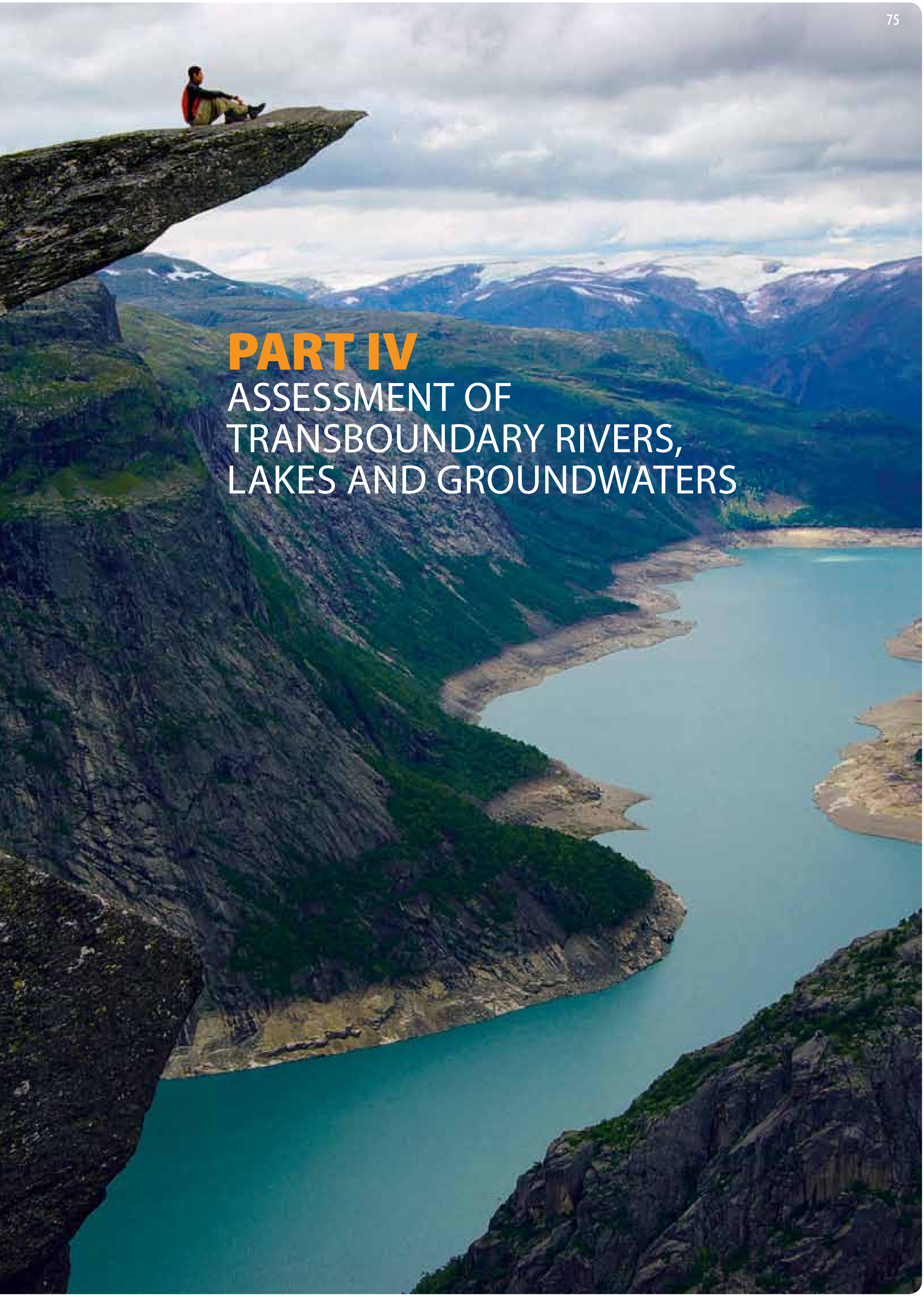


PART IV
ASSESSMENT OF TRANSBOUNDARY RIVERS, LAKES AND GROUNDWATERS

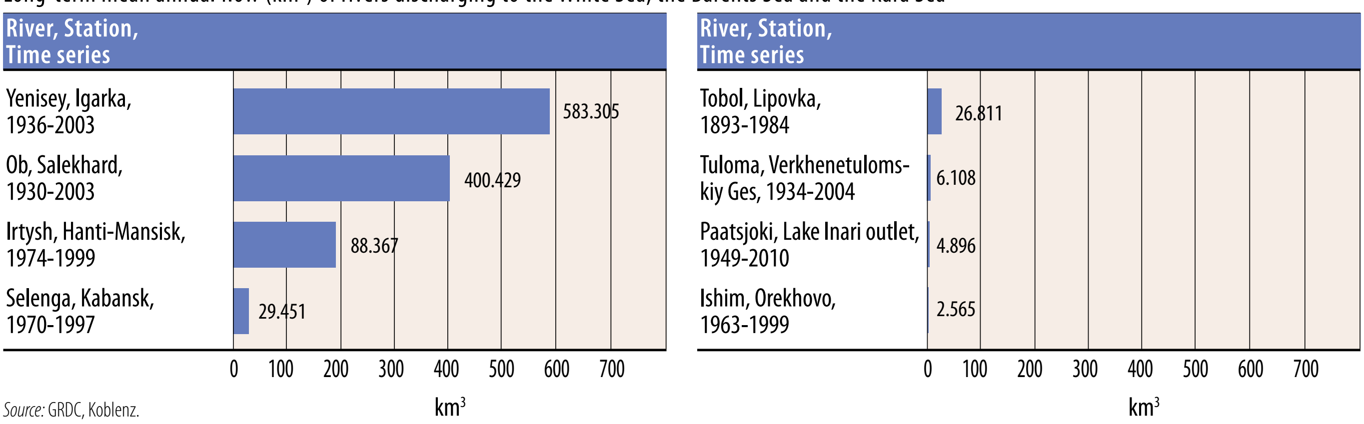
CHAPTER 1
DRAINAGE BASINS OF THE WHITE SEA, BARENTS SEA AND KARA SEA

This chapter deals with the assessment of transboundary rivers, lakes and groundwaters, as well as selected Ramsar Sites and other wetlands of transboundary importance, which are located in the basins of the White Sea, the Barents Sea and the Kara Sea.

Assessed transboundary waters in the drainage basins of the White Sea, the Barents Sea and the Kara Sea

Basin/sub-basin(s)	Recipient	Riparian countries	Lakes in the basin	Transboundary groundwaters within the basin	Ramsar Sites/wetlands of transboundary importance
Oulanka	White Sea	FI, RU			
Tuloma	Kola Fjord > Barents Sea	FI, RU			
Jakobselv	Barents Sea	NO, RU		Grense Jakobselv (NO, RU)	
Paatsjoki/Pasvik	Barents Sea	FI, NO, RU	Lake Inari	Pasvikeskeren (NO, RU)	Pasvik Nature Reserve (FI, NO, RU)
Näätämö/Neiden	Barents Sea	FI, NO, RU		Neiden (NO, FI)	
Teno/Tana	Barents Sea	FI, NO		Anarjokka, Karasjok, Levajok-Valjok, Tana Nord (NO, FI)	
Yenisey	Kara Sea	MN, RU			
- Selenga	Lake Baikal > Angara > Yenisey > Kara Sea	MN, RU			
Ob	Kara Sea	CN, KZ, MN, RU			
- Irtysh/Ertis	Ob	CN, KZ, MN, RU		Preirtysh (KZ, RU), Zaisk (CN, KZ)	
- - Tobol	Irtysh	KZ, RU		North-Kazakhstan aquifer (KZ, RU)	
- - Ishim/Esil	Irtysh	KZ, RU			Tobol-Ishim Forest-steppe (KZ, RU)

Long-term mean annual flow (km³) of rivers discharging to the White Sea, the Barents Sea and the Kara Sea



Source: GRDC, Koblenz.

OULANKA RIVER BASIN[1]

The basin of the 135-km long river Oulanka (67 km in the Russian Federation) is shared by Finland and the Russian Federation. The assessment covers the Oulanka River upstream of Lake Paanajärvi.

The Oulanka River originates in the municipality of Salla in Finland. The Kuusinki River, a transboundary tributary originating in Finland, joins it not far from Lake Paanajärvi on the Russian side.

Basin of the Oulanka River

Country	Area in the country (km²)	Country's share (%)
Finland	4 915	88
Russian Federation	651	12
Total[a]	**5 566**	

[a] The basin area is 5,566 km² to Lake Paanajärvi. The Oulanka is part of the Koutajoki water system, with a total basin area of 18,800 km² draining to the White Sea.
Source: Finnish Environment Institute.

Hydrology and hydrogeology

In the Finnish part of the basin, surface water resources are estimated at 744 × 10⁶ m³/year (average for the years 1991 to 2005) and groundwater resources at 20.3 × 10⁶ m³/year, adding up to a total of 764 × 10⁶ m³/year (or 132,000 m³/capita/year).

The flow of the Oulanka is not regulated. Spring flooding is common.

Pressures, status and responses

There is no significant human pressure in the Oulanka basin. The basin area is mainly covered by forests.

According to data from 2000 to 2007, the ecological state at the Oulankajoki station (Finland) was evaluated as high. Chemical water quality is also good. Water quantity and quality in the Oulanka are not monitored in the Russian Federation.

Trends

The status of the river at the border section is expected to remain high.

According to the Finnish Meteorological Institute, an average annual temperature increase of 2.1-2.4 °C and an average precipitation increase by 7% are predicted for 2020-2049 compared to 1971-2000. The number of snow-covered days is predicted to decrease by 30% in 2071-2100, as compared to 1961-1990. The possibility of heavy rain floods even in summer time will increase, especially in small river systems. Groundwater level may increase in winter and decline in summer.

TULOMA RIVER BASIN[2]

The basin of the river Tuloma is shared by Finland and the Russian Federation. The Tuloma has two transboundary tributaries, the Lutto[3] and Notta/Girvas, which flow to Lake Notozero (or Upper Tuloma Reservoir) in the Russian Federation. The sub-basins of the Petcha and of Lower Tuloma are entirely in Russian territory. The Tuloma flows from Lake Notozero to the Barents Sea through the Kola Fjord.

Basin of the Tuloma River

Country	Area in the country (km²)	Country's share (%)
Finland	3 285	16
Russian Federation	17 855	84
Total	**21 140**	

Sources: Finnish Environment Institute (SYKE), Scheme of complex use and protection of water resources, river basin Tuloma; OAO Scientific Research Institute of Hydraulics B.E. Vedeneeva, 2001.

Hydrology and hydrogeology

In the Finnish part of the Tuloma basin, surface water resources are estimated to amount to 668.6 × 10⁶ m³/year and groundwater resources to 5.99 × 10⁶ m³/year, overall representing 2.698 × 10⁶ m³/capita/year.

There are two reservoirs in the Russian part of the Tuloma basin, the Upper and Lower Tuloma reservoirs,[4] which are used for hydropower generation and also to reduce impact from severe floods that occur frequently.

There are only small, insignificant aquifers (of type 3) in uninhabited wilderness areas in Finland's eastern and northwest border areas shared with the Russian Federation. Links to surface waters are weak in general.

Pressures, status and responses

The basin area is mainly covered by forest, ranging from mixed forest to tundra vegetation. Protected areas make up 8.2% of the surface area of the Finnish part of the basin. In the territory of the Russian Federation, protected areas include Lapland State Biosphere Reserve (278 ha) and four natural reserves of federal and regional importance (total area 195 ha). The area hosts many rare plant species.

In the Finnish part, the human influence and transboundary impact is negligible.

In the Russian part, flooding affects road traffic between the border and the Kola Peninsula almost every year. In the Russian Federation, energy generation as a pressure factor is assessed as widespread but moderate. Five forestry districts, three agricultural enterprises and the Nerpa shipyard operate in the Russian part of the basin. Animal husbandry, fur farms and greenhouses in Tuloma village, as well as reindeer herding are activities with only local impact. In-

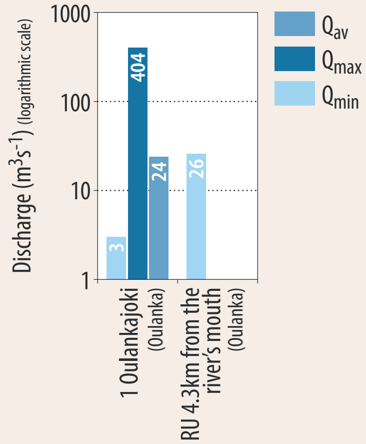
Total water withdrawal and withdrawals by sector in the Tuloma Basin

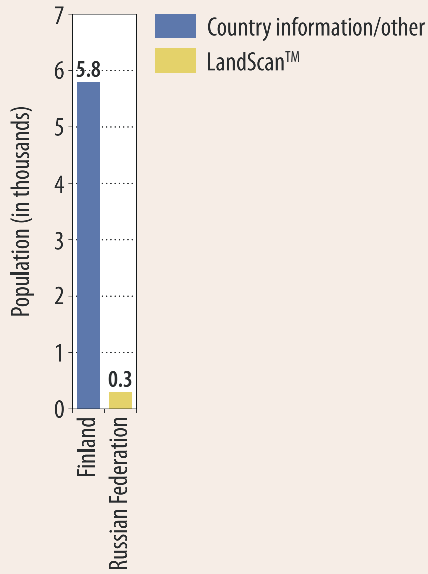
Country	Year	Total withdrawal ×10⁶ m³/year	Agricultural %	Domestic %	Industry %	Energy %	Other %
Finland		N/A	N/A	N/A	N/A	N/A	N/A
Russian Federation	2009	21.7[a]	0.4	79.5	20.1	[b]	-

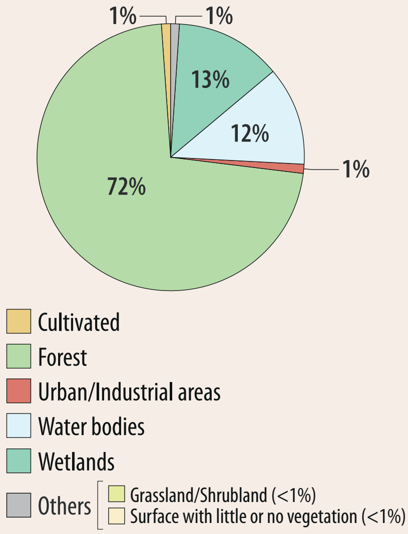
[a] Withdrawal for consumptive uses only.The biggest water user is the water supply company Murmanskvodokanal, which takes 78.4% of the withdrawal.
[b] Water withdrawal/diversion for electricity generation (non-comsumptive) is 15,137 × 10⁶ m³/year at Upper Tuloma hydropower station, and 11,668 ×10⁶ m³/year at Lower Tuloma hydropower station.

[1] Based on information provided by Finland and the Russian Federation, and the First Assessment.
[2] Based on information provided by Finland and the Russian Federation, and the First Assessment.
[3] The river is also referred to as Lotta. The Tuloma belongs to the Teno-Näätämö-Paatsjoki River Basin District.
[4] The Upper Tuloma Reservoir was built 1963–1965, with an installed capacity of 50 MW and a total volume of 11.52 × 10⁹ m³ (effective volume 3.86 × 10⁹ m³). The Lower Tuloma Reservoir was built in 1936 with an installed capacity of 228 MW and a total volume of 390 × 10⁶ m³ (effective volume 37.2 × 10⁶ m³).

DISCHARGES, POPULATION AND LAND COVER IN THE OULANKA RIVER BASIN

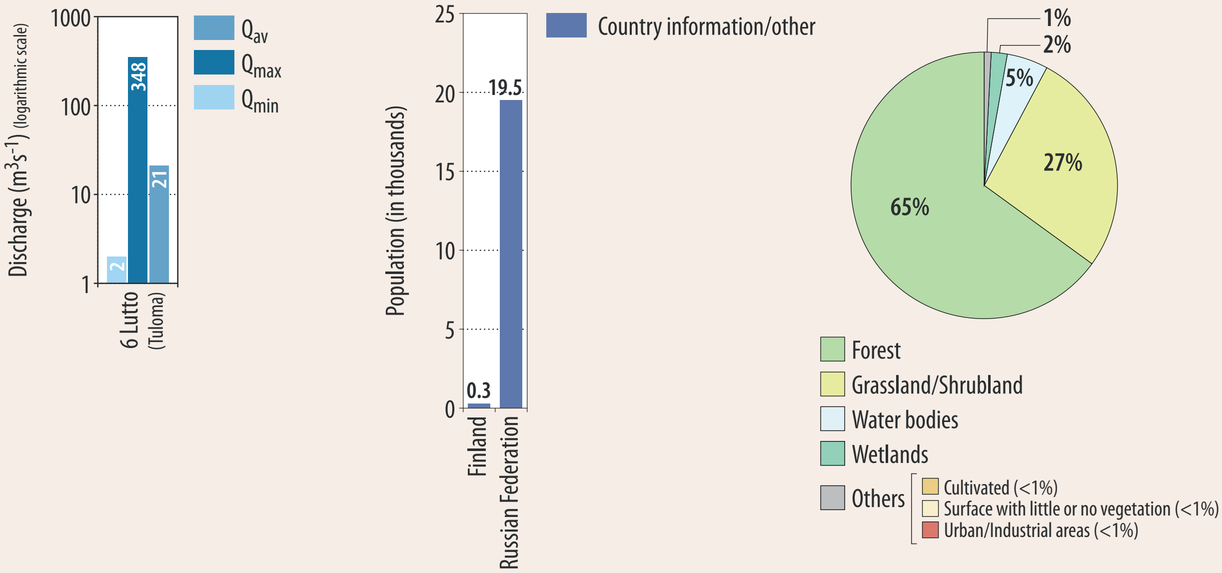






Source: UNEP/DEWA/GRID-Europe 2011.

DISCHARGES, POPULATION AND LAND COVER IN THE TULOMA RIVER BASIN



Sources: UNEP/DEWA/GRID-Europe 2011; Finnish Building and Dwelling Register; Scheme of complex use and protection of water resources, river basin Tuloma; OAO Scientific Research Institute of Hydraulics B.E.Vedeneeva, 2001.

dustrial logging, which was primarily carried out in the sub-basins Vuva and Notta/Girvas, ceased in 1998. The extent of tourism is small, but the area has high recreational use potential.

A copper-nickel ore deposit was exploited in Piretshnyi until recently, but currently the mine is closed. Pressure from industrial wastewater discharges is ranked as local but severe; permits were issued for discharges amounting to 7.32×10^6 m^3 for 2010 and discharges without permits are estimated to amount to 645,000 m^3.

Solid waste disposal in the Russian part of the basin is a local, but severe pressure factor, posing a risk of surface and groundwater pollution. There is hardly any waste processing in the Murmansk region, and waste is burned in an incinerator plant without pre-sorting. The village of Drovjanoe has a municipal landfill, but in other settlements both authorized and unauthorized dumps — commonly not meeting sanitary requirements — are used for disposal.

Even though there is some pressure on water resources from urban wastewater discharges, the degree of connectedness to water supply and sewerage collection in many settlements in the Russian part is reported to be high: 95% in Murmashi, 87% in Upper Tuloma, 96% in Piretshnyi and 87% in Tuloma. The greatest amount of wastewater and pollutants (share of the total load in parenthesis) are discharged through Murmanskvodokanal: 59.2 tons of organic matter measured as BOD (66%), 5.19 tons of phosphorus (77%), and 47.9 tons of suspended solids (74%), among others. This is also reported to be the source of all the synthetic surfactants and ammonium.

Status and responses

The Russian Federation reports the main pollutants to be metals (iron and copper) and organic matter. Average concentrations of phenols typically range from 0.003 to 0.006 mg/l in "clean" rivers, to up to 0.011 mg/l in "polluted" ones.

Concentrations of specific pollutants/elements in the Upper Tuloma Reservoir at the outskirts of Upper Tuloma village, measured during the period from 1986 to 2009

Determinand (unit)	Number of measurements	Average concentration	Lowest concentration measured	Highest concentration measured
COD (mg/l)	750	14.0	1.7	27.5
BOD5 (mg/l)	753	0.54	0.03	2.15
Suspended solids (mg/l)	751	1.976	0	21
Ammonium-nitrogen (mg/l)	750	0.01	0	0.3
Nitrite-nitrogen (mg/l)	750	0	0	0.041
Phosphate (mg/l)	751	0.002	0	0.065
Total iron (mg/l)	751	0.15	0	1.67
Copper (μg/l)	736	4.0	0	29
Zinc (μg/l)	331	8	0	59
Nickel (μg/l)	466	3	0	48
Lead (μg/l)	31	0.5	0	5
Mercury (μg/l)	434	0.017	0	0.7

FIGURE 1: Ammonium-nitrogen and phosphate concentrations in the Upper Tuloma Reservoir, at the outskirts of the village of Upper Tuloma, measured from 1986 to 2009

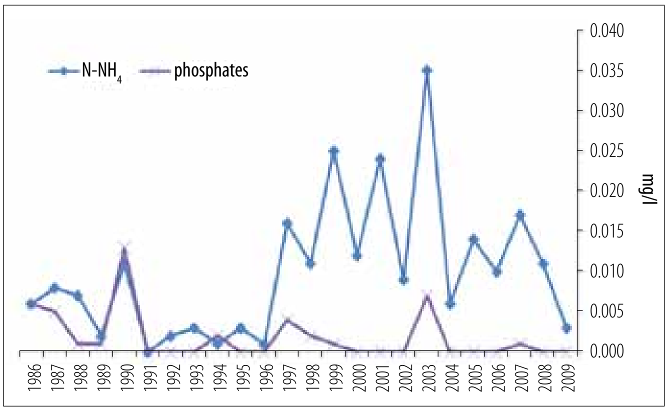
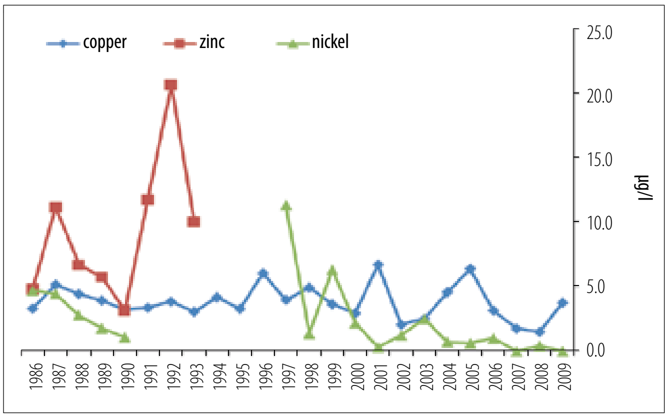


FIGURE 2: Copper, zinc and nickel concentrations in the Upper Tuloma Reservoir, at the outskirts of the village of Upper Tuloma, measured from 1986 to 2009



The Tuloma is one of the cleanest rivers in the North-West of the Russian Federation. According to long-term monitoring and the Russian water quality classification, the Upper Tuloma Reservoir and the rivers Notta and Lutto can be described as slightly polluted.

The main shortcomings in monitoring transboundary water resources are reported to be the low frequency of observations (in the Russian Federation, these are currently made during main hydrological phases — 4 to 6 times a year for physical and chemical parameters), a lack of biological (hydrobiological, toxicological) observations, and a lack of observations of pollutant concentrations in bottom sediments.

The present fish fauna has been monitored in a project exploring the possibility of restoring the salmon stocks, which were historically excellent in the Tuloma River system, but the construction of the two power stations stopped the migration.

The river is covered by the transboundary water agreement of 1964 between the two riparian countries, and by the Finnish-Russian Commission operating on that basis.

Trends

The rivers at the border section are expected to remain of high and good status.

Predicted climate change impacts on the hydrology are described in the assessment of the Teno/Tana.

JAKOBSELV RIVER BASIN[5]

The basin of the 45-km long river Jakobselv[6] is shared by Norway and the Russian Federation. The river flows between steep hills and has many rapids. It discharges into the Varanger fjord in the Barents Sea, and is known to be good for recreational fishing, in particular of salmon.

Basin of the Jakobselv River

Country	Area in the country (km²)	Country's share (%)
Norway	174	67
Russian Federation	86	23
Total	**237**	

Source: Norwegian Water Resources and Energy Directorate; Ministry of Agriculture of the Russian Federation.

Hydrology and hydrogeology

Surface water resources generated in the Norwegian part of the Jakobselv Basin are estimated at 130.73× 10^6 m^3/year.

The maximum discharge, with 3% exceedence probability, is 140 m^3/s, determined in the Russian Federation.

Most of the time, groundwater feeds the river, but during spring flooding the river recharges the adjacent aquifers.

Pressures, status and transboundary impacts

There is very high sulphur deposition in the basin due to the smelters in Nikel, Russian Federation. The trend has been decreasing, though: The SO_2-emissions have been reduced by 75% between 1979 and 2006, and the sulphate concentrations have been reduced by 37% between 1986 and 2008. Alkalinity and acid neutralizing capacity have increased.[7] A national lake survey in 2004-2006 in Norway showed the highest concentrations of nickel (Ni) in surface sediments in the lakes in eastern Finnmark on the Sør-Varanger Peninsula. Changes in concentrations revealed a severe increase in the concentrations of nickel

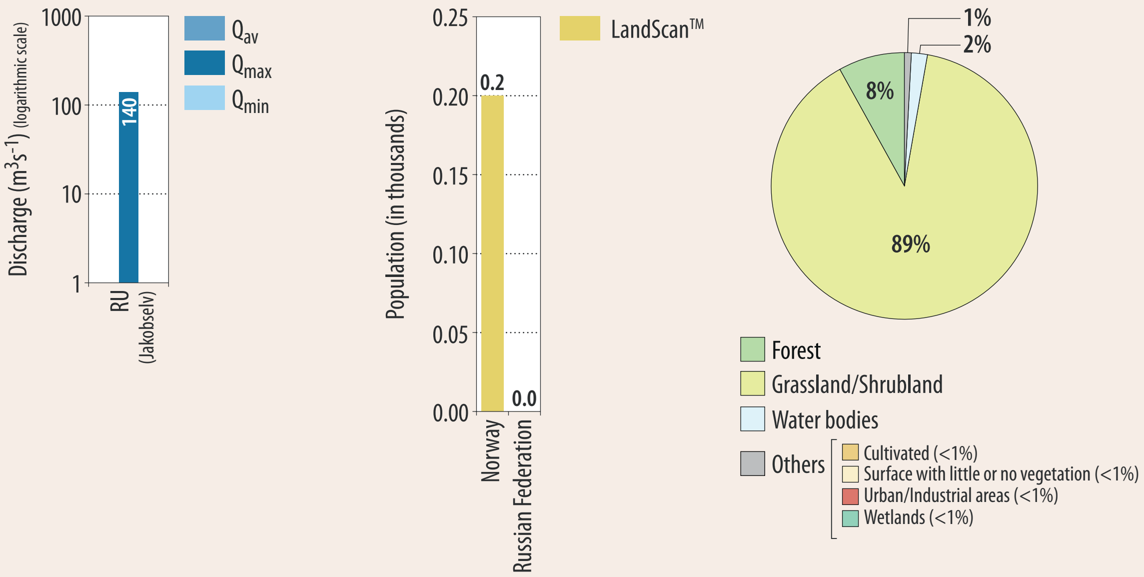
GRENSE JAKOBSELV AQUIFER (NO. 1)

	Norway	Russian Federation
Type 3; Late Quaternary sand and gravel; strong links with surface water.		
Border length (km)	212	N/A
Area (km²)	2 410	N/A
Renewable groundwater resource (m³/d)	198 720	N/A
Thickness: mean, max (m)	50, 100	N/A
Pressure factors	Abstraction of groundwater is insignificant.	N/A
Groundwater management measures	Surveillance and early warning monitoring is needed.	N/A

Source: Norwegian Water Resources and Energy Directorate; Ministry of Agriculture of the Russian Federation.

[5] Based on information provided by Norway and the Russian Federation, and the First Assessment.
[6] The river is also known as the Grense Jakobselv and Vorema.
[7] *Source:* Monitoring of long-range transport of polluted air and precipitation. Annual report - Effects 2008 (in Norwegian). Norwegian Institute for Air Research. 2009.

DISCHARGES, POPULATION AND LAND COVER IN THE JAKOBSELV RIVER BASIN



Sources: UNEP/DEWA/GRID-Europe 2011; In the municipality of Sør-Varanger (Norway), according to the Statistics Norway.
Note: Population in the Russian part of the Basin is less than 50.

in surface sediments compared with subsurface sediment, indicating influence of the smelters. The same pattern of increasing nickel was observed in water chemistry and in air pollutants.[8]

In the Russian part of the basin, the only reported concern — albeit moderate and local in extent — is breaking and hydromorphological change of the right bank of the river. This is addressed by reinforcing the bank: in 2007 some 5 km of bank was strengthened by rock rubble.

PAATSJOKI/PASVIK RIVER BASIN[9]

Finland, Norway and the Russian Federation share the basin of the Paatsjoki/Pasvik River[10]. The river, which is long 143 km, is the outlet from Lake Inari in Finland to the Barents Sea. The river flows into the Varangerfjord, not far from Kirkenes. Vaggatem, Fjørvatnet and Hestefossdammen are transboundary lakes within the basin.

Lake Inari is a large (1,084 km^2) subarctic, oligotrophic clear lake. The catchment area of Lake Inari forms the Finnish part of the Paatsjoki water system. Lake Inari has been regulated since 1942 by power plants situated in the Russian Federation and Norway.

Basin of the Paatsjoki/Pasvik River

Country	Area in the country (km^2)	Country's share (%)
Norway	1 109	6
Finland	14 512	79
Russian Federation	2 782	15
Total	**18 403**	

Source: Lapland regional environment centre, Finland, Statistics Norway, 2008.

The basin is in taiga and tundra zones. Bogs of various types are common; some 12% of the basin area in Finland is wetlands or peatlands. Pasture area has decreased in the Russian part due to increased groundwater levels. The Pasvik National Park is transboundary, with 14,700 ha of its total surface area of 16,610 ha in the Russian Federation (Pechenga district) and the rest in Norway (Øvre Pasvik, also a Ramsar Site). Some 43.2% of the basin area in Finland is protected.

Hydrology and hydrogeology

High flows result from substantial amounts of water retained in snow cover over long winters released upon melting. The river flow is regulated and there are seven hydroelectric power plants, five of which are Russian. The related reservoirs are Kaitakoski, Jäniskoski, Rajakoski, Hevoskoski and Borisoglebsk. Skogfoss (maximum capacity 46.5 MW) and Melkefoss (22 MW) hydropower stations are located in the Norwegian part.

Surface water resources generated in Norway's part of Paatsjoki/Pasvik Basin are estimated at 5,344 m^3/year (1961 to 1990)[11]. Surface water resources generated in Finland's part of Paatsjoki/Pasvik Basin are estimated at 5,140 × 10^6 m^3/year, groundwater resources are 36.8 × 10^6 m^3/year.

Based on measurements made from 2005 to 2009 at the gauging station at the Kaitakoski hydropower station in the Russian Federation, the average discharge is 167.2 m^3/s.

Of the total amount withdrawn in the Russian Federation (11.90 × 10^6 m^3/year), 78.3% was surface water and 21.7% groundwater according to the State statistic reports on water use. Some 48% of the withdrawal was for industry and 32% for domestic use. The total water use (including non-consumptive) for hydropower generation is some 37 × 10^9 m^3/year. In Finland, withdrawal from the rivers Teno/Tana, Näätämö/Neiden and Paatsjoki/Pasvik in total was 0.55 × 10^6 m^3 in 2007. Skogfoss Waterworks in Norway abstracts some 19,000 m^3/year destined to domestic use.

In the Finnish part, the aquifers that continue to the neighbouring countries' territory are small, insignificant for water use, and consist of sands and gravels with a mean thickness of some 15 m and maximum thickness of some 100 m.

[8] *Source:* National Lake Survey 2004–2006. Part III: AMAP. Norwegian Institute for Water Research. 2008.
[9] Based on information provided by Finland, Norway and the Russian Federation, and the First Assessment.
[10] The river is known as Paatsjoki in Finland and as Pasvik or Pasvikelva in Norway.
[11] *Source:* Norwegian Water Resources and Energy Directorate.

AQUIFER PASVIKESKEREN (NO. 2)

	Norway	Russian Federation
Type 3; late Quaternary; sand and gravel; strong link with surface water.		
Area (km²)	53.7	N/A
Thickness: mean, max (m)	12, 12	N/A
Groundwater uses and functions	Supports ecosystems as well as maintains baseflow and springs	N/A
Other information	National groundwater body code: NO324600775	N/A

Pressures

In Russian territory, the Pechenganickel industrial complex smelters emit dust, which results in deposition of metals in the basin, exerting severe pressure on the downstream river system. Copper, nickel and mercury concentrations in the water are elevated. The level of sulphate deposition is high, but alkalinity of water buffers its effect to some degree. There is a marked decrease of alkalinity in the spring, but the remaining alkalinity is still sufficient to avoid acid water.

Water quality at the confluence of the Kolosjoki tributary (Borysoglibs'ka hydropower station) is negatively affected by inadequately treated discharges of waters from mines and smelters' slag dumps to the tributary. The illegal discharges of domestic wastewaters in the villages of Borisoglebskiy and Rajakoski in the Russian Federation have a negative impact on river water quality.

The impact of water regulations by the power plants in Norway and the Russian Federation is ranked as widespread but moderate. The impact of industrial activities is assessed to be local but severe.

The impact of agriculture and forestry is assessed to range from insignificant to minor. Groundwater level increase and weeds affect forestry negatively in the Russian part. Only Hevoskoski Reservoir is used for recreation purposes.

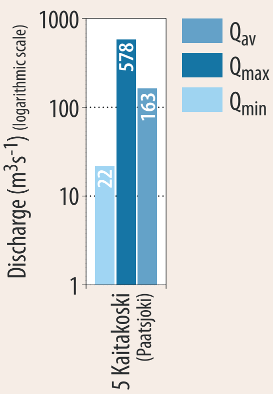
Estimated loads of nutrients from different sources in the Finnish part of the Paatsjoki/Pasvik Basin (from the Environmental Information System (HERTTA) at the Finnish Environment Institute).

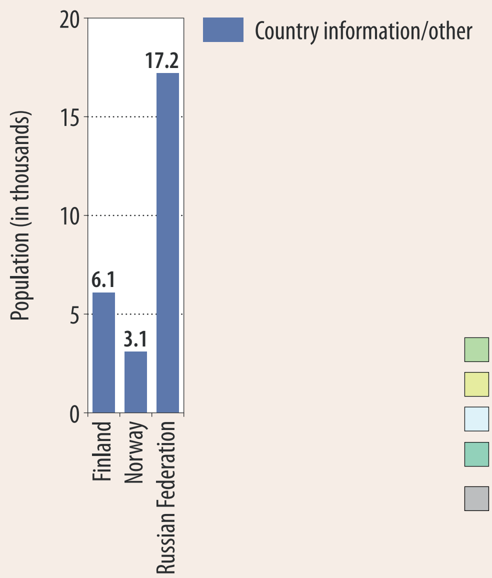
Activity	Nitrogen load (tons/a)	Phosphorus load (tons/a)
Natural/background	2 093	73
Wastewater, municipalities	21.9	0.1
Wastewater, scattered settlements	6.6	1.2
Agriculture	0	0.6
Forestry	68	6
Fisheries	2.2	0.2

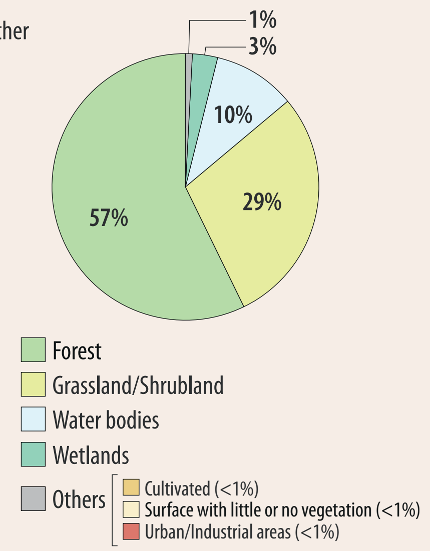
The population density in the drainage basin of Lake Inari is very low (0.5 persons/km²), and the human impact is negligible. Only treated wastewaters of Ivalo village (4,000 inhabitants) and Saariselkä tourist centre are discharged into the Ivalojoki River, which flows into Lake Inari.

According to the regulation permit of Lake Inari, the annual water-level fluctuation could be 2.36 m. However, in practice, water-level fluctuation has been on average 1.47 m during the period of 1980-2008. The regulation has some undesirable effects on Lake Inari's biota. Increased winter draw-down affects littoral species and habitats negatively. Moreover, regulated water-levels are higher in autumn than naturally, and increase bank erosion.

DISCHARGES, POPULATION AND LAND COVER IN THE PAATSJOKI/PASVIK RIVER BASIN





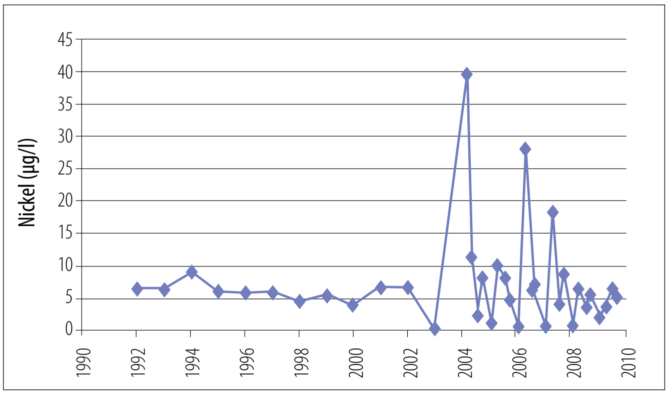


Sources: UNEP/DEWA/GRID-Europe 2011; In the municipality of Sør-Varanger (Norway), according to the Statistics Norway.

Status and transboundary impacts

In 2009, based on water quality monitored[12] in five locations, an increase in concentrations of sulphate and heavy metals was observed in the Russian part of the basin. No significant changes were otherwise observed, compared with the previous year. Given the large water volume of the Paatsjoki/Pasvik, the observed high metal concentrations (e.g. copper) indicate continued pollution and accumulation of these elements.

FIGURE 3: Measured nickel concentrations in the Pasvik River, near Svanvik, Norway



Source: Comprehensive study on Riverine Inputs and Direct Discharges (OSPAR).

Above the Kaitakoski hydropower station, water is classified as "clean", and downstream at Borysoglibs'ka hydropower station as "moderately polluted", that is respectively class 2 and 3 in the Russian quality classification system.

According to the ecological classification employed in Finland — based on the WFD — the ecological quality of the Paatsjoki/Pasvik was excellent in 2009. According to the same classification, in 2009 the ecological status of Lake Inari was good. The status was revised from excellent because of the impacts of flow regulation.

Effects of climate change in some hydrological variables have been observed in Lake Inari. The duration of the ice cover has become shorter, and ice thickness seems to have become thinner, although that change is not statistically significant. Also, the mean temperature of water mass during the period from May to September has increased. These changes seem to have been more pronounced during the 2000s. The oxygen saturation has decreased near bottom in the deepest point of Lake Inari (maximum depth about 95 m) during spring (March-April). At the same time, the water temperature has increased, having most likely decreased oxygen content (accelerated decomposition).[13]

Transboundary cooperation and responses

The Norwegian water regulation adopted in December 2006 incorporates the WFD into Norwegian law. As part of its implementation, a River Basin Management Plan (RBMP) for the Finnmark District was prepared including the Tana, Neiden and Pasvik basins (adopted in 2009). In Finland, the RBMP covers the catchment areas of the rivers Teno/Tana, Näätämö/Neiden, Uutuanjoki and Paatsjoki, which form a single River Basin District.

To reduce emissions of pollutants with mine water discharges from Pechenganickel, recycling of water for production needs was started in the Severniy mine. Treatment facilities have been constructed for waters from the Severniy, Severniy-Glubokiy and Kaula-Kotselvaara mines in the Russian Federation. The smelter area was cleaned of heavy and non-ferrous metals, and new technology was introduced for processing copper-nickel concentrate. Several discharge points of industrial wastewaters will be eliminated as a result of closure of mining and metallurgical production, and their transfer to Monchegorsk.

An exchange of water quality data on the Paatsjoki/Pasvik between the Russian Federation, Norway and Finland does not take place at present. However, the "Development of a joint environmental monitoring program in the Norwegian, Finnish and Russian border area"[14] project, with the objective of ensuring reliable and comparable monitoring data, was implemented from 2003 to 2006. Water quality assessment in Norway and Finland with the Russian Federation is not clear-cut. For a consistent assessment of water quality in the Paatsjoki/Pasvik, the Russian Federation suggests that a special monitoring programme should be devised, coordinated between the three countries.

Recommendations concerning regulation practices, management of fish stock and fishing, mitigation of erosion, monitoring of the state of Lake Inari, and communication were made by the Lake Inari Monitoring Group in 2008.

The Finnish-Russian and Finnish-Norwegian Commissions on transboundary waters operate on the basis of bilateral agreements. There is a trilateral agreement about the regulation of Lake Inari.

The Finnish-Norwegian Commission prepared a multiple-use plan for the Paatsjoki/Pasvik River in 1997, and the Russian authorities were included in the process.

Trends

At the Finnish-Russian border, the river is of good status. Improvements in water-quality in the Russian Federation require huge investments in cleaner production and clean-up of sites, but measures in that direction are being reported by the Russian Federation.

In the Russian part, water use for industry was expected to increase by 15% in 2010 and 2011, and domestic use was expected to decrease.

According to Finland, a set of climate change scenarios suggests an increase of 1.5–4.0 °C in annual mean temperature and 4–12% increase in annual precipitation in the forthcoming 50 years. The frequency of spring floods may increase. Groundwater level may increase in winter, and decline in summer. Reduced groundwater recharge may cause oxygen depletion in small groundwater bodies and consequently increased metal concentrations in groundwater (e.g. iron, manganese).

[12] The monitoring was carried out by the Murmansk unit on Hydrometeorology and Environmental Monitoring of Roshydromet.

[13] Puro-Tahvanainen, A. & Salonen, E. Effects of climate change into hydrology, water quality and fishes in Lake Inari. In Simola, H.(ed): Symposium on Large Lakes 2010 – Climate change – changing freshwater ecosystems and society. Publications of the University of Eastern Finland, Reports and and Studies in Forestry and Natural Sciences 4. 2010.

[14] www.pasvikmonitoring.org.

PASVIK NATURE RESERVE[15]

General description of the wetland

The Ramsar Site has a size of 1,910 ha, of which approx. 450 ha is covered by waterbodies. The reserve includes the most intact section of the Paatsjoki/Pasvik river system, characterized by many bays, islets, shallow waters and typically extensive mires, dominated by stands of sedge species. In the central part of Pasvik valley, and in the south of the nature reserve, the river still follows its original course. The river is surrounded by Scots pine forests which are characterized by a few species of lichen and ericaceous species on dry ground. Of particular interest are well-developed structures of permafrost called palsa mires, i.e. permanently frozen parts of the mire. Dense thickets of willow species can be found along the river. In shallow and protected bays the aquatic flora is particularly well developed. In the river, rich stands of pondweed dominate, while in more shallow parts species like bur-reed and Common Water-Crowfoot dominate.

Main wetland ecosystem services

As the degradation of the wetlands in the northern regions is low, there are hardly any flooding problems despite the flooding in spring. The significant transport of sediments and the continuous shifting of the estuary as a consequence of this process are important in maintaining a natural estuary ecosystem. Leisure activities within the reserve include fishing, bird watching and boating. The latter is strictly restricted, due to specific border regulations. In the surrounding area of the reserve there is reindeer husbandry (on the Norwegian and Finnish sides), forestry, hunting, fishing and other leisure activities. However, the area is sparsely populated, and the impact from tourism is low.

Cultural values of the wetland area

The site is of archaeological interest as it has been shown that the first human settlements in the area occurred over 8,000 years ago. Saami people dominated the area prior to the settlement by Norwegians. As the valley of the Pasvik River is located at the border of the Russian Federation, Finland and Norway, its historical background is influenced by different cultures. Furthermore, the farm of famous Norwegian naturalist Hans Tho. L. Schaanning on Varlam Island, the Russian Federation, and at Noatun, Norway, is currently protected as a national historical monument.

Biodiversity values of the wetland area

The area is important for breeding and staging for a large number of species. Of the 78 bird species on the Norwegian Red List (2006) as many as 55 (70%) are found in the Paatsjoki/Pasvik valley. Eight of these species, such as Garganey (EN), Smew (EN), Bean goose (VU), Northern Shoveler (VU) and Greater Scaup (VU) are listed as critically endangered (CE), endangered (EN) or vulnerable (VU). The area is also important for a series of boreal species with limited distribution in Europe; for instance the Northern Hawk Owl and the Great Grey Owl. In addition to common species typical of the climate zone, the area hosts a stable breeding population of Brown Bear (EN) and Eurasian Otter (VU). In terms of flora, the area hosts a number of Eastern species such as the Arrowhead and Lapland sedge. The rich and varied aquatic vegetation found in this river is a rare example for rivers draining into the Barents Sea.

Pressure factors and transboundary impacts

The regulation of the Pasvik River by hydro-electric power plants outside the Ramsar area has some influence on the fluctuation of the water level. While large tracts of forests have been logged in the surrounding area on both sides of the border, there are still great areas of virgin taiga remaining. Prospecting for minerals has been undertaken in the catchment area, while the extraction of major deposits was rejected with the establishment of the reserve. A plan for the construction of a new highway between Norway and Finland along the river still exists, but is strongly opposed due to the unspoilt character of the area.

Transboundary wetland management

The Ramsar Site was established first as a National Nature Reserve in 1993, and received the status of Ramsar Site in 1996. All kinds of human activity within the conservation area are regulated. The area is part of the Pasvik-Inari Trilateral Park, which consists of five connected and cooperating protected areas in Norway, Finland and the Russian Federation (total area 188,940 ha). The Russian Strict Scientific Nature Reserve Pasvik Zapovednik (14,687 ha) is also part of this trilateral park, and plans for designation of this area as a Ramsar Site currently exist. Moreover, the Ramsar Site is part of the Øvre Pasvik Important Bird Area (20,000 ha). Within the Trilateral Park, the harmonization of management, research methodology, as well as ecotourism, are among the main objectives. With the aim of developing a long term monitoring strategy, a number of species surveys have been undertaken as part of the Pasvik Programme in all three countries, with a new addition dealing with climate change and airborne pollutants.

Since 1980, the Norwegian-Finnish Commission on Transboundary Water has acted as an advisory body to the governments of both countries. The Russian Federation has been taking the role of observer and expert since 1991.

Photo by Guo Yumin

[15] *Sources:* Ramsar Information Sheet 2009, Norwegian-Finnish Commission on Transboundary Waters; Website of the trilateral park Pasvik-Inari: http://www.pasvik-inari.net/neu/eng/main.html.

NÄÄTÄMÖ/NEIDEN RIVER BASIN[16]

The basin of the river Näätämö/Neiden[17] is shared by Finland and Norway. The river flows from Lake Iijärvi (Finland) to Norwegian territory, and discharges into the Barents Sea. On Finnish territory, it flows about 40 km through wilderness; there are many rapids in the river. Geaågesuolojavri is a transboundary lake in the basin.

Basin of the Näätämö/Neiden River

Country	Area in the country (km²)	Country's share (%)
Finland	2 354	81
Norway	553	19
Total	**2 907**	

Sources: Finnish Environment Institute (SYKE), River Basin Management Plan for the Finnmark Water Region.

The surface water resources in Finland are estimated at 265.2×10^6 m³/year (average for the years 1991 to 2005), and groundwater resources at 11.9×10^6 m³/year. Total water resources per capita in the Finnish part of the basin are 1.385×10^6 m³/year/capita.

Surface water resources in the Norwegian part of the basin are estimated at 925.44 m³/year (average for the years 1961 to 1990).[18]

Hydrology and hydrogeology

Most of the time, groundwater feeds the river. During spring flooding the river recharges the adjacent aquifers.

Pressures, status and transboundary impacts

The anthropogenic pollution in the river basin is very low. There is no significant transboundary impact on Norwegian territory. Neiden Waterworks (Norway) withdraws some 21,000 m³/year for domestic use.

In the Finnish part, the ecological status of the river is classified as excellent. The river is an important watercourse for the reproduction of Atlantic salmon, and there is long-term monitoring of salmon stocks.

The water quality status of the river at the border section is expected to remain good.

Responses

Norway and Finland have signed bilateral agreements on water transfer (1951) and fishing (1977) in the Näätämö/Neiden River. In 1980, the agreement on a Finnish-Norwegian Commission on Boundary Watercourses was signed.

In Norway, the Näätämö/Neiden River is covered by the RBMP of the Finnmark River Basin District, and a programme of measures has also been defined specifically for Näätämö/Neiden as part of the Programme for the whole District. In Finland, similarly, the basin is covered by the RBMP covering the rivers Teno/Tana, Näätämö/Neiden, Uutuanjoki and Paatsjoki/Pasvik.

The Finnish-Norwegian Commission prepared a multiple-use plan for the Näätämö/Neiden River in 1987. Needs for updating the plan have been discussed in the Commission.

TENO/TANA RIVER BASIN[20]

Finland and Norway share the basin of the Teno/Tana River[21], which discharges into the Barents Sea, and is important for salmon reproduction. With its headwaters, the Teno/Tana River forms 283 km of the Finnish-Norwegian border.

Basin of the Teno/Tana River

Country	Area in the country (km²)	Country's share (%)
Norway	11 314	69
Finland	5 133	31
Total	**16 386**	

Source: Lapland Regional Environment Centre (Finland).

Surface water resources generated in the Norwegian part of the Teno/Tana Basin are estimated at $6{,}226 \times 10^6$ m³/year (based on observations from 1961 to 1990)[22]. Surface water resources generated in the Finnish part are estimated at $5{,}645 \times 10^6$ m³/year, and groundwater resources at 26.89×10^6 m³/year, representing 4.36×10^6 m³/year per capita.

Hydrology and hydrogeology

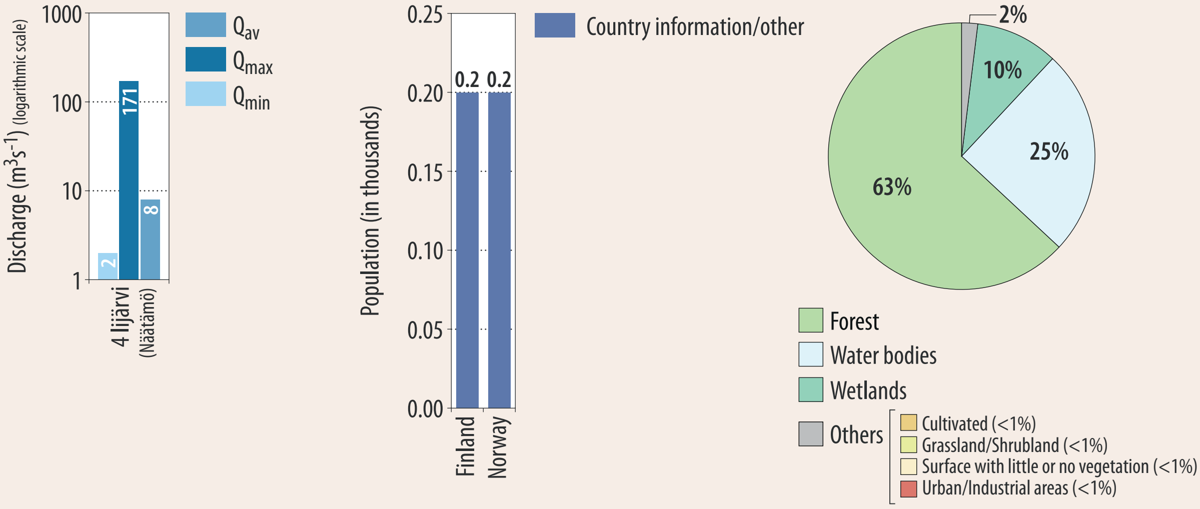
Most of the time in the Norwegian part, groundwater feeds the river as baseflow, but during spring flooding the river recharges the adjacent aquifers. Groundwater also supports ecosystems during the frost season. Finland assesses the transboundary aquifers in the eastern and northwestern borders shared with Norway as small and insignificant, situated in uninhabited wilderness areas. Groundwaters generally discharge into rivers, lakes and swamps in the Finnish part of the basin. Groundwater occurs in sand and gravel aquifers, which are some 15 m thick (not exceeding 100 m).

NEIDEN AQUIFER (NO. 3)

	Norway	Russian Federation
Type 3; Late Quaternary sand and gravel aquifer; dominant groundwater flow is from Finland to Norway; links with surface water are reported to be strong.[19]		
Area (km²)	15	5
Thickness: mean, max (m)	10, 15	9,14
Groundwater uses and functions	Groundwater maintains baseflow and springs, and supports ecosystems during frost season.	Groundwater flow is maintaining baseflow and supports ecosystems.
Other information	National groundwater body code is NO324400934	National code for groundwater area is FI12 148 196

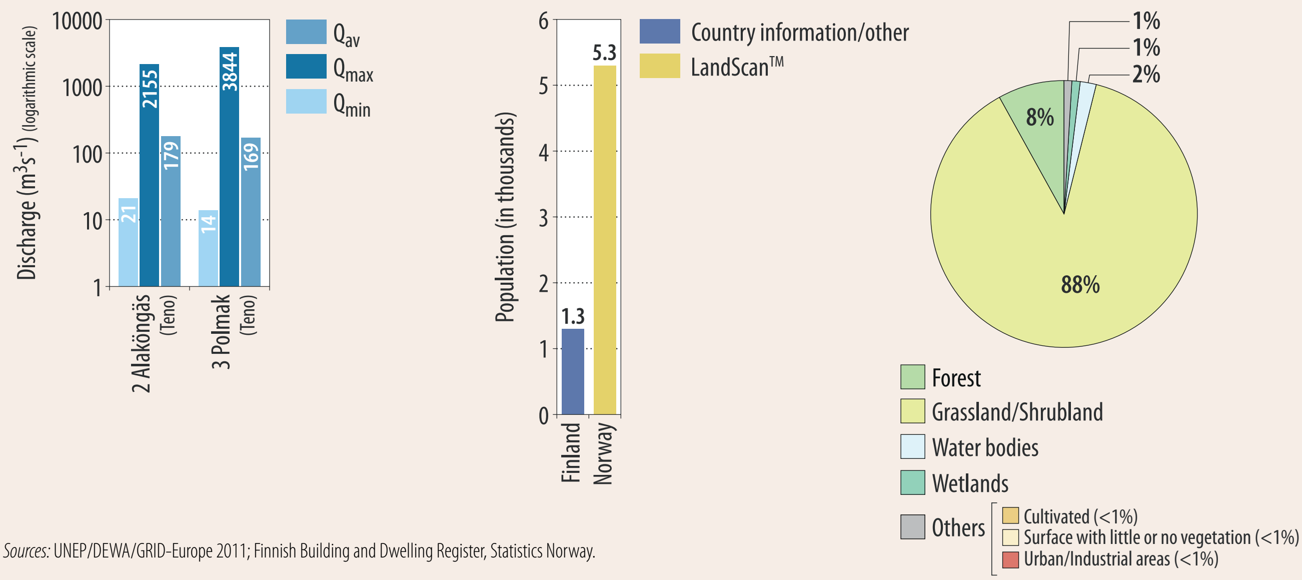
[16] Based on information provided by Finland and the First Assessment.
[17] The river is known as Näätämö in Finland and Neiden in Norway.
[18] *Source:* Norwegian Water Resources and Energy Directorate.
[19] *Sources:* Norwegian Water Resources and Energy Directorate; the Geological Survey of Norway.
[20] Based on information provided by Finland and Norway, and the First Assessment.
[21] The river is known as Teno in Finland and Tana in Norway.
[22] *Source:* Norwegian Water Resources and Energy Directorate.

DISCHARGES, POPULATION AND LAND COVER IN THE NÄÄTÄMÖ/NEIDEN RIVER BASIN



Sources: UNEP/DEWA/GRID-Europe 2011; Finnish Building and Dwelling Register, Statistics Norway.

DISCHARGES, POPULATION AND LAND COVER IN THE TENO/TANA RIVER BASIN



Sources: UNEP/DEWA/GRID-Europe 2011; Finnish Building and Dwelling Register, Statistics Norway.

TRANSBOUNDARY AQUIFERS IN THE TENO/TANA BASIN[23]

Name and number	Groundwater characteristics	National identification code(s)	Surface area (km²)	Thickness: mean, max (m)
Anarjokka (No. 4)	Type 3; Late Quaternary, sand and gravel; strong link with surface water	NO323400442	16.2	
Levajok-Valjok (No. 5)	Type 3, Late Quaternary, sand and gravel, strong links with surface water	NO323400963	26.7	17.1, 19.5
Karasjok (No. 6)	Type 3, Late Quaternary, sand and gravel, strong links with surface water	NO323400964	91	12.8, 50
Tana Nord (No. 7)	Type 3, Late Quaternary, sand and gravel, strong link with surface water	NO323400656	219	17.4, 36

Pressures

The anthropogenic pollution in the river is very low; there is no significant transboundary impact.

Surface water is withdrawn for domestic purposes in the small village of Båteng in Norway, at the border. The total withdrawal of surface water in Finland from the Teno/Tana, Näätämö/Neiden and Paatsjoki/Pasvik was 0.55 ×10⁶ m³ in 2007.

Urban wastewater at Karasjok, Tana Bro and Seida in Norway, and at Karigasniemi and Nuorgam in Finland, undergoes biological and chemical treatment. The urban wastewater at Utsjoki in Finland is treated chemically. The impact of wastewater discharges is assessed at local and moderate. In the Finnish part, the nutrient load from municipalities and scattered settlements is estimated at 0.9 tons-year of phosphorus and 8.1 tons/year of nitrogen. Agriculture and forestry are other relatively small sources of nutrient loading.

Status and transboundary impacts

The Teno/Tana has moderate concentrations of organic matter, mainly due to natural leaching from soil and bogs. The load of organic matter from villages does not measurably affect water quality in the main river. The reported parameters monitored by Norway for the past 20 years — suspended solids, total organic carbon (TOC), total phosphorus and total nitrogen — do not show any particular trend. The natural fluctuations in concentrations throughout the year are pronounced; in the lower part of the river they are influenced by particles from erosion during heavy rainfall and snowmelt. Generally, there are very few anthropogenic pressures on water quality in the whole river basin. The Teno/Tana has a stable high status.

Responses

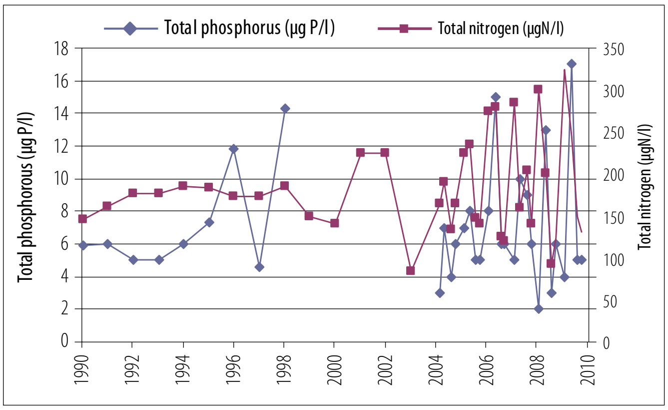
The 1980 Agreement on a Finnish-Norwegian Commission on Boundary Watercourses provides the framework for transboundary cooperation on regulating, hydraulic development, water supply and protection of water resources.

The Finnish-Norwegian Commission has prepared a multiple-use plan for the Teno/Tana, which was last updated in 2006.[25]

Trends

A set of climate change scenarios developed in Finland suggests an increase of 1.5–4.0 °C in annual mean temperature, and a 4–12% increase in annual precipitation in the forthcoming 50 years. The frequency of spring floods may increase.

FIGURE 4: Total phosphorus and total nitrogen concentrations in the Teno/Tana, measured in Seida, Norway[24] (approximately 30 km from the river's mouth; latitude 70º 14', longitude: 28º 10')



Groundwater level may increase on winter and decline in summer, with the lowest late summer/autumn levels possibly decreasing below the current lows.

YENISEY RIVER BASIN AND THE SELENGA SUB-BASIN[26]

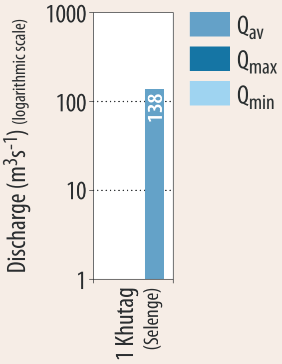
The Yenisey River flows entirely within Russian territory, but the upper part of the basin is transboundary, including parts of the transboundary Selenga River (total length 1,024 km; 409 km in the Russian Federation and 615 km in Mongolia)[27], shared with Mongolia.

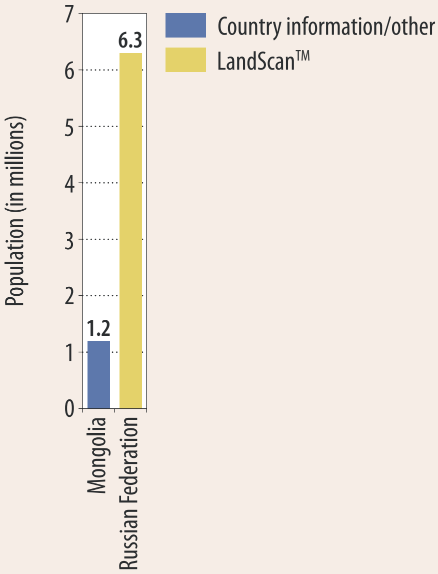
The recharge area of the Yenisey basin consists — in addition to the Yenisey itself — of the Selenga River, Lake Baikal (31,500 km²) and the Angara River. The Selenga has its source in Mongolia (Shishhid Gol River), and ends in Lake Baikal. The Yenisey discharges into the Kara Sea.

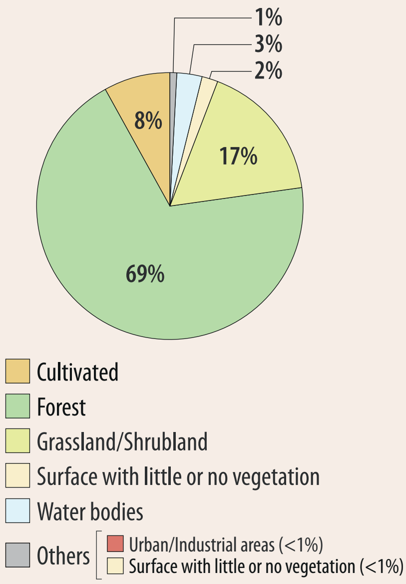
The Selenga River Basin is covered mainly by forest and mountain-steppe, and has an average elevation of about 1850 m a.s.l. In the upper and middle parts, the Yenisey is a mountain river, but further downstream the basin is lowland, with an average elevation of 247 m a.s.l.

[23] The information here refers only to the Norwegian part of these aquifers/groundwater bodies.
[24] *Source:* Comprehensive Study on Riverine Inputs and Direct Discharges (OSPAR), Norwegian Institute for Water Research.
[25] For information on the RBMPs, please refer to the assessment of the Paatsjoki/Pasvik.
[26] Based on information provided by Mongolia and Russian Federation and the First Assessment.
[27] *Source:* Davaa, G. Surface water resources of Selenge aimag, Darkhan. 1990.

DISCHARGES, POPULATION AND LAND COVER IN THE YENISEY RIVER BASIN AND SELENGA SUB-BASIN







Sources: UNEP/DEWA/GRID-Europe 2011; National Statistical Department, Mongolia, 2008.

Basin of the Yenisey River and sub-basin of the Selenga River

Country	Area in the country (km²)	Country's share (%)
Selenga sub-basin		
Mongolia	282 050	63.3
Russian Federation	163 195	36.7
Total Selenga sub-basin	**445 245**	
Yenisey basin		
Mongolia	282 050	11.1
Russian Federation	2 261 700	88.9
Total Yenisey basin	**2 543 750**	

Sources: Integrated Management and Protection of Water Resources of the Yenisey and Angara rivers, Krasnojarsk Regional Branch of the International Academy of Ecology and Nature, Krasnojarsk, 2006; Surface water resources of the USSR, Gidrometizdat, Leningrad, 1973; Davaa, G. Surface water of Mongolia, Ulaanbaatar, 1999.

Hydrology and hydrogeology

Surface water resources generated in the Mongolian part of the Selenga river basin are estimated at 18 × 10^9 m^3/year, and groundwater resources at 6.6 × 10^6 m^3/year, representing 20,960 m^3/year/capita.[28]

The average discharge of the Selenga is 290 m^3/s in the border section. The total discharge of the Yenisey at the mouth is 18,730 m^3/s.

According to Mongolia, transboundary groundwaters occur in 1) Quaternary alluvial deposits (mean thickness 10–15 m and maximum thickness 20 m); 2) Cambrian limestones, sandstones, siltstones and conglomerates; and 3) fracture systems related to tectonic faults in Precambrian granites. The dominant groundwater flow direction is from Mongolia towards the Russian Federation. The links between surface and groundwater are medium, with groundwater mainly recharging from surface water, and interaction between surface water and groundwater in the basin is reported to play an important role in the functioning of the riparian ecosystem.

Pressures

Widespread and severe pressure factors in the Mongolian part of the Selenga Basin include floods caused by heavy rain, gold mining (52 companies operating), forest fires, and insects affecting forests (beetles *Coleoptera sp.*). Also widespread, but more moderate in impact, are wool processing, tanneries and beverage factories, as well as overgrazing. Hydromorphological change of the river channel is a local but potentially severe pressure factor. Thermal power stations in Ulaanbaatar city and discharge of urban wastewater are assessed to be of comparable importance.

Status and transboundary impacts

Average mineralization of groundwater in the Selenga river basin is 450 mg/l. Based on data from four monitoring stations, the pH is 7.8.

In the Russian Federation, heavy metals and petroleum products exceed the maximum allowable concentrations for fisheries in the water of the Selenga River. Water quality is assessed as "very polluted".

Lake Baikal serves as a natural barrier for the transboundary flow of pollutants, preventing their impact on the downstream part of the watercourse.

Responses

Management activities implemented by the Russian Federation in the Selenga River basin in 2008-2010 with federal funding included a complete renovation of four dams and two protection dams. The work includes overhaul of hydraulic structures, dredging/clearing the channel of the river Selenga, and clearing/dredging the channels of its tributaries. Measures were also taken to protect the area and population from the negative impacts of water.

Renovation of the technology and facilities of the following wastewater treatment plants is foreseen during the period 2010-2021 in the framework of the National Programme on Water in Mongolia: Tolgoit in Ulaanbaatar, Moron city of Khovsgol aimag and Darkhan city. Mongolian water legislation requires mining companies and factories to take measures to protect water resources. Accordingly, in Orkhon aimag, Erdenet copper mine is reusing its wastewater.

The Russian-Mongolian Joint Commission on the Protection and Use of Transboundary Waters, which operates on the basis of the intergovernmental 1995 Agreement on the protection and use of transboundary waters, meets regularly. The provisions of the Agreement include an exchange of information on transboundary waters. Monitoring surface water quality is carried out at four monitoring points. Information on discharge, regime, quality monitoring results and flood and emergency situations is exchanged in the joint Mongolian-Russian Working Group, established by order of the Minister of Nature and Environment of Mongolia, and its Russian counterpart.

Currently, there are 19 surface water monitoring stations observing daily in the Selenga Basin in Mongolia. In the framework of the "Strengthening Integrated Water Resources Management in Mongolia" project, 17 groundwater-monitoring wells will be set up within the Selenga River Basin area.

The Eroo River Basin Council was established in 2007, and the Tuul River Basin Council in 2010 in Mongolia. The first Meeting of River Basin Councils of Mongolia was held in Ulaanbaatar in June 2010. In the framework of a project, the Water Agency of Mongolia develops IWRM Plans for the Orkhon and Tuul River Basins. A vulnerability assessment of these two basins was carried out by UNEP, in collaboration with Peking University and the Water Institute, from 2005 to 2007. Mongolia is interested in conducting joint research and studies on developing an IWRM plan for the Selenga River Basin. In recent years, the riparian countries have jointly carried out several studies, e.g. a survey of the Selenga River's water regime, a fishery survey, and an inventory of pollution sources in the Upper Selenga Basin.

Total water withdrawal and withdrawals by sector in the Selenga sub-basin

Country	Year	Total withdrawal ×10^6 m^3/year	Agricultural %	Domestic %	Industry %	Energy %	Other %
Mongolia	2009	539.8[a]	36	13	22	0	28
Russian Federation	2009	425[b]	8	N/A	74	N/A	N/A

Note: Groundwater makes up 60–80% of the total water use in Mongolia. Rural people in Mongolia use water from rivers, streams and snow water as drinking water.
[a] Water Authority of Mongolia.
[b] Withdrawal in the Selenga River Basin.

[28] *Sources:* Regional scheme of use and protection of water resources in Selenge river basin, Ulaanbaatar, 1986 and for groundwater resources: Jadambaa, D., Geo-ecology Institute of Mongolia, Ulaanbaatar.

Trends

At the present time, a scheme of complex use and protection of the water bodies of the Selenga River is being developed in the Russian Federation, including planning and implementation of water management and water conservation measures, measures to mitigate impacts of floods, and other adverse impacts.

Mining companies' activities in the proximity of water bodies is limited through enforcement of the 2009 Mongolian Law on "Prohibition of the prospecting and exploitation of the mineral resources within the forest and water reservoir areas". A campaign (Atar III) aimed at increasing crop and vegetable production will continue.

Mongolia is very sensitive to climate change due to its geographic location, sensitive ecosystems and socioeconomic condition. Surface water resources are predicted to increase during the first stage of climate change. However, there is no sign whatsoever of increase yet. In the last 60 years, the average yearly temperature has increased by 1.9 °C, while annual precipitation has decreased by about 10%. Depending on the location, dynamics of temperature and precipitation changes differ. Melting of the permafrost area is expected to have effects on bridge and road constructions as well as buildings. To adapt to climate change in the water sector, Mongolia prioritizes the formulation and stabilization of a water resources management policy. Water saving and protection activities are also promoted.[29]

OB RIVER BASIN[30]

The basin of the Ob River is shared by China, Kazakhstan, Mongolia and the Russian Federation.

The Irtysh/Ertis is the main (first order) tributary of the Ob. The Tobol and the Ishim/Esil are transboundary tributaries of the Irtysh/Ertis.

Basin of the Ob River

Country	Area in the country (km²)	Country's share (%)
Russian Federation	2 192 700	73.77
Kazakhstan	734 543	24.71
China	45 050	1.51
Mongolia	200	0.01
Total	**2 972 493**	

In the Russian part of the Ob Basin, surface water resources are estimated at 408.3 km³/year and groundwater resources at 0.47 km³.

Pressure, status and responses

In addition to the pressure factors in the basin of the for Irtysh/Ertis and its tributaries (see separate assessment), exploitation of oil and gas in the Russian Federation exerts pressure on the water resources in the Middle and Lower Ob.

IRTYSH/ERTIS SUB-BASIN[31]

The basin of the 4,248-km long river Irtysh/Ertis[32] is shared by the Russian Federation, Kazakhstan, and, with a very small share, by China and Mongolia. The river has its source in the Altai Mountains in Mongolia (at an altitude of 2,500 m), and discharges into the Ob. The average elevation of the basin in the Russian Federation is of the order of 250–285m a.s.l. The character of the basin varies from plain to high-mountain. The Tobol and the Ishim are transboundary tributaries of the Irtysh/Ertis River.

Sub-basin of the Irtysh/Ertis River

Country	Area in the country (km²)	Country's share (%)
Russian Federation	726 000	67
Kazakhstan	316 472	29
China and Mongolia	45 250	4
Total	**1 087 722**	

Sources: Scheme of complex use and protection of water resources in the Irtysh basin, volume 1, general characteristics of the Irtysh Basin, ZAO PO "Sovintervod", Moscow, 2009; Scheme of complex use and protection of water resources in the basin of the Irtysh River. Consolidated Note 2005.

Hydrology and hydrogeology

Surface water resources in Kazakhstan's part of the Irtysh/Ertis Basin are estimated at 33.66 km³/year (out of which 7.8 km³/year is incoming water from outside the territory of Kazakhstan). Explored exploitable groundwater resources in Kazakhstan's part of the basin are estimated at 2.967 km³/year.

In Kazakhstan, a cascade of large hydroelectric power stations (Bukhtarminskaya, Shulbinskaya, Ust-Kamenogorskaya and others) is used to regulate the flow.

Pressures

In the upper reaches in Mongolia, the Irtysh/Ertis is one of the cleanest and least mineralized rivers in the world.

Pressure factors in China include industry and water withdrawal for irrigated agriculture (e.g. through the more than 300-km long canal from the Black Irtysh[33] to Karamay).

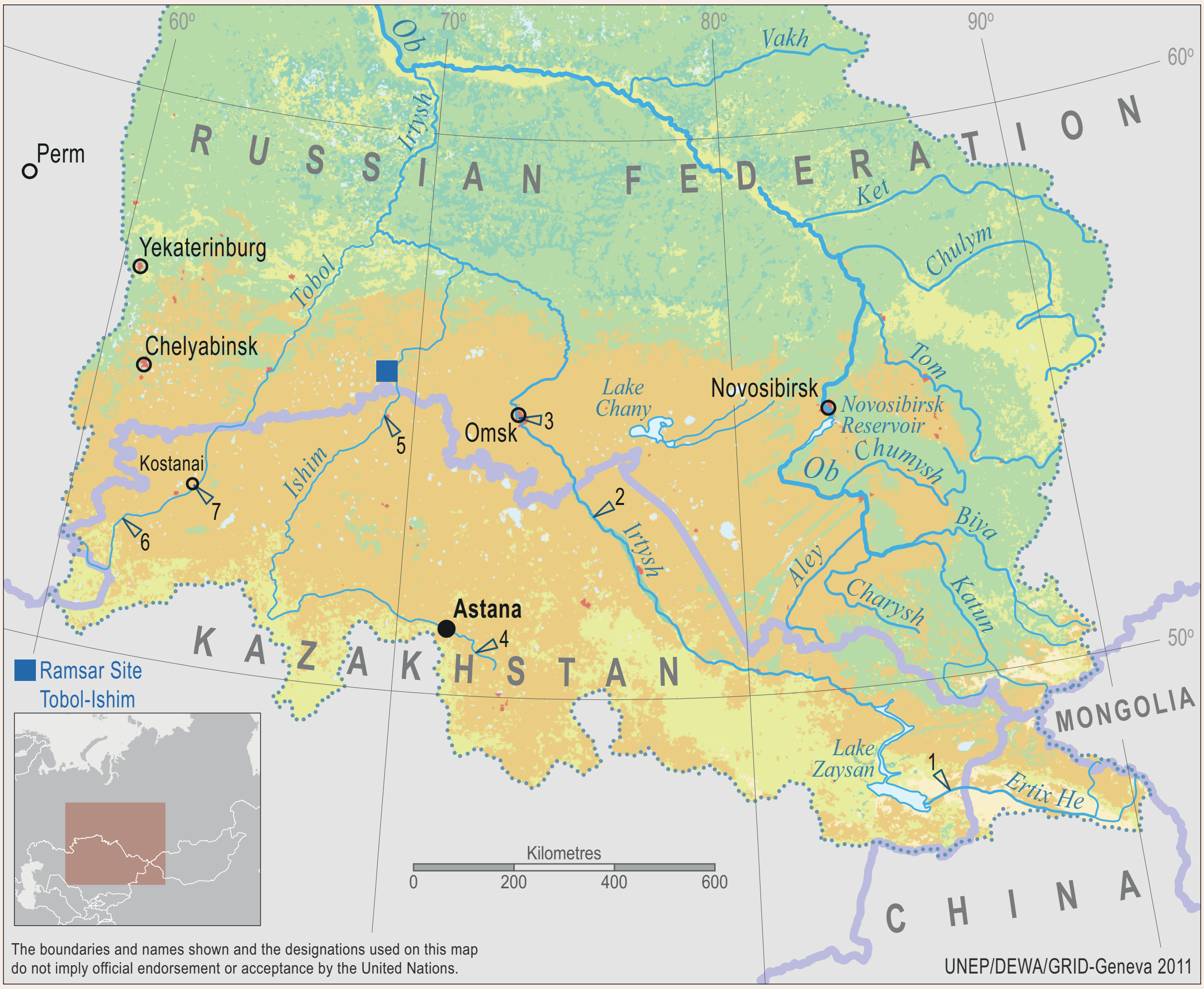
In the mid-1990s, the Irtysh/Ertis in Kazakhstan was heavily affected by pollution from the metal-processing industry, discharge of untreated water from mines, ore enrichment, and leakages from tailing dams, as well as wastewater discharges from Ust-Kamenogorsk. In the past years, several measures have been taken to improve the situation by Kazakh authorities, also with the support of international organizations.

Total withdrawal and withdrawals by sector in the Ob River Basin

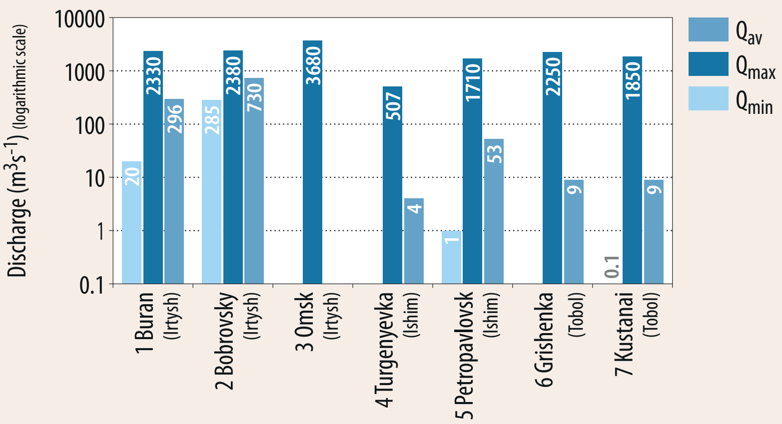
Country	Year	Total withdrawal ×10⁶ m³/year	Agricultural %	Domestic %	Industry %	Energy %	Other %
Russian Federation	2003	923.4[a]	N/A	N/A	N/A	N/A	N/A
Kazakhstan	2003, 2004	3 530.6[b]	30.4	8.4	50.8	N/A	10.4

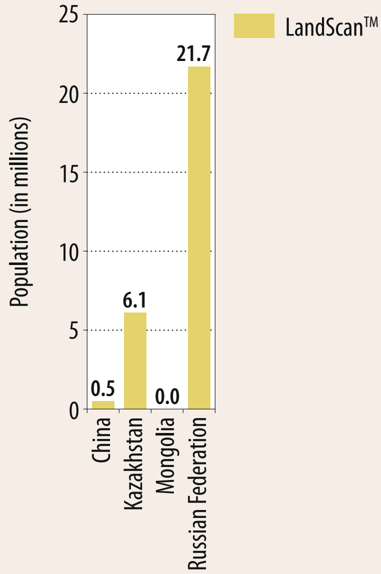
[a] The amount withdrawn by the Russian Federation is 70.3% surface water and 29.7% groundwater. The figure is the total withdrawal from all water bodies of the Ob Basin.
[b] The figure for Kazakhstan consists of withdrawals from tributaries of the Ob, the Irtysh, Tobol and Ishim.

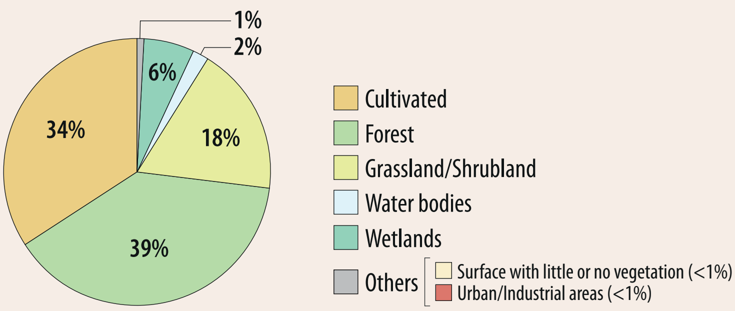
[29] *Source:* Mongolia: Assessment Report on Climate Change 2009. Ministry of Environment, Nature and Tourism, Mongolia. 2009.
[30] Based on information provided by the Russian Federation and the First Assessment.
[31] Based on information provided by Kazakhstan and the Russian Federation, and the First Assessment.
[32] The river is known as Irtysh in the Russian Federation, and as Ertis in Kazakhstan.
[33] The upstream part of the Irtysh flowing to Lake Zaysan is called Black Irtysh.



DISCHARGES, POPULATION AND LAND COVER IN THE OB RIVER BASIN







Sources: UNEP/DEWA/GRID-Europe 2011; Ministry of Environmental Protection of Kazakhstan.
Note: Population in the Mongolian part of the Basin is less than 400.

PREIRTYSH AQUIFER (NO. 8)

	Kazakhstan	Russian Federation
None of the illustrated transboundary aquifer types, see the sketch (Figure 5). Intergranular/multilayered aquifer; Paleogene and Cretaceous sands; groundwater flow direction from Kazakhstan (South) to the Russian Federation (North).		
Border length (km)	1 055	1 055
Area (km^2)	98 900	
Renewable groundwater resource (m^3/d)	2.644×10^6	
Thickness: mean, max (m)	333, 847	
Groundwater uses and functions	Groundwater abstraction is some 32.5×10^6 m^3/year, with 49% for agriculture, 48% for household water and 2% for industry.	
Pressure factors	Groundwater abstraction from the confined aquifer layers; Development of a regional cone of depression as a consequence of decreasing groundwater level is a problem.	
Management measures	A joint modelling to evaluate exploitable groundwater resources and their allocation is needed.	

FIGURE 5: Sketch of the Preirtysh aquifer (No. 8) (provided by Kazakhstan)

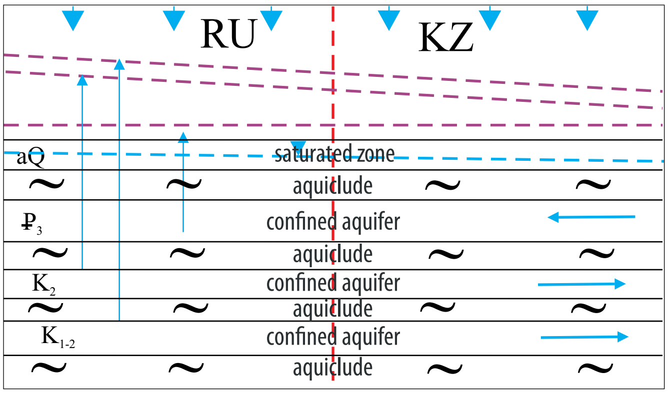
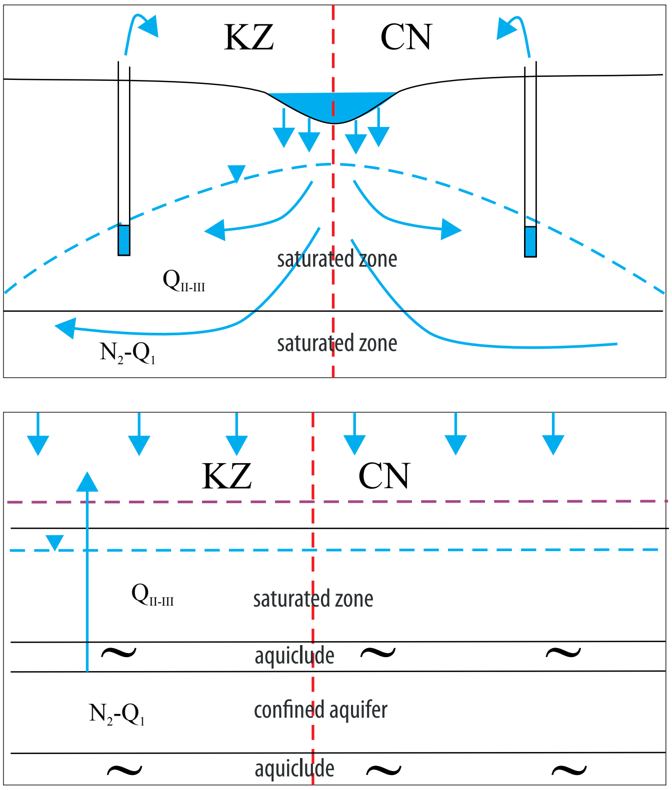


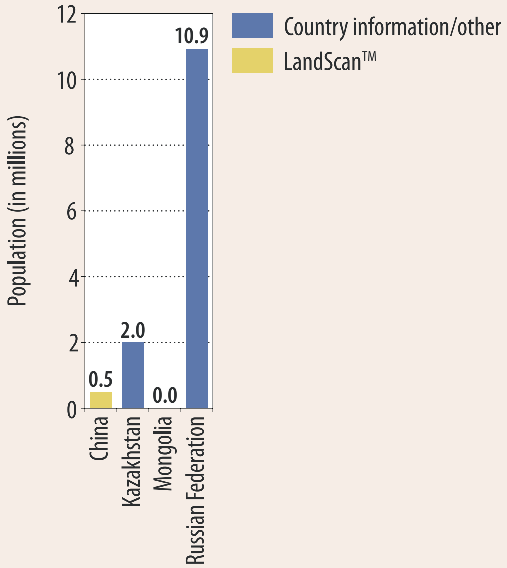
FIGURE 6: Sketch of the Zaisk aquifer (No. 9) (provided by Kazakhstan)



ZAISK AQUIFER (NO. 9)

	Kazakhstan	China
None of the illustrated transboundary aquifer types, see the sketch (Figure 6). Sand and gravel and pebbles; groundwater flow direction along the border from South to North; links with surface waters vary, being either strong or weak.		
Border length (km)	115	N/A
Area (km^2)	30 150	N/A
Renewable groundwater resource (m^3/d)	3.084×10^6	N/A
Thickness: mean, max (m)	83, 166	N/A
Groundwater uses and functions	Groundwater abstraction is some 1.32×10^6 m^3/year, 100% for household water.	N/A
Pressure factors	The abstraction is significantly less than the estimated exploitable groundwater resources. No actual problems.	N/A
Groundwater management measures	Early warning and surveillance monitoring are needed.	N/A

POPULATION IN THE IRTYSH/ERTIS SUB-BASIN



Sources: UNEP/DEWA/GRID-Europe 2011; Ministry of Environmental Protection of Kazakhstan.
Note: Population in the Mongolian part of the sub-basin is less than 400.

The conflict between hydropower production and shipping has been increasing due to limited water resource availability, and due to such factors as retaining water in the reservoir of Shul'binsk in the summer for hydropower production.

The main natural factors resulting in adverse impacts from water on the population and economic infrastructure in the Russian part of the Irtysh/Ertis Basin are floods, ice dams, rise of water levels in lakes, water erosion and the reduction of river channel capacity.

Wastewater discharges to the Irtysh/Ertis in the Russian part of the basin were estimated at some 2,167 × 10^6 m^3 in 2007. From 2002 to 2009, the volume of sewage discharge in total and of untreated sewage in the Omsk region in the Russian Federation has been decreasing fairly constantly.[34]

Status and transboundary impacts

At the monitoring station Boran, water entering the territory of Kazakhstan from China was classified as "clean" (class 2) in 2009. The concentration of total dissolved solids was 140 mg/l on average.

At the border with the Russian Federation, the water flowing from Kazakhstan was classified as "moderately polluted" (water quality class 3) in 2009. The concentration of total dissolved solids was 185 mg/l.

In the Russian part, the overall water quality was ranked as "very polluted" (class 4A) in 2007, according to the Russian classification. At the Tatarka monitoring station (17 km downstream from the border with Kazakhstan), water quality was classified as "polluted" (class 3b) in the same year.[35] From 2006 to 2009, a general decrease has been observed in the concentrations of metals (copper, iron, magnesium and zinc). Phenol and oil product concentrations also decreased in the same period. Downstream from Omsk, the concentrations of these metals, phenols and oil products, as well as biochemical oxygen demand (BOD5) and chemical oxygen demand (COD), have been observed to increase towards the border of Omsk and Tyumen oblasts in the Russian Federation.[36]

Trends

Water quality in the Irtysh/Ertis tended to improve in the late 1990s and in the 2000s.

At the same time, industrial and agricultural production in the basin has increased in the 2000s, and this trend is predicted to continue.

TOBOL SUB-BASIN[37]

The sub-basin of the 1,591-km long river Tobol is shared by the Russian Federation and Kazakhstan. The river has its source between the southern Ural and Turgay Plateau in Kostanai Oblast in northern Kazakhstan, and discharges into the Irtysh/Ertis River in the Tyumen Oblast (Russian Federation). The major transboundary tributaries are the Ubagan, Uy,[38] Ayat, Sintashta[39] and Toguzyak.

Total water withdrawal and withdrawals by sector in the Irtysh/Ertis sub-basin

Country	Year	Total withdrawal ×10^6 m^3/year	Agricultural %	Domestic %	Industry %	Energy %	Other %
Russian Federation	2007	2 785[a]	N/A	N/A	N/A	N/A	N/A
Kazakhstan	2003	3 166	31.5	5	52.9	-	10.6
	2010	4 100	34.2	5	45.2	-	15.6

[a] Of this total amount, some 77.7% (2,600 × 10^6 m^3/year) was surface water and 22.3% (620 × 10^6 m^3/year) was groundwater.

Water quality classification of the Irtysh/Ertis in Kazakhstan

Location of observation on the Irtysh/Ertis	Water pollution index[a] – water quality classification 2008	2009	Parameters exceeding MAC	Multiplier of MAC exceedence
Boran village, at the border with China	0.47; class 2, "clean"	0.70; class 2, "clean"	copper (2+)	1.39
Preirtysh, at the border with the Russian Federation	0.75; class 2, "clean"	1.07; class 3, "moderately polluted"	copper (2+)	1.8
			total iron	1.75

[a] The water pollution index is defined on the basis of the ratios of measured values and the maximum allowable concentration of the water-quality determinands.
Source: Kazhydromet, Ministry of Environmental Protection of Kazakhstan.

[34] Annual Nature Protection Reports of Omsk Regional Government.
[35] Scheme of complex use and protection of water resources in the Irtysh River Basin. Book 2. Assessing the environmental status and key issues of water bodies of the Irtysh Basin. ZAO PO Sovintervod, Moscow, 2009.
[36] Annual Nature Protection Reports of Omsk Regional Government (2006-2009).
[37] Based on information provided by Kazakhstan and the Russian Federation, and the First Assessment.
[38] The river is known as Uy in the Russian Federation and as Ujem in Kazakhstan.
[39] The river is also known as the Sintasti (Zkelkuar).

The basin area has a lowland character, with an elevation from 100 to 200 m a.s.l.

Sub-basin of the Tobol River

Country	Area in the country (km²)	Country's share (%)
Russian Federation	305 000	74.4
Kazakhstan	105 110	25.6
Total	**410 110**	

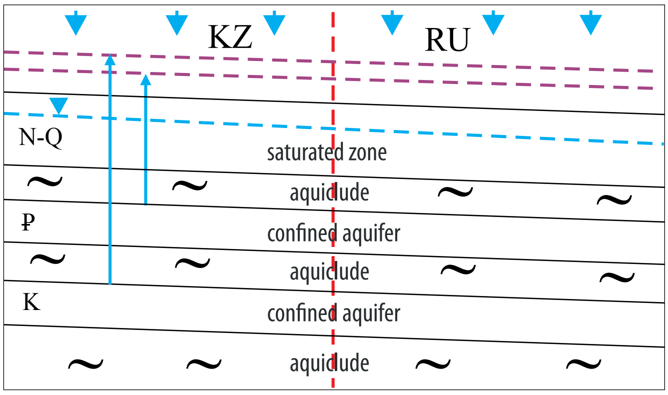
Sources: Scheme of complex use and protection of water resources in the basin of the Irtysh River, volume 1, general characteristics of the Irtysh Basin, ZAO PO "Sovintervod", Moscow, 2009; Integrated River Basin Management Plan, Kazakhstan, 2006.

Hydrology and hydrogeology

In the part of the basin that is Kazakhstan's territory, surface water resources are estimated at 777 × 10^6 m³/year (average for the years from 1938 to 2004), and groundwater resources at 286 × 10^6 m³/year.

The mean annual flow of the Tobol is 0.48 km³/year (15.2 m³/s). There are 624 reservoirs in the basin, providing drinking water and serving flow regulation.

FIGURE 8: Sketch of the North Kazakhstan aquifer (No. 10) (provided by Kazakhstan)



Pressures

Parts of the Tobol basin, for example in the Ural region and in the area of natural salt lakes in the Ubagan River sub-basin, have mineral rich bed-rock or high salinity soils that cause elevated concentrations of certain metals and other elements.

Industry and agriculture are developed in the sub-basin. Water management infrastructure and works, including withdrawals, inter-basin water transfer, operation of dams and reservoirs (Karatomarsk in particular), as well as amelioration work on agricultural and forested land, also impact on the flow and water availability.

In Kazakhstan, the main anthropogenic pollution sources are municipal and industrial (mining and ore processing) wastewaters, residual pollution from closed-down chemical plants in Kostanai, accidental water pollution with mercury from gold mining in the Toguzyak sub-basin, and heavy metals from other tributaries to the Tobol. Diffuse pollution from fertilizers in agriculture has been decreasing, but remains a problem. Spring floods result in polluted surface run-off.

In the Russian part, the main sources of pollution of surface waters are wastewater discharges from settlements where wastewater treatment does not meet the regulatory requirements. Diversion of water from the river, inter-basin transfer, operation of dams and reservoirs, and drainage works on agricultural land and forested areas are also among the pressures.

Erosion by water is intensified during periods of flooding, causing, for example, destruction of river banks in the Kurgan and Chelyabinsk regions in the Russian Federation.

NORTH-KAZAKHSTAN AQUIFER (NO. 10)

	Kazakhstan	Russian Federation
None of the illustrated transboundary aquifer types, see sketch (Figure 7). Intergranular/multilayered aquifer (confined), sand and gravel; groundwater flow direction from Kazakhstan (South) to the Russian Federation (North); links with surface waters. The aquifer extends to the basins of both Tobol and Ishim (in Kazakhstan the aquifer is within the Tobol Basin).		
Border length (km)	1 840	
Area (km²)	147 600	
Groundwater uses and functions	Groundwater abstraction about 47.3 × 10^6 m³/year (2008). Some 80% of it was for domestic use and 20% for industry.	

Total water withdrawal and withdrawals by sector in the Tobol sub-basin

Country	Year	Total withdrawal ×10^6 m³/year	Agricultural %	Domestic %	Industry %	Energy %	Other %
Russian Federation	2009	2 090.87	N/A	N/A	N/A	N/A	N/A
Kazakhstan	2004	151.62	17	31.65	50.92	-	0.43
	2010[a]	182.12	28.65	26.9	44.2	-	0.25

[a] The figures of Kazakhstan for 2010 are estimates. Withdrawals in 2015 are expected to be more than 20% higher than in 2010. Withdrawals for household water and for industrial purposes are predicted to decrease, and agricultural withdrawals are expected to increase.

Status

In 2008 and 2009, water quality in the Tobol (at Milyutinko station), as well as in the Ayat and Toruzyak tributaries, was classified as "moderately polluted".

According to monitoring in 2007, the general water quality in the Tobol in the Russian Federation was classified as "very polluted",[40] according to the Russian quality classification system.[41]

Responses

The 1992 Agreement on the joint use and protection of transboundary water bodies between the Russian Federation and Kazakhstan provides the basis for joint activities. The agreement contains provisions for a regular (monthly) exchange of information on the status of transboundary waters, and the emergency notification procedure in case of accidental spills or significant pollution of rivers. Hydrochemical and hydrological monitoring of transboundary waters is being carried out.

Water quality classification in the Tobol sub-basin

Location of observation in the Tobol Basin	Water pollution index[a] – water quality classification		Parameters exceeding MAC (2009)	Multiplier of MAC exceedence
	2008	2009		
Tobol River, Milyutinko station, 25 km upstream from the Russian border	1.58; "moderately polluted" (class 3)	1.49; "moderately polluted" (class 3)	copper (2+)	4
			hydrocarbons	2.23
			total iron	2.90
			iron (2+)	20.00
			manganese	20.50
			nickel	1.16
			sulphates	2.50
			ammonium nitrogen	1.04
				1.10
Ayat River, Varvarinka station, 5 km downstream from the Russian border	1.51, "moderately polluted" (class 3)	1.64, "moderately polluted" (class 3)	copper (2+)	4
			total sodium and potassium	1.19
			hydrocarbons	2.92
			COD	1.11
			total iron	3.90
			iron (2+)	14.00
			manganese	12.1
			sulphates	2.24
			saline nitrogen	1.13
			magnesium	1.27
Toruzyak River, Toruzyak station, 70 km upstream from the Russian border	1.45, "moderately polluted" (class 3)	1.88, "moderately polluted" (class 3)	sulphates	2.97
			total sodium and potassium	1.21
			hydrocarbons	3.19
			total iron	3.40
			iron (2+)	30.00
			phenol	1.00
			nickel	1.60
			manganese	17.20
			copper (2+)	2.303
			nitrate nitrogen	1.865
			magnesium	1.66

[a] The water pollution index is defined on the basis of the ratios of measured values and the maximum allowable concentration of the water-quality determinands.
Source: Kazhydromet, Ministry of Environmental Protection of Kazakhstan.

[40] Since 2002, water quality is assessed based on water pollution level classification developed by Roshidromet's Hydrochemical Institute using integrated assessments and 5 water quality classes: 1 class – conditionally clean; 2 class – slightly polluted; 3 class – polluted, 4 class – very polluted; 5 class – extremely polluted. The division into classes is based on critical indicators of pollution. Before 2002, the Russian water quality classification was based on the Water Pollution Index.

[41] Scheme of complex use and protection of water resources in the basin of the Irtysh River. Book 2. Assessing the environmental status and key issues of water bodies of the Irtysh Basin. ZAO PO "Sovintervod, Moscow, 2009.

Trends

Pollution in the Tobol in Kazakhstan has been increasing since 2001, and water quality has been downgraded from class 2 (clean) to class 3 (moderately polluted). Pollution has an adverse impact on drinking-water supply.

ISHIM/ESIL SUB-BASIN[42]

The sub-basin of the Ishim/Esil[43] is shared by Kazakhstan and the Russian Federation. The river originates in the Niaz mountains in Kazakhstan, and flows into the Irtysh/Ertis River.

Sub-basin of the Ishim/Esil River

Country	Area in the country (km^2)	Country's share (%)
Russian Federation	34 000	18
Kazakhstan	155 000	82
Total	**189 000**	

Sources: Scheme of complex use and protection of water resources in the basin of the Irtysh River, volume 1, general characteristics of the Irtysh Basin, ZAO PO "Sovintervod", Moscow, 2009; Integrated River Basin Management Plan.

Hydrology and hydrogeology

The surface water resources in the part of the basin that is Kazakhstan's territory are estimated at 2.59 km^3/year, and groundwater resources at 0.165 km^3/year.

In the Russian part, surface water resources are estimated at 2,630 m^3/year and groundwater resources at 48.329 m^3/year, representing 5.9 m^3/year/capita.[44]

There are 16 reservoirs, with a volume exceeding 1 million m^3 on the Ishim/Esil River; all of them in Kazakhstan. The guaranteed minimum flow at the border section (2.4 m^3/s) is reflected in the operational rules for the joint management of two reservoirs (Segrejevsk and Petropavlovsk reservoirs). A specific working group under the auspices of the joint Russian-Kazakh Commission deals with water-quantity issues, including flow regulation.

Pressures

In the settlements in the Ishim/Esil Basin in the Russian Federation, the requirements for water supply sources and treatment of municipal and industrial sewage are not met.

Status

Water quality in the Ishim/Esil at the Dolmatovo station (689 km from the river mouth) in Kazakhstan was classified as "moderately polluted" (Water Pollution Index 1.70). A concentration exceeding the Maximum Allowable Concentration was observed for copper (5.02 times MAC, zinc 1.08 MAC, sulphate 1.30 MAC and total iron 1.43 MAC).

From the mid-1990s onwards, the water quality has been described as "clean" (class 2) or "moderately polluted" (class 3).

Overall assessment of water quality of the Ishim/Esil in the Russian Federation was classified in 2007 as "very polluetd" (class 4B) according to the Russian classification system (water pollution index 4.9).[45]

Total water withdrawal and withdrawals by sector in the Ishim/Esil sub-basin

Country	Year	Total withdrawal $\times 10^6$ m^3/year	Agricultural %	Domestic %	Industry %	Energy %	Other %
Russian Federation	2009	12.26	N/A	N/A	N/A	N/A	N/A
Kazakhstan	2004	212.97	22	42.4	20.3	-	15.3
	2010[a]	33.05	11.9	56.5	30.7	-	0.9

[a] The figures of Kazakhstan for 2010 are estimates.

TOBOL-ISHIM FOREST-STEPPE[46]

General description of the wetland

The site covers 217,000 ha, and is located in the Ishim province of the forest-steppe zone (birch and aspen forests interspersed with meadows and steppe) on the Western Siberian Plain (average elevation 138 m a.s.l.), 190-250 km south of the city of Tumen and 7 km to the south of the town of Ishim. Characteristic features of the landscape include enclosed lakes, linear formations such as gently sloping ridges, dry river-beds, depressions and wide shallow river valleys (the Ishim/Esil and Emets[47]). The wetlands are represented mainly by lakes (which cover an area of 95,000 ha) and small rivers with marshy catchments, but also by forested peatlands, salt inland marshes and wet meadows. The lakes vary in salinity from 1 g/l (freshwater), dominating in the northwest, to more than 25 g/l in a south-easterly direction as climatic conditions become more arid and

[42] Based on information provided by Kazakhstan and the Russian Federation, and the First Assessment.
[43] The river is known as Ishim in the Russian Federation and as Esil in Kazakhstan.
[44] Scheme of complex use and protection of water resources of the Ishim. Volumes 1 (Summary of the explanatory note, 2004), 3 (water resources and their current status, 2004) and 6 (water management and protection activities, 2005), ZAO PO "Sovintervod, Moscow.
[45] Scheme of complex use and protection of water resources in the basin of the Irtysh River. Book 2. Assessing the environmental status and key issues of water bodies basin. Irtysh. ZAO PO "Sovintervod, Moscow, 2009.
[46] *Source:* Ramsar Information Sheet.
[47] The Emets River is a tributary of the Vagay which is a tributary of the Irtysh.

continental. The hydrological regime of the lakes is characterized by dramatic long term (20-50 years) and less pronounced short term (5 years) cyclical changes in inundation, which are determined by variations in climate, with evaporation as a key factor. This results in marked changes in water level, hydrochemical composition, size, shape and even the disappearance of lakes for several decades. The lakes are fed by surface run-off, groundwater and precipitation (450–475 mm annually).

Main wetland ecosystem services

The rivers and lakes, as well as other water bodies, are very important reserves of freshwater. The storage of floodwaters helps to regulate the flow of water in the rivers, and is used for hydropower production. A specific micro-climate has formed in the area, under the influence of extensive water surfaces and wetland vegetation, which helps to reduce the effects of droughts and dry winds. Agriculture, including the production of cereal, fodder crops and vegetables, is well developed. Hay is produced and cattle graze close to human settlements. The harvesting of berries and mushrooms plays a significant role. Fishing is practiced in most lakes in the region throughout the year. Waterfowl hunting is permitted during specific periods. The river banks and lake shores are used for recreation by local people.

Biodiversity values of the wetland area

The Tobol-Ishim forest-steppe supports a great number of migrating and breeding populations of wildfowl and colonial shore birds, including several rare migrating species, such as the Lesser White-fronted Goose, Red-breasted Goose, Bewick's Swan and Taiga Bean Goose, as well as regular migrating species such as the Common Crane. In the Ramsar Site within the protected area "Byelozersky zakaznik", a project on Siberian Crane reintroduction is under implementation. Further, the site lies at the northern edge of the breeding area of a number of species such as the Dalmatian pelican, the black-winged stilt, and the avocet. Mammal species include 50 species such as elk, lynx, and wolf. Fishes include both indigenous species and introduced species. Other species of interest are the Siberian salamander, and the sand lizard. Many lakes and marshes are overgrown with emergent, floating and submerged aquatic plants. Species listed in the Red Data Book of the Russian Federation include orchids such as Lady's-slipper Orchid and Ghost Orchid. Moreover, the Ramsar Site is a refuge for species which are on the edge of becoming endangered due to the disappearance of steppe landscapes, such as the Allium nutans, Pulsatilla flavescens Siberian Iris.

Pressure factors and transboundary impacts

The concentrations of heavy metals are naturally elevated, due to the occurrence of mineral-rich bedrock. Additionally, natural salt lakes cause elevated mineralization, which deteriorates the quality of drinking water. Anthropogenic pollution sources are municipal and ore mining wastewaters, as well as residual pollution from closed-down chemical plants in Kostanai. Moreover, water resources are being overused for irrigational purposes, which cause variations in the water level. Poaching has a significant impact, and has become a large-scale activity during the past decades. Grazing and hay production have a negative effect on waterbirds during the breeding period, especially during hot and dry climatic conditions. The permanent presence of people causes a higher likelihood of fires.

The introduction of plankton-eating species and carps into some of the water bodies has caused a great reduction in the biomass of zooplankton and benthos, which are the main food resources for many species of waterbirds. The population of Crucian Carp (an indigenous species) has decreased, as juveniles are caught along with the carp. Fishing is also a major cause of disturbance of birds and other animals. Despite strict limitations, waterfowl shooting (especially in spring) has a considerable negative effect upon local and migrating populations of waterfowl.

Transboundary wetland management

There are 10 protected areas of different status within the Ramsar Site, such as the Federal Byelozersky Zakaznik (since 1986, 17,850 ha of core and 2,168 ha of buffer zone) and regional protected areas – Okunevsky (1930 ha), Pyesochny (930 ha), Kaqbansky (22,400 ha), and Tavolzhan (2,720 ha). The Federal Byelozersky Zakaznik was a model area for the international GEF/UNEP project on Siberian Crane, in which six countries have been cooperating in terms of population management. The Russian Federation and Kazakhstan cooperate on transboundary waters through a joint commission established on the basis of the 1992 bilateral Agreement. However, disagreements exist in terms of water use for irrigation and maintenance of infrastructure on the Kazakhstani side. A number of measures aimed at limiting economic activities have been proposed, including restrictions on grazing, fishing of Crucian Carp during the spawning period, and fishing during the breeding season of waterbirds, as well as the use of fishing nets that are fixed on river banks. There is a need to establish protected belts around all the lakes, and to carry out measures for the restoration of trees and shrubs in these zones. There is also a need to prohibit the shooting of waterfowl in spring.