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Long-term pumping-induced groundwater quality changes at a brackish-water desalination facility, Sanibel Island, Florida

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ABSTRACT

The Island Water Association owns and operates a brackish-water reverse osmosis (BWRO) desalination facility with a treated water capacity of 26,477 m^3/d. The feedwater for the plant is pumped from two different aquifers via 16 production wells (24,888 m^3/d). Both aquifers are semi-confined and they are recharged bottom upwards from the higher leakance lower confining unit, with limited recharge from the low leakage upper confining unit. The aquifer system is density stratified with increasing salinity with depth; the higher salinity water at depth, along with bottom upwards recharge, has led to a slow upward trend in salinity. In operation for nearly 38 y, the facility has increased the quantity of water pumped from the aquifer system. A solute transport model was conducted before the construction of the wellfield in 1982. The model generated a series of curves showing the projected increase in dissolved chloride concentration based on various pumping rates. Projections showed 80 y of increases with pumping and an eventual flattening of the curves. Over the past 20 y, dissolved chloride data collected from the 16 production wells show increase is a range from 0% to 60%. The overall feedwater, a blend of all wells, has shown increases in total dissolved solids from about 2,500 to 2,800 mg/L. These data values are much lower than the original model predicted, with both a lower starting concentration and a lower rate of increase. Based on the collected data, regression analysis, and a 20 y forward projection, the BWRO plant will be able to continue operation without a significant design change in the primary membrane process.

Keywords: Brackish-water reverse osmosis desalination; Groundwater source; Salinity change; Sanibel Island, Florida

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