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Would a physical barrier be effective during pumping from coastal aquifers? Laboratory and field scale modelling.

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Physical barriers (low permeable subsurface walls) are one of many other control methods to reduce saltwater intrusion in coastal aquifers. Several experimental and numerical studies, mostly two-dimensional, were performed in the literature to investigate the effect of cutoff wall on the intrusion of saltwater toe wedge; however, none investigated the effect of cutoff wall on saltwater intrusion during pumping condition in 3D. Therefore, the aim of this work is to characterize the minimum geometric ratio (depth and length) of a cutoff wall and how far it should be from the well in order not to allow saline water to contaminate the abstracted freshwater. At first, two-dimensional experiments were completed with cutoff wall under transient conditions in order to examine its impact on the saltwater wedge. Two scenarios we considered; one without freshwater abstraction and in the other, freshwater is abstracted from a well downstream the wall. In the second scenario, the wall had insignificant effect on reducing the saline water wedge particularly at higher pumping rates. When no abstraction existed, there was almost 37% reduction in the toe length for the setup tested here. The SEAWAT code was then used to determine the optimum wall depth and location for pumping well scenario. At cutoff wall depth of 40-75% of the aquifer depth, there was no change in the critical abstraction rate from the well.