Geophysical Research Abstracts
Vol. 16, EGU2014-7395, 2014
EGU General Assembly 2014

Managing induced riverbank filtration (IRF) at the Serchio River well field, Tuscany, Italy (Italy)

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Along the Serchio River (Tuscany –Italy) a series of well fields is set for an overall amount of about 1 m^3/s pumped groundwater providing drinking water for about 300000 people of the coastal Tuscany (mainly to the town of Lucca, Pisa and Livorno). Water is pumped enhancing riverbank filtration into a high yield (10^{-2} m^2/s transmissivity) sand and gravel aquifer by artificially rising river head and setting pumping well fields along the river reach.

However, being it unmanaged aquifer recharge, concerns arise both for quality and quantity of the abstracted groundwater. It happens in dry climate extremes (i.e. 2002/2003 or 2011/2012) that Serchio River flow falls below minimum environmental flow (MEF). Long term contamination of river water had been causing contamination of groundwater, as in 2002/2006, when pesticide contaminated surface water was polluting the well fields causing several problems to water supply. Such problems were overcome by setting in place derogatory regulations and then through dissemination and stakeholder activities reducing pesticide presence in surface water (EU LIFE SERIAL WELLFIR project). Although widely adopted, IRF is also not well stated from a regulatory point of view, eventually leading to concerns by a legal point of view.

Within the framework of the MARSOL FPVII-ENV-2013 project an experimental site at a well field will be set to demonstrate the feasibility (by a technical, social and market point of view) and the benefits of managing IRF versus the unmanaged option. The Serchio experimental site will involve merging existing and proved technologies to produce a Decision Support System (DSS) based on remote data acquisition and transmission and GIS physically-based fully distributed numerical modeling to continuously monitor and manage well fields, reducing also human operated activities. The DSS along with the installed sensors, data transmission and storage tools will constitute a prototype whose potential market exploitation will be tested.

Site characterization will be completed taking advantage of the MOSAIC on-site investigation platform for subsurface survey (http://www.ufz.de/index.php?en=16349). A set of sensors will be installed and operated to monitor by a quantitative and qualitative point of view hydrologic variables in the river water, in the aquifer, the unsaturated zone and the wells. Data will be continuously acquired and remotely transmitted to a server where they will first be checked for consistency and then sent to a database for processing in a dedicated modelling environment included in the DSS. Hydrogeochemical analysis for selected species will be performed both on surface-/ground-water and pore water.

The DSS combining and integrating measurements and the modelling environment will be developed and equipped with an alert system to inform water managers about the scheme performance and reaching limits of infiltration rates against river MEF or water quality indices. The hydrological and mass transport model will be implemented and calibrated at the demo site. This activity will be needed in order to perform reliable subsequent modelling tasks within this WP. A calibrated and time-variant water budget will be produced at the end of this task.

The developed DSS including the GIS integrated modelling environment will be applied to the Serchio IRF well field to demonstrate the benefits of switching from unmanaged artificial recharge to Managed Aquifer Recharge (MAR). Applications will involve estimating induced infiltration rates and travel time from surface water to the well fields, optimization of groundwater exploitation in complex well field schemes and performing simulations on pollution events for deriving time estimates and effectiveness of remedial actions to be set in place. All these simulations will be used to draft an operational and contingency plan for the Serchio IRF well field in accordance with the government authorities and the company manager.

Since the successful implementation of a DSS is to be measured not only in terms of traditional marketing metrics,

a systemic market assessment will be performed. In particular, after an exhaustive identification of stakeholders, related competences and evolutionary trajectories, economic and strategic performances will be analysed from a systemic respective, thus introducing life cycle thinking principles. Both a comprehensive literature review and in field investigations will inform the analysis. Dissemination activities will include: setting up an Italian network on MAR; focus group for policy makers and group of citizens (env. associations, etc.); training for private professionals (chartered engineers, geologists, agronomists, chemists, ...) and technicians of public authorities.