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The condition and needs of monitoring the quantitative status of groundwater bodies in Serbia

Състояние и потребност от мониторинг за количествена характеристика на подземните водни тела в Сърбия

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Water is the most important natural resource for the survival of humanity, which commits us to its collective rational use and protection against pollution, with a goal of establishing good foundations for the sustainable development of water resources for future generations. On 23 October 2000, the European Parliament and the Council of the European Union adopted the Water Framework Directive (2000). In doing so, the European Union has changed its previous and established its new long-term water policy. It is a document with guidelines and standards for integrated and sustainable water management in the territory of all EU Member States, as well as in those that are in the process of accession. The Directive sets out certain conditions which should enable the implementation of the adopted policy of sustainable water use and water protection. It establishes the obligation to carry out monitoring of the quantity and chemical composition of groundwater as the basic procedure for achieving the goals of sustainable development. The main objective of the Framework Directive is to bring all natural waters into “good condition”, i.e. to ensure good chemical and environmental status of the water.

In Serbia, groundwater monitoring was established in 1947, by a decision of the Federal Administration of the Hydrometeorological Service of the Federal People’s Republic of Yugoslavia (FPRY) (Nikolić et al., 2012). The operation of water stations was regulated by Water Laws of individual republics and the Law on Hydrometeorological Activity. According to the “Rulebook on identification of networks and programs of operation of hydrological stations of interest for the whole country” (Official Gazette of the SFRY 50/90), observations were made at major stations, at stations of first and second order, and viewed spatially, stations were created exclusively in alluviums of larger rivers and aquifers within Quaternary deposits. Over the last century and the current one, this number has changed and ranged from initial 41 observation sites (in 1947) to 420 (in 2011). Quality monitoring began in 1968, by sampling at 35 different groundwater hydrological stations (Nikolić et al., 2012). In the previous period, this number has varied and ranged to a maximum of 84 stations. Sampling is currently being performed at 57 sites and covers 32 groundwater aquifers. According to the schedule for 2019, the existing sampling program of the Republic Hydrometeorological Service of Serbia (RHSS) includes a network of 386 groundwater hydrological stations, covering less than a half of the entire territory of Serbia, i.e. the network extends to 34 water bodies. As a candidate country for EU membership, Serbia has begun the process of harmonizing its legislation and regulations to create the basis for the development of an adequate hydrological network of groundwater stations. The first steps in the implementation of the EU WFD, Serbia made in 2003, within the framework of the International Commission for the Protection of the Danube River (ICPDR). Subsequently, in order to further align Serbia’s water policy with the requirements and objectives of the WFD, a number of laws and bylaws were adopted, such as: The Law on Water (Republic of Serbia [RS] Official Gazette no. 30/10), the Law on Meteorological and Hydrological Activity (RS Official Gazette 88/2010), Rulebook on establishment of water bodies of surface water and groundwater (RS Official Gazette 96/2010), Rulebook on the environmental and chemical status of surface water and parameters of chemical and quantitative status of groundwater (RS Official Gazette 74/10) and the Regulation on establishing the annual program for monitoring the status of water, which is adopted specifically for each year. The adoption of these legislative and regulative acts created the conditions for the monitoring of groundwater to be organized in Serbia in accordance with the requirements of the WFD.

The groundwater aquifer was chosen to be the stepping stone for the monitoring of groundwater, i.e. the smallest unit used for the network planning, which is a separate volume of ground water within one or more water-bearing layers. The adopted Rules on the determination of surface water and groundwater bodies of water (Official Gazette 96/2010) identified 153 groundwater water bodies. At the initiative of the RHSS, while for the purpose of harmonization of the network with the legislation, during 2015, a project was created to expand the network of groundwater stations, in cooperation with the Department of Hydrogeology of the Faculty of Mining and Geology, where, in addition to the observation network of RHSS, a proposal was made to use springs for water supply as well (Dokmanović et al., 2016). Thus, by Regulation, 43 water supply sources were included in the groundwater status monitoring program for 2019. All selected subterranean groundwater were water bodies characterized as: intergranular-compacted aquifers, karst aquifers, and cracked aquifers, and three types of monitoring were established: surveillance, operational and exploratory. In WFD, the level status of groundwater is the main parameter for determining its quantitative status. There is no exact limit, but it is required to ensure a level that does not endanger the available groundwater resource by long-term exploitation, and which ensures that there will be no failure to achieve environmental goals in the associated surface water, or endanger terrestrial ecosystems (Stevanović et al., 2014). Given the dilemmas of what and when is meant by overexploitation (Custodio, 1992; Burke, Moench, 2000), only relative categories had to remain. The problem with determining the chemical status is that the maximum allowable concentrations are not defined, except for only a few parameters. If it is not possible to repair and achieve a “good” status of water, in order to achieve the goals, it is required that the chemical status must remain at least the same as it was at the time of adoption of the legislation, i.e. at the beginning of the work on its implementation. The RHSS delegated its competence in monitoring the quality of water from piezometers to the Environmental Agency of Serbia and in 2013, monitoring encompassed about 70 Agency’s piezometers, with such data submitted to the European Environment Information and Observation Network (EIONET).

When it comes to the high-quality karst water sources, their monitoring was almost non-existent before the definition of aquifers and groundwater monitoring. In the previous period, observations of regimes of this type of aquifers were carried out on a continuous basis only at the spring of the river Mlava, which began in 1949 and continue to this day (Stevanović et al., 2015). In addition to the Mlava spring, in a shorter period of time (without interruption from 1995 to 2004) five more springs had been observed: the Veliko spring, the spring of the Vapa River, of the Tolišnica River, the Gostilje spring and the Andrić spring (Ristić, Vakanjac, 2018). As this type of water resource is of great importance for the water supply of the population

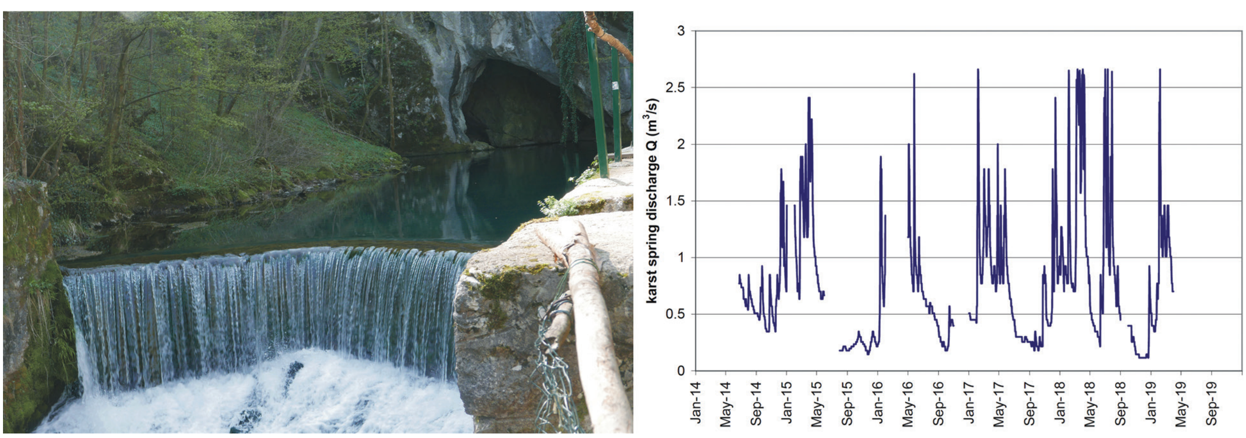

Fig. 1. The spring of the Krupaja (left) and discharge hydrograph of the spring (right)

and industry of Eastern and Western Serbia, it was necessary proposes that important hydrogeological items – springs – be included in the monitoring of the regime of their discharge, as well as to monitor the qualitative status of their discharged water. One of the first springs at which discharge monitoring was established is the Krupaja spring, where observations began in 2014 and continue to this day. The Krupaja spring drains the southwestern parts of the North Beljanica aquifer (Figure 1a). For the purpose of this paper, the obtained results on water levels have been processed for the first time, followed by hydrometric measurements and the establishment of a flow curve for the purpose of defining the discharge regime of this spring. Figure 1b provides a hydrograph of the discharge. The average annual discharge value obtained on the basis of the conducted procedure is about 0.75 m^3/s. The maximum values are characteristic for the spring season, while the minimum discharge values are recorded during the summer and autumn months. The absolute minimum value was 116 L/s, which was recorded between November 14 and December 13, 2018. Absolute peaks of 2.65 m^3/s were recorded each year during the observation period, with these peaks occurring repeatedly during 2018.

Based on observed hydrometric measurements performed by the FMG, Department of Hydrogeology, the absolute maximum recorded at this spring was 31 m^3/s in May 2014. This value tells us that the maximum flow volumes can have much higher values, which is not indicated by the obtained hydrograph shown in Fig. 1b. Accordingly, we can assume that values of maximum outflow during the observation period must be taken with precaution. In order to obtain the most realistic values, it is necessary to first make sure that the selected observation site is well suited to reflect the realistic discharge regime of the spring. Also, it is certainly desirable to set up an automatic station for continuous recording of changes in the levels of water that flows out of the spring under consideration. For the purposes of the qualitative status of karst aquifer groundwater, it would be good to set up a sensor that would automatically record changes in turbidity, temperature, pH and Eh values of the water. It has also been proposed to establish a sampling procedure of karst aquifer groundwater that would sample water every month, for the purpose of monitoring the regime of the quality status.

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