



Groundwater and surface water monitoring program for karst river basin: example of the Jadro and Žrnovnica Rivers

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The catchment of the Jadro and Žrnovnica Springs is situated in the Dinaric karst mainly formed of carbonate rocks and partly of impermeable flysch. The Jadro Spring has been used for water supply for almost 2000 years. Nowadays, it is the main water supply resource for the wider area of Split, the second largest city in Croatia, and it represents a valuable natural resource and as such should be protected from deterioration and chemical pollution. Reliable and comparable methods for groundwater monitoring are an important tool for assessment of groundwater quality and also for choosing the most appropriate measures. The present meteorological, hydrological and water quality monitoring networks have several drawbacks, and consequently, do not provide a coherent and comprehensive overview of meteorological, hydrological or water quality situation within the river basin. Namely, there is no meteorological station located inside the river basin, so continuous measurements of meteorological parameters have not been performed. However, daily precipitations have been measured since 1961 at eight locations: Dugopolje, Lećevica, Dicmo, Muć, Klis, Bisko, Gornje Sitno and Prančević Brana. Hydrological observations have been performed in profiles which are interesting in terms of water use (e.g. determination of spring capacities, or discharge control for proscribed minimum flow rates). The collection of hydrological data including water levels and flow rates started in 1983. In the interim period, some hydrological stations ceased operating, some have unreliable data, mostly due to the changes in riverbeds and the influence of backwater, whereas some stations experience longer periods of very poor coverage of rate of flow measurements, particularly at high water levels. Currently, five hydrological stations are active: Jadro-Majdan, Jadro-Dioklecijanov kanal, Jadro-Noví kanal, Žrnovnica-Izvor and Žrnovnica-Laboratorij. Water temperatures and quantities of sediment have not been recorded at any of these stations. Since 1970s, Croatian waters carry out water quality monitoring on surface waters and springs in accordance with the National water quality monitoring program. In the Jadro and Žrnovnica Rivers catchment area, the National water quality monitoring program is performed at the following stations: Jadro-Izvorište, Jadro-Ribogojilište, Jadro-Ušće, Žrnovnica-Izvorište and Žrnovnica-Ušće. In line with the Croatian legislation that has been in force, the monitoring of water status at these stations has been performed 12 times a year by testing: mandatory indices (physico – chemical, oxygen regime, nutrients, microbiological, biological) and specific indices (metals, organic compounds). The group of mandatory indices serves for determining of the general ecological function of water, whereas the group of specific indices serves for a wider assessment of the general ecological function of water and for determination of the terms of water use for particular purposes. The proposed meteorological, surface water and groundwater monitoring programs for the basin of the Jadro and Žrnovnica Rivers have three main objectives: (1) harmonization of monitoring with requirements of the EU Water Directives, (2) collection of data essential for further investigation of hydrologic and hydrogeologic characteristics of the karst aquifer, (3) continuous collection of data required for water management at operational level. Following these objectives, the proposed monitoring programs detail the design of surveillance, operational and investigative monitoring for surface waters and the monitoring of quantitative and chemical status for groundwaters. The proposed monitoring programs cover all essential meteorological, hydrological and water quality parameters to the extent relevant for the water management at operational level and the further investigation of hydrologic and hydrogeologic characteristics of the karst aquifer. Groundwater monitoring points are four boreholes located in: Dugopolje, Konjsko, Gizdovac and Bisko. Surface water quality monitoring is performed at four locations: Jadro-Izvorište, Žrnovnica-Izvorište, Jadro-Ušće and Žrnovnica-Ušće. The meteorological monitoring program anticipates installation of eight automatic meteorological stations located in: Dugopolje, Muć, Lećevica, Bisko, Dicmo, Gizdovac, Konjsko, Vučevica and Putišić.