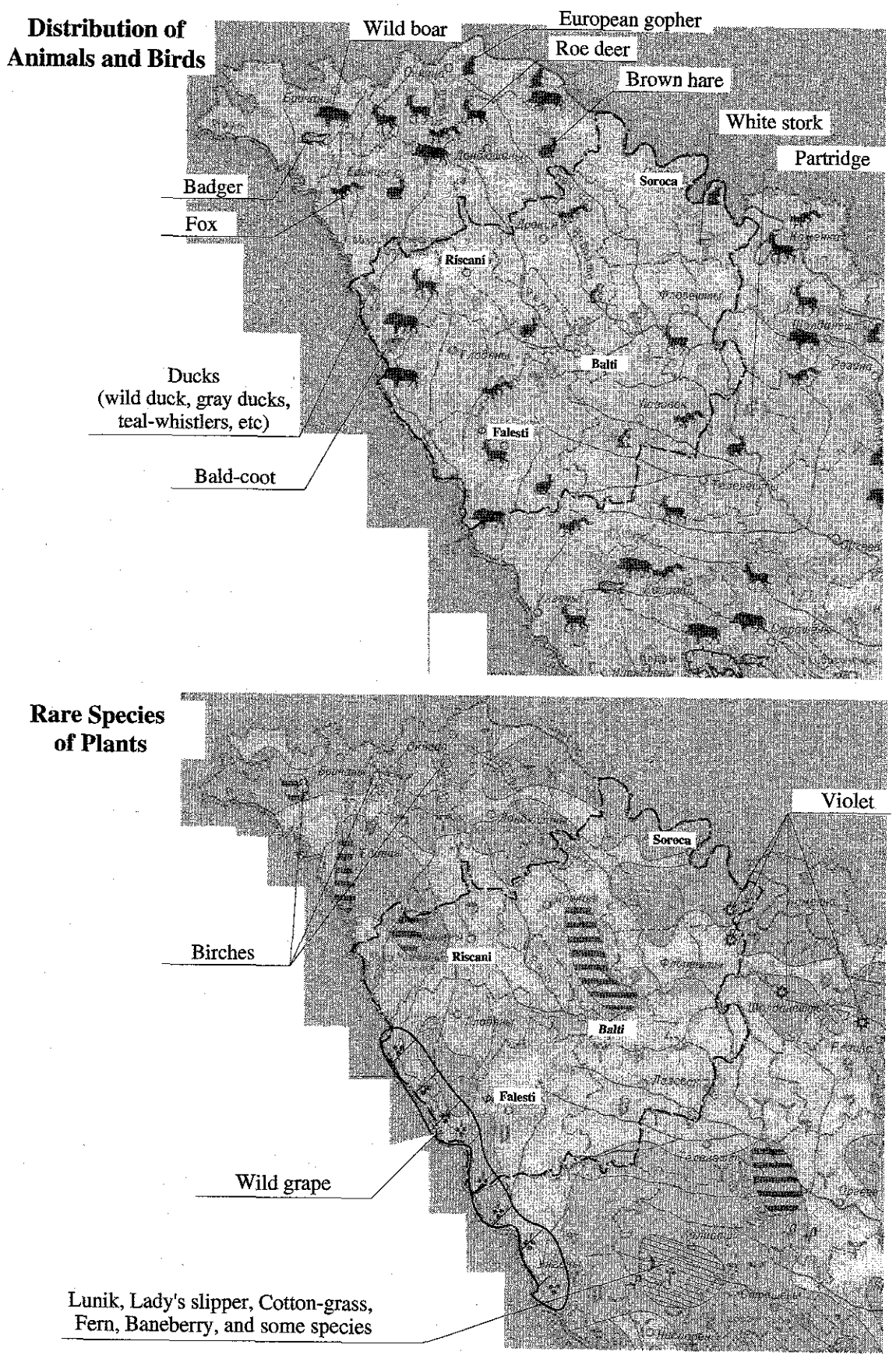
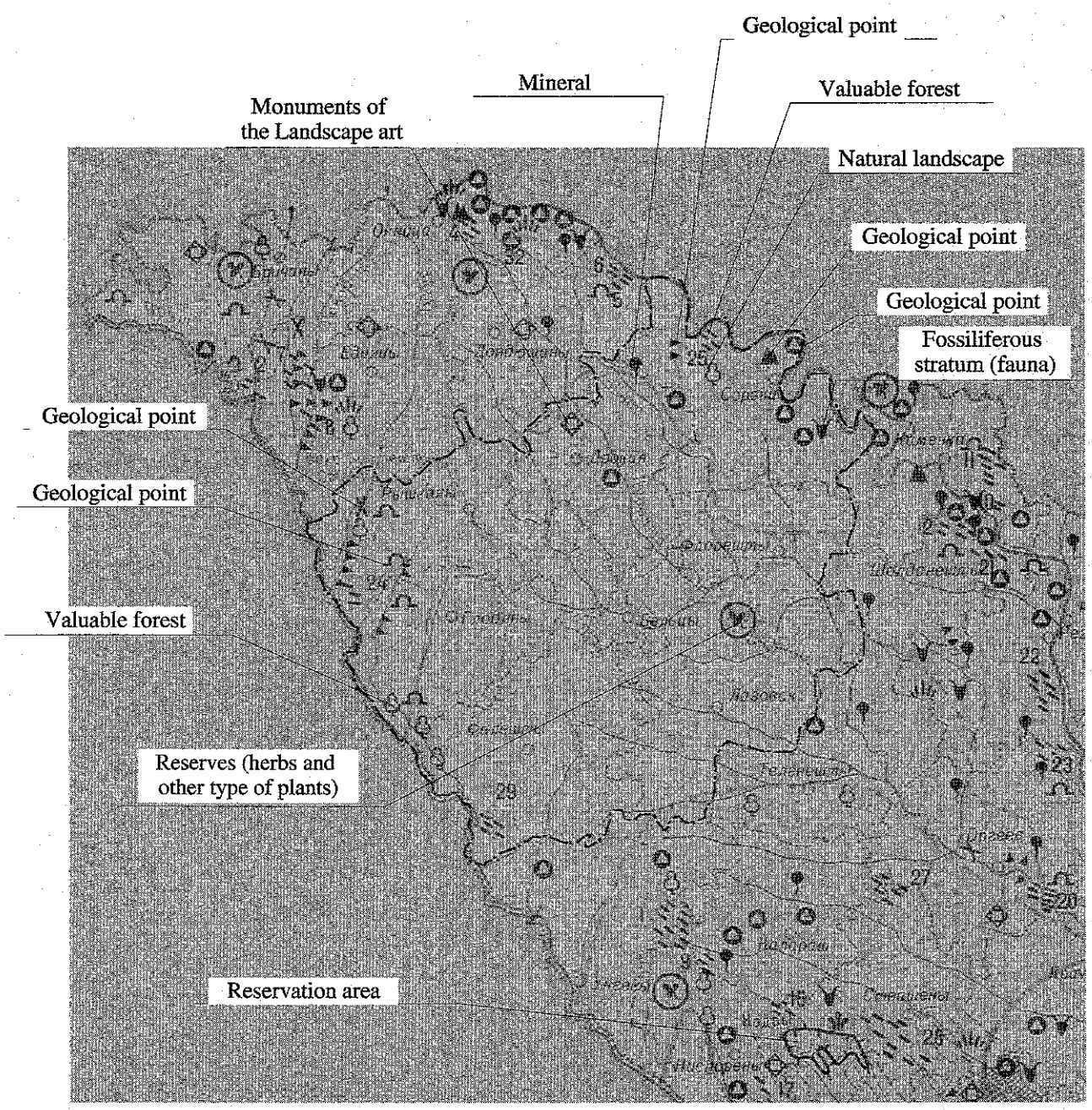


Source: "Atlas of the Moldovan SSR" 1990, Main Direction of Geodesy and Cartography of the Council of Ministers of USSR.

Figure 2.8.2 Fauna and Flora in the Study Area



Reserved sectors of natural landscape

24 : Suta-de movile

25 : The Goloshnitsa forest

29 : Izvoare

Figure 2.8.3 Natural Objects under Protection in the Study Area

2.8.3 Health Conditions

(1) Morbidity

Table 2.8.1 shows statistical data of Ministry of Health concerning water related diseases of inhabitants in the 4 cities/towns in the Study Area.

Table 2.8.1 Morbidity of the Population in the Study Area (2000)

City / Town	Morbidity Indices (number of cases registered per 10 thousand inhabitants)					Dental fluorosis (prevailing) for children under 14 years old (%)
	Cardio-vascular diseases	Digestion diseases	Kidney diseases	Viral hepatitis A	Acute Intestinal diseases	
Balti	584.8	63.80	8.0	11.2	68.0	2
Soroca	260.4	9.98	3.75	5.8	54.6	0
Falesti	433.0	56.20	3.2	13.5	18.8	80
Riscani	435.0	52.86	5.1	13.9	63.4	5
Country Average	103.3	25.1	3.5	7.27	25.6	12

Source: National Center of Preventive Medicine, Ministry of Health

The epidemiological investigations performed by the National Center of Preventive Medicine confirm the fact that in rural areas, where water contamination with nitrates is high, infant morbidity registered is 2 or 3 times higher than in other areas, and cases of cirrhosis for adults are much more frequent than in other areas. The health risks increase in direct proportion to the increase of the concentration of nitrates in water.

Special situation was observed in Falesti town regarding dental fluorosis among children (80 %), and 66 % of the children appeared to have dental fluorosis of more advanced second degree. It means that even the teeth structure is affected. Futhermore, 35 % of the children appeared to have different osseous diseases, i.e. starting phase of osteofluorosis (bone fluorosis). This town is the most affected by dental fluorosis in the country.

The relation between some chronic diseases and poor water quality is demonstrated by the morbidity indices. The indices are greatest in Balti City where the water quality data for tap water were worst among the 4 cities/towns. The best situation is found in Soroca City, where no particular water quality problems are found compared to the other 3 city/towns, except for shallow well waters.

(2) Evaluation of Health Risks

1) Typical Water Pollutants in the Sudy Area

Typical pollutants in the waters used in 4 cities/towns are as follows:

1. Substances, whose concentrations do not change in the distribution networks but depend on the initial content in the water source, are: As, F, Se, Na, NO_3, SO_4, Cl, pesticides;

2. Substances, whose concentration changes in the distribution networks, are: Al, Fe, Mn, H_2S, NH_3.

The most significant pollutants in water sources are the following (in order of importance):

1. **Fluoride**: in higher concentrations (above 2 mg/l) it provokes essential changes in skeleton structure of human body and especially hard affects teeth, slows down skeleton development trends;

2. **Nitrates**: represent a double threat: appearance of anemia at newborn children and possibility of formation of cancerogenic substances in human organisms;

3. **Sodium**: in high concentrations (above 200 mg/l) it can negatively affect the human health by formation of kidney stones;

4. **Sulfates**: in high concentrations may cause undesired gastrointestinal reactions and spoil the taste of water, they also contribute considerably to pipe corrosion;

5. **Hydrogen sulfide**: is an irritating substance and negatively affects the color and taste of water.

6. **Chlorides**: negatively affect water taste and substantially contribute to pipe corrosion, thus increasing the content of metals in water;

7. **Total hardness**: in high concentrations above 10 milli mol/l may negatively affect the human health by distorting the exchange of minerals in organism, also bad for water taste, leads to pipe corrosion.

2) Epidemiological risk factors

Out of all the indicators, total coliform is most frequently considered from the epidemiological point of view. Epidemiological risks are said to appear in cases when more than 20 units of total coliform (Standard - max. 3) and any of colifage (Standard - non-presence) are present in the distribution networks. In such cases, infectious diseases such as dysentery, acute intestinal diseases, caused by pathogenic or conditionally pathogenic germs, and viral hepatitis A are registered most frequently.

3) Assessment of Quality of Water Used for Drinking Water Supply

In 2000 the National Center for Preventive Medicine conducted the survey on the quality of waters used for drinking water supply, covering 1689 settlements in the country, and assessed the water quality data against the drinking water quality standards. Assessment scores for the four cities/towns are shown in comparison with the country average in Table 2.8.2.

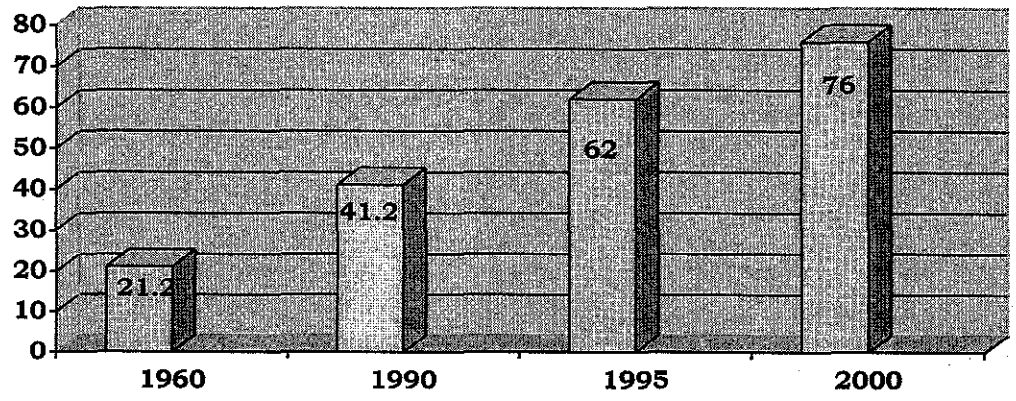
Table 2.8.2 Assessment Scores for Quality of Water Used in Drinking Water Supply for Four Cities/Towns (Year 2000)

City / Town	Deep wells		Shallow wells		Distribution networks	
	Chemical indices (%)	Micro-biological indices (%)	Chemical indices (%)	Micro-biological indices (%)	Chemical indices (%)	Micro-biological indices (%)
Balti	47.4	5.0	88.5	70.4	22.6	3.7
Soroca	4.0	0.0	62.9	75.8	4.3	2.9
Falesti	100.0	7.0	89.0	35.0	13.7	9.5
Riscani	42.0	3.0	90.0	21.5	15.0	7.9
Country Average	49.4	9.2	82.4	31.3	17.9	9.7

Source: National Center of Preventive Medicine, Ministry of Health
Note: Percentage of water samples that did not satisfy the drinking water standards. A sample is assessed to be unsatisfactory when any of water quality parameters does not satisfy the standard.

In all the four cities/towns, specially in Riscani and Falesti, water supply is intermittent and intervals between the supply hours are very long. Therefore, most of the inhabitants are forced to use the waters from shallow wells that, according to the water quality survey in the current Study, have exceedingly high concentrations of nitrates (in some cases up to 536 mg/l). The Figure below shows the changes of the average content of nitrates in shallow wells in the country during the last 40 years. Significant increase of the nitrate contamination is observed. The number of wells with nitrates content above 50 mg/l has grown substantially. These facts indicate that shallow wells cannot be considered as viable alternative source of drinking water.

Percentage of Shallow Wells in Moldova with Excessive Content of Nitrates



2.9 Summary of Issues

2.9.1 Technical Aspects

(1) Superannuated Water Supply Facilities

During 1990s in Moldova, the national economy and people's living standard declined. The income of water supply utilities decreased due to the decrease in water charges collected, while the electric power charge increased. This situation made the water supply utilities financially broken and difficult for renewal and proper maintenance of water supply facilities. Delays of payments for electricity bills result in the stoppage of the power supply, and it in turn prevents stable operation of the facilities.

Many components of the water supply facilities being operated by Apa Canal Soroca - Balti now need to be repaired, renewed or added. These include the pumps in the intake pumping station and the transmission pumping stations, motors, valves, power control panels, automatic operation control devices and monitoring board. In the water treatment plant, the components needing repair, renewal and new addition include chemical feeding equipment particularly chlorination unit, automation of in and out flow valves for sedimentation and filtration basins, improvements of the sludge treatment facilities for the sedimentation basin sludge and backwash wastewater sludge, automation of operation and control, and monitoring board. The plant heating system also needs renewal.

(2) Over-Capacity of Facilities

The capacities of water supply facilities designed during the Soviet era are generally much larger than that actually needed today. These include the facilities now operated intermittently by Apa Canal Soroca - Balti, and those in Falesti and Riscani of which construction works were suspended in 1994 - 1995. The lift pumps and transmission pumps of Apa Canal Soroca - Balti are of excessive capacities, and they require large electricity power thereby pushing up the energy cost. This is one of the causes of the financial breakdown of the organization. To solve this problem, renewal of the pumping facilities is required so that their capacities match the actually needed capacity.

The facilities of which construction works stopped in Falesti and Riscani have been so deteriorated by weathering and robberies in the past several years that resumption of the works cannot be considered realistic any more. Even if their construction works were completed, operation and maintenance of the facilities would require a prohibitively high cost due to the sexcessive sizes.

(3) Water Sources and Water Quality

The waters Prut River and Nistru River are available as sources for water supply in the Study Area. Although both rivers are in some extent contaminated, it is possible to produce the water that meet the drinking water quality standards through the application of the treatment technologies of coagulation/flocculation, sedimentation, filtration, and chlorination.

However, when deep well waters are considered as water source, the quality of the deep well waters in Balti, Falesti and Riscani cannot meet the drinking water quality standards without treatment. Particularly, high concentration of fluoride in the deep well waters will require advanced treatment technologies such as reverse osmosis.

(4) Necessity of Adequate Capacity of Distribution Reservoirs

Distribution reservoirs are provided so that they distribute the amount of incoming water, which is produced at a rate of daily maximum demand, in the manner that meets hourly variations of the water demand from supply areas. The Construction Norms and Rules 2.04.02-84 requires that the total capacity of distribution reservoirs be the sum of the capacity which meet the hourly variation of the demand and the capacity necessary for fire fighting.

In City of Balti, the total reservoir capacity meeting the demand of some 8 hours may be reasonable by considering the size of the population. However, there are cases that the Soroca - Balti pipeline system suddenly stops its operation as electricity supply is not stable. This situation requires provision of distribution reservoirs of larger capacity.

Since the present total capacity of the distribution reservoirs in Balti is only for 4 hours, Apa Canal Soroca - Balti must stop water treatment and transmission operations as the present distribution reservoirs in Balti are filled up in 2 - 3 hours. Such frequent stoppage of the facility operation will bring about negative effects to the system itself, such as instability of the treatment plant performance.

For all of above reasons, the authorities consider that Balti City badly needs distribution reservoirs with a total capacity for 24 hours or more.

2.9.2 Institutional Aspects

(1) Institutional Aspects at the National Level

In Moldova there is lack of a proper, efficient institutional framework for the water supply and sewerage sector. There are two institutions responsible for the administration of the sector at the

national level: (1) the Ministry of Environment, Construction and Territorial Development (MECTD); and (2) Apele Moldovei. Although the former assumes all the legislative and administrative activities at the national level for, inter alia, the water supply and sewerage sector, it embodies no specific department or division directly in charge of sector administration. The latter undertakes, among other things, the administration of the sector as it gives license to new or altered water supply and sewerage utilities prior to their operation. All the same, they lack legislative base to carry out administrative activities at the national level since the Moldova's Water Law or any other laws do not set forth the authority of sector administration, licensing and monitoring of water supply utilities.

The institutional status of the water supply sector in Moldova is currently in a state of evolution. After the independence of the nation, institutional structures in every sector have only slowly been propelled to the process of transition from the centrally planned economy to the market economy. In an advanced market economy, public utilities including water supply are naturally assumed to be self-reliant in institutional as well as financial terms. In the market economy any social entity can have license to run a business of water supply if it can fulfill legislative, financial, technical and institutional requirements prior to the application of such a license. In Moldova, all the water supply and sewer systems, namely, Apa Canals in Moldavian terms, used to be state- or publicly-owned. After the independence, however, all of the publicly-owned ones were transferred to the beneficiary municipalities, i.e., counties, cities, towns, villages or their combination.

(2) Institutional Aspects at the Local Level

Most Apa Canals, except for Chisinau, are standing on the edge of collapse mainly due to grossly short revenues, which has resulted in frequent or prolongued suspension of their operation. For example, ACSB suspended operation from September 2000 to August 2001 due to lack of power supply. The power company disconnected its service to ACSB because of a large accumulation of the latter's unpaid power bills. The reason for such financial difficulty facing ACSB is the unpaid wholesale water bills in large amounts from their customers, namely, Apa Canal Soroca and Apa Canal Balti. On the other hand, however, both Apa Canals have been suffering from short income due to large unpaid water bills, especially ones for non-domestice customers, which would have brought more revenue to Apa Canals than that from the domestic users. Water rates for domestic users are in general too low, which also cause short revenue for the utilities. Industrial and commercial users, of which water rates are very high, cannot contribute to the utilities as expected since they have much less water demand due to reduction in business than before. Low willingness-to-pay of users also stems from the low level of service such as insufficient water quantity, low water pressure and doubtful safety of water.

The low rate of metering for domestic users is another cause of the low efficiency of water charges collection since there are considerable under-estimates of actual consumption. However, the installation of meters at apartment houses, which is the form of residence for the majority of people, is hindered because of the typical design of the houses. As to the water charges collection, the existence of tariff-exempt customers such as low-income pensioners, war veterans and religious institutions is also a problem. Central and local government offices, schools, military cantonments, etc., which used to receive water at no cost, are reluctant to pay their water bills mainly due to very small or total lack of budget allocations for such a purpose.

The high rate physical losses, i.e., leakage is invisible, but a serious cause of financial difficulty of the water utilities. Physical water losses not only rob the water utilities of revenues but also cause the cost of providing extra water sources.

The deterioration in working condition of water supply facilities in the Study area is a very major issue. No proper maintenance and replacement of facilities have been undertaken for Apa Canals under the present study for the past decade mainly due to lack of financial resources. The provision of operation and maintenance manuals is inadequate. As there is no concept of preventive maintenance, replacement schedules for equipment and hardware are non-existent. The job descriptions for each division and its personnel with Apa Canals are poor in comprehensiveness. Proper manuals for regular (daily, weekly, monthly, etc.) inspection of facilities are rarely used or not provided. As a result, the mechanical and electrical facilities are in operation at markedly low efficiencies. As observed by the Study team, the rate of water losses (leakage) is high due to the deteriorated integrity of water distribution mains.

As observed by the Study Team, the organizational structure and functions of each division of Apa Canals are rather complex and not well defined. For instance, the organizational structure chart of ACSB illustrates command lines among (1) Director, (2) Chief Engineer, (3) Personnel Manager, (4) Chief Accountant, (5) Chief of Water Treatment, (6) Chief of Pumping Stations, (7) Electric Facility Chief, (8) Chief of Logistics, (9) Water Dispatch Engineer, and (10) Laboratory Chief. However, the structure lacks some important functions, e.g., (1) general affairs, (2) planning, (3) customer services, (4) maintenance of mechanical facilities, (5) water mains maintenance, etc. At the water retailing level, the line of authority is unclear in some Apa Canals, e.g., Apa Canal Balti and Apa Canal Soroca. The personnel assigned to respective divisions and sections are often redundant, which significantly contributes to the operating expenditure.

(3) Legislative Aspects

As for legislative aspects in the water supply and sewerage sector, legislative provisions appear to be inadequate as there exist only a few laws and ordinances, which would legally control the activities in the sector. Although there are the Water Act and the Law on Drinking water, they do not include sufficient stipulations on the creation, operation and maintenance of water supply and sewer service utilities including their licensing. The laws do not contain clauses, which provide legal foundations for water utilities to be financially viable with reasonable tariffs to recover the cost. As a result, the respective municipalities or the government would have to subsidize the water utilities, which means they would lack the incentive to make efforts for their financial self-reliance. Given this, there must be a law, such as the local public utilities law, which sets forth the responsibilities and authorities of public utilities including the assurance for them to set financially viable user tariffs.

The industrial standards currently used in Moldova, inter alia, the the water supply sector, are based on GOST, some of which are too old (made in the 1970s and 80s), and include not only standards for manufacturing and construction but also environmental and water quality standards. There is a definite need to upgrade them to provide compatibility with the advanced technologies, which are expected to be introduced in the course of the development of the sector.

2.9.3 Financial Aspects

In essence, the financial aspects of the problems for the Apa Canals are the shortage and unreliability of their revenue.

(1) Cash position has to be given more emphasis.

Although it is a progress that Apa Canals have introduced accrual basis accounting at 1998, the revenue must realize in any organization including Apa Canals. Accrual accounting system does not work if revenue does not realized in reasonable period. Tariff collection problems in all Apa Canals show insufficiency of accrual accounting system in such situations.

Whole accounting system in Apa Canals must be focused to cash position. In the balance sheet, top location of assets should be cash and near-cash assets should follow. In the liability side, short-term liabilities that have to be paid within one year must have top position. Large fixed assets and owner's equity will be located in lowest position. They do not need daily concentration of attention.

(2) The collection of water tariff.

The collection of water tariff is fundamental activity to sustain water supply organization. Water distribution does not work without financial basis. As mentioned in 2.6.3, the improvement of collection suggested but the water budget of government organizations is out of control of individual Apa Canals. It is recommendable for Apa Canals to outsource tariff collection to professional collection businesses with incentive scheme.

(3) Cost recovery from domestic customers.

Except for water tariff, any assistance from central and local governments cannot be expected in the area of operational and maintenance costs. Therefore, Apa Canals have to recover at least O&M costs from tariff revenue. As 70 % - 80 % of water supply goes to population, Apa Canals have to be sustained mainly with the revenue from population. Demand from enterprises has decreased drastically. Most factories currently closed do not have the schedule to reopen. Considering, the country's location and the size of population, large-scale industrial development except for food processing industry is difficult in near future.

Major remaining role of government (both central and local) is to facilitate the development of tariff structure to recover costs of Apa Canals and to allocate water budget to public organizations.

(4) Reduction of water supply cost.

The primary cost item of water distribution is electricity bill. The effort increase energy efficiency is required. Especially, the pumps in Apa Canal Soroca-Balti should be replaced with more efficient equipment.

(5) Introduction of management accounting system (cost control).

After improvement of tariff structure and tariff collection, then, cost control measure should be introduced in order to improve labor efficiency and material efficiency. Under current unstableness of operation, typical cost control system will not work

(6) To attain financial stability of Apa Canal Soroca-Balti.

Although Apa Canal Soroca-Balti and Apa Canal Balti are independent to each other, without financial stability of Apa Canal Soroca-Balti, the water supply from Apa Canal Soroca-Balti to Apa Canal Balti is not stabilized. The financial stability of Apa Canal Soroca-Balti depends on the financial performance of retail organization, Apa Canal Balti and Apa Canal Soroca also (if Apa Canal Soroca wants to receive water supply from Apa Canal Soroca-Balti). But because of its size,

the critical organization is Apa Canal Balti. Therefore, the financial issues of both Apa Canal Soroca-Balti and Apa Canal Balti are closely interrelated.

In order to coordinate the financial issues between wholesaler and retailers, we recommend to establish a comprehensive long-term financial plan that covers the financial aspects of both parities and solves following issues;

1) To realize the wholesale price to sustain Apa Canal Soroca-Balti financially.
2) To realize the retail water tariff to recover whole retail Apa Canals costs including water purchase cost from Apa Canal Soroca-Balti.
3) To collect retail water tariff as much as possible.

As retail Apa Canals have their own wells, they have tendency to prefer freehand on the water supply from Apa Canal Soroca-Balti depending upon wholesale water price.

In case of perfect free market, freehand of buyers is acceptable and necessary to improve the performance of wholesaler. But in this case, substantial coordination and cooperation is required between both parties.

(7) To establish long term payment plan for liabilities.

By showing feasible and reliable payment plan, Apa Canal Soroca-Balti has to negotiate its creditors to get their acceptance .

2.9.4 Environment and Health Aspects

(1) Health and Quality of Water

Until just recently when the Soroca - Balti pipeline system, using the Nistru River water as water source, resumed its operation, the water supply systems in Balti and Soroca Cities were entirely dependent on the groundwater sources. In Falesti and Riscani Towns, groundwater is the sole source of water supply. Issues concerning quality of source waters and health are summarized below.

1) Deepwell Water

Quality of deep well waters in Balti, Riscani and Falesti is not acceptable as drinking water without treatment. Substances whose concentration exceeds the drinking water quality standard are:

Balti: color, ammonia, nitrates, fluorides
Falesti: color, total solids, ammonia, fluorides
Riscani: total solids, ammonia, fluorides

2) Shallow Well Water

Shallow wells are used in all of the 4 cities/towns by inhabitants to compensate non-existence or inadequacy of central water supply system. However, quality of shallow well waters has risks to the health of the inhabitants. Substances whose concentration exceeds the drinking water quality standard are:

Balti: total hardness, total solids, nitrates
Soroca: total hardness, nitrates
Falesti: total hardness, total solids, nitrates, E. coli
Riscani: total hardness, total solids, nitrates

3) River Water

The quality of waters of Nistru River and Prut River corresponds largely to the second class of raw water quality standards. When adequately treated in treatment plants, no problem is expected in water supply system.

4) Health

Morbidity indices in the 4 cities/towns are generally higher than the country average, and much higher in Balti, Falesti and Riscani. The health risk is typically demonstrated in Falesti where the morbidity of dental fluorosis is far above the the country average. It corresponds to the high concentration of fluorides in deep well water and shallow well water.

High concentration of nitrates in shallow wells of all the 4 cities/towns also presents high risks to the health of the inhabitants.

(2) Quality of Environment

1) Water Environment

Although the quality of river waters of Nistru and Prut is acceptable as the raw water for water supply with required treatment, discharges of inadequately treated wastewater are threatening the healthy utilization of river waters. Problem is particularly serious in the downstream Soroca because of deteriorated sewerage facilities.

Insufficient treatment of wastewater and disposal of sludge are affecting also to the sanitary conditions of the environment.

2) Air/Noise

There are certain degrees of problems in air quality and noise in the city of Balti. Automobiles are emerging as principal sources of air pollutants and noise.

PART 2
MASTER PLAN

CHAPTER 3 FRAMEWORK FOR THE WATER SUPPLY MASTER PLAN

3.1 Planning Areas and Their Categorization

3.1.1 Planning Areas

Areas to be taken into consideration for projecting water demand in the water supply master plan are as follows. These areas are shown in Figure 3.1.1.

1) When considering the rehabilitation and expansion of the existing Soroca - Balti pipeline system

   - Cities of Balti and Soroca, and the villages situated along the present Soroca - Balti pipeline: Zastinca, Tepilovo, Ocolina, Vancina, Vancina Mica, Pirlita, Lugovoe, Kotovsk, Cainarii Vechi, Bezeni, Izvoare, Alexandrovca, Frumusica, Trifanesti, Alexandreni, Cubolta, Biruinta, and Grigoresti
   - Towns of Falesti and the villages situated along the route from Balti to Falesti: Reutel, Ciuluc, Catranic, and Egorovca
   - Town of Riscani and the villages situated along the route from Balti to Riscani: Cirlateni, Singuren, Recha, and Racaria
   - Town of Drochia and the villages situated along the route from Soroca to Drochia: Schineni, Popestii de Sus, Zgurita, Chetrosu, and Surii Noi
   - Towns of Floresti and Singerei, and the villages situated along the route from Balti to Singerei: Bilicenii Noi, and Bilicenii Vechi

2) When considering independent water supply systems for Falesti and Riscani using Prut River water as water source

   - Town of Falesti and the villages situated along the route from the possible treatment plant site to Town of Falesti: Hrubna Noua, Taxobeni, Vranesti, Horesti, Lucaceni, Risipeni, Bocsa, Musteatsa, Frumusica, Socii Vechi and Caluger
   - Town of Riscani and the villages situated along the route from the possible water treatment plant site to Town of Riscani: Varatic, Dumeni, Duruitoarca Noua, Horodiste, Pociumbeui, Hiliuti, Pirjota, Sturzeni, Alexandresti, Borosenii Noi, Moseni, Vasileuti, Stubieni and Zaicani

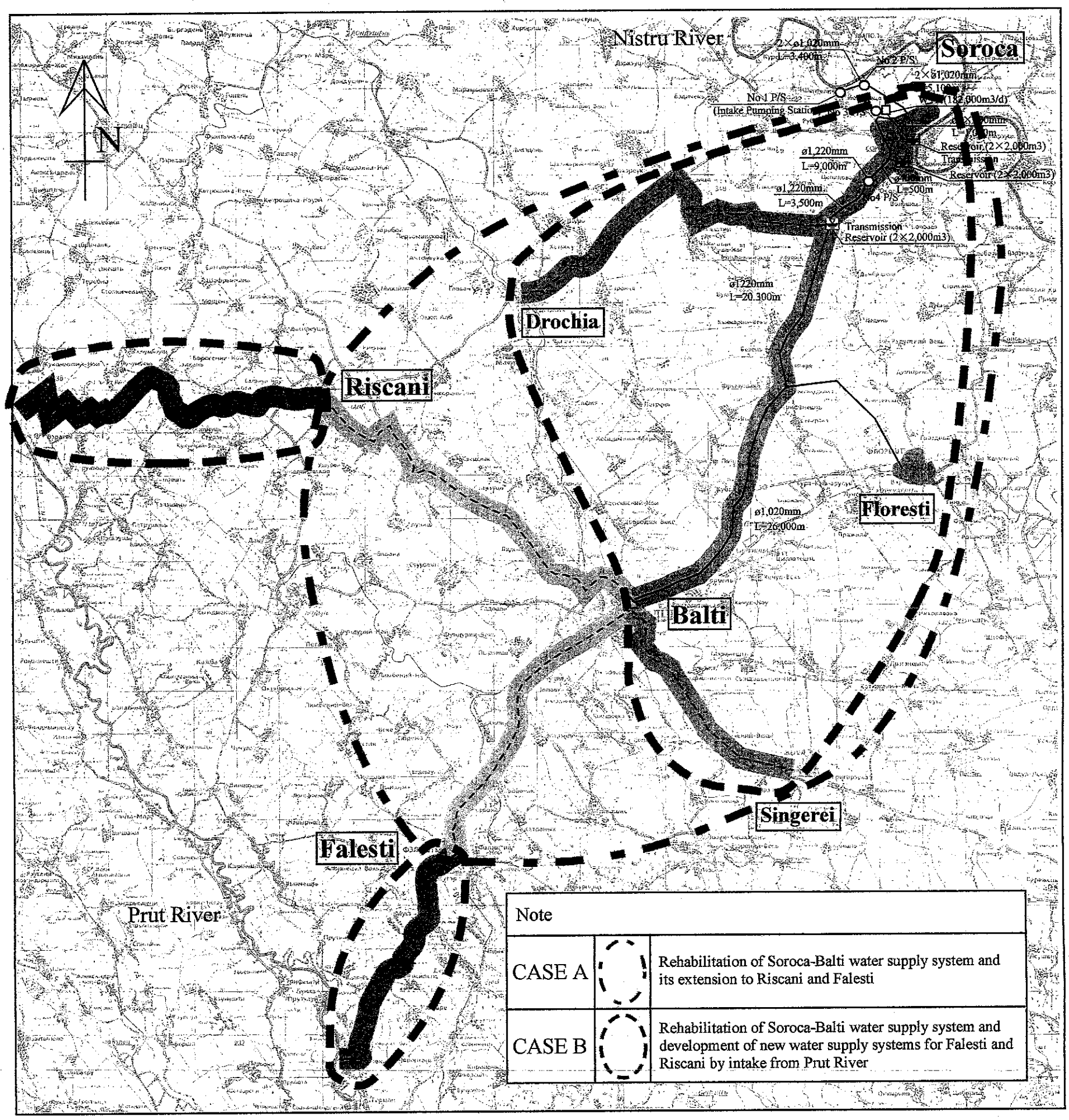


Figure 3.1.1 Areas Considered for the Projection of Water Demand in the Water Supply Master Plan

3.1.2 Categorization of Planning Areas

The population scales of cities, towns and villages indicated above vary greatly, from several hundred to 160,000. Also there are large differences in the present state of water provision. While a few areas are covered by water supply system by nearly 100 %, some communities have no provision at all. These cities/towns/villages are categorized into the following 3 groups for determining future water supply coverage and for projecting future water demand.

(Category 1) Cities/Towns with a population of more than 10,000

These are 7 cities/towns of Balti, Soroca, Falesti, Riscani, Floresti, Drochia, and Singerei. These municipalities presently have water supply systems, and their further developments are expected.

(Category 2) Villages with a population below 10,000 where water supply facilities with house connections exist

These include the villages of Cirlateni, Recha, Catranic, and Egorova.

(Category 3) Other villages having no water supply provision or having only stand posts and/or yard connections

3.2 Target Year

The target year for the water supply master plan in this Study has been set to the year 2015.

3.3 Population Forecast

3.3.1 Previous Forecasts

There are no existing population forecasts for the planning area. The population of Moldova has been in the decreasing trend after 1995 at annual rates between 0.2 % and 0.4 %. However, in the recent several years, a significant portion of the population decrease has been occurring in the region of Transnistra which stands on a special political position. Table 3.3.1 shows the population trend during the past 6 years.

Table 3.3.1 Population Change (1996 - 2001)

Unit : 1,000 Persons

Year	1996	1997	1998	1999	2000	2001
National total population	4,334	4,320	4,305	4,293	4,282	4,264
Annual change of the above		-14	-15	-12	-11	-18
Population excluding Transnistria	3,604	3,599	3,654	3,649	3,641	3,634
Annual change of the above		-5	+55	-5	-8	-7
Population in Transnistria	730	721	651	644	641	630
Annual change of the above		-9	-70	-7	-3	-11
Emigrant population	4.7	5.5	4.8	6.3	9.1	

Source: Refs. 3, 25, 26

Note: The population figure is of the beginning of each year, and the emigrant population figure is of during the year.

There are only a few existing studies that dealt with the future population trends. These include References 3 and 32. While realizing difficulties of precise projection of the future population, these studies expected a stable population until about the year 2020. In Reference 3, it was assumed that there would be a net increase of the population by 62,000 in the territory excluding Transnistrria until the year 2020, movement of the population from rural areas to urban areas, and from urban areas to abroad.

3.3.2 Population Forecast

(1) Population Growth Rate

In Reference 32, it was expected that the real GDP in Moldova would increase gradually to reach about annual 5 % in 2005, and this level would continue thereafter.

As regards regional difference, there are reasonable opinions among authorities that future economic development will be brighter in the northern region in comparison to the southern region, due to larger possibility of industrial rehabilitation.

By assuming such a scenario, it is expected that employment in the northern will increase to a certain extent in the in the future, especially in the city of Balti. This will be accompanied by mild increase of population primarily by inflow from other regions, since there will be no significant increase in the national total population.

In consideration of above, the following population growth rates are assumed for the Study Area.

Area	Annual Population Growth Rate
City of Balti	0.5 %
City/Towns of Soroca, Falesti, Riscani, Floresti, Drochia, Singerei (the present population above10,000)	0.2 %
Villages	0 %

For Category 1 areas (7 cities/towns of the population above 10,000), it is presumed that industries will recover to some extent accompanied by population inflow from rural areas. The population growth rate of annual 0.2 % is assumed for the Category 1 areas, except for the city of Balti where a growth rate of 0.5 % is assumed since the city is the second largest in the country and more growth is expected than other cities/towns in the region.

For Categories 2 and 3 areas (villages), the population growth rate is set to 0 %. Although the rural population at the national level is considered to be decreasing, it is expected that the population decrease in these villages in the Study Area will be restrained due to increased job opportunities in the nearby cities/towns and improved provision of water supply.

(2) Forecasted Population

Population forecast calculations were made under above-stated conditions with the year 1998 as the base year. The results are shown in Table 3.3.2.

The population growth during the period from 1998 to 2015 is 6.6 % for the 7 cities/towns.

Table 3.3.2 Population Forecast for the Study Area (Persons)

Area	Year				
	1998	2000	2005	2010	2015
Soroca	46,000	46,184	46,741	47,305	47,875
Balti	162,550	164,179	168,325	172,575	176,933
Floresti	20,100	20,180	20,424	20,670	20,919
Drochia	22,000	22,088	22,354	22,624	22,897
Singerei	15,969	16,033	16,226	16,422	16,620
Soroca - Balti	25,886	25,886	25,886	25,886	25,886
Balti - Singerei	4,252	4,252	4,252	4,252	4,252
Soroca - Drochia	14,486	14,486	14,486	14,486	14,486
Subtotal	311,243	313,288	318,694	324,220	329,868
Riscani	16,367	16,433	16,631	16,831	17,034
Falesti	18,963	19,039	19,269	19,501	19,736
Balti - Falesti	8,116	8,116	8,116	8,116	8,116
Balti - Riscani	12,150	12,150	12,150	12,150	12,150
Subtotal	55,596	55,738	56,166	56,598	57,036
Total	366,839	369,026	374,860	380,818	386,904
In the case when independent water supply systems are considered for Riscani and Falesti with Prut River as water source.					
Riscani	16,367	16,433	16,631	16,831	17,034
Prut - Riscani	21,017	21,017	21,017	21,017	21,017
Total	37,384	37,450	37,648	37,848	38,051
Falesti	18,963	19,039	19,269	19,501	19,736
Prut - Falesti	11,517	11,517	11,517	11,517	11,517
Total	30,480	30,556	30,786	31,018	31,253

3.4 Water Demand Forecast

3.4.1 Population Served by Area Category

The present ratio of the population served with water supply in the Study Area is highest in Soroca City at 98 %. On the other hand, there are villages along the routs being considered that have no water supply service now.

For the Category 1 areas, the ratio of served population in 2015 is set to 95 %, except for Saroca City where the ratio remains as the present at 98 %.

For the Category 2 and 3 areas, the ratio of served population in 2015 is set to 80 %.

It is assumed the served population ratio increases gradually by the year 2015. The served population thus calculated is shown in Table 3.4.1.

Table 3.4.1 Forecast of Population Served in the Study Area (Persons)

Area	Year				
	1998	2000	2005	2010	2015
Soroca	44,988	44,988	45,339	45,886	46,442
Balti	158,230	158,230	161,592	165,672	168,086
Floresti	18,150	18,150	18,382	18,604	19,873
Drochia	9,235	9,235	13,413	16,968	21,752
Singerei	10,400	10,400	12,169	13,958	15,789
Soroca - Balti	6,760	6,760	6,760	14,875	20,893
Balti - Singerei	0	0	0	1,701	3,402
Soroca - Drochia	1,961	1,961	1,961	5,795	11,589
Subtotal	249,724	249,724	259,614	283,459	307,826
Riscani	4,366	4,366	8,316	11,782	16,182
Falesti	9,500	9,500	12,525	15,600	18,749
Balti - Falesti	510	510	1,077	3,716	6,493
Balti - Riscani	3,324	3,324	5,060	7,461	9,721
Subtotal	17,700	17,700	26,978	38,560	51,145
Total	267,424	267,424	286,594	322,018	358,972
In the case when independent water supply systems are considered for Riscani and Falesti with Prut River as water source.					
Riscani	4,366	4,366	8,316	11,782	16,182
Prut - Riscani	4,246	4,246	5,319	9,718	16,814
Total	8,612	8,612	13,635	21,500	32,996
Falesti	9,500	9,500	12,525	15,600	18,749
Prut - Falesti	455	455	2,992	5,938	9,213
Total	27,179	27,179	42,787	64,538	93,954

3.4.2 Water Use and Unit Water Demand

(1) Water Use

The uses of supplied water are categorized as follows:

- Domestic use
- Livestock use
- Commercial / Institutional use
- Industrial use

(2) Unit Water Demand

According to the result of the sociological survey conducted in the current Study for the 4 cities/towns, specific water consumption is very small at 26 - 40 Lcd (liter/capita/day). These figures were obtained under the situation where available amount of water is limited and supplied only intermittently. In the past, larger amount of water was supplied in these cities/towns. In the City of Chisinau, the specific consumption is reported to be 130 - 150 Lcd Therefore, the consumption data obtained from the above survey cannot be referred in planning future water demand.

In this Study, the water demand will be determined in reference to the norms and standards used in Moldova, i.e., Construction Norms and Rules 2.04.02-84, Water Supply External Networks and Facilities, and Standard Specific Consumption defined by Apele Moldovei.

The daily average water consumption by each use is determined to be as follows.

1) Specific water consumption per capita of domestic use by facility level

Above mentioned norms and standards are shown below.

	Norm(1)	Standards of (2) Apele Moldovei
Residences having house connection of water supply and sewerage		
With centralized hot water supply	230 - 350 Lcd	250 Lcd
With bathrooms and individual water heaters	160 - 230 Lcd	190 Lcd
Without bathroom	125 - 160 Lcd	140 Lcd
Yard taps and stand posts	30 - 50 Lcd	50 Lcd
Schools	10 Lcd	Included in above

Source: (1) Construction Norms and Rules 2.04.02-84, "Water Supply, External Networks and Facilities," GOST.
(2) Ref. 6-4.

Trial calculations of domestic water demand were made using the average values of above Norm and the values set by Standards of Apele Moldovei. The average values of water consumption per capita in the Study Area calculated in these two cases were very close and considered to be reasonable as compared with the present level in Chisinau. In this Study, the values given by the Standards of Apele Moldovei will be used.

2) Specific water consumption per capita of animals in private holding

The following values given by the Norm will be used.

Horse	55 Lhd (liter/head/day)
Cow	60 Lhd
Pig	15 Lhd
Sheep, Goats	8 Lhd
Poultry	1 Lhd

It is assumed that the livestock consumption of water is met by 50 % by natural waters such as streams, ponds and shallow wells. Therefore, remaining 50 % of water necessary for livestock is assumed to be supplied by water supply system.

3) Commercial / Institutional Demand

Commercial and institutional demand of water is assumed to be 10 % of the domestic use, as this ratio was adopted in a recently developed plan in other areas in Moldova (Ref. 1-1).

4) Industrial Demand

Since industrial water demand varies with characteristics of city/town, it is desirable to determine the demand for each of cities/towns based on actual existing demand and future prospect. However, such data have not necessarily been available for all the cities/towns considered in the this study. Therefore, the case of the City of Balti has been referred, because the city predominantly affects to the total water demand in the areas being considered, and some data are available. In 1999, when the Soroca-Balti water supply system was operating throughout the year, the annual water consumption by enterprises was reported to be 606,000 m^3 (equivalent to 1,660 m^3/d), which is 8.4 % of the present domestic demand (year 2000) calculated in the manner described above. By adding a safety margin, industrial demand is assumed to be 10 % of the domestic demand in the Category 1 areas (7 cities/towns).

(3) Design Water Demand (Maximum Daily Water Demand)

The ratio of the maximum daily demand to the average daily demand is given by the Norm as 1.1 - 1.3.

For the Category 1 areas, the average value of 1.2 is adopted. For the other areas, the value of 1.3 is adopted, considering higher ratio of watering for cultivation due to wider area of residence premise. These values are applied to the domestic use and the commercial / institutional use.

(4) Leakage

For the existing water distribution facilities, the amount of unaccounted-for water, such as leaks from distribution and service pipes and errors in flow measurements, is reported to be 30 - 40 %. The leakage rates in the 4 cities/towns estimated in the current Study based on the field survey, existing data, and relevant references were 27 % - 38 %. Based on the assumption that the water losses will be reduced through continual effort in replacing deteriorated pipes of the of distribution networks, the leakage rate is set to be 20 % in this planning. A preliminary plan for the pipes replacement is given in the Supporting Report.

3.4.3 Water Demand Forecast

(1) Domestic Water Demand

It is considered that the specific water consumption increases in parallel with the increase of served population as the water supply provisions are improved. Provided that the water is sufficiently available, the increase of the specific water consumption can be attributed to the improved provision of water consuming facilities in each household. The ratios of population applicable to the values of specific water consumption given by the Standard are considered in the following manner.

1) With centralized hot water supply

Except for the village of Recha on the route between Balti and Riscani, there is now no cities/towns/villages where centralized hot water supply is operated. And it is not expected that this service will resume in the future. Therefore, the ratio of the population in this category of specific water consumption is assumed to be 0 %.

2) With bathrooms and individual water heaters

The 1998 statistics shows that the ratio of households having these provisions is highest in Falesti among the 4 cities/towns at 26 %. According to the sociological survey in the current Study, the

households having water heater are 59 (11.9 %) out of 494 sample households. The ratio is very small among the households whose monthly family income is below 300 Lei. The average monthly income is about 600 Lei in Balti and Soroca Cities, and about 400 Lei in Falesti and Riscani Towns. It is reported that by 2015 Moldova's national income will increase to 1.5 - 2.0 times of the present income.

In consideration of above, the ratio of households that will have these provisions in 2015 has been roughly estimated as follows:

- 30 - 40 % for the Category 1 areas (7 cities/towns)
- 10% for the villages where several percent of households have heater at present
- 5 % for the villages where there are house connections of water but no household having water heater
- 0 % in other villages

It is assumed that the ratio changes linearly toward the year 2015.

3) Without bathroom, and Stand post and yard connection

The ratios of the households categorized into "house connection" and "stand post and yard connection" among the households served with water are estimated. The ratio of households categorized as "without bathroom" is set to the reminder of the households with "house connection" minus the households with "water heater."

For the Category 1 areas, the ratio of the "house connection" population is set to 95 % in 2015, and that of the " stand post and yard connection" is set to 0 %.

For the Category 2 areas, above percentages are set to 45 % and 35 %, respectively in 2015. For Category 3 areas, these are set to 30 % and 50 %, respectively in 2015.

These ratios are assumed to change linearly toward 2015.

(2) Livestock Water Demand

The livestock water demand is assumed to increase from 1998 in proportion to the increase of served population.

(3) Commercial / Institutional and Industrial Water Demands

The commercial / institutional and industrial water demands are assumed to increase in proportion to the increase in the domestic water demand.

(4) Water Demand Forecast

Table 3.4.2 shows the maximum daily water demand calculated for a five-year interval from 2000 to 2015 under the conditions described above.

As regards the amount water production, internal use of water such as that in the treatment plant must be added. This amount is assumed to be 3 % of the maximum daily water demand.

In the case of expanding the Soroca-Balti water supply system to cover all the 7 cities/towns and the villages along the pipelines, the total maximum daily water demand in 2015 (90,724 m^3/day) is 1.70 times of that in 2000 (53,500 m^3/day).

Breakdown of the maximum daily water demand by water use categories in above case is as follows.

Daily Maximum Water Demand by Water Use Categories (m^3/day)

Water Use	2000	2008	2015
Domestic	37,341	48,319	63,472
Commercial / Institutional	3,734	4,832	6,346
Industrial	3,019	3,798	4,791
Livestock	489	680	994
Sub-total	44,583	57,629	75,603
Losses	8,917	11,526	15,121
Total	53,500	69,155	90,724

The daily average domestic water demand in above case is as shown below.

Daily Average Domestic Water Demand

	Year 2000			Year 2008			Year 2015		
	Population served (persons)	Water demand (m^3/d)	Specific water demand (Lcd)	Population served (persons)	Water demand (m^3/d)	Specific water demand (Lcd)	Population served (persons)	Water demand (m^3/d)	Specific water demand (Lcd)
Total	267,424	31,046	116	307,849	40,090	130	358,972	52,509	146
City of Balti	158,230	19,717	124	164,040	22,040	134	168,086	26,186	156
Other 6 Cities/ Towns	96,639	10,477	108	117,736	15,946	135	138,787	21,724	157
Villages along the pipeline	12,555	852	68	26,073	2,104	81	52,098	4,599	88

Table 3.4.2 Water Demand Forecast (m^3/day) in the Study Area (Daily Maximum)

Area	Year			
	2000	2005	2010	2015
Soroca	7,961	8,942	10,541	12,178
Balti	33,907	34,879	39,877	44,950
Floresti	4,039	4,338	4,795	5,515
Drochia	1,274	2,622	4,006	5,795
Singerei	927	2,025	3,217	4,254
Soroca - Balti	630	630	2,127	3,272
Balti - Singerei	0	0	275	551
Soroca - Drochia	189	189	901	1,801
Subtotal	50,927	53,625	65,739	78,317
Riscani	1,100	2,081	3,063	4,347
Falesti	2,718	3,515	4,346	5,197
Balti - Falesti	128	221	611	1,072
Balti - Riscani	625	880	1,285	1,791
Subtotal	4,572	6,696	9,305	12,407
Total	53,500	60,321	75,044	90,724
Total of 7 cities/towns	51,928	58,401	69,845	82,237
Total of the villages	1,572	1,920	5,199	8,487
In the case when independent water supply systems are considered for Riscani and Falesti with Prut River as water source.				
Riscani	1,100	2,081	3,063	4,347
Prut - Riscani	497	738	1,685	2,896
Total	1,597	2,819	4,748	7,243
Falesti	2,718	3,515	4,346	5,197
Prut - Falesti	117	560	1,111	1,704
Total	6,029	9,713	14,953	21,387

CHAPTER 4 DEVELOPMENT OF THE WATER SUPPLY MASTER PLAN

4.1 Development Alternatives

The existing conditions and problems of water supply in the cities/towns of Balti, Soroca, Falesti, and Riscani were described in Chapter 2, and the future water demands were described in Chapter 3. Based on the analyses of above conditions, problems, and present and future needs in these areas, the following 3 Alternatives have been proposed as the candidates for the water supply facility development master plan:

Alternative 1: The Soroca-Balti water supply system is rehabilitated and expanded to supply water to all of 4 cities/towns.

Alternative 2: The Soroca-Balti water supply system is rehabilitated to supply water to Soroca and Balti, and two independent water supply systems are developed using Prut River water to supply water to Falesti and Riscani.

Alternative 3: Groundwater resources are used in all of 4 cities/towns by constructing additional wells, and water treatment facility is constructed in Balti, Falesti and Riscani for fluoride removal.

4.1.1 Alternative 1

Alternative 1 is composed of the rehabilitation of the Soroca-Balti water supply system and expansion of the transmission pipeline from Balti to Riscani and Falesti, respectively (see Figure 4.1.1). The water source in this Alternative is Nistru River and the water demand is 91,000 m^3/d as described in Chapter 3.

The existing pumps in the pumping stations of the Soroca-Balti water supply system should be replaced by new ones of appropriate capacity which is about a half of the original design capacity. The capacity of the water treatment plant is sufficient with rehabilitation of one of two original series.

The new water transmission pipeline from Balti to Falesti will be approx. 32 km, and that from Balti and Riscani will be Approx. 35 km.

There is no design standard in Moldova regarding the capacity of distribution reservoirs. Since the frequency of power stoppage is relatively high in this region, it is desirable to store a sufficient amount of water in the distribution reservoirs for stable supply of water to consumers. Therefore, as recommended by Apele Moldovei, the design capacity of distribution reservoirs has been determined

to be the volume equivalent to the daily maximum water demand. The water demand of the city of Balti in 2015 is 45,000 m^3/d. The total capacity of the existing distribution reservoirs in Balti is 12,000 m^3 (2 x 6,000 m^3). The capacities of two unfinished reservoirs are 2 x 10,000 and 2 x 6,000 m^3, respectively. Therefore, new reservoirs will not be necessary to meet the water storage for 24 hours when these unfinished reservoirs are completed.

The water demand in the city of Soroca in 2015 is 12,200 m^3/d. The existing distribution reservoirs have a total capacity of 8,000 m^3 (2 x 2 x 2,000 m^3). Therefore, a new reservoir with the capacity of 4,200 m^3 will be required to meet the water storage for 24 hours in 2015.

For the towns of Riacani and Falesti, the water demands in 2015 are 4,400 m^3/d and 5,200 m^3/d, respectively, and the capacities of the existing reservoirs are 3,000 m^3 and 1,000 m^3, respectively. Therefore, new reservoirs with the capacity of 1,400 m^3 and 4,200 m^3, respectively, will be required in 2015.

4.1.2 Alternative 2

Alternative 2 is composed of the rehabilitation of the Soroca-Balti water supply system for the cities of Balti and Soroca and the establishment of new water supply systems for Riscani and Falesti (see Figure 4.1.2). The water sources in this Alternative are Nistru River and Prut River. The water demand for the Soroca-Balti water supply system in 2015 is 80,700 m^3/d including cities of Balti and Soroca and other towns and villages along or near the water transmission pipeline. The water demand from the town of Falesti and the villages along the transmission pipeline is 6,900 m^3/d, and that from Riscani and the villages along the transmission pipeline is 7,200 m^3/d.

The rehabilitation of Soroca-Balti water treatment plant and replacement of pumps in the existing pumping stations are also necessary as in Alternative 1, but the required capacity of the system is smaller than that in Alternative 1.

For the new water supply systems in Falesti and Riscani, the routes of new transmission mains will be the same as those of the unfinished water supply systems. However, the old transmission pipes will not be used because of the deterioration of the pipes. And unfinished water treatment plants and other unfinished facilities in both towns will not be used also, because their capacities are too large and most of the mechanical and electrical facilities have not been installed. However, the same treatment process as that of the unfinished plants will be adopted for the new treatment plants.

The requirements of the distribution reservoirs in all the cities/towns are the same as that in Alternative 1.

4.1.3 Alternative 3

Alternative 3 is composed of construction of additional wells to meet the water demand in 2015 for all of the 4 cities/towns, construction of new raw water transmission mains from the new wells to the receiving reservoirs, and the construction of fluorides removal plants for three cities/towns of Balti, Falesti and Riscani (see Figure 4.1.3).

This Alternative assumes that the extractable quantity of groundwater is sufficient to meet the water demand in 4 cities/towns in 2015. According to limited data currently available, this assumption seems to be not viable. However, this is included as an Alternative for the case when available quantity of water has been found to be sufficient to meet the water demand through future investigations.

In this Alternative the served areas are limited to the areas of 4 cities/towns and do not include other towns and villages considered in Alternatives 1 and 2. For the fluorides removal process to be employed in the 3 city/towns other than the city of Soroca, it is necessary to account for the water loss at about 40%. Therefore the required amounts of water extraction in 2015 for the 4 cities/towns are as follows:

City of Balti : 75,000 m^3/d (45,000 m^3/d)
City of Soroca : 12,200 m^3/d
Town of Falesti : 8,700 m^3/d (5,200 m^3/d)
Town of Riscani : 7,300 m^3/d (4,400 m^3/d)

The reservoir requirements in the 4 cities/ Note: ( ) shows the projected water demand towns are as the same as those in Alternatives 1 and 2.

4.1.4 Summary

The content of these 3 Alternatives for the water supply master plan is summarized in Table 4.1.1.

Table 4.1.1 Three Alternatives for the Water Supply Master Plan

System	Master Plan					
	Component		Alt-1	Alt-2	Alt-3	Remarks
Soroca-Balti Water Supply System	Water Treatment Plant	Rh	○	○		Alt-1: 94,000 m^3/d Alt-2: 80,700 m^3/d
	Pumps (No.1 ~ 4 P/S)	Rp	○	○		-
	Transmission Pipeline	Rh	○	○		-
	Transmission Pipeline to Falesti and Riscani (extension)	N	○			32 km (to Falesti) 35 km (to Riscani)
Balti	Reservoirs	C	○	○	○	2 x 10,000m^3 2 x 6,000m^3
	Wells and Raw Water Transmission Pipeline	N			○	67 wells, Pipeline: 6 km
	Fluoride Removal Plant	N			○	Q = 75,000 m^3/d
Soroca	Reservoirs	N	○	○	○	4,200 m^3
	Wells and Raw Water Transmission Pipeline	N			○	25 wells, Pipeline: 12 km
Falesti	Reservoirs	N	○	○	○	4,200 m^3
	Water Treatment Plant (Prut River)	N		○		Q = 7,100 m^3/d
	Transmission Pipeline and P/S (from Prut River)	N		○		32 km
	Wells and Raw Water Transmission Pipeline	N			○	72 wells, Pipline: 20 km
	Fluoride Removal Plant	N			○	Q = 8,700 m^3/d
Riscani	Reservoirs	N	○	○	○	1,400 m^3
	Water Treatment Plant (Prut River)	N		○		Q = 7,500 m^3/d
	Transmission Pipeline and P/S (from Prut River)	N		○		34 km
	Wells and Raw Water Transmission Pipeline	N			○	20 wells, Pipeline: 10 km
	Fluoride Removal Plant	N			○	Q = 7,700 m^3/d

Note) Rh: Rehabilitation, Rp: Replacement, N: New construction, C: Completion of unfinished work