

# Chapter 3

# Surface Water and Groundwater

## **General information**

The average annual flow volume of water in the Republic of Armenia is about 6.2 billion m<sup>3</sup>, of which the average annual flow volume of groundwater is about 3 billion m<sup>3</sup>.

Armenia is in a relatively favorable situation in terms of natural reserves of water resources. Taking into account all available water resources in the Republic, annual water resources per capita are about 2500-2700 m<sup>3</sup>. According to recent calculations of the hydrological cycle, annually more than 17.6 m<sup>3</sup> of water come from precipitation, of which about 11.5 billion m<sup>3</sup> evaporate.

### ***Rivers of the Republic of Armenia***

Rivers of Armenia are tributaries of the major rivers of the South Caucasus, the Arax and the Kur. There are about 9480 small and large rivers in Armenia, with a total length of about 23 000 km. Of these, 379 rivers have a length of 10 km and more. Although Armenia is considered a country with an average reserve of water, the distribution of water resources in the country is extremely uneven. The density of the river network ranges from 0 to 2.5 km/km<sup>2</sup>, and the average density is about 0.8 km/km<sup>2</sup>.

### ***Reservoirs of the Republic of Armenia***

Reservoirs have been built for the use of river water resources, as well as to regulate river flows. The annual regulated river flow is 1272.5 million m<sup>3</sup>.

There are 74 reservoirs in Armenia with a total capacity of 988 mln. m<sup>3</sup>. Thirteen more reservoirs (832 mln.m<sup>3</sup>) are currently under construction. Of the 74 reservoirs, 35 have capacity of 1 mln.m<sup>3</sup> and more. The Akhuryan Reservoir is the largest, with a capacity of 535 mln. m<sup>3</sup>. Reservoirs serve the needs of irrigation, the energy sector, fishing and recreation.

### ***Quality and quantity of groundwater resources***

In Armenia, groundwater resources play a very important role in the water balance. About 96% of water used for drinking comes from groundwater resources. This water is very clean. The quality of groundwater resources in Armenia is very high, though recent data on the quality of groundwater are not available. On most of the territory of Armenia, it is possible to use groundwater for drinking needs without additional treatment. Certainly, water quality in some springs deviates from chemical and biological standards; these springs cannot be used for drinking needs. About 25% of springs have high concentrations of nitrites, nitrates and fluorine compounds.

### ***Lakes***

There are more than 100 lakes on the territory of Armenia, some of which are without water during the dry season.

By size and economic significance, Lake Sevan and Lake Arpi are the most significant ones. The Hrazdan and Akhuryan Rivers originate from these two lakes. There are also lakes of smaller size and economic importance, with only local significance. Table 1.3.1 lists the main small lakes of Armenia.

**Table 1.3.1 Main Small Lakes of Armenia**

N	Name	River basin, mountainous range, use	Altitude above sea level (m)	Area (ha)	Capacity (thousand m <sup>3</sup> )	Maximum depth (m)
1	Kari	Kasakh, Aragats, water supply	3190	30.0	357	8
2	Akna	Hrazdan, Geghama, irrigation	3030	80.0	2500	15
3	Arnot	Vedi, Geghama, irrigation	2350	4.0	206	12.6
4	Gazana	Vokhchi, Zangezur, irrigation	3590	25.0	360	10
5	Kaputan	Vokhchi, Zangezur, irrigation	3300	10.0	1500	22
7	Sev	Vorotan, Syunik, irrigation	2666	200.0	9000	7.5
8	Metsamor	Metsamor, Ararat valley, irrigation	860	30.0	310	9.4

Source: Ministry of Nature Protection of the Republic of Armenia

### **Water use**

According to data for 2002, the total water abstraction in Armenia was 1735.5 mln.m<sup>3</sup>, (on average, 580 l/ capita/day).

**Table 1.3.2 Water Abstraction in Armenia, in 1990 and from 1993 to 2002, mln.m<sup>3</sup>**

Year	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total water abstraction	3942	3198	2983	2531	227	1850	1994	1966	1871	1726	1735,5
From groundwater resources	1252	1121	1042	851	816	520	530	536	533	530	475
Total water use	3497	2089	1943	1478	1377	1683	1800	1172	1087	997	1312
By sector											
Irrigation and agriculture	2362	1252	1238	742	776	1343	1456	940	840	802	1115
Industry	501	286	237	209	165	120	120	75	83	94	87
Households	634	551	468	527	436	220	224	157	164	101	109

Data in the table are approximate.

Source: Ministry of Nature Protection of the Republic of Armenia.

Most of the water used in the Republic is for irrigation. The distribution of water use by sectors from 1990 to 2002 is shown in Table 1.3.2.

Until 1990, average annual water use in the Republic was 3.5 - 4 million m<sup>3</sup>. During the last decade, water use ranged from 1.5 to 2 billion m<sup>3</sup>, due to the reduction in irrigated areas and in industrial production.

After 1990, water abstraction for economic needs by mechanical pumps was reduced due to the energy crisis and the rise in electricity prices. Recently, there has been a trend to shift to gravity flow methods.

From 1999-2001, the Ministry of Nature Protection with the support of the World Bank implemented the Water Resource Management Planning Program, with the aim to systematize

the sphere of water resource management. Within the framework of this program, water resources of the republic were estimated and fundamentals of water policy were developed.

In 2002, a new Water Code of the Republic of Armenia was developed and adopted. Based on this Code, in 2002 the National Council on Water was established under the Prime Minister. The National Council on Water is considered the highest consultative body on issues of water resource management. Within this Council, a Commission on Settling Disputes on Water Use was established.

The establishment of basin management bodies is among main concepts of the new Water Code. In 2003, under a resolution of the Prime Minister of the Republic of Armenia, five water basin management bodies were established. These are the first such bodies in the South Caucasus. The establishment of basin management bodies will promote the rational use and integrated management of water resources.

In October 2002, under a resolution of the Prime Minister, the Commission on Transboundary Water Resources of the Republic of Armenia was established: its activities will promote the improvement of transboundary water resource protection and management.

For the effective management of water resources and their protection, as well as for the implementation of the new Water Code of RA, about 30 norms and methodological acts have been developed and adopted by the Government of the Republic of Armenia. They systematize the process of issuing permits for water use, the register of water resources, as well as the protection and use of water bodies, including natural monuments and others.

Untreated or insufficiently treated sewage is the main cause of the pollution of water bodies. In Soviet times, the level of pollution in Armenia's rivers was quite high, which led to worsening water quality. At present, data on the pollution levels of surface water of Armenia are not precise. The analysis of the scarce data available shows that an improvement of water quality in rivers in recent years, due to the decrease in the volume of irrigation as well as the fact that the majority of industrial enterprises have ceased to operate. At present, within the framework of the limited monitoring activities implemented, it can be assumed that the quality of surface water is sufficient, except for flows from Yerevan and other large cities. It should be mentioned also that without proper attention during the large-scale recovery of industrial activity, water quality could deteriorate. The problem is aggravated by the fact that none of the 19 existing waste water treatment plants in the Republic of Armenia functions. This is partly due to the earthquake in 1998, as well as the energy crisis at the beginning of the 1990s. According to technical and economic calculations, of the 19 waste water treatment plants it is possible to restore only 6 or 7. The other need to be reconstructed using modern treatment technologies.

In Armenia, all cities and about 20% of rural settlements have sewage systems.

All waste water treatment plants in the Republic were constructed before 1990. The technologies applied in the plants are not efficient and do not meet modern requirements. Moreover, the treatment technologies used were based on practically free energy (both natural gas and electricity). Under present conditions, their use is extremely expensive and the use of existing water treatment facilities cannot be justified.

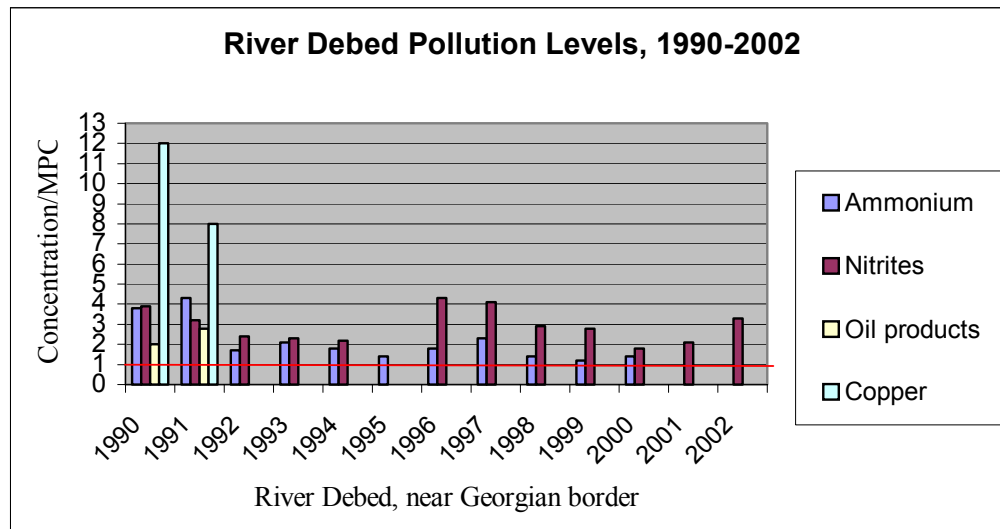
There is a need for major investments to restore water treatment facilities or construct new ones.

The Environmental Monitoring Center of the Ministry of Nature Protection monitors the quality of water bodies in the republic.

The monitoring of surface water pollution includes regular observations made by hydrological and hydrochemical stations, study of the chemical composition of the water in rivers, lakes and reservoirs, considering pollution from industrial, household and other sources, as well as analysis and assessment of pollution levels.

The water monitoring system was established in 1964. Until 1990, monitoring was carried out in 54 water bodies. There were 111 observation sites. Since 1994, the number of observation sites has increased to 131, however it should be mentioned that monitoring of surface water is not systematic. Thus, in 2002 observations were carried out only in 34 water bodies at 81 observation sites.

From 1984 to 1990, surface water samples were taken from the transboundary rivers Debed, Aghstev, Araks and Vokhchi. Figure 1.3.1 below presents situation in the Debed river, where ammonium, nitrates, copper and oil products were in excess of MPC.



**Figure 1.3.1**

Source: "Environmental Impact Monitoring Center" State Non-Commercial Organization of the Ministry of Nature Protection of RA