Section 1. Sustainable water supply systems

Brief outline of the report
Use of ground water for drinking purposes in the Arkhangelsk Oblast
(Ground water as a source for drinking water supply)

Ground water together with surface water is a source **drinking water supply** and is used for life support.

Ground water as a source for household and drinking water supply has a number of advantages as compared to the surface water:

- it is characterizes by a higher quality and does not require expensive and multi-component treatment,
- it is better protected from dirt and precipitation,
- it is not exposed to considerable seasonal and multi-year fluctuations,
- it can be extracted in close proximity to consumers,
- water intake facilities can be put into operation step by step in accordance with the increase of water demand.

The necessity to use ground water in the household and drinking water supply systems on a priority basis is determined by a number of legislative documents.

That is why the most important task in the sphere of ground water management is to regulate its use with the purpose to supply the demand from population and economy including the arrangement of sustainable reproduction of resources.

Ground water from different horizons can be used and is used as sources for household and drinking water supply in the Arkhangelsk Oblast. Water quality in them meets the drinking water standards by most parameters (a map).

To produce ground water for household and drinking water supply plots of land are provided. They are located both on the ground water deposits and outside them (separate wells).

In spite of obvious advantages and legislation surface water continue to be traditionally used in the Arkhangelsk Oblast. Although surface water is not protected from pollution, its quality and state for many years have been considered as unsatisfactory. Huge financial resources are spent for treatment of contaminated surface water in the cities, in some of the areas surface water is used without any treatment thus causing regular outbreaks of infectious diseases.

Ground water resources in the Arkhangelsk Oblast are not exploited to their full capacity. Annual surface water extraction is 650-700 million m^3 per year, underground water – 55 million m^3 per year, i.e. 7-8 % out of the total volume. Ground water extraction for household and drinking water supply in the Oblast is only 16-19 % (the average figure in Russia is 45%). At the same time fresh underground water is of great importance for the development of the region for it is the most protected, and by large, the only household and drinking water supply source that is exploited almost in all the district of the Oblast. Groundwater sources are used as the only water supply source in 4 cities with the population up to 50 thousand people (Kargopol, Mirnyj, Mezen, Nyandoma)

and 14 urban-type settlements. Among cities Mirnyj and Nyandoma remain the largest consumers of underground water.

Consolidated data for ground water production and supply on the territory of the Arkhangelsk Oblast in 2009

	Regional district	Ground water production, thousand m^3 per day			Water discharge without using: dewatering and losses, thousand $м^3$ per day	Use of ground water, thousand m^3 per day			
		Total	Including:			Total	Including for:		
			Water extraction sections	dewatering and drainage sections			Household and drinking water use	Production and technical water use	Agricultural water use
1	2	3	4	5	6	7	8	9	10
1.	Velskij	6,281	6.281		0,259	6,022	2,183	0,652	3,187
2.	Verkhnetoyemskij	0,266	0.266		0,002	0,264	0,231	0,031	0,002
3.	Vilegodskij	0,441	0,441		0,036	0,405	0,333	0,059	0,013
4.	Vinorgadovskij	0,814	0,814		0,098	0,716	0,45	0,243	0,023
5.	Kargopolskij	1,83	1.83		0,014	1,816	1,448	0,155	0,214
6.	Konoshskij	2,597	2,597		0,338	2,259	1,815	0,444	0
7.	Kotlasskij	1,081	1,081		0,295	0,786	0,683	0,061	0,042
8.	Krasnoborskij	0,236	0,236		0	0,236	0,178	0,04	0,018
9.	Lenskij	0,847	0,847		0,017	0,83	0,504	0,326	0
10.	Leshukonskij	0,454	0,454		0,054	0,4	0,303	0,097	0
11.	Mezenskij	0,574	0,574		0,028	0,546	0,465	0,069	0,012
12.	Nyandomskij	7,395	7,395		1,065	6,33	5,758	0,498	0,074
13.	Onezhskij	2,56	2,524	0,036	0,781	1,779	1,704	0,075	0
14.	Pinezhskij	1,395	1,395		0,054	1,341	1,025	0,307	0,01
15.	Plesetskij	79,134	54.022	25,112	36,515	42,619	34,805	7,795	0,019
16.	Primorslij	58,422	0,402	58,02	58,02	0,402	0,106	0,296	0
17.	Solovetskij	0	0		0	0	0	0	0
18.	Ustjyanskij	2,215	2,215		0,149	2,066	1,699	0,367	0
19.	Kholmogorskij	1,307	1,307		0	1,307	1,142	0,08	0,085
20.	Shenkurskij	0,176	0,176		0,004	0,172	0,157	0,016	0
	Totally in the Oblast	**168,03**	**84.86**	**83,17**	**97,73**	**70,30**	**54,99**	**11,61**	**3,70**

In general the calculated fresh ground water extraction in the Arkhangelsk Oblast in 2009 was 168.03 thousand m^3 per day or 61.3 million m^3 per year. Out of the total amount of extracted water 84.86 thousand m^3 per day were run by water extraction facilities, 83.17 thousand m^3 per day were extracted out of quarry dewatering without water use (quarries Pokroskij, Ogarkovskij, Severoonexhskij bauxite mine SOBR, Pomorje).

Fresh ground water supply in the Oblast in 2009 was 70.30 thousand m^3 per day, including 54.99 thousand m^3 per day for household and drinking purposes, for production and technical purposes – 11.61 thousand m^3 per day, for agricultural purposes – 3.7 thousand m^3 per day. 83.17 thousand m^3 per day of quarry dewatering is discharged without water using. Water discharge without using (dewatering and losses) is 97.73 thousand m^3 per day or 58% of the total production volume.

Water extraction level of most water consuming enterprises does not exceed 100 m^3 per day. Only 5 water consumers used 500-1000 m^3 per day, and 17 water consumers – more than 1 thousand m^3 per day.

According to the powers of the local bodies for natural resources management one of their jobs is to estimate the state and quality of the resource base for underground water and ensure its rational use. The present-day objectives for development of the ground water resource base for drinking purposes is to create and increase potential for maximum possible drinking ground water supply to population and industries, to switch completely or partially to protected ground water sources for household and drinking water supply, to create strategic reserves of ground water stocks.

Today the resource base of drinking ground water in the Arkhangelsk Oblast is represented by its hypothetical resources (15727.09 thousand m^3 per day) and estimated reserves of registered deposits (1308.21 thousand m^3 per day). With the number of population in the Oblast 1209.2 thousand people, one inhabitant can consume 13 m^3 per day of hypothetical drinkable ground water resources and more than 1 m^3 per day of estimated reserves.

List of drinkable ground water deposits (as for 01.11.2010)

№	Name	Water-bearing layer	Reserves, thousand m^3 per day	Water extraction thousand m^3 per day in 2009
1	2	3	4	5
1.	Arkhangelskoye	V	210.0	-
2.	Belogorskoye	Q_{III-IV}	228,7	-
3.	Bereznikovskoye	P_2kz_2	1,0	0.24
4.	Velskoye	P_2kz_2	0,2	0.03
5.	Berkhnetoyemskoye	P_2t	3,33	-
6.	Denislavskoye	$C\text{-}P_1$	65.8	1.99
7.	Zolotitskoye	V	56,0	-
8.	Kargopolskoye	$C\text{-}P_1$	56,8	-
9.	Karpogorskoye	$P_2kz\text{-}t$	3,42	-
10.	Konoshskoye	P_2kz_2	12,12	-
11.	Krasnoborskoye	a II	1,2	0.03
12.	Lesnoye	C_2	0,145	0.05
13.	Leshukonskoye	$P_2kz_2 – t$	5,2	-
14.	Mezenskoye	$P_2kz_2\text{-}t$	3,01	-
15.	Nyandomskoye	$C\text{-}P_1$	21,96	1.47
16.	Onezhskoye	f III	4,42	2.27
17.	Oktyabrskoye	P_2nu	2,0	1.09
18.	Permilovskoye	C_{2-3}	457,0	0.315
19.	Privodinskoye	P_2t	1,43	0.88
20.	Tundra – Lomovskoye	C_{2-3}	35,0	0.02
21.	Savinskoye	C_{2-3}	40,995	0.03

22.	Severoonezhskoye	C_{1-2}	20.7	-
23.	Skorodumovskoye	P-T	0.13	0.04
24.	Tovrinskoye	C_{2-3}	9,0	0.21
25.	Urdomskoye	la II	2,9	0.60
26.	Tchernenskoye	C_{1-2}	0,1	-
27.	Mirninskoye	C_3- P_1	65,77	38.19
	Total		**1308.3**	**47.9**

Operated / producing deposits are highlighted

Explored reserves of fresh ground water are located in 17 administrative districts, and mainly can be used for household and drinking water supply to the population. The regional districts are not evenly provided with the ground water reserves: most of them are concentrated in the Plesetskij and Primorskij districts, where most of the deposits have been found (15). In the districts like Vilegodskij and Shenkurskij there are no explored reserves.

4 district centres (settlements Iljinsko-Podomskoye, Yarensk, towns Kotlas and Shenkursk) are not provided with estimated ground water reserves.

Rural settlements do not have explored ground water sources for water supply. There have been no tasks to find them, accordingly geological exploration has not been performed.

Degree of the reserves development. There are 27 sources of drinkable ground water controlled by the State in the Oblast. Out of them 10 deposits are used according to their target purpose, at other 6 deposits subsoil areas are provided for operation with separate wells, 11 more deposits are not used at all.

The degree of reserves development in the Arkhangelsk region (ratio between the volume of extraction and the volume of reserves) is 12.8%, which is rather low for the Oblast. Only at 2 out of 16 operated deposits (Mirninskoye and Privodinskoye) the degree of reserves development is over 50%.

The present-day use of ground water for household and drinking water supply on the territory of the Arkhangelsk Oblast is **54.99** thousand m^3 per day, which is **0.35%** of hypothetical reserves, and **4.2 %** of resources.

Development of deposits explored 15 – 25 years ago is restricted by non-geological factors: economic situation, technological conditions, state of communal housing facilities, conservative character of the sector, large distances from the explored sites to consumers, lack of money in the local budgets of municipalities, and absence of sustainable financial sources for the local target programs.

Thus, in spite of constant demand for good-quality drinking water in practically every district of the Oblast, in spite of long-term works to increase the resource potential, including also exploration of new sites where it can be found, actual need for discovered reserves in the Oblast is still rather low.

Natural characteristics of the ground water in use. On the territory of the Oblast there are separate hydro chemical provinces with high content (as compared to the existing norms) of some micro components: **ferrum, strontium stable, sulphates, rarely – manganese, and also some of the physical parameters (color index, turbidity), and**

hardness. Their presence in the water in concentrations exceeding maximum permissible concentrations is explained by natural factors: geological structure, lithological composition of reservoir, water supply conditions and water circulation.

The suggestions from the Arkhangesknedra (Arkhangelsk Subsoil Reserves Agency) to take measures aimed at sustainable management of the resource potential for maximum possible drinking underground water supply to the population of the Arkhangelsk Oblast:

- to ensure priority of underground water bodies when choosing a source for drinking water supply;
- step-by-step transition of water supply of towns and settlements in the Arkhangelsk Oblast to underground sources on the basis of explored deposits reserves;
- shifting a number of existing water extraction points to more protected aquifers (Plesetsk, Savinskij, Kargopol),

- implementation of comprehensive water protecting measures and observation of special regimes within sanitary protective zones around water intake facilities;

- introduction of modern water treatment methods and technologies, including development of water treatment strontium-using methods (Mezenskiy, Vinogradovskiy, Velskiy districts);

- financing from the budget for geological exploration for drinking underground water to find water supply sources (including back-up sources) for settlements (with population more than 1 thousand people).
- **development of a program document, which would include:**
- a complex of current and perspective administrative, sanitary, technical, planning and other activities, aimed to provide population with drinking water in sufficient amount and to improve its quality;
- to identify financial sources on different levels.