater transport and treatment	Disturbance of fauna Nuisance to population welfare
	Emissions of toxic gases	Anaerobic processes in WWTP	Wastewater transport and treatment, sludge disposal	Public health and welfare of nearby population
Soil	Increase of soil erosion	Non surfaced soil on the top of the backfilled trench	Clearance of pipe routes above ground	Loss of soil, aesthetic nuisance
	Soil pollution	Disposal of sewage sludge	Wastewater treatment	Contamination of groundwater Quality of cultivated plant Health hazards for consumers
Fresh water	Pollution of surface waters	Discharge of treated wastewater	Wastewater collection and treatment	Pollution of rivers Decrease of freshwater biodiversity
Aesthetic of scenery	Unsightly building damaging beautiful scenery	Buildings sheltering pumping station, premises of WTP, water tanks and treatment works	Raw and drinking water transport and distribution (intake station, booster station) Drinking water production (WTP)	Damage to aesthetic of tourist places
Human and socio-economic environment	Nuisances to health and welfare of the nearby population	Emission of noise and vibration	Wastewater transport and treatment	Decreased value of housing, Economic loss relating to health and welfare problems (school, work absenteeism, etc.)
		Emission of toxic and noxious gases	Wastewater transport and treatment, sludge disposal	
		Damage to road pavement	Bad resurfacing of trenches	

5.2. ENVIRONMENTAL IMPACT DURING THE CONSTRUCTION PHASE

5.2.1.1. Impact on air

Air pollutant emissions

Presently the air pollutants in Chisinau are mostly emitted by the transport sector (see § 4.6). The predominance of transport pollutant is likely to be observed even in winter owing to the use of the natural gas as a combustible in the heating facilities and the decommission of the heavy industrial facilities after the collapse of the Soviet Union. The pollution is likely higher in the central, populated areas of the city where traffic jams are frequent at the end of the working day. Based on average annual concentration of NO_2,, Chisinau more heavily polluted than the largest European cities, but the locations of the monitoring stations needs to be checked.

Two main sources of air pollution will occur during the construction works:

- earthworks (trench digging and filling and transport of material) may generate large quantities of dust during the (long) dry season. These particles are not really toxic, but may generate:
    - troubles to eyes and nose of nearby
    - soiling of private goods (cars, houses, etc.)
    - deposit on the plant leaves and affect photosynthesis
- movements/operation of vehicles and heavy machinery involved in the works, that will cause emission of toxic exhaust gases and fine particles

The extent of these emissions will be in all cases limited to the vicinity of the sources, which may be moving over the duration of works (case of pipe laying or rehabilitation works). The main emission of fugitive dust will be produced in sub-urban and rural areas where is soil is not paved. Within these zones, the pipe works planned by the PIP have very little extension as compared to the urban zones with paved soil. However, even in these paved zones, excavation of trench and temporary removal and or transport of backfilling material may generate dust emissions under dry and windy conditions. Scouring the soil to install new infrastructures and treatment works in the WWTP will be also a dust emission sources, but the involved surface areas are very limited.

It is clear that exhaust gases emitted into air by the working machinery and vehicles will add to that emitted by the usual vehicles moving every day, but the increment can be deemed not significant given the limited number and size of the machinery involved in the works.

5.2.1.2. Impact on noise and vibration levels

Rise of noise and vibration levels

The works, especially those relating to digging, laying and trench filling will require machines such as pneumatic drills, compressors, mechanical diggers, trucks, and on WWTP sites bulldozers, graders, finishers, concrete mixer, that will produce high levels of noise, especially when the road/sidewalk pavement is being perforated. Noise from this equipment can reach up to 90 dBA each at 10 meters distance. In homogenous condition, the attenuation of noise causes a decrement of 6 dBA when the distance is doubled. It is also recalled that a noise level of 55 dBA at the limit of buildings during the day is the guideline issued by World Bank and WHO for residential areas, this guideline being increased to 70 dBA for commercial, industrial areas. Actually, 70 dBA is considered as the threshold of occurrence of hearing impairment: this level will be reach around 100 m away from a source producing 90 dBA at 10 m. As for air pollution, the impact of noise will be limited in duration for the populated areas bordering the pipes to be laid. Nuisance may however be significant for sensitive areas such as schools and

hospitals. Noise emission may last longer at the construction site of new (small size) facilities and within the WWTP but this later infrastructure is located quite far away from the populated areas, which will reduce the noise impact.

The limited magnitude of works is not likely to generate significantly harmful vibrations.

5.2.1.3. Impact on soil

Loss of natural soil

Loss of natural soil will occur when new pipes will be laid and new facilities build or installed in rural and suburban areas where soil have not been surface yet. It includes also a part of the area covered by the new equipment within the WWTP. The vast majority of trenches to be dug for the purpose of PIP are located in urban or suburban areas where the soil has been paved for many years and then has lost its ecological function. Moreover, the pipe where originally covered by backfilling material which is lacking in organic matters. At this stage of the project, it is difficult to estimate the surface of natural topsoil be stripped out but it should reasonably not exceed 12 ha i.e. 1 ha for the new facilities (4 packaged treatment plants including 500 m^3 reservoirs), 9 ha for the new equipments within the DWTP and WWTP with are likely to the constructed on unpaved soil and 2 ha for the water and wastewater network lying under unpaved soil (10 km * 2 m). The total excavated volume which will not be reused for the backfilling of trenches should not exceed 120,000 m^3 whereas more than 200,000 m^3 of earth material will be handle by machinery for digging and backfilling the trenches.

Because the most proportion of the excavated material will be reused and the bedding sand not replaced on the longest part of the network affected by works, only a small volume of material will need to be extracted from quarries and borrow pits. This material will mainly consist in aggregated for the concrete batching, the volume of which should not exceed few thousands of cubic meters.

Pollution of soils

Soil contamination by spills of hazardous material may occur if oily products from engines are spilled along the outfall route due to improper disposal of used oils, lubricants or waste. The surfaces and volumes of soil likely to be affected by these kinds of spills are very limited.

5.2.1.4. Impact on waters

Pollution and circulation of surface waters

The watercourses threatened by pollution will mainly be the Bic River and its tributaries. Risk of accidental spill of pollutants such as lubricant, fuels or solid waste cannot be ruled out, but these possible spills are not likely to significantly increase the pollution level of this river which currently receives untreated industrial effluents and all the treated wastewater of Chisinau. Another pollution threat may arise if excavated material is stockpiled on the river bank and likely to be conveyed to the river bed by the runoff of rain water. Given that the stockpiles of excavated material are supposed to be quickly removed for backfilling, this impact should stay very moderate.

Pollution of groundwater

The shallow groundwater may be polluted by transfer of chemical pollutants spilled onto the ground. However, the vulnerability of the “shallow” water table is generally rather weak due to its depth (10 m from the surface) and the nature of soils (silty clay) which does not favour the migration of pollutants. The water table is higher in the vicinity of river beds but in this case, the pollution is quickly transferred to the river water. So the extent of this kind of pollution should stay very small.

The deep groundwater is definitely not reachable by the pollution of surface ground except, after a quite long migration period, by very mobile substances such as nitrates, which would be discharged for long periods. Deep well drilling may cause pollution of the deep groundwater by mixing with an overlying polluted shallow groundwater.

5.2.1.5. Impact on terrestrial ecosystems

Terrestrial ecosystems likely affected by the project implementation are of moderate ecological interest because mainly consisting in low meadows which already undergo anthropic impacts and tree plantations. Moreover, as showed in paragraph6.2.1.3, the surface area of stripped natural soil will be really moderate. Noise, air pollution, vibrations and movements generated by the works will not significantly disturb the urban and suburban fauna which has been withstanding these nuisances for ages.

5.2.1.6. Impact on aquatic ecosystems

Give the current very low ecological status of the Bic River, which is not favourable to the development of aquatic life, no real impact on aquatic life is expected to rise. For some better preserved tributary streams, the level of pollution should be too low to significantly affect the aquatic life except in case of major accident.

5.2.1.7. Impact on human environment

Acquirement of private land

Just a very small surface of private land, or land used by private persons, will need to be acquired for the purpose of the PIP. Given the PIP is of public interest, the acquisition procedure should be developed without conflict and grievance from the affected people.

Damage to private or public goods

Since long sections of water pipes follow roads or urban streets, the observance of the right of the way should prevent any damage to the private goods. Accidents involving public infrastructures such as electric poles or steam pipes may occur, but with a very low probability if the works are attributed to skilled contractors.

Disruption to public services

For obvious reasons the water supply will have to be cut off for a short period around the work sites. If the riparian population is not informed and prepared, negative impacts may arise from this disruption. Likewise, accidental damage to other network such as power (see above) may cause significant impacts to the population.

Disruption to road traffic

Both water and wastewater pipes cross many roads and urban streets. Out of crossing point, the trenches will be mostly dug alongside the carriage way, on the road shoulder. For these reasons, disruption to road traffic and narrowing of the carriage way will frequently occur during the rehabilitation of more than 200 km of both water and wastewater pipes. This will very likely increase the frequency and the duration of traffic jams which are already noticeably in Chisinau although the city has a well-structured road/street network.

Adverse effects on health, welfare and safety of the nearby population

As stated above, welfare of population leaving in the close vicinity of work sites, especially where the pipe network will be rehabilitated, will be affected by noise, vibration and dust emitted by contractor's vehicles and heavy machinery. Works on the wastewater network may generate locally emissions of bad odours very unpleasant for the population living, working or just walking nearby.

Furthermore, movements of vehicles and machinery as well as poorly or not signalized excavations or stockpiles of material may increase the risk of accidents among the population crossing the work sites on foot or by two and four wheel vehicles.

5.2.2. DURING OPERATION STAGE

5.2.2.1. Impact on soil

Soil erosion

Soil erosion may occur during the operation stage if the top of backfill material of trenches is left bare without pavement or vegetation in a sloped area. Along these sections, the scoured strip will be prone to erosion by the runoff of rainwater which may take away the surrounding natural soil. Given that the existing pavement is supposed to be reinstated, erosion can only affect the 2 ha of trenches located in unpaved area (see § 6.2.1.3).

Soil pollution from sludge deposit

Even if, as compared to the present situation, the sludge treatment proposed in the PIP (dewatering an anaerobic digestion) is indubitably a real improvement it terms of quantity, odour emission and pathogen content, it will not reduce the sludge toxicity associated with heavy metals and other persistent organic pollutants (POPs). Both proposed outlets for treated sludge i.e. landfilling or agricultural use, will increase the concentration of heavy metals and other pollutant in soil. The pollution level will be higher with landfilling than with agricultural land spreading but if sludge is continuously spread onto agricultural land the heavy metal concentration in soil will increase gradually. At present, the sewage network of Chisinau does not receive effluent of major polluting industries, and the heavy metal concentration of wastewater is not expected to be a significant concern, at least for biological treatment.

5.2.2.2. Impact on air

Emission of biogas

Biogas generated by anaerobic digestion of sludge is mainly composed (up to 90%) of methane (CH_4) and carbon dioxide (CO_2) which both are greenhouse gases (GHS) but not toxic and not harmful for the local environment and consequently not considered as air pollutants. Biogas also contains is very low proportion (less than 1/1000 in volume) hydrogen sulphide (H_2S) and other sulphur compounds, ammonia and a large number of organic gases such as aromatic hydrocarbon, volatile chlorinated organic compounds, as well as heavy metals (few $\mu g/m^3$), a part of which being classified as carcinogenic or toxic. If the biogas is released into air from the top of digester, the initial very low concentration and the plume dilution are expected to lesser the health impact on the (remote) surrounding population to an acceptable level. No study has demonstrated any adverse health effect of biogas emission on general population. Health problems may however occur among the workers in case of acute exposure to biogas, in case of rupture of biogas transporting pipe.

Actually, biogas is generally collected and burned either in open air (flaring), or in boilers power generators or heat and power co-generators. These last valorisation processes of biogas often enable the need in power of the WWTP to be fully covered, at least out of the coldest months. The PIP provides for the use of the biogas to fuel the existing cogeneration turbine installed in the WWTP and still operational although it has not been operated since several years ago. This use requires an enrichment and purification treatment of biogas for the removal of CO_2, water, H_2S, ammonia as well as particulate matter. This treatment will also eliminate the vast majority of trace toxic gases. Re-odorization of biogas will be necessary to make any gas leak detectable.

5.2.2.3. Impact on noise

Noise emission from new facilities and equipments

New facilities, i.e. package treatment plants are not very noisy because of are of small dimension, powered by electricity and without of high water falls. They will be installed in urban and periurban areas were a background noise already prevails. New pumps and pumping groups are not expected to be noisy because meeting the current standards for this kind of equipment and will be installed within concrete building. New equipment installed in the DWTP and WWTP are not supposed to be noisier than the former ones and sludge dewatering and digesting are not known to significantly raise the noise level outside their buildings.

5.2.2.4. Impact on solid waste

Production of sludge and other waste

5.2.2.5. Impact on water

Pollution of ground and surface water from sludge deposit

After landfilling or agricultural land spreading heavy metals will migrate down to the shallow groundwater together with the rain water infiltration but their mobility will be significantly reduced by the rather high pH of the soil (except for arsenic). Given the large thickness and the quite low porosity of the geological layers protecting the deep water table, the deep ground water (used for water supply) is very unlikely to be contaminated by heavy metals and other persistent pollutants released by sludge.

Certain unsuitable conditions of land spreading (sloped area, frozen soil, etc.) may cause the direct discharge of the sludge into the surface waters, which will likely result in increased organic matter and heavy metal concentration.

5.2.2.6. Impact on landscape

Aesthetic damage to pleasant landscape

The most visible, new equipment set up for the purpose of PIP will be the 4 package treatment stations (Ialoveni, Ghidighici, Balisevshi and Petricani) and the 15 new wells (protected by small buildings) in the vicinity of the main DWTP (STA) in Chisinau. All these building will be located in urban, periurban and rural areas without tourist value, except the Ghidighici Lake. They will have a moderate footprint (less than 500 m^2), a very basic rectangular shape and will be less that 5 m high. So the will look like basic warehouses without significantly negative aesthetic effect on their surroundings unless they are painted in very unsuitable colour. The new treatment equipments and the three cylinder-shaped digesters installed within the fenced site of the WWTP, at the edge of Chisinau city, should not change noticeably the industrial landscape of the site and should not be visible from the populated areas. After decommission of the drinking water treatment plant of Vadu Lui Voda (SAN), the derelict infrastructures may cause aesthetic damage to the landscape of this tourist area.

5.2.2.7. Impact on human environment

Impact to Road Traffic

The operation of the rehabilitated WWTP will increase the vehicles circulation for the haulage of both inputs (polymer, lime and other chemicals) and treated sewage sludge to be landfilled out of the WWTP site or spread onto agricultural plots. Because of both digestion and dewatering, the volume of sludge will be reduced to less than 150 m^3/day,

that are 10 to 20 trucks/day. Actually, in case of agricultural valorisation of sludge, the number of vehicles may dramatically increase due to the restricted period of application and the size of the farmer's trails. Nevertheless, no major traffic jams or other traffic problems are expected to occur due to the sludge transportation. The location of the WWTP in an industrial area at the eastern edge of Chisinau city will prevent sludge transporters to cross the most populated areas of the city.

Health Risk Associated with Sludge for Users and Consumers

Although the mesophillic digestion process undergone by the sludge eliminates a large part of pathogens, the digested will not be considered as safe product. As a consequence, if sludge is used for agriculture with basic precautions, there will be a possible risk of the farmers spreading them on their plots and possibly for the consumers of crops which have grown on these plots.

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1. PROPOSED MITIGATION MEASURES

6.1.1. THE DIFFERENT CATEGORIES OF MITIGATION MEASURES

From an implementation point of view, the environmental impact mitigation measures of the PIP project will be divided into the five following categories:

- Measures to be included in the detail design studies such as, architectural consideration, etc.
- Measures forming part of good environmental practices of the sub-contractors in charge of the works, such as environmentally sound lubricant management, internal regulation for workers, etc.. For many reasons, such as lack of environmental awareness and time or cost related reasons, some contractors remain reluctant to follow these good environmental practices. Implementation of this kind of measures should be therefore ensured by including a set of environmental requirements directly into the contract documentation (technical specifications). These clauses will then be taken into account by the tenderers when they will prepare their bid for the project.
- Measures consisting of additional works, such as cleaning of derelict facilities can be undertaken by ACC or sub-contracted to a specialised company. In most cases, these additional works are to be undertaken by the construction contractor. Accordingly, they have to be included into the contract documents and taken into account in the BOQ.
- Accompanying measures. These activities are not related to the construction works per se (for example, communication campaigns) and cannot generally be undertaken directly by the contractor. They should be commissioned to specialized private companies, NGOs, government organisations or agencies. These measures also comprise recommendations for the promotion of agricultural reuse of sludge will be added in order to increase the chance of success of this outlet, which is the most environmentally sustainable and strongly favoured by the EU legislation.
- An environmental enhancement measure for the middle and long term is also proposed with a view of ensuring that this program will result in a real improvement of the current environmental situation associated with the activities of ACC, especially as regards the pollution of the Bîc River.

Each of these measures is discussed below for the specific case of ACC's Priority Investment Program.

6.1.2. FINAL DESIGN CONSIDERATIONS

i. Architectural integration of new facilities

The architectural design of the new facilities set up outside the existing treatment sites (packaged treatment plant and wells) is expected to be very basis (rectangular, low buildings). However the choice of the material and the paint colour of walls and roof should be compatible with and visually related to the surrounding rural or urban landscape. The selection of material should also minimize regular and long term maintenance and thus prevent the external degradation of the facilities after a too short time.

Landscaping works including tree plantations will be undertaken for embellishment of new WWTP site.

6.1.3. ENVIRONMENTAL REQUIREMENTS FOR CONTRACTORS AND SUPERVISORS

ii. Work camp and facilities siting

Should a new site yard, base camp or stationary facilities (asphalt plant, concrete batching plant, etc.) be open for the purpose of the project, the Contractor shall request approval of the Employer/Engineer prior to start occupying of the site. The boundaries of camps/yards shall not be located within:

- 50 m of any river and water body
- 100 m of any sensitive receptor such as housing, school and health centre

The site must be provided with adequate water drainage network avoiding areas of stagnant water. Access to and movements inside the sites must not generate dust that can be harmful to workers and riparian population.

iii. Management of staff, hygiene and safety

The regulations governing the site installations must specifically mention safety regulations and strictly prohibit the consumption of alcohol during working hours.

The Contractor shall ensure, so far as is reasonably practicable, the health, safety and welfare at work of his employees including those of his sub-contractors and of all other persons on the camps, facilities and work site. To this aim, the Contractor shall submit to the Employer or its Engineer (Supervisor) a Health and Safety Plan (HSP) which sets out the Health and Safety Policy of the Contractors, as well as the detailed methods to prevent accident for all the relevant worker's situations relating to the type of works and for the public. For example, as regards the pipe rehabilitation/replacement, the HSP will have to cover at least the work in confined spaces, the cutting/handling of asbestos-cement pipes, the fencing and signalisation of the work area (trenches) and all the Personnel Protection Equipment (PPE) to be worn by workers. The HSP will have to be approved by the Employer/Engineer before the commencement of works.

The Contractor shall report details of any accident to the Employer and the Police, if appropriate, as soon as possible after its occurrence

iv. Management of hydrocarbons and other hazardous substances

Hydrocarbon storage areas and refuelling areas must be concrete made and located away from any watercourse. Tanks above ground must be placed on a watertight concrete made area and fitted with a retention basin.

v. Waste management

The Contractor shall place proper containers within the construction camp and permanent work sites in order to collect all kinds of common solid waste such as: glass, paper, cardboard and plastic waste and packaging. Common waste will be transferred to the containers of the company responsible for general domestic waste collection or by the Contractor towards a dumping site which is formally used for domestic waste.

Particular attention should be paid to the handling, transport and disposal of asbestos cement waste which are no considered as hazardous waste but have to be handled with precaution.

Special waste such as batteries, oil filters, etc., generated by both terrestrial and marine vehicles and machinery, shall be collected in special containers proof for any leakage/spillage of toxic liquid/solids and then conveyed in relevant vehicles toward the landfill dedicated to hazardous waste.

vi. Control of vegetation, tree felling, protection of public and private equipment

Clearing must be done manually. Cutting trees above 4 m high or with aesthetic shall request authorization of the Employer.

When crossing public or private equipments and roads, the Contractor shall take all necessary precautions to avoid causing damage to industrial pipes (if any) and to electricity or phone lines.

Any roadside or embellishment trees felled accidentally or intentionally for the purpose of the project shall be replaced.

vii. Protection of Air Quality

Vehicle with an open load-carrying area used for transporting potentially dust-producing material shall have properly fitting side and tailboards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extend over the edges of the side and tailboards.

Machinery, vehicles and equipment will be fitted with pollution control devices, which will be checked at regular intervals to ensure that they are in working order. Best available pollution control technologies will be required.

Water sprays shall be used during the delivery and handling of materials when dust is likely to be created and during dry and windy weather.

viii. Noise Management

Generally speaking, the Contractor shall consider noise as an environmental constraint in his planning and execution of the works and try as much as possible to attenuate this constraint by:

- using equipment conforming to international standards and directives on noise and vibration emissions,
- maintaining exhaust systems in good working order, properly designing engine enclosures, using intake silencers where appropriate and regularly maintain noise-generating equipment,
- restricting working activities to the period from 7 a.m. to 6 p.m. within populated areas,
- informing managements of sensitive equipment such as health centres and schools when works are anticipated to occur nearby and agree with them on working time and period in order to reduce nuisance to the concerned population

ix. Protection of Quality of Surface Waters

The Contractor shall not discharge or deposit any waste, spoil material and matter arising from the execution of the Work into any river, stream or drainage system.

x. Management of spoil material on land

As much as possible, material extracted from trenches where the new pipes will be laid down will be reused as backfilling material or earth-filling material for other construction projects.

The spoil material is to be collected and transported to be disposed into an adequate stockpiling zone. The stockpiling zone shall be proposed by the Contractor to the Employer/Engineer which should approve them in accordance with the following criteria:

- stockpiling zones should not be located in a wooded or cultivated area
- stockpiling zones should be located on flat or very gently sloped area
- material disposed onto stockpiling zone should not be likely to contaminate watercourses by land sliding or runoff of rain water.
- material disposed onto stockpiling zone should not be likely to hinder the natural runoff of rain water.

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xi. Protection of Public and Private Utilities

The Contractor shall take into account in his program the periods required to locate, access, protect, support and divert such services, including any periods of notice required to undertake such a work in consultation with local owners, population and authorities operating such services.

The Contractor shall take all measures to avoid damage to or interference with public services and assume responsibility for any damage and for full restoration of the damage.

xii. Management of Traffic and Public Safety in the Vicinity of Worksites

The Contractor shall enforce speed limit for its vehicles and those of its sub-contractors.

The contractor shall provide a written and clear traffic management plan including schedules and places of flagmen, traffic cones, barricades and/or lights.

Worksites on along roads shall be properly signposted with adequate marks and tools such as cones and coloured bands. Fences to protect pedestrian should be erected on diversion paths.

Access to private houses, shops and all commercial public buildings shall be preserved by the means of safe footbridges.

xiii. Restoration of Road Pavement

After laying pipe and backfilling the trench with adequate material, all the damaged surface of carriage ways and sidewalks shall be restored in accordance to the relevant standards.

6.1.4. ADDITIONAL ENVIRONMENTAL WORKS

xiv. Restoration of manholes

Some manholes along the ACC's network are not properly covered and thus may be a source of danger for the general population especially the children who can be attracted by these almost open holes for a playing purpose. Sometimes, the manholes are just covered by a piece of concrete plate from which rusted steel rebars are dangerously protruding. Moreover, the aesthetic effect of these manholes is very bad in the urban areas (see Picture 4). It is so recommended that the ACC's manholes should be inspected and there cape properly replaced or repaired with the aim of preventing any ingress of unauthorized persons and any danger for persons handling the caps.

Picture 4 Dangerous and unaesthetic manholes closed to the main Drinking Water Plant in Chisinau

xv. Construction of remote transit storage areas

The report of wastewater treatment gives, for a daily production of 40 tDS, a surface area for spreading digested sludge of 5,000 ha, based on meeting the fertilizer needs of usual crops, which are estimated to 3 tons DS of sludge/year. However, the best agricultural practices in industrial countries (like France) usually prohibit the spreading of sewage sludge on a same plot more than once every three years to prevent accumulation of heavy metals. Accordingly, if for one year the total production of sludge can be spread on 5,000 ha, the next two years 5000 ha of other land will have to be found for sludge spreading, i.e. at least 15,000 ha should be "contracted" by ACC for receiving sewage sludge over a long period. Furthermore, the future sludge users should have their plots within a quite short distance from the sludge storage site to reduce the cost of transport for farmers and/or ACC. It is clear that beyond a short distance, ACC will likely have to take on the transport cost up to the agricultural plots. With an only storage area located at the WWTP, this area of would likely be difficult to contract within a reasonable distance because of the presence of Chisinau city.

A potential sludge landfill site has been identified near Cobusca Veche, around 30 km east of Chisinau WWTP. This site is located in rural area and surrounded with agricultural land and some scattered small size towns. In order to minimize the landfill disposal of sludge, which is not sustainable, not recommended by the EU and banned by a lot of European countries, it would be profitable to construct beside the appropriated disposal cells a transit sludge storage area where sludge would be properly stockpiled. This will significantly increase the number of potential sludge users which will be interested in hauling sludge only over a very short distance. Likewise, other transit storage areas can be set up along the main road connecting the WWTP to the sludge landfill.

xvi. Cleaning up and safety control of the derelict facility

After the decommission of the drinking water treatment plant of Vadul Lui Voda (SAN), the facility shall be cleaned up from all its chemicals and hazardous/harmful substances which are likely to be release from the derelict equipment (oil, fuel, etc.). All the substances, including the diluted ones, which cannot be reused as well as solid waste shall be adequately handled, put into containers, transported and treated according to the standards or the recommendations of the producer. A survey shall be conducted with a view of identifying polluted soils that shall also be removed and treated as hazardous waste. Recyclable matters such as metal should be removed and sold to the recycling

companies. . If not further use is anticipated for the former DWTP, it shall be fenced and carefully closed in order to prevent ingress of unauthorized persons.

xvii. Cleaning up and reclamation of the WWTP old sludge drying beds and former settling pond of drinking water sludge

Former sludge drying bed of the Chisinau WWTP can be considered as a brown field because the composition of disposed sludge, some of which dating back from the 70s, is not really known and likely to be higher in toxic substances (heavy metals) than in the current sludge. Moreover the state of the bottom and the potential pollution of the underlying soil are also unknown. The drying be cover an area of nearly 30 ha which will be profitably recovered by the WWTP for other, more environmentally sound activities such as storage of future treated sludge.

It is recommended to conduct a survey with a view of assessing the level of hazard associated with the storage of old sludge. Sampling and analyses of old sludge, as well as of the underlying soil and water table will be carried out focusing mainly on heavy metals, cyanides and Persistent Organic Pollutants (polycyclic aromatic hydrocarbons, PCB, pesticides and other). According to the result of the monitoring campaign, adequate measures will be taken for removal, treatment and disposal of sludge and, if necessary the contaminated soils.

Likewise, prior to be discharged into the sewage network, drinking water sludge produced at the main drinking water plant of Chisinau used to be conveyed to a settling pond set up outside the DWP site (see Picture 5). For years, the drinking water sludge (far less toxic than sewage sludge) has settled down in this pond which is accessible to the population and seems to be used for recreational activities (pedal-boat). A monitoring campaign of this pond is hence also recommended with a view of determining the pollution status of the water and sediment and assessing the necessity of cleaning-up.

Picture 5 Former settle pond for drinking water sludge in Chisinau

6.1.5. ACCOMPANYING AND SOFT MEASURES

xviii. Compensatory tree plantations

In order to compensate for loss of soil and natural vegetation as well as to fight against soil erosion it is proposed to replant tree on a surface of 25 ha which is a bit more than twofold the surface of natural vegetation destroyed by the construction works (see § 6.2.1.5). This plantation will be done on land owned or managed by ACC or public land, at the request of Forestry Services, for example around the future landfill site. Arrangements will be made with the Authority in charge of forestry (Forestry Service) in order to determine species to be planted, most appropriated areas to be planted and other modalities. If possible, plantations will be made by the ACC's staff under the supervision of Forestry Service or by a skilled operator.

xix. Plantation of herbaceous species

Out of strictly urban areas, all the backfilled trench sections which will not restored as roads, tracks, footpath or sidewalk will be planted with herbaceous species. Species used for plantation shall show the following features, in order of decreasing importance: autochthonous, not known as intrusive in the surrounding ecosystem, adapted to ecological conditions, rapid growth and strong covering power, shallow root system, not grazed by cattle. The width of the planted strip will at minimum equal that scoured for the purposes of the Project. It is presently difficult to estimate the total surface which will need to be so planted, but just a moderate part of the network should be concerned. At a rough guess it can be assumed that the surface will not exceed 10 km * 3 m = 3 ha.

xx. Communication on the wastewater treatment

Wastewater treatment works generally suffer from a bad image generally due to the lack of knowledge, often associated with the lack of transparency from the operating company. In the case of Chisinau, bad memories associated with the former emission of odours from untreated sludge, which used to be perceived by a lot of population of Chisinau town, may have contributed to this negative feeling.

To definitely erase the negative perception of the WWTP by the Chisinau population, especially the young people, it is proposed to organize regularly visits and guide tours for schoolchildren, student, industrial management personnel and representative of population (NGOs and other) focusing on:

- explaining the need for wastewater treatment and the (improved) general process applied
- presenting the advanced treatment process of sludge and their disposal outlets
- setting out the monitoring plan and how the results will be available for the public

Press releases can be also used to keep the population informed.

xxi. Promotion of the Agricultural Use of Digested Sewage Sludge

It has been clearly stated in the report dedicated to wastewater treatment that the reuse of stabilized sludge is the most sustainable outlet, especially in comparison with incineration and landfill disposal. But even if the fertilizing value is of sludge is clearly demonstrated in the scientific literature, if the digested sludge is almost without odor and quite easy to handle and even if the transport cost are reduced or subsidized by the producer, the success of this operation is far to be ensured. Cultural reluctance to the use of this kind of matters as well as incomplete knowledge about the health risk associated to heavy metal may cause the farmers rejecting this practice. The quantities of sludge produced will be tremendous (40 Tons Dry Solids/day), even after digestion and dehydration, so the challenge is to convince as much farmers as possible, especially large scale farmers to use the sludge on at least 15,000 ha (see measure xv). An adequate action plan should be implemented to promote the agricultural use of sludge to suspicious farmers. Such an action plan is described in Annex 1.

6.1.6. ENVIRONMENTAL ENHANCEMENT MEASURES FOR THE MIDDLE-TERM

xxii. Setting Up a Plan for the Restoration and Protection of the Bic River

Through the implementation of the PIP, the upgrade of preliminary treatment (grit, oil and grease removal), primary treatment (sand removal) and secondary treatment (carbon removal) will enhance the quality of the treated wastewater. However, without any additional (tertiary) nitrogen and phosphorus, the ecological status of the Bic River is not expected to significantly improve. Actually, these tertiary treatments are planned to be included in the Long Term Investment Plan (LTIP) and thus are likely to be implemented within the next decade. Unfortunately, other factors than the discharge of treated wastewater by the Chisinau WWTP currently contribute to the bad quality of the Bic water, namely:

- the lack of "environmental flow" from the Ghidighici lake (managed by Apele Moldovei), which reduces dramatically the natural flow of the Bic river in the dry period
- the presence of incompliant waste dumpsites, in particular those containing cyanide waste from which the runoff may transport cyanide down to the river bed
- the discharge of untreated wastewater from housings and industrial facilities located within Chisinau city but not connected to the ACC's sewage network
- the discharge of untreated wastewater from housings and industrial facilities located downstream of Chisinau city, in the District of Aneni Noi, down to Gura Bicului

Pending the implementation of the LTIP, and in the compliance with the EU Water Framework Directive (WFD 2000/60/EC), it would be profitable to set up a Committee for the Restoration and Protection of the Bic River (CRPB) comprised of, as a minimum, the following institutions:

- ACC
- Chisinau municipality
- District of Aneni Noi
- Apele Moldovei
- Ministry of Environment

Actually, the Bîc River cannot longer be considered as a natural water body but as a "heavily modified body of water" as per the WFD terminology. According to the Article 4 of the WFD, this kind of water bodies shall be protected and enhanced by the Member state, with the aim of achieving good ecological potential and good surface water chemical status at the latest 15 years 15 years from the date of entry into force of the WFD, i.e. by 2015. The first assignment of the CRPB will be to elaborate and Action Plan to progressively eliminate or reduce the pollution load of the main sources of pollution of the Bîc River, as well as to maintain an environmental flow enabling sufficient dilution of the residual, irremovable pollution sources such as the discharge of wastewater having undergone an advanced treatment in the Chisinau WWTP.

6.2. INSTITUTIONAL ARRANGEMENTS

6.2.1. ENVIRONMENTAL RESPONSIBILITY AND TASKS OF ACC

ACC is the contracting authority. It should ensure compliance of the project with the national policy and regulations related to the protection of the environment as well as the EU procedures in terms of environmental management. According to EU environmental regulations i.e. Directive 97/11/EC amending 85/337/EEC, only the project codified. WW-T-01, which provides for upgrade of wastewater treatment and implementation of sludge

anaerobic digestion in Chisinau WWTP, is subject to mandatory EIA. Environmental assessment procedures of other PIP projects will be in accordance with the Moldovan regulations. Basically, it is of ACC's responsibility to ensure that environmental concerns of all PIP projects, as described in environmental scoping (see § 6.1) are addressed at every stages, i.e. feasibility (i.e. present stage), design, construction, operation and, if relevant, decommissioning.

In the short term, ACC shall ensure the environmental measures described in the present report and the Environmental and Social Action Plan (ESAP) are properly taken into account by the Supervision consultant and the construction Contractor. ACC shall also directly contract or come to arrangements with relevant operators to undertake the so called accompanying measures.

During the operation stage, ACC will be responsible for any the environmental damage caused by the operation of the constructed, upgrade or rehabilitated facilities both in normal or abnormal condition. Because environmental damages may often originate from disruption of technological process or from the bad state of equipment, ACC shall be responsible for the proper maintenance of all facilities as well as for purchasing and using all the matters and chemicals required for the proper operation of equipments, as recommended by the suppliers. Moreover, a sustainable use and/or disposal of sewage sludge shall be implemented by ACC.

6.2.2. RESPONSIBILITY AND TASKS THE SUPERVISION CONSULTANT

The Supervision Consultant shall make sure that the construction contractor properly implements the environmental requirements specified in the contract documentation and in the Contractor's Environmental Management Plan and Health and Safety Plan (CEMP and CHSP, see below).

Since the environmental supervision needs to be carried out on a daily basis, the Supervision Consultant team should include a skilled Environmental and Safety Supervision Officer (ESSO).

The duties of the Environmental and Safety Supervision Officer (ESSO) will be:

- to review and approve of environmental documentation issued by the Contractor
- to liaise with environmental focus point of ACC
- to liaise with the environmental authorities and other relevant institutions (Apele Moldavei, etc.)
- to liaise with the local communities and with other stakeholders likely to be affected by the project
- to monitor the contractor environmental practices. The ESSO will be particularly responsible for approving the sites for disposal of spoil material
- the elaboration of the environmental chapter of the Supervisor's monthly progress report

At the end of the works, the ESSO shall carry out a final environmental audit of the works. The result of the audit will be taken into account for the final acceptance of the outfall construction works.

The ESSO should be a national/regional civil engineer, with preferably a postgraduate specialization in environmental engineering. An experience in environmental supervision of infrastructure projects would be an asset.

6.2.3. RESPONSIBILITY AND TASKS OF THE CONTRACTOR

The Contractor shall appoint one responsible member of his staff to act part or full time as Site Environment Health and Safety Officer (SEHSO), and he shall notify the Supervisor of such appointment. The SEHSO shall be experienced in all matters relating

to environmental management, health and safety on work sites and facilities and shall be familiar with all relevant environmental and safety regulations and legislation in force in industrialised countries. The SEHSO shall have the power to receive instructions from the Supervisor on matters relating to the health and safety of personnel on sites and the environmental management of sites. The SEHSO shall also be involved in training of employees on environmental/safety practices and sensitization of population affected by the project.

The Contractor shall propose the Curriculum Vitae of the SEHSO to the approval of the Supervisor within two months following the formal assignment.

In addition, and to avoid any ambiguity, the contractor (and more particularly the SEHSO), will be required to prepare, as soon as appointed, and before beginning building his construction camp, a Contractor's Environmental Management Plan (CEMP) and a Contractor's Health and Safety Management Plan (CHSMP)..

The CEMP shall include as a minimum the following documents:

1) Health and safety procedures
2) Solid waste, fuel, lubricants and wastewater management procedures
3) Noise management procedures
4) Air quality management procedures
5) Spoil material management procedures
6) Road traffic, public and private utilities management procedures

The CHSMP shall include as a minimum the following documents:

- Health and safety Contractor's staff
- Health and safety training for workers
- Individual and collective protection of workers
- Fencing and signalisation of work sites (particularly open trenches) to protect both workers and general population
- Risk analysis methodology
- Emergency procedures

All these procedures should comply with the environmental requirements included in the tender and contract documentation and shall be provided to the Supervision Consultant within one month following the formal assignment.

6.2.4. GRIEVANCE REDRESS MECHANISM

The Report on the Stakeholder Involvement Plan describes the framework of grievance redress (or "complaint-solving") mechanism provided for by the Moldovan legislation. Actually environmental and social impacts of the PIP will be caused either by the contractors appointed by ACC during construction stage or by ACC operational services (in charge of WWTP, other facilities and water networks) during operation stage. During these two stages, the grievance redress mechanism should address affected person's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people.

It is recommended that, in compliance with the Moldovan legislation, the requirements of EBRD and the International best practice, a Grievance Unit (GU) be set up within ACC. The complaints made by Affected Persons (AP) will be lodged with Grievance Unit by written letter or phone call (hotline). Both Grievance Unit's address and hotline number

will be clearly indicated in all worksites during construction stage including mobile pipe laying works and at each constructed standing facility (WWTP, and pumping stations) during the operation stage.

As soon as a complaint will be lodged, it will be registered by the GU and the AP will be sent an acknowledgement of receipt with a grievance reference number.

For damages caused by a contractor in construction stage, ACC will organized a meeting with the AP, the contractor's representative (Site manager) and the head of the Supervision team within 15 calendar days from the date of complaint registration. Environmental officers from both contractor and supervision team (ESSO and SEHSO) will also attend this meeting. During this meeting, a solution of grievance redress will be proposed to the AP and recorded in a minute report signed by the contractor, supervisor and the AP. A formal grievance redress document in accordance with the minute report will be then officially sent to the AP under cover of ACC. This document will indicate the agreed solution and its features (financial compensation, nature compensation, restoration works, etc.) and the delay for implantation will not exceed 20 calendar days from the date of meeting.

For adverse impacts occurring during operation stage (for example, frequent bad odours perception by population neighbouring WWTP), the grievance redress mechanism will be addressed by the ACC's involved staff (management staff WWTP, for example). After meeting with the AP, a solution will be elaborated and officially sent to the AP. It will be the responsibility of the ACC to resolve the issue within 4 weeks from the date the complaint is received.

If the AP is not satisfied with the proposed solution or in the absence of any response within the stipulated time, the AP as a last resort may submit his/her case to the Justice.

During the construction stage, the Supervision team, through its ESSO will be responsible for checking the procedure and for and resolutions of grievances and complaints. This will have to be recorded as part of final supervision report triggering the deliverance of Taking Over Certificate.

In addition, as part of the Project's internal monitoring and evaluation, ACC will keep a written record of all grievances and complaints brought forward by APs, as well as their final resolution for both construction and operation stage. This procedure should not be innovative for ACC which is certified ISO 14001.

6.3. ENVIRONMENTAL MITIGATION PLAN

The Impacts Mitigation Plan is recapitulated in Tables 7.1a to 7.1d. For each identified moderate or significant impact, a set of mitigation measures is proposed with the way to implement the measures and to ensure that the measures are adequately implemented.

Table 7.1a Mitigation Plan of impacts potentially occurring in construction stage

Impact	Activity	Mitigation measure	Locations	Period	Responsible for Implementation	Responsible for Supervision	Means of Verification	Cost
Noise and vibration	Site cleaning / preparation Earthworks Construction works Equipment installation Construction of new facilities Pipe laying	The contractor shall: - use equipment conforming to national of international standards and directives on noise and vibration emissions - maintain exhaust systems in good working order, properly designing engine enclosures, using intake silencers where appropriate and regularly maintain noise-generating equipment - restrict working noisy activities between 07 a.m. to 06 p.m. within the residential areas - inform management staff of likely impacted schools and hospitals about the work program in order to find arrangements for limiting the nuisance	Within residential areas (mainly pipe network)	Construction	Contractor	ESO	Non-compliance statement in works monthly report	No marginal cost
Air quality	Site cleaning / preparation Earthworks Construction works Equipment installation Construction of new facilities Pipe laying	Machinery, vehicles and equipment will be fitted with pollution control devices, which will be checked at regular intervals to ensure that they are in working order In residential areas - trucks carrying earth, sand or stone will be covered with tarps to avoid spilling - water or wetting agents will be sprayed on work sites not covered by pavement or vegetation and during the delivery and handling of dusty materials.	Within residential and rural areas	Construction	Contractor	ESO	Non-compliance statement in works monthly report	No marginal cost
Loss of soil	Site cleaning / preparation Earthworks	As much as possible the extracted material will be reused for backfilling trench and excavations.	On all work sites, especially laying of water pipes	Construction	Contractor	ESO	Non-compliance statement in works monthly report	No marginal cost
		All sand and selected material brought to the worksites by the contractor will have to be extracted from borrow sites authorized by the environmental authorities.	On all work sites	Construction	Contractor	ESO		No marginal cost
		Deposit of spoil material on public land shall be done on sites authorized by the environmental authorities. Protection of stockpiles against runoff erosion.	Spoil material disposal sites	Construction	Contractor	ESO		No marginal cost

ESO: Environmental supervision Officer

Table 71.b Mitigation Plan of impacts potentially occurring in construction stage

Impact	Activity	Mitigation measure	Locations	Period	Responsible for Implementation	Responsible for Supervision	Means of Verification	Cost (Euro)
Pollution of soil and waters	Site cleaning / preparation Earthworks Construction works Equipment installation Pipe laying	Disposal of spoil material in any water course is strictly forbidden Hydrocarbon storage and refuelling areas must be concrete made and located away from any watercourse. Tanks above ground must be placed on a watertight concrete made area and fitted with a retention basin. On- site fuelling and greasing will be restricted to heavy machinery, all precautions will be taken to avoid any spillage. In case of spillage, the oil/fuel patch will be covered by sand and removed to be disposed into adequate landfill. No fuel and lubricant will be stored in containers more than 100 l within 100 m of a watercourse or a water body. Placing proper containers within the permanent and mobile work sites in order to collect all kinds of common solid waste such as: glass, paper, cardboard and plastic waste and packaging. Common waste will be transferred to the containers of the company responsible for general domestic waste collection or by the contractor towards a dumping site which is formally used for domestic waste. Hazardous waste such as batteries, oil filters, etc., shall be collected in special containers proof for any leakage/spillage. If not recycled, they will be conveyed to adequate landfill. Particular waste such as section or asbestos cement debris should be handled and transported with care and disposed in an appropriate dumping site.	All worksites and construction camps	Construction	Contractor	ESSO	Non-compliance statement in works monthly report	No marginal cost
Destruction of terrestrial flora and fauna	Site cleaning / preparation	Manual land clearing. Cutting trees above 4 m high or with aesthetic value shall request authorization of the Supervisor. In residential or suburban areas: - temporary fences placed around the roadside or adornment trees not to be felled - replantation of felled roadside or adornment trees in the same site but in such a way that the roots of the new tree will not likely to damage the buried pipe.	All work sites	Construction	Contractor	ESSO	Non-compliance statement in works monthly report	No marginal cost
		Tree plantation on 25 ha, Involvement of Forestry Service in choice of species, plantation methodology. Plantations will be made by AAC's staff or a skilled operator	ACC land or public area (public forests)	Construction	ACC's staff or skilled operator	Forestry Service + ESO	Specific report	25,000

ESSO: Environment and Safety Supervision Officer

Table 7.1c Mitigation Plan of impacts potentially occurring in construction stage

Impact	Activity	Mitigation measure	Locations	Period	Responsible for Implementation	Responsible for Supervision	Means of Verification	Cost (Euro)
Damage to private and public goods	Site cleaning / preparation Earthworks Construction works Equipment install. Pipe laying	Detailed location private and public goods likely to be affected by works and working with care in the vicinity of these goods. In case of damage, full restoration by the contractor at its own expenses	All work sites, more particularly where laying pipes	Construction	Contractor	ESSO	Non-compliance statement in works monthly report	No marginal cost
Disruption to public services	Site cleaning / preparation Earthworks Construction works Equipment installation Pipe laying	Detailed location of public services. Continuous liaison with operating companies/authorities in order to properly protect and/or divert public services without heavy impacts. In case of anticipated cut-off, information of the served population to attenuate disturbance. When working in the vicinity of overhead power cables, the contractor shall ascertain and satisfy himself about the safe clearances to be maintained from the power cables in consultation with the authority operating the power line. Contractor's full responsibility for any damage and for full restoration of the damage.	All work sites, more particularly where laying pipes	Construction	Contractor	ESSO	Non-compliance statement in works monthly report	No marginal cost
Disruption to road traffic	Site cleaning / preparation Earthworks Pipe laying	The contractor shall ensure the continuity of the road traffic. If traffic interruption is necessary, the information of the concerned population shall be ascertained by the contractor with a proper schedule in order to attenuate disturbance. After laying pipe and backfilling the trench with adequate material, all the damaged surface of carriage ways and sidewalks shall be restored in accordance to the relevant standards.	All work sites, more particularly where laying pipes	Construction	Contractor	ESSO	Non-compliance statement in works monthly report	No marginal cost
Increased risk for health and safety of nearby population	Site cleaning / preparation Earthworks Construction works Equipment installation Pipe laying	Seed limit for contractor's and subcontractor's vehicles: 40 km/h inside residential areas and 50 km/h outside residential areas. The contractor shall provide a written and clear traffic control plan including schedules and places of flagmen, traffic cones, barricades and/or lights. Work sites on along roads shall be properly signposted with adequate marks and tools such as cones and coloured bands. Fences to protect pedestrian, on diversion paths. Access to private houses, shops and all commercial public buildings shall be preserved by the means of safe footbridges.	All work sites, more particularly where laying pipes	Construction	Contractor	ESSO	Non-compliance statement in works monthly report	No marginal cost

ESSO: Environment and Safety Supervision Officer

Table 7.1d Mitigation Plan of impacts potentially occurring in operation stage

Impact	Activity	Mitigation measure	Locations	Period	Responsible for Implementation	Responsible for Supervision	Means of Verification	Cost (Euro)
Soil erosion	Laying pipes in non-surfaced areas	Plantations of autochthonous herbaceous species on the top of the backfilled trench in natural areas (3 ha in total).	Natural areas crossed by pipe network	Construction	Skilled operator	ESSO	Plantation report	30,000
Soil pollution	Pollutant released by sewage sludge	Construction of remote storage areas	Adequate site (to be determined)	Construction	Contractor	ACC	Works monthly reports	200,000
Soil pollution	Pollutant released by sewage sludge	Promotion of agricultural use of sludge	Agricultural plots of contracted farmers	Construction and operation	ACC or skilled operator	ACC	Progress reports	Not supported by the PIP
Water pollution	Discharge of treated wastewater into the Bic River	Setting up a Committee for the Restoration and the Protection of the Bic River	Chisinau	Operation	Chisinau Municipality and ACC	Members of Committee	Progress reports	Not supported by the project
Public health and safety	Presence of uncovered manholes	Restoration of manholes covers	Manholes	Construction	Contractor	ACC	Works monthly reports	50,000
	Presence of derelict facility	Cleaning up and safety control	Vadul Lui Voda DWTP	Construction	Skilled operator	ACC	Report	50,000
	Presence of old sludge drying beds	Cleaning up and restoration – preliminary survey	Chisinau WWTP	Construction	Skilled operator	ACC	Report	30,000
	Presence of former settling pond for drinking water sludge	Cleaning up and restoration – preliminary survey	Chisinau WWTP	Construction	Skilled operator	ACC	Report	10,000
Bad image of wastewater treatment	Operation of WWTP	Communication campaign, guide tours	Adequate site (to be determined)	Operation	ACC	MoM-GoE	Works monthly reports	Not supported by the PIP
Adverse effect on landscape and sceneries	Presence of new facilities and equipment	Architectural integration and landscaping works.	New facilities and equipment	Construction	Contractor	ESO	Supervision report	Not supported by the PIP

ESSO: Environment and Safety Supervision Officer

6.4. MONITORING PLAN

Monitoring will address parameters associated with the main potential impacts of the PIP implementation on the environment during the construction and operation stages. During the construction stage, the main part of the monitoring activities focus on the contractor's environmental practices aiming at reducing, preventing or restoring environmental damages, hence monitoring can be compared to an "environmental supervision". During the operation stage, the monitoring aims to characterize the source of damage to environment and the consequent change of receiving environment.

The environmental supervision will be carried out by the Environment and Safety Supervision Officer of the Supervisor (ESSO). Environmental supervision should be mainly based on

- frequent visits of work sites, work camp and facilities
- discussion with the Contractor's staff, especially the Site Environment, Health and Safety Officer (SEHSO)
- discussion with the nearby population and other stakeholders
- monitoring of supervision indicators, some of which being actually non observance of environmental requirements by the Contractor rather than classical quantitative indicators

Actually, it is difficult to propose only quantitative indicators for supervision, except for certain environmental works and accompanying measures (for example, tree plantations) which should be monitored as the other (core) works, because environmental practices are a set of behaviours the assessment of which is subjective. The qualitative indicators set out in Monitoring Plan (will be considered as items of check-list and the ESSO will have to review and comment each item and to establish, if the need arises, a non-compliance note to be slot in the monthly supervision reports.

The (quantitative) indicators to be monitored during the operation stage will be relating to:

- the sources of impacts: quality of effluent and sludge
- the quality of receiving physical environment: water and sediment downstream of WWTP discharge point
- the sustainability of the management of treated sewage sludge

It is clear that the WWTP management shall keep on monthly quality monitoring of both raw and treated wastewaters.

Overall monitoring activities are described Table 7.2a and 7.2b.

Table 7.2a Monitoring Plan for the construction stage (environmental supervision)

Environmental impacts	What?	When?	Where?	How?	By Whom?
Air pollution	Overall assessment based of site visit Spreading of water/wetting agent is residential area Use of tarps on the hauling trucks	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
Noise and vibration level	Overall assessment based of site visits Control of working hours	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
	Compliance with standard for noise levels:	Monthly during construction stage, 10 sites on average	Work sites in residential areas	As per standard	ESSO
Soil and water pollution	Fuel storage Imperviousness of fuel and maintenance areas Restriction to on-site fuelling Waste oil collection and storage Collection and elimination of domestic solid waste Collection and elimination of hazardous waste Spillage of oil and other harmful substances (*) Disposal of spoil material and other solids Compliance/approval of stockpiling area	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
Damage to terrestrial flora	Number of trees protected with fences Number of felled trees (*) Justification of felling Surface planted with herbaceous species (pipe routes) (*) Surface of tree re-plantation (*)	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
Protection of public and private utilities	Number of incidents (*) Complaint from affected populations (*) Damage left without satisfying restoration	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
Disruption to public services	Number of incidents (*)	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
Traffic management	Frequency/number of traffic jams (*) Number of traffic disruptions (*)	Continuously during construction stage	Every work sites	Visual control, reporting in the work monthly report	ESSO
Safety of nearby population	Speed limitation Relevant road signs Number of incidents/accidents (*)	Continuously during construction stage	Work sites in residential areas	Visual control, reporting in the work monthly report	ESSO
All kinds of impacts affecting the population	Complaints from riparian population, see grievance redress mechanisms (*)	Continuously during construction stage	Work sites in residential areas	Registration of complaints	Grievance redress Unit

ESSO: Environment and Safety Supervision Officer
(*) quantitative indicators

Table 7.2b Monitoring Plan for the operation stage

Environmental component	What?	When?	Where?	How?	By Whom?
Effluent quality	Routine parameters	Daily	Inlet and outlet of WWTP	Sampling and analysing with suitable equipment (standardized method)	ACC laboratory staff
Sludge quality	Dewatered sludge (after digestion): - dry solids - Al, As, Cd, Co, Cu, Cr, Fe, Hg, Mn, Ni, Pb, Zn - Cyanide total and free (*) - N total, NH4, P total and K total - heavy metals and cyanide released by leaching test	Quarterly	At the outlet of dewatering system	Pooled sampling and analysing with suitable equipment (standardized method)	ACC laboratory staff
Sludge reused	- number of farmers using sludge - agricultural surface (ha) - quantity of sludge spread on agricultural land (DS) - quantity of sludge reused for non-agricultural purpose - % of reused sludge	Yearly	Agricultural land surrounding Chisinau	Register consultation	ACC WWTP staff
Sludge disposed	- quantity of sludge disposed onto landfill	Yearly	Sludge landfill	Register consultation	ACC WWTP staff
Bîc River water pollution	Analyses of Bic River water: - pH, suspended solids, TDS, COD, BOD, residual, Cl Al, As, Cd, Co, Cu, Cr, Fe, Hg, Mn, Ni, Pb, Zn - N total, NH4+, NO3-, P total, HPO4- - Total and free cyanides (*) - Chlorophyll a (*) - Oil and grease - Faecal coliforms, total coliforms, faecal streptococcus	Monthly	Upstream (at least 100 m) and downstream(at least 50 m) of discharge point,	Sampling (tree samples analysed separately), treatment and analyses with suitable equipment (standardized method)	ACC laboratory
Bîc River sediment pollution	Analyses of Bîc River Sediment - Al, As, Cd, Co, Cu, Cr, Fe, Hg, Mn, Ni, Pb, Zn - Total organic carbon,	Yearly	Downstream of discharge point, between 20 and 50 m distance	Sampling of the 0-10cm top layer in low water period: 5 samples pooled	Skilled operator (sampling and analysis)

(*) adequate equipment to be acquired by ACC laboratory unless analysis is sub-contracted to an external, certified laboratory

ANNEX 1: ACTION PLAN FOR THE PROMOTION OF AGRICUTURAL USE OF THE TREATED SEWAGE SLUDGE

6.1. LEGISLATIVE FRAMEWORK AND RESPONSIBILITIES OF SLUDGE PRODUCER, SLUDGE USERS AND THE COMPETENT AUTHORITIES

As mentioned in the chapter dedicated to legal framework (see § 2.2.2.6), the Moldovan regulation stipulates the used of municipal sludge in agriculture is allowed under the condition that maximum values indicated for heavy metal as regards concentrations in sludge and in receiving soils as well as the 10 years-cumulated loads to the same plot are not exceeded. Referenced methods are provided for analysis of sludge and soils. Furthermore, spreading of sludge is prohibited onto:

- Pastures and fodder crops less than three weeks before livestock grazing or harvest of fodder crops
- Plots cultivated with fruits and vegetable crops during the period of vegetation, except the fruit trees
- Land dedicated to fruits and vegetable crops, less than 10 month before the harvesting period

Responsibilities and duties of stakeholders involved in the sewage sludge management are not described in the Moldovan legislation. These stakeholders are namely:

- the sludge producer: in the present case, ACC;
- the sludge users: farmers or owners of land to be spread on:
- the competent authorities : Ministry of Environment, Ministry of Agriculture, etc.;
- in certain cases, the sludge “preparers”, for example, a company using sludge to make compost. Often the sludge producer is also a sludge preparer.

A relevant example of the responsibilities and duties of the above-mentioned stakeholders is given by the regulation in force Romania, which is a UE country close to Moldova from a biophysical and cultural standpoint. The following rules are drawn from the Romanian regulation OM 344/2004, which are in line with the regulation and practices applied in the EU.

In EU countries, use of sludge in agriculture is submitted to a permit delivered by a “Permitting Authority” (in Romania: the Environmental Protection Agency - EPA and its local bodies) to the sludge producer. Previously, the sludge producer will have to identify farmers and land areas that meet the necessary conditions for sludge use (according to both chemical requirements and soil/plot characteristics mentioned in the above paragraphs). The suitability of the land will have to be assessed by a relevant Service of the Ministry of Agriculture, on the request of the sludge producer.

The application file should include:

- the quantity of sludge produced and the amount intended for agricultural use
- the composition of the sludge, especially as regards the above mentioned chemical requirements
- the type of sludge treatment
- information about the sludge user, location of the land, period on which sludge will be applied, and the type of crop

On receiving the application for a permit, the permitting authority will consult with the regional water and agricultural authorities. If the permit is refused, the sludge producer must find alternative means of sludge disposal. If the application complies with the

regulations, the authority is bound to issue the permit in time for the sludge producer to proceed.

The sludge producer is solely responsible for ensuring the quality and quantity of sludge, for organising the transport and spreading of sludge, and for any environmental and health effects after application. A record of the relevant information on sludge quantity and quality and details of the recipient farmer must be maintained by the sludge producer, to be made available to the competent authorities. The sludge producer must also ensure that the follow up monitoring of the soil is carried out (presumably by Agricultural Services).

If it is quite obvious that the spreading of sludge will be done by the farmers, according to the terms of agreement with the sludge producer, the later will be hold fundamentally responsible for any harmfulness and nuisance which might be arise from spreading. Likewise, the responsibility of sludge transport basically rests with the producer even if outsourced to a third operator.

The farmer is responsible for incorporating the sludge into the soil in the same day as application (this is likely to be difficult to achieve in practice). He must also inform the sludge producer about his intended crop rotation.

The Permitting Authority, through its devolved Services is responsible for controlling and supervising the activities of the sludge producer and user to ensure compliance with the regulations, and can invoke sanctions if the requirements are not met.

In Romania, the Services of the Ministry of Agriculture are responsible for:

- conducting and financially supporting the monitoring of soil, waters and crops receiving or likely to be affected by the sludge
- co-operating with local EPA in the review of applications for permit
- registering (names and addresses) the farmers using sludge on their plots with information on the types of sludge, application modes, and crop rotations

The Romanian regulation also states that agricultural advisors should organise information campaigns for the sludge users, companies and consumers. They should also offer consultancy to farmers on the use of sludge.

6.2. INSTITUTIONAL ARRANGEMENTS AND SLUDGE MANAGEMENT UNIT

It is recommended that ACC sets up a "Sludge Disposal Unit" (SDU) within its headquarters or the WWTP premises. The SDU will be made up of at least by two environmental or agriculture engineers, one senior and one junior, respectively appointed as SDU manager and assistant manager and a secretary. The activities of the SDU team will mainly consist of:

- following up the quality of the produced sludge and its compliance with both the legal and farmers requirements, in supervising sampling collection, ordering analysis, and registering the results in a relevant database. In case of no compliance, the SDU will have to check with the WWTP management staff the cause of dysfunction and try to work it out
- following up the quantities of available digested sludge
- liaising with the Ministry of Environment and the Ministry of Agriculture to develop protocol and supervise implementation of pilot schemes and agronomic trials on dedicated areas or private farms
- liaising with the Ministry of Environment to obtain necessary permits for sludge application or landfilling and to organise information meetings for the public about the environmental benefits of sludge land spreading as well as the control of environmental and health nuisance

- liaising with the local branch of the Ministry of Agriculture with a view to promote the use of sludge by local farmers, if necessary through the farmers associations, and to elaborate and distribute a guidebook for farmers willing to use sludge
- supervising the hauling and delivery of sludge to the remote storage areas (if any) and keep the registry of sludge storage updated
- supervising the disposal of non-reused sludge to the dedicated landfill
- supervising the sludge delivery to the farmer plots, especially with a view to avoid nuisance to the surroundings
- following up the application of sludge to agricultural plots in the adequate season
- following up the results obtained by the farmers using sludge in terms of crop yield as well as their satisfactory levels by the means of relevant forms
- developing a computerised data base where will be input all relevant data with respect to sludge quality, storage and delivery to farmers or the landfill, farmers using sludge, plots receiving sludge, agronomic results, etc..
- preparing each year, an agriculture use programme on the basis on the farmers demand and the anticipated sludge available in the next season
- seeking other sustainable and feasible ways to process and dispose sewage such as composting, solar drying, heating pump, energy recovery, co-incineration with waste, etc.

All of the data collected by the SDU, especially results of sludge and soil analyses, will be recorded in a database for each area of land receiving sludge. A computerised database will simplify the calculations necessary, give warning when limit values may be approached, and periodic reports are more easily produced for auditing by the appropriate authorities. Record keeping is an essential and integral aspect of managing sludge use programmes, and should be planned at the inception. The database will also provide a record of marketing and customer information, and fulfils the common regulatory requirements associated with environmental and health protection.

Every year, a Sludge Use Report will be issued by the SDU, a copy of which will be send to the Ministry of Environment and other Authority.

6.3. FARMERS/PUBLIC AWARENESS AND EDUCATION

Because of the origin and nature of sewage sludge, and the fact that this kind of material has never been used so far in Moldova, the farmers might be expected to show an adverse perceptions and some concerns over safety and acceptability of sludge as a fertilizer. Usually, the main concerns that need to be addressed are:

- health aspects (pathogen and toxic), particularly when handling sludge, but also consumers of crops;
- agronomic value, particularly reliability of nutrient supply and potential detrimental effects on crop growth or quality, mainly relating to nature of the soil

It is clear that the availability of digested, dehydrated sludge rather than liquid, raw sludge will be a real asset to fight reluctance of farmers. Nevertheless, many obstacles can be met between opinion and real practice, and a lot needs to be done to convince still reluctant farmers as well as the public and the buyers and consumers of crop products.

Once the farmers have been convinced of the agronomic benefits of sludge and the agricultural use programme is established, it may be necessary to satisfy general concerns regarding the public health aspects and the long-term environmental effects on the agricultural soils. Acceptance by the public of sewage sludge land spreading requires a public relations exercise to inform and educate about the need for recycling of sludge to land as opposed to dumping in landfill or incineration. This can be achieved through

the media and by exhibitions and field visits at spreading sites. The promotion must be supported by public meetings where it will be demonstrated that all environmental aspects of land spreading are understood and controlled so that the practice is safe and of environmental and agricultural benefit without hazard for public health. Environmental and Public Health authorities should be involved in these meetings. Furthermore, the farmers using sludge should be considered by the public as genuine environmental operators who take an important part in recycling the waste produced by the general population.

6.4. PILOT SCHEMES

As soon as digested, dehydrated sludge will be available, it will be critical to implement a series of demonstration field trials, if possible located at several places within 30 km of Chisinau (Districts of Anenii Noi, Ialoveni and Cruleni), in order to propose a representative sampling of soils.

The expected outcomes of the agronomic field trials would be to:

- clearly demonstrate to the farmers who will be invited to visit the plots the beneficial effects of sludge application on crop growth and production. The results will also be disclosed to the population through the newspapers and other media
- develop specific extension advice for farmers, preferably endorsed by the authorities, thus providing agronomic information on the nutrient value of sludge to the main crops grown in the region under the local conditions of soils, climate and husbandry practices.
- If possible, take part to a regional network of Water companies including Romania, which develop the use of their sludge in agriculture in order to compare the approaches and the result and to provide feedback to the companies which would be interested by the way of recycling sewage sludge.

The trial design should focus on the crop response of usual, if possible long cycle crops (maize, sunflower) to the sludge as compared to the response to a typical chemical fertilizer. This would provide well-characterised fertiliser response data which will be very helpful for advising farmers on application rates and fertiliser practice when using sludge on the given crop and soil type. Trials, with different crops and on different soils will be mostly profitable.

To ensure the success and the reliability of these critical field trials and of their specialised requirements, it is recommended that the setting up, supervision and reporting of the trials be undertaken by Agricultural Services in collaboration with the SDU, with external consultants support as necessary.

6.5. "MARKETING" APPROACH FOR SUPPLYING SLUDGE TO FARMERS

In many European countries, such as France, for example, to make the agricultural use of sludge attractive to farmers, several types of arrangements have been made, notably:

- spreading machinery purchases or rent by the WWTP operator and used by its own staff
- spreading carried out by a specialised private operator, appointed by the WWTP operator
- spreading carried out by the farmer (paid for this service or not) with its own machinery or machinery borrowed from the WWTP operator

In most cases, the cost relating to the transport of sludge up to the plot is undertaken and financed by the WWTP operator and the spreading cost for the farmer is close to zero. However, it should be noted that this kind of arrangement are often made when sludge is supplied in liquid or dewatered form. When sludge undergoes an advanced treatment

such as composting, it is no longer considered as "waste" but as "fertilizing matter" and the farmers' contribution increases.

For ACC, the point is to create a real incentive for farmers to use sludge and develop a formal and perennial partnership based on confidence and reliability as soon as the dried sludge will be available. Consequently, the use of sludge by farmers has to be very attractive from financial standpoint, even if at present the chemical inorganic fertilizers are fairly extensive. With this aim it is recommended that:

- ACC bears the cost related to the transport and deposit of sludge to the agricultural plots to be spread on, accordingly, it will be up to ACC to select farmers whose plots are within 20-30 km distance of the WWTP or remote storage areas, given that this distance will have to be run anyway to transport sludge from WWTP to the dedicated landfill
- once the sludge have been deposit onto the plot:
    - for large- and medium-scale farms, owning a muck spreader, the lifting and spreading works may be undertaken and financially borne by the farmer (but this will have to be negotiated)
    - for the small-scale farms, without muck spreader, the spreading will be undertaken by the ACC (or out-sourced to an operator) and only a moderate lump sum payment for each ha (less than the cost of spreading) may be asked to the farmer

Small farmers actually cannot be overlooked because they may have plot in the vicinity of the WWTP and so transport cost will be saved.

ACC will also bear all the cost relating to the soil analyses for the suitability assessment and the follow-up of plots receiving sludge, cost for implementation of agronomic field trials as well as, if the need arises, compensation cost for farmers borrowing their own plots for the first agronomic filed trials.

ANNEX 2: BIBLIOGRAPHY

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