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Management and utilization of a fresh water body adjacent to saline water bodies in fracture and karstic aquifers in Israel.

Joseph Guttman
Mekorot: Israel national Water Co., Hydrology, Tel-Aviv, Israel (yosgut@gmail.com, 972-3-6230672)

Water quality is an issue of equal importance to water scarcity, and water quality degradation is a considerable issue in water management.
During the Upper Pleistocene period, sea transgression covered large regions of the Eastern Mediterranean including the area which is Israel today. Later on, the regression of the sea together with the rainfall flushed out the sea water from the aquifers. The replacement of the sea water by fresh water was not totally completed and in many places (especially in synclines), we can find fresh water and saline water at the same formation and without any geological or hydrological barrier.
In arid countries like Israel, where each drop of fresh water is utilized, overexploitation of fresh water that is seated near saline water bodies can cause a movement of the saline water towards the fresh water body causing its salinity to rise. On the other hand, reducing the pumping of the fresh water may result in overflowing of certain amount of fresh water towards the saline water body and losing part of the fresh water potential. The main challenge is to find the proper equilibrium between the two water bodies.
Large amounts of groundwater in Israel are utilized from fractured and karstic aquifers. The hydraulic properties of these aquifers (very high permeability and low storativity) may cause a very rapid movement of the saline water towards the fresh water body and accelerating the increase in salinity in the wells.
Such cases appear in one well field in the northern part of Israel during the drought period in the 1990's. Over pumping in a few wells caused a sharp rise in salinity in several wells from about 50 mg/l Cl- to about 500 mg/l Cl- during a period of only 2-3 months. Pausing the pumping, reduced temporarily the salinity in these wells. Re-pumping in much lower discharges raises again the salinity to its higher values.
The management of such well fields becomes very complicated because we can see different salinity behavior, despite the fact that the wells are located at the same geological position and pumped from the same layers. In some wells the salinity is constant over time, in contrast to other wells that have seasonal fluctuations by tens to hundreds of mg/l. The seasonal salinity fluctuation is accompanied by higher monthly pumping. During low demand periods there is a drop in the salinity and vice versa. Such behavior indicates that the saline water body is very close to the radius of influence of the well and that the wells are pumping mixtures of fresh and saline water.
From our experience, the salinization at those well fields is a result of a combination between the geology, hydrology, water balance and pumping regime. At the beginning of the operation, it is impossible to predict which wells are the most sensitive to salinization. It became known to us only after a few years of operation and monitoring.
The large fluctuations in the natural recharge in arid zones besides the constant growth in demand cause water deficit in some periods. At these times, pumping of fresh water causes a drop in the water level in the fresh water bodies and movement of saline water towards the fresh water. Sustainable management obligate keeping the sensitive equilibrium between the two water bodies. One solution to maintain this equilibrium is to pump water from the saline water in parallel to the pumping of the fresh water.