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Eight years of groundwater monitoring at the building site of the MOSE system for the safeguard of Venice

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The survival of Venice is threatened by the continuous increase of frequency and intensity of tidal floods. To prevent these events, a safeguarding system known as MOSE is under construction at the inlets of the Lagoon of Venice. Four arrays of mobile barriers will be lifted in the case of exceptionally high tides (>1.10 m) to insulate the Lagoon. The prefabrication of the mobile barriers required a large construction area close to the final installation sites. Given the lack of space in the inlets of Lido and Chioggia, two basins of the future navigation locks were used for this purpose, and a system of water pumps and wells was therefore installed in each site to ensure the accessibility and safety of the construction areas.

The impact of dewatering on the aquifers on the mainland in Punta Sabbioni (inlet of Lido) was monitored by means of continuous hydraulic head measurements in a network 25 piezometers, 11 screened in the phreatic aquifer and 14 in the shallowest confined aquifer. These aquifers are separated by a 5 m thick clayey aquiclude, and a 30 m thick impervious layer isolates them from the underlying confined aquifers, which were therefore not monitored. Each monitoring well was equipped with an automatic water pressure transducer and the hourly recorded hydraulic heads were compensated with the barometric pressure. The time series were compared with the natural driving forces (tides, rainfall, evapotranspiration) and the anthropogenic impact sources (dewatering pumping, slurry walls, land reclamation channels). The dynamics of seawater intrusion were also studied through monthly measurements of the vertical profiles of the electrical conductivity (EC) of groundwater.

The monitoring activity was successful in assessing the impacts of the construction works. A drawdown was observed in the confined aquifer due to the dewatering pumping, with a maximum displacement of some 5 m on the mainland and an extension of some 1000 m from the dewatered basin. By contrast, no impact was observed in the phreatic aquifer, proving that the combined insulation effect of the slurry wall and the aquiclude was successful in avoiding the depletion of this water body. At the end of the dewatering pumping, the confined aquifer fully recovered, returning to its pristine conditions in a few months. The EC measurements revealed that a de-salinization trend occurred in a portion of the phreatic aquifer, due to the presence of the slurry wall.

The results of the monitoring programme brought some useful insights, that could also be applied to other groundwater monitoring programs in large construction works. The ante operam monitoring phase lasted for some 15 months, thus allowing a thorough understanding of the groundwater dynamics over more than an hydrological yearly cycle. A large area was covered to identify the impacted areas with a high level of precision. The short-term groundwater level dynamics have been revealed thanks to continuous measurements in all the monitored wells. EC measurements proved to be a low-cost and valuable tool to study the cycles and the long-term trends of seawater intrusion.

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