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THE GROUNDWATER MONITORING IN THE NOVGOROD REGION IN THE SYSTEM OF REGIONAL NATURE MANAGEMENT

This article examines the current state of the groundwater system monitoring in the Novgorod region. The groundwater monitoring observations serve as the basis for prediction assessment of water resources. The efficiency of water resource management largely depends on the comprehensiveness and reliability of information on the groundwater condition.

The existing groundwater monitoring system has proven to be incapable of fully implementing its functions. It requires a fundamental reorganization and further development at the contemporary scientific and technical level, since groundwater resource management is impossible without a quantitative forecast of groundwater condition and properties.

From the perspective of rational Nature management, the leading ecological function of underground hydrosphere is carried out by fresh underground waters. Rational Nature management underlies the sustainable development of the Northwest region, which is economically viable for the European territory of the country.

Key words: groundwater monitoring, aquifer system, water resources, nature management, sustainable development.

Within the nature management structure of the North-western region of the Russian Federation, water resource management is of special importance. Water resource management should be performed in the framework of the adopted Concept of transition of the Russian Federation to sustainable development of 1996, the federal law on environmental protection of 2002, the Water code of the Russian Federation of 2006, and the subsoils law and it should be of targeted nature giving priority to utility and drinking water supply.

Groundwater, being a part of both water resources and subsoils, is a valuable deposit, the use of which is increasing every year in the socioeconomic sphere, mainly, within drinking and utility water supply. Groundwater management, especially, in the conditions of considerable anthropogenic stress, is impossible without a quantitative forecast of groundwater condition and properties. The efficiency of water resource management solutions, the choice of line and extent of environment protection initiatives depend to a certain degree on the completeness and validity of information on the intensity and nature of changes in the groundwater condition [1, p. 85].

In order to ensure rational extraction of groundwater, it is necessary to introduce groundwater monitoring aimed at the assessment of its condition, as well as the forecast of changes in its condition under anthropogenic and natural forcing. The solution to the water resource management problem is constantly adjusted as new data on the parameters of water resource condition are obtained.

Today, groundwater monitoring is one of the central and best-developed subsystems of state subsoil monitoring (SSM). Groundwater monitoring in the framework of SSM cooperates in terms of information with the unified state system of natural and anthropogenic emergency prevention and response, state water body monitoring, state water body register, social-hygienic monitoring of the quality of groundwater drinking and utility water supply sources.

This article sets out to assess the efficiency of groundwater monitoring in the Novgorod region.

The Novgorod region is situated within the Russian platform comprised of a complex of sediments ranging from the upper Proterozoic to the mid-Carboniferous deposited on the Archaean-Proterozoic crystalline basement below the Quaternary sediments. Sweet groundwater is widespread in the upper part of the sedimentary cover and belongs to the Quaternary and Palaeozoic deposits. The water-bearing system of sediment cover is comprised of a layer of terrigeneous and carbonate rocks containing interstitial and karst waters. The groundwaters of major aquifers are, as a rule, artesian. In terms of natural protection of groundwaters, most of the studied area is relatively protected. Thanks to insignificant anthropogenic stress, negative anthropogenic impact is exerted on the geological environment, in particular, groundwaters, occasionally. The anthropogenic stress is the highest in Novgorod, Borovichi, Staraya Russa, Okulovka, and Uglovka — the sites of large industrial facilities.

In terms of hydrogeology, most of the region (49.2 thousand km^2) is situated within the Leningrad artesian basin. Its eastern part (6.1 thousand km^2) covering the Pestovo, Moshenskoye, Khvoinaya and parts of the Lyubytino, Borovichi, and Okulovka, as well as part of the Valdai, Demyansk, and Maryovo districts in the south and southeast of the regions belongs to the Moscow artesian basin [2, p. 16].

The region is supplied with ground and surface waters. Groundwater water supply sources are represented by the aquifer systems (AS) of the upper and mid-Devonian developed from the surface in the Leningrad artesian basin (the Sargayevo-Daugava, Snezhskoye-Plavsk, and Aruküla-Šventoji AS), which account for 70% of water yield, and the aquifer systems of the lower and mid-Carboniferous composing the upper layer of the hydrogeological section of the Moscow artesian basin (the Venyov-Protvino and Myachkovo-Kashira AS). The waters of Quaternary sediments develop sporadically, their practical value is limited. In general, the predicted sweet groundwater resources in the Novgorod region are several times higher than the future demand; however they are very unevenly distributed over the territory [2, p. 17].

Water supply of towns and urban settlements is based on the use of both surface and groundwaters. The utility and drinking water consumption accounts for 50% in the general water supply balance. In the Batetsky, Borovichi, Valdai, Volot, Krestsy, Maryovo, Lyubytino, Okulovka, Poddorye, Staraya Russa, and Holm districts, drinking water supply is provided by groundwaters only. In the Demyansk, Soltsy, Khvoinaya, and Shimsk districts, groundwaters account for 95—98%. In other districts, this indicator

ranges from 9 to 51%. On the 50—70% of the Novgorod, Soltsy, and the north of the Staraya Russa district, grounwaters are absent [2, p. 60].

Moreover, mineral waters are widespread in the territory of the region; they are used for balneological purposes at Staraya Russa resort, as well as by local bottled water producers.

Important objects of study for state groundwater monitoring are the Quaternary sediment aquifers and aquifer systems, aquifer systems of the mid- and lower-Carboniferous (the Kashira, Venyov-Protvino systems) and of the mid- and upper Devonian (Sargayevo-Daugava, Snezhskoye-Plavsk, and Aruküla-Šventoji systems) [2, p. 18].

The structures of the state groundwater monitoring networks fall into several groups according to the governing body. The basic state network includes observation posts supervised by the State subsoil monitoring service of the Ministry of natural resources and the environment of Russia. The agency and territorial networks cover observation posts supervised by the corresponding agencies of the Russian Federation and municipalities of the constituent entities of the Russian Federation. The territorial network is designed for studying the existing geological environment pollution sites aiming to assess their impact on the groundwater quality. The local network observation posts are supported by subsoil users and other economic entities.

As of 2010, the monitoring network operating in the Novgorod region included 107 wells, out of which 41 belonged to the federal and territorial, and 51 to the local networks [2, p. 18].

In the Novgorod region, aquifers and aquifer systems are studied:

— in the territories with natural hydrodynamic regime: 16 posts in the Leningrad artesian basin and 5 posts in the Moscow artesian basin;

— at large groundwater intake facilities operating at producing sites, as well as in the detected and potential pollution areas: 27 posts in the Leningrad artesian basin and 7 posts in the Moscow artesian basins;

— in specially protected territories (the Valdai national park): 6 observation posts [2, p. 29].

Most objects under observation in the Novgorod region (aquifers and aquifer systems) are studied within local networks. Below is the distribution of networks according of objects under observation in artesian basins.

The Leningrad artesian basin

1. An aquifer system of the Quaternary sediments (a study into the conditions of formation of natural groundwater resources). Monitoring is conducted at six wells of the federal network.

2. A lower-Carboniferous terrigeneous-carbonate system (the formation of groundwater natural resources and storages). There are no federal network observation posts.

3. An upper-Devonian terrigeneous system (including the formation of groundwater resources and storages), including the Snezhskoye-Plavsk aquifer. The sweet waters of the system are used in nine district centres of the region. There are no observation posts of the basic state network. The largest anthropogenic object — a potential threat to the geological environment —

is the Neva underground gas storage facility occupying an area of dozens of square kilometres. The quality of groundwater is monitored at seven local network wells.

4. A mid-Frasnian terrigeneous-carbonate aquifer system (which is the major source of utility and drinking water supply) including the Sargayevo-Daugava aquifer providing water supply to the western and northern parts of the region. It is represented by three posts of the federal and one of the territorial networks. The monitoring of a large depression cone development in the zone affected by water intake facilities in the four areas of the Staraya Russa aquifer is carried out within the aquifer system.

5. The upper-Eifelian-the lower Frasnian terrigeneous system, including the Aruküla-Šventoji aquifer, which is almost completely bedded below the Sargayevo-Daugava aquifer, is used for supplying water to the north-west of the region. It is supervised at one observation post of the federal network. A number of small depression cones are monitored within the local network.

The Moscow artesian basin

1. A Quaternary aquifer (level forecast, study into the conditions of groundwater natural resource formation), two federal network observation posts.

2. An upper-mid-Carboniferous carbonate system (widepread in the eastern part of the Novgorod region — the Pestovo, Moshenskoye, Borovichi, and Khvoinaya districts). It is represented by one observation post of the federal network.

3. The lower-Carboniferous terrigeneous-carbonate systems, including the Venyov-Protvino aquifer, two observation posts.

It is indicative that the aquifers contributing most to the water supply system are observed predominantly in the framework of the local network [2, pp. 20—21, 35—37].

No groundwater basins exhibiting resource depletion and decreased groundwater levels below the admissible minimum have been detected on the territory of the Novgorod region. The condition (quality) of groundwaters has hardly changed over the last ten years. Organoleptic indicators (colour, turbidity), oxidising, iron content, which are affected, as a rule, by natural factors in case of ground waters, fell short of the standard.

However, the existing groundwater monitoring systems face a number of problems. Some of the monitoring network observation posts need to be repaired. The abandoned posts of the state network are neither suspended, nor liquidated due to insufficient financing; pollutants can penetrate groundwater through the remaining wells.

The state network is engaged predominantly in the observation of natural groundwater regime, while the local one in the modified regime (at water intake facilities). At the same time, the observation network has not been registered as state property, thus, it cannot be legally protected when land owners plan to use the well site otherwise. Therefore, it is necessary to solve the problem of legal status of the basic and territorial monitoring networks at the state level. The observation of anthropogenic pollution of groundwaters

is conducted mostly by subsoil users; however, only half of them regularly report to local State subsoil monitoring offices. In order to identify the present condition and stress the need for a monitoring network in the areas of anthropogenic pressure on geological environment, it is necessary to ensure prompt supply of information on the characteristic of anthropogenic objects and their location. The hydrochemical groundwater regime in the areas of anthropogenic impact requires more attention (in view of the fact that the federal financing of this regime is almost nonexistent).

The study of natural (background) groundwater regime, which is taken as the initial state and the reference point for groundwater measurements, requires further development of the state groundwater monitoring network (SGMN) in the Novgorod region at the following objects of federal significance:

1) a SGMN object — "the Quaternary aquifer system in the impact area of a potential source of pollution (the Azot chemical plant)";

2) a SGMN object — "the lower-Carboniferous aquifer system of natural groundwater condition" in the recharge area for the assessment of the level regime and the groundwater quality.

3) a SGMN object — "the upper-Devonian aquifer system with natural groundwater condition. There is no monitoring network in the area, thus, it is recommended to drill a number of wells for the observation of level and quality control from the recharge to discharge area.

The efficient functioning of state subsoil monitoring system is possible only against the background of systematic information cooperation with related environmental protection services and the administration of the Novgorod region. There is a need for better coordination of observation organisation and performance and data systematisation between the related agencies and services engaged in the field of environmental protection and nature management.

Apparently, the existing groundwater monitoring network has lost its significance from the perspective of exhaustiveness of its functions and requires a serious reorganisation and further development. So, the problems solved by the state monitoring system should be considered not within the border of constituent entities but within those of SGMN priority objects: artesian basins crucial for aquifer recharge and natural-anthropogenic complexes.

From the perspective of rational nature management, sweet groundwater resources take priority over other environmental functions of underground hydrosphere. The resource function, in its turn, is determined by the conditions of formation, distribution and exploitation of this type of waters — the factors that affect groundwater regime.

As of today, the solution to the problem of control and management of the water resources condition on a vast territory can be found through the establishment of an effective technology of automated monitoring. A monitoring system employing recent technologies should have modern equipment and a unified methodology for obtaining, processing, and analysing informa-

tion on the condition of objects observed. Such technology will help solving the following acute problems [3, p. 148]:

— control over the spreading of pollutants in groundwater basins;

— rational establishment of borders of sanitary protection zones of groundwater intake facilities;

— rapid emergency detection and development forecasting;

— rational decision-making.

Rational nature management underlies gradual sustainable development of the North-western region — a region crucial for the economy of the European part of the country.

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