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Regeneration of a confined aquifer after redevelopment and decommission of artesian wells, example from Grafendorf aquifer (Styria, Austria)

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Water is essential for life and it is therefore necessary to protect drinking water sustainably. Compared to shallow groundwater, deeper groundwater is especially important due to its characteristic tendency to remain extensively unaffected by environmental impacts. Thus, the uncontrolled waste of this valuable resource has to be avoided. A lot of artesian wells have been established in Grafendorf bei Hartberg (Styria, Austria). Almost all wells were not state-of-the art. As a result the different aquifer horizons began to intermix. Additionally some of the artesian wells had a permanent free overflow and the water was not even used. Consequently, since 1950, where the mean discharge of 37 wells was 0,334 l/s per well, the discharge has decreased to 0,090 l/s until 2013, which means a decline of about 75 %. As a reaction to these declines a decommissioning campaign was conducted where 69 artesian wells have been closed by injecting a cement-bentonite suspension (ratio 3:1).

The Grafendorf aquifer is situated in the Styrian Basin and consists of 5 separated artesian horizons in Neogene sediments. These artesian horizons range from 42 m (1st horizon) to 176 m (5th horizon) and mostly consist of sand, partly of fine/medium/coarse gravel and partially with minor clay content. In order to analyse the reaction of the Grafendorf aquifer to these redevelopments, 5 monitoring wells could be used for the analysis. Some monitoring wells include different aquifer horizons and hydraulically short cut them. Thus, in this work the analysis focus on the general trend of the whole aquifer system neglecting the individual interactions between the different aquifers. In a first investigation step the hydraulic properties of the aquifer system has been determined using pumping tests which were analysed with different analytical solutions with the software AQTESOLV.

Overall the pumping test solutions hardly differ in the transmissivity and hydraulic conductivity. On the contrary the results for the storativity and specific storativity differ highly which was used to determine the proper analytic solution. The average transmissivity is about 9 x 10^{-4} m^2/s and the hydraulic conductivity is about 1,5 x 10^{-4} m/s. The watertable trends of the 5 observed wells were analysed. The preliminary results show an increase of the watertable between 0,10 m to 0,40 m in 3 wells and even 0,1 bar (1 m) in one well. In one well a decline of 3 m can be observed since the wells have been decommissioned. However the regeneration of the aquifer has been mostly positive so far, nevertheless more studies have to be done in future to prove a long-term behaviour of the aquifer and in particular to investigate the reaction of the individual horizons and the interaction between them.