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Quantitative assessment of the groundwater-sewer network interaction in Bucharest city (Romania)

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Groundwater management in urban area must take account of every possible and relevant phenomena arising from the complex interaction between subsurface water, surface water, and urban infrastructure. In Bucharest, the need of the sewer system rehabilitation initiated a study of the interaction between groundwater and the sewer network. Recent conclusions show that the sewer network acts mainly like a drainage system for the groundwater. However, it could be easily proven that several sewer segments located mainly in the unsaturated zone contaminate the groundwater by leakage. The groundwater infiltration in the sewer conduits can cause the decrease of the groundwater level leading to structures instability problems as well as to the increase flow-rates of the sewer system. The last one affects seriously the wastewater treatment plants efficiency. The sewer network leakage cause groundwater pollution and locally could increase the groundwater level triggering buildings instability or other urban operational problems. The current study focuses on the consequences of sealing a part of the sewer system and so disturbing the existing groundwater behavior which may lead to serious consequences. In this framework, the analysis results of a groundwater flow model used to quantify the interaction between the groundwater and the sewer network are presented.

The two-layers groundwater flow model simulating the Colentina and Mostistea overlaid sedimentary aquifers covers about 75 km2. Its conceptual model relies on a 3D geological model made by using 23 accurate geological cross-sections of the studied domain. The model set-up and its calibration are done using pumping tests data, groundwater hydraulic heads, and water levels of the sewer system. Infiltration rates into sewers are modeled by applying a modified form of Darcy's law that uses the notion of infiltration factor. This last encompasses the hydraulic conductivity of the clogging layer, the infiltration area and the flow path length. The advantage of using a groundwater flow model when quantifying the exchange with the sewer system lies on the possibility of computing the leakage rate from sewer system. This is not the case when using the dry weather flow method because it provides an equivalent response of the system resulting from the sum of every infiltration and leakage rates. Thus only the predominant component will be pointed out: the infiltration rate or the leakage rate.

The obtained model can be used to simulate the sewer system rehabilitation effect on groundwater and thus will allow the design of different solutions in order to finally prevent urban disturbances.