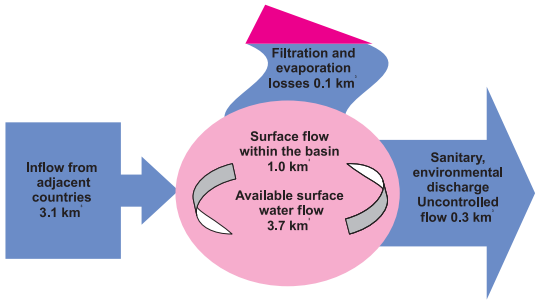
Shu-Talas River Basin

Surface flow from adjacent territories is 3.1 km^3, or half of the total water reserves. Taking into account the balance of the rivers Shu, Talas, and Asa, 3/4 of their flow come to Kazakhstan from the Kyrgyz Republic and only 1/4 (1.0 km^3) forms in the territory of Kazakhstan. Losses caused by evaporation and filtration are at 0.1 km^3, only sanitary and environmental discharges comprise 0.3 km^3, which means that water is not used efficiently in the basin. This can be explained by the proximity of the irrigated lands of Zhambyl Oblast to the border of Kyrgyzstan. Water provision to the industries of the region depends on relations between the Republic of Kazakhstan and the Kyrgyz Republic.

Figure 9. Shu-Talas Basin

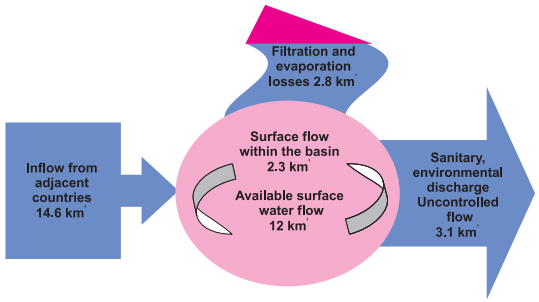


Source: *Water Resources Committee of RK, 2002*

Aral-Syrdarya Basin

The volume of water coming from the adjacent territories is 14.6 km^3, comprising 66.5% of the basin water reserve. 3.3 km^3 of water forms in the basin. Losses caused by evaporation and filtration amount to 3.8 km^3, and necessary sanitary and environmental discharges amount to 3.1 km^3. The available water resources are 12 km^3.

Figure 10. Aral-Syrdarya Basin



Source: *Water Resources Committee of RK, 2002*

1.1.7. Prospective Hydro-Economic Balances

To substantiate the concept of development and implementation of the national strategy of improvement of hydro-economic sector, and of the whole economy of the country, evaluation of prospective and probable hydro-economic balances is critical.

Recent and probable hydro-economic balances of the Republic of Kazakhstan are given in the tables /Appendix 6/ and provide a clear picture of water resource distribution and water deficit, which affect the economy and environmental conditions of the country.

Based on data of the national hydro-meteorological services of Central Asia Region (CAR), during recent decades there has been a tendency of ambient temperature increase in winter and summer periods, resulting in decreased snow reserves and degradation of glaciers. In particular, the glaciers of the Pamir and Altai ranges lost 19% of their ice reserves from 1957 to 1980, and this process is intensifying. During this period, the area of the glaciers of Trans-Ili Alatau and Jungar Alatau decreased threefold. This signifies that changing climatic conditions in the region may cause depletion of water resources. At the same time, all CAR countries demonstrate inefficient and uneconomic consumption of water, which exceeds the average parameters of water consumption in developed countries by several times. However, every state makes certain plans and forecasts for water consumption increase, primarily for agricultural development and utility and housing needs. Increase of water consumption in future without large-scale and efficient measures aimed at water conservation will result in the growth of water resources deficit, with significant potential economic repercussions for all CAR countries. Without adequate measures, a permanently growing water deficit will cause deterioration of the quality of water.

The evaluation of prospects of water consumption in Kazakhstan, Turkmenistan and Uzbekistan, which are in the lower part of the river basins, shows that in the nearest future implementation of water saving measures should become of high importance to satisfy a still growing demand for water.

The Kyrgyz Republic and the Republic of Tajikistan, located in the zone of formation of the main flow of the transbondary rivers - and therefore the most water-rich among the CAR countries - predict growing water consumption and therefore propose to initiate negotiations on the revision of the principles and mechanisms of distribution of water between Central Asia countries, making reference to the resolution of the Heads of the State of Central Asia of 1994.

Further, it should be taken into account that in future Afghanistan might increase its share of water for social and economic development of the northern part of the country. This may significantly change the flow of the Pyandzh River and the Amudarya River completely, causing water distribution problems across the region.

The threat of increased water intake by China from the rivers Ili and Irtysh is an additional risk factor in respect to the national security. The problem of Kazakhstan's and China's current consumption of water resources of their shared cross-border rivers might become one of the most critical issues in relations between these two countries and other Central Asia states.

Recent trends in terms of climate change, economic development and the demographic situation in Central Asia suggest that an acute water supply problem looms for Kazakhstan in the near future.

1.2. Water Use and Protection

1.2.1. Water Use Practices

Recently, average annual water consumption by industries of the Republic of Kazakhstan decreased from 35 to 20 km^3 due to unfavorable fluctuations of water availability and structural changes in the country. Some 85% of water is supplied from surface water sources, the remaining part is supplied from ground, marine and sewage waters. The main volume of water resources (about 78%) is consumed by agriculture.

Table 3. Average Water Use Indicators, %

Republic of Kazakhstan	Water consumption, %				
	Total	Utilities	Industry	Agriculture	Other
	100	5.0	16.0	78.0	1.0

Source: *Water Resources Committee of MoA RK, 2002*

Since 1990, consumption of water from natural sources has been decreasing, with a concurrent reduction of consumption of water for agricultural, industrial, domestic and utility needs. Due to the current economic situation and reductions in irrigated area, water intake for agricultural purposes has decreased by twofold. Currently, about 15 km^3 of water is used for irrigation (regular and estuary) based on the surface flow of the rivers Syrdarya, Ili, Shu, Talas and Irtysh.

Reduced water consumption volumes are characteristic of industrial sectors where water consumption in 2000 decreased to 2.2 km^3 compared to 4.8 km^3 in 1992. The bulk of the water is consumed by heat energy, non-ferrous metallurgy and petroleum operations.

Ground waters are used mainly for domestic and utility purposes and comprise an insignificant part of the total volume of water consumption (only 3-5% of the total volume).

Table 4. Ground Water Use Pattern, %

Domestic	-	66
Industrial	-	23
Regular irrigation	-	4
Inundation of pastures	-	7

Source: *Water Resources Committee of Ministry of Agriculture of Republic of Kazakhstan, 2002*

1.2.2. Water Use by Sectors of Economy

The major groups of water consumers in the Republic of Kazakhstan include: agriculture, industry and utility and housing facilities. The general tendency for all these is decreasing water consumption in comparison to the beginning of the 1990's, when total water intake in the Republic amounted to 30-35 km^3 per year. In recent years the volume of water used has averaged 20 km^3 per year, and this is likely to increase.

Data for 1997-2002 provided by the Committee for Water Resources of the Republic of Kazakhstan /60/ in respect to water resource consumption by the major groups of water consumers show the following:

The volume of water intake from natural water objects in 2002 comprised 20.07 km^3, which is more than in 2001 by 0.11 km^3. This increase is related to higher water intake for domestic and industrial purposes. In comparison to 2001 water intake decreased in Almaty, Pavlodar and South Kazakhstan oblasts by 296, 104 and 218 million m^3 respectively, due to decreased water consumption in irrigation and consumption of technical water at TETs-1 and TETs-2 in Pavlodar, and the Ekibastuz TETs.

The total water intake of 20.07 km^3 includes: fresh water from natural water objects – 19.3 km^3 (surface water 18.08 km^3 and ground water 1.18 km^3), seawater – 0.64 km^3. In addition, the figures include 0.15 km^3 of recycled sewage water and 0.03 km^3 of collected drainage water.

Water intake according to purpose comprises, in km^3:

- Production needs – 3.97;
- Domestic needs – 0.87;
- Agricultural needs – 14.67; and
- Fishery and other needs – 0.55.

Actual water consumption in the Republic as a whole is 15.1 km^3, including fresh water – 14.3 km^3, seawater – 0.63 km^3, treated sewage and collected drainage water – 0.18 km^3. Based on the previous year, consumption of fresh water increased by 0.35 km^3, i.e. by 3%, but compared to 1991 water consumption has decreased by 50%.

In comparison to 2001, water disposal increased by 0.90 km^3 and in 2002 comprised 5.61 km^3. In 2001, 3.45 km^3 of sewage, mine and collected drainage water were discharged into natural water bodies, while 0.76 km^3 was discharged into reservoirs and 1.4 million m^3 went underground.

In comparison with the year 2001, the volume of water in the recycled water supply increased by 0.32 km^3 and totaled 5.16 km^3 for the Republic as a whole.

Water Consumption for Domestic Purposes

Satisfaction of the population's water needs in potable and domestic supply is a water consumption priority, though potable water in the general water consumption structure is less than 5%.

In 2002 water consumption for domestic purposes of cities, workers' camps and industrial enterprises increased by 3% compared with 2001 and stood at 0.61 km^3. It is currently expected that average water consumption for domestic purposes will increase in the Republic by 4% per year. Together with the general increase in water consumption in the domestic sector, there is a tendency of increasing per capita water consumption in Kazakhstan.

Public utilities annually discharge about 0.14 km^3 of sewage water into natural water bodies, of which only 0.05 km^3 are treated to comply with minimum standards. This situation is aggravated by the fact that a significant volume of industrial waste water (in some cities up to 24%) is discharged into treatment facilities which are not designed to treat such waste water.

Water Consumption for Industrial Purposes

Kazakhstan's industrial water consumption averages about 5 km^3/year - the intake being 5.8-7.8 km^3/year. The enterprises of heat energy, non-ferrous metallurgy and the petroleum industry are the main industrial consumers. In recent years, overall industrial water consumption decreased by up to 4 km^3/year, due to decreases in production.

In 2002, water consumption for industrial purposes comprised 3.69 km^3 or 18% of total water consumption. In addition, intake from surface and other sources amounted to 3.97 km^3. In general, water consumption for industrial purposes in comparison to 2001, increased by 0.8%.

There are prospects for decreases in industrial water consumption per production unit due to the implementation of systems for recycling and repeated-consecutive water supply.

Water Consumption for Agricultural Purposes

Agriculture is the main water consumer in the Republic, with regular surface flow irrigation being the main user. Water consumption for irrigation purposes in the Republic decreased from 21.5 km^3/year in 1990 to 17.8 km^3/year in 1995, with irrigated areas decreasing from 2.3 and 1.9 million hectares over the same period. In 2002, total water consumption for agricultural purposes comprised 14.68 km^3, including 14.47 km^3 of non-recoverable use. This includes:

a) Water consumption for regular irrigation	9.90 km^3
b) Water consumption for estuary irrigation	0.50 km^3
c) Water consumption for watering hay fields in river flood lands	3.91 km^3
d) Water consumption for agricultural water supply	0.18 km^3
e) Water consumption for watering pasture lands	0.12 km^3
f) Maintaining aquifers	0.07 km^3

Thus, 14.31 km^3 or 97% of total water consumption is for irrigation (regular and estuary, including watering hay lands).

Low water consumption for agricultural purposes in 2002 is explained by high spring rainfall, reducing farms' demands for irrigation water. In addition, the actual area of irrigated agricultural land decreased from 2001-2002. The area of regular irrigated land fell by 52,000 ha - mainly in Almaty oblast (by 18,100 ha) and Zhambyl oblast (by 33,600 ha) and comprised 1.22 million ha overall; lands of engineering-liman irrigation and inundated hay lands reduced by 16,200 ha, and comprised 580,600 ha; the area of inundated grazing lands decreased by 10 million ha to stand at 94.8 million ha.

Use of Water for Hydropower

Unlike water consumers - irrigated farming, industrial-domestic and agricultural water supply - the hydro-electric power industry is a water consumer that uses the power of water by building reservoirs, dams or derivative hydraulic facilities. At the same time hydro-electric power stations (HEPS) use recoverable water resources of the rivers without polluting them with industrial wastes.

The hydraulic potential of the Republic of Kazakhstan is about 170 billion kWh per year, with the technological potential being 62 billion kWh per year; and economic potential being 27 billion kWh. At present, of the total potential, only 8 billion kWh per year are being consumed. Hydro-electric power resources are not evenly distributed in Kazakhstan. The majority of these resources are concentrated in three regions:

1. **Eastern Zone,** in the basin of the Irtysh River including its tributaries Bukhtarma, Uba, Ulba, Kurchum, Kaldzhir, Kenderlyk and Uidene.
2. **Southeast Zone,** in the basin of the Ili River including its tributaries flowing from the Trans-Ili Alatau Mountains (Kaskelen, Aksai, Turgen, Chilik, Charyn) and in the basin of the eastern Balkhash and the group of Alakol lakes fed by rivers flowing from the Jungar Alatau Mountains (Koksu, Karatal, Aksu, Lepsy and Tentek).
3. **Southern Zone,** in the basins of the rivers Syrdarya, Talas and Chu.

Table 5. Use of Hydro-electric resources in Kazakhstan

#	Regions	Potential hydropower resources, billion kWh	Including technically available for use	Power generated in 2000,billion kWh
1	Almaty region	30.5	11.3	1.2
2	Taldykorgan region	37.0	16.0	0.3
	Total: South-East	**67.5**	**27.3**	**1.5**
3	East Kazakhstan Oblast	50.0	20.0	5.2
4	Zhambyl Oblast	7.7	2.4	0.01
5	South Kazakhstan Oblast	10.7	2.8	0.5
6	Other oblasts	34.0	2.0	0.1
	TOTAL:	**170**	**54.5**	**7.31**

Source: Kazgidroproyekt, 2003

Despite Kazakhstan's significant hydro-electric potential, the share of HEPS in energy generation is only 15%. At present, Kazakhstan has five big HEPS with total installing capacity of 2,154 MW and generating output of 7,050 million kWh, as well as 68 small HEPS with total installed load of 78 MW and average annual power generation of 360 million kWh.

From the environmental point of view the construction of hydropower stations has both positive and negative impacts.

Positive impacts:

- A permanent recoverable source of power - the river flow;
- Use of resulting water reservoirs as fisheries;
- Use of the water reservoirs and their coastal zones for recreation and tourism;
- Water reservoirs create conditions for rest and nesting of migratory birds;
- No pollution
- Creation of water reservoirs can protect lowlands from the destructive impact of floods.

Negative impacts:

- Change of the regime of river flows on a multi-year and seasonal basis, i.e. change of natural regime of the river;
- Creation of artificial obstacles to the migration of fish by constructing water lifting and water reservoir dams;
- Downstream death and destruction of young fish and fish eggs during water level fluctuations in water reservoirs;
- Withdrawal of lands (agricultural, forest, etc.) to create water reservoirs;
- Inundation of lands, their swamping and change of flora in the coastal zone when creating water reservoirs;
- Relocation of people and removal of engineering lines from the flood zone and inundation of water reservoirs;
- Destruction of flora in the zone of water reservoir inundation
- Possible change of the microclimate in the coastal zone.

These negative impacts relate only to large hydro-electric power stations with water reservoirs. Small hydropower stations do not have these shortcomings and have insignificant impact upon the environment.

Currently attention should be paid to the condition of the HEPS facilities operating on the rivers. Inspection of existing HEPS on the rivers Irtysh, Ili, Syrdarya and other stations shows that these stations have serious faults and defects caused by improper operation (Shardary, Shulba and other hydropower stations), which might result in emergency situations. In particular, the Shulba Station was not commissioned into operation since construction was not completed (fitting out of the building of the hydropower station, the navigable lock; hydraulic equipment (6 units) are in temporary operation). At the same time proceeds from the sale of electrical power can be used to complete the construction and to build a counter regulator at the Shulba Hydropower Station.

The Shardary Hydropower Station was commissioned into operation in 1967 and has a state ownership. Its hydraulic facilities and equipment are in 'pre-emergency' condition:

- The equipment has worn out during its operation and needs to be replaced;
- The dam is exposed to intensive filtration (gryphons); and
- The throughput capacity of the Kyzylkum regulator has decreased from 200 m^3/sec to 90 m^3/sec- during excessive consumption vibration of the gates can be observed.

There should be efficient mechanisms of state control over the hydro-power industry's status, primarily over the condition and operation of the major hydropower stations which have been transferred into concession.

Issues of interstate cooperation between Kazakhstan, Kyrgyzstan and Uzbekistan in terms of use of water and power resources of transboundary rivers are still pending. Such lack of cooperation can result in crisis situations that can be environmentally and economically damaging to the countries concerned.

The economic development of Kazakhstan will cause inevitable urbanization and growth of peak loads, which may require further development of the hydro-electric power industry and construction of major hydropower stations. Development of agricultural production - due to increases in the number of farms and expansion of small processing businesses – will require independent power generating sources, which may be hydropower stations.

Pursuant to the strategy of industrial development and power consumption forecasts for the period until 2030, it is planned to build a major HEPS with a total capacity of 468 MW; the projected hydro potential of Kazakhstan's small rivers is about 2,400 MW. Almaty and South Kazakhstan oblasts offer the greatest potential in the development of small hydropower stations; however, they currently import electrical energy from other regions.

It is expected that strengthening of the position of small business and implementation of the program for development of rural areas will stimulate development of small hydropower stations.

1.2.3. Water Use Efficiency

In spite of the significant reduction of water consumption in the Republic of Kazakhstan, it should be acknowledged that the level of *efficiency* of water use is not sufficient in all water consuming industries and in irrigated farming in particular. The main unrecoverable losses of water occur within the irrigation network and in the fields; they exceed 40% of water supplied to Kazakhstan's farms.

Total water consumption for irrigation purposes in the basin of the Aral Sea, including the Republic of Kazakhstan, is about 12,000 m^3/ha. It should be noted that Israel - an international leader in irrigation technologies - in similar climatic conditions consumes less than half of this volume for irrigation purposes /63/.

Inefficiency of water consumption is observed in other groups of water consumers, including systems supplying water to populated areas. The system of water supply operating in the country does not meet requirements of reliable water supply and potable water quality. Water losses in the centralized water supply systems are also considerable - due to their poor condition - and account for some 20-30% of the total volume of water supplied.

The industrial sector suffers from degradation of the technical condition of its systems of recycled and repeated water supply, increased spillage from the trunk water pipeline and distributing network. The main reason is lack of financing for maintenance of water supply systems.

1.2.4. Surface Water Quality

Water quality in almost all Kazakhstan's water objects remains unsatisfactory, in spite of decreases in production and volumes of wastewater discharge. The principal pollutants occur in wastewater from chemical industries, petroleum processing, and machine building industries and non-ferrous metallurgy. The main damage to the environment, and in particular to water reservoirs, is caused by polluted wastewater discharged without prior treatment.

One of the hydrological features of Kazakhstan is that it has flow transit and dispersal zones, as well as delta zones of major river basins (Syrdarya, Ili, Ural and Irtysh rivers).

As the flow of practically all Kazakhstan's rivers is regulated, the regime of flow formation on river sections below water reservoirs is altered significantly. As a result of the impact of the rivers and the areas of catchment and intensive water consumption, there are changes to the hydrological regime and water quality in the transit and dispersal zones. This mutual impact is characterized by intensive water intake from the rivers for industrial and irrigation purposes and discharge back into the rivers of wastes containing salt, chemicals and other pollutants.

Described below are the characteristics of surface water quality in the main water objects of Kazakhstan, based on data provided by RSE KazGidroMet Environment Pollution Monitoring Center / 57,70,71/.

Aral-Syrdarya Basin

The level of nitrite pollution of the surface water of the basin remains high. In 2001 nitrites exceeded the maximum permissible concentration (MPC) by in 46% of tested samples, and the maximum level of pollution reached 27 MPCs.

The chemical composition of the Syrdarya River forms within the Republic of Uzbekistan. The water enters Kazakhstan (Kokbulak border post) with an average content of nitrite nitrogen of about 4 MPCs. Maximum concentration – 16 MPCs, the average content of copper reaches 4 MPCs, phenols – 3 MPCs, sulfates – 6.5 MPCs. The maximum level of pollution is observed in spring when the content of pollutants reaches: copper and nitrites 3 MPCs, sulfates – 7 MPCs, phenols – 6 MPCs, petroleum products – 4 MPCs. The water of the Shardary Water Reservoir is polluted mainly with sulfates, nitrites, phenol and copper.

The main tributaries of the Syrdarya River are also significantly polluted. The Keles River is characterized by a value of WPI (Water Pollution Index) corresponding to quality class 3, i.e. 'moderate pollution'. The principal pollutants are sulfates, copper, phenols, the content of which varies from 2 to 11 MPCs. The Arys River is polluted moderately (sulfates, copper, phenols and nitrites). The level of pollution of the Badam River is characterized by a WPI value of quality class 3, with the average concentration of sulfates, copper, phenols, nitrites and petroleum products exceeding MPC by 2-5 times.

Irtysh Basin

The level of heavy metal pollution of the surface water of the basin remains high. In 2001 levels of copper exceeded MPC in 99.6% of samples, zinc in 57% of samples, with the content of zinc and copper exceeded 10 MPCs. The water quality class is level 4, i.e. the water is 'highly polluted'.

Water Pollution Index in the area of the village of Buran is 1.02, quality class is 3 – "moderately polluted" water. Down river in the city of Ust-Kamenogorsk the level of pollution due to wastewater discharges from the East Kazakhstan industrial complex increases significantly. The gate "0.5 km below TMC" located below the junction of the Irtysh River and the Ulba River is the most polluted. In addition to the polluted Ulba River, the quality of surface water in this area is affected by wastewater from the treatment facilities of the right bank of the Irtysh.

The quality of the surface water of the Irtysh between the villages of Glubokoye and Predgornoye is affected by two right tributaries: the Glubochanka River and the Krasnoyarka River. These waters are polluted by discharges from the Belousovsk, Irtysh and Berezovsk mines and transit waters from the above-situated sources of pollution in Ust-Kamenogorsk. The average annual concentration of copper and zinc in these rivers amounts to 40-50 MPCs, with maximum concentrations often exceeding 100 MPCs.

In the end gate of the village of Borovskoye, the pollution index for the Irtysh River equals 1.14, corresponding to "moderate pollution".

Ural-Caspian Basin

The principal pollutants of the surface waters of the basin are boron and organic substances. The content of nitrites, phenols and copper is 80%, 49% and 22% respectively in the selected samples.

The water of the Ural River is polluted on the territory of the Russian Federation. Within Kazakhstan, wastewater discharges into the riverbed are not observed.

The Ilek River remains the most polluted water body in the basin. The content of boron and chromium in the river is caused by the tailing ponds of the former Alga chemical plant and AZKhS JSC, via ground water. In the gate of Alga "0.5 km below ground water discharge" the content of boron in the water varies from 35 to 129 MPCs. Within the city of Aktobe the content of boron equals 13.8 MPCs, phenols – 1 MPCs, nitrite nitrogen – 1.2 MPCs, chromium – 6.9 MPCs. The quality class of water in the Ilek River changes from 4 – "polluted water" to 6 – "very polluted water".

Balkhash-Alakol Basin

The principal pollutants of the surface water of the basin of the Ili River are petroleum products, the content of which in 83% of tested samples exceeded MPC (on the average 2.5 MPCs). According to the pollution index the basin is characterized as moderately polluted.

The chemical composition of the Ili River in Kazakhstan is created by pollutants from the People's Republic of China and the polluted surface flow and washout from agricultural lands adjacent to the basin. Within the area of the Dubun berth the concentration of copper reached 21.4 MPCs (maximum value – 181 MPCs), the content of phenols, zinc and petroleum products in the water was 1-3 MPCs. In this area the water of the river is estimated as 'dirty'. Down river the concentration of copper is a little lower. In the gate below the Kapshagai Hydropower Station the quality of water hardly changes and corresponds to class 4 on the WPI, i.e. "polluted water".

The principal pollutants of Balkhash Lake are heavy metals: copper and zinc, and petroleum products, phenols and fluorides. The content of copper exceeded MPC in all samples selected in Maly Sary-Shagan Bay and Bertys Bay.

Nura-Sarysu Basin

The area of the basin is characterized by a low level of water supply. Due to regulation of the lower part of the flow, it forms based on wastewater discharge from industrial enterprises.

The major polluted tributary of the Nura is the Sherubainura River. The rivers of this basin are characterized by nitrite pollution. The number of samples in which the content of nitrites exceeds MPC comprises 56%, nitrogen ammonia and copper – 50%, phenols and petroleum products – 67%, fluorides – 80%, zinc – 58%.

The quality of water in the basin is estimated to correspond to WPI class 4 – "polluted water"

Ishim and Tobol-Torgai Basin

In comparison with other basins, the level of pollution of the surface waters of the basins of the rivers Ishim and Tobol is significantly lower, and water quality class corresponds to "moderate pollution".

Data given in Table 6 shows that recently in the territory of Kazakhstan WPI of the surface waters within the areas impacted by cities and industrial centers has in general decreased. However, increased WPI for some rivers (Krasnoyarka River, Ishim River and others) is observed.

Based on monitoring of the surface waters of Kazakhstan conducted by the subdivisions of RSE KazGidroMet in the 1st quarter of 2003, the most polluted is the basin of the Irtysh River. The most polluted rivers of the East Kazakhstan Oblast are: Breksa, Tikhaya, Glubochanka and Krasnoyarka. The content of nitrogen ammonia exceeds MPC by 2.29 times, copper – 3.1-25.7 times, zinc – 17.5-40.1 MPC, petroleum products – up to 2.4 times and manganese – up to 8.6 MPC.

Table 6 /57/. Levels of Pollution of the Surface Water in Cities and Industrial Centers of Kazakhstan

Name of control station	WPI*		
	1997	2000	2001
Ural River, the city of Uralsk	2.96	1.28	1.76
Ilek River, the city of Aktobe	7.38	4.19	4.00
Ilek River, the city of Alga	4.86	5.81	4.98
Syrdarya River, the city of Kyzylorda		1.70	1.26
Badam River, the city of Shymkent	2.68	2.20	2.98
Shardary Water Reservoir	2.93	1.94	1.40
Talas River, the city of Taraz	1.38	0.88	1.24
Malaya Almatinka River, the city of Almaty	2.90	1.68	2.44
Bolshaya Almatinka River, the city of Almaty	1.95	0.81	1.78
Balkhash Lake, Tarangalyk Bay	2.38	3.70	3.96
Balkhash Lake, M. Sary-Shagan Bay	2.56	4.83	4.52
Samarkand Water Reservoir	3.35	2.64	2.65
Nura River, the city of Temirtau	4.38	4.12	2.90
Sherubainura River – Estuary	3.94	10.45	3.53
Kara-Kengir River, the city of Zhezkazgan	-	5.95	6.42
Kengir Water Reservoir	-	4.50	3.39
Irtysh River, the city of Ust-Kamenogorsk	1.43	1.57	1.54
Irtysh River, the city of Pavlodar	-	1.51	1.02
Irtysh River, the city of Aksu	-	1.17	1.14
Bukhtarma River, the city of Zyryanovsk	1.47	1.57	1.77
Ulba River, Tishinsky Mine	8.64	4.67	4.92
Ulba River, the city of Ust-Kamenogorsk	3.36	1.98	1.97
Tikhaya River, the city of Leninogorsk	9.46	5.80	5.00
Breksa River, the city of Leninogorsk	12.60	4.18	6.72
Krasnoyarka River, the village of Predgornoye	3.33	7.60	7.13
Ulba River, the city of Shemonaikha	1.49	1.36	1.36
Ishim River, the city of Astana	1.32	1.22	1.51
Ishim River, the city of Petropavlovsk	1.46	0.60	0.36
Tobol River, the city of Kostanai	0.49	2.17	0.79

**WPI – Water Pollution Index; Please see Technical Note*
Source: State Water Cadastre of the Republic of Kazakhstan. Annual data on surface water quality. 1999-2001. Almaty

1.2.5. Ground Water Quality

Based on data of the ground water monitoring service, about 700 potential sources of pollution have been discovered within the Republic /60/. These are industrial enterprises, solid and liquid wastes storages, stock breeding complexes, tailing ponds of industrial and agricultural facilities, irrigated farm lands, treated industrial wastes, urban agglomerations, oil fields and oil refineries, etc. Based on audit

data, only 477 enterprises of the Republic had 762 industrial wastes collectors. However, not all enterprises with such collectors were covered by the audit. Unfortunately, more recently there has been no opportunity to make a comprehensive description of the amount of discharge and waste and the qualitative and quantitative composition of pollutants. Nevertheless it has been established that 241 enterprises in the Republic are polluters of surface waters, and at 158 sites pollution has been detected by regular observation, and on 83 sites by single samples.

The principal sources of pollution in the Republic are industrial and agricultural facilities, and to a lesser extent, utilities.

The highest number of polluted sites and areas were revealed in Almaty Oblast (40), Karaganda Oblast (33), and East Kazakhstan Oblast (22). Of the areas with polluted ground water, the majority (over 200), are characterized by higher salinity, water hardness, plus concentration of sulfates and chlorides exceeding MPC. Some 75 sites are characterized by the presence of nitrogen compounds in the ground water, 59 with heavy metals, 41 with phenols and 28 with organic compounds.

According to the degree of hazard caused by pollutants, ground water pollution at 127 sites can be described as dangerous and at 63 sites as moderately dangerous. There are 48 sites with highly dangerous groundwater pollution levels, while these levels are described as 'extremely' dangerous at three sites.

Throughout the country there are 272 water intakes in zones of ground water pollution, 92 of which are part of the regular observation network. Ground water pollution at other water intake sites was established by random observation. In most cases ground water pollution at water intake sites is connected with economic activities, and at 44 intakes it is determined by natural factors. 143 water intakes are characterized by high salinity of ground water, hardness, content of chlorides and sulfates. In a number of intakes ground waters are polluted by heavy metals (Aktobe Oblast – 12 water intakes, East Kazakhstan – 15 water intakes, Kostanai Oblast – 17 water intakes). The maximum number of water intakes in zones of ground water pollution is in Karaganda Oblast – 77, East Kazakhstan Oblast – 28, North Kazakhstan Oblast – 25. At 180 water intakes where single observations revealed ground water pollution a regular observation network was required.

1.2.6. Water Resources Monitoring and Control in Kazakhstan

State management of hydro-meteorological and environmental monitoring in the Republic of Kazakhstan is conducted by RSE KazGidroMet.

A network of hydrologic observation stations is designed to collect data on the condition of water bodies and water resources of the Republic of Kazakhstan. The placement of hydrologic observation stations is based on the principle of obtaining accurate parameters of the regime – level and annual flow. The number and density of observation stations are determined by natural-climatic conditions and needs of the economy.

Regular hydrological observations on the surface water facilities of the republic of Kazakhstan are conducted at 3 hydro-meteorological stations, 180 level stations, 23 lake stations and 3 marine stations. Rivers longer than 100 km are sufficiently covered by observation. Recently there has been a decline in the number of stations on rivers of lengths from 10 to 100 km. Operating hydro-meteorological stations are located mainly at the elevations up to 2,000 m, with some located higher.

Water quality observations are made based on hydro-chemical and hydro-biological parameters in 53 water bodies, 101 surface water control stations and 142 gates.

Water sample analyses are conducted in the network laboratories of the Environment Pollution Monitoring Center of KazGidroMet in accordance with approved methods.

The significant reduction in observation stations on water bodies requires the optimization of the surface water resources monitoring network. The priority task is restoration and organization of the network of hydrological observations on cross-border water bodies.

Groundwater monitoring in the Republic of Kazakhstan is conducted by the Committee for Geology and Subsoil Protection of the Ministry of Energy and Mineral Resources. The main concern is ground and low-pressure ground waters in the zone of active water exchange and waters of feasible aquifers.

On the territory of Kazakhstan there are 6,838 observation stations of State Ground Water Monitoring, including 3,152 observation stations related to the regional network, 3,621 related to the local network and 65 wells relating to the proprietary network. The existing observation stations, their location and equipment can not fully monitor and account for the current hydro-ecological situation in Kazakhstan and the extent of manmade impacts. The observation network is unevenly dispersed and in many cases is

concentrated in more developed areas, while the major oil and gas provinces and regions of ecological disaster remain unstudied.

One key specific feature of Kazakhstan's groundwater regime is the decreasing average multi-year value of pre-spring and spring maximum water levels. In most ground water reservoirs, after stabilization of the water level, resulted from decreased water intake, there has been a decrease in water levels caused by low water years. Changes in the salinity and chemical composition of ground waters are not reported.