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From inventory analysis to numerical modelling: Preparing Riverbank Filtration for prolonged droughts – infiltration-supported riverbank water extraction

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Extreme weather events can have a severe impact on riverbank filtration. For example, a prolonged severe drought like the Central European summer drought of 2018 reduces river streamflow, which can quickly and negatively impact pumping performance and water quality. In addition, long dry periods in the summer months are often accompanied by increased residential water demand. Therefore, weather and climate extremes, which are projected to become increasingly dynamic and intense, lead to difficulties for public water supply and represent major challenges for public water providers.

In the German WaX-Project “TrinkXtrem” (BMBF), adaptation strategies and management models for a riverbank filtration system of Wasserversorgung Rheinhessen-Pfalz GmbH on the Rhine River were developed.

The bank filtration system comprises two primary components: groundwater and infiltrating surface water. Near the riverbank, the river water level dynamically influences both, groundwater levels and quality. Further away from the river, groundwater level responses become progressively slower and the influence of surface water diminishes.

Therefore, a carefully considered monitoring system is essential to capture the spatially variable groundwater dynamics with frequent data collection. To this end, a well-calibrated numerical groundwater model was developed, suitable for simulating the current situation and future scenarios.

Based on the model results, innovative and sustainable management concepts that integrate facility expansion with managed aquifer recharge are developed. These concepts aim to ensure public water supply during potentially extended peak water demand periods in the future, with minimal adverse effects on the environment. Additionally, these concepts seek to create added values by stabilizing landward groundwater levels to facilitate conservation of floodplain areas and forests as well as to support agriculture.

Furthermore, future scenarios that combine peak residential water demand with periods of extreme low flow are developed and numerically modelled, and the impacts of mitigation measures are evaluated.