Seawater Intrusion in Coastal Aquifers

By

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Seawater intrusion (SWI) is an ongoing issue exacerbated internationally by the growing need for freshwater along coastlines, which is affected by rising sea levels and changing climates, challenging sustainable management. This research focuses on finding intrusion behavior under the different layering and packing of formation material. The more realistic and conventional remediation techniques are tested for their efficiency under the influence of inclined ocean-aquifer boundary. A laboratory-scale glass box apparatus of dimension $100\times50\times10$ cm^3 was used to experiment with a *70°* inclined interface. Individual material with different permeability was used to form the stratified formations. The thesis documents the importance of an inclined ocean aquifer boundary in stratified layers aquifer formation with static sea level and sea level rise and accessed the efficiency of subsurface barrier and mixed barrier. Additionally, a novel physical barrier has been tested for efficiency and proven to be more effective than existing physical barriers. Comparing the results of the heterogeneous base case and subsurface barrier installed condition, a huge quantity of about 38.93% of groundwater was conserved from contamination. Results show that the under-surface barrier is much more successful in stopping intrusion when materials with monotonically increasing permeability are considered, as the toe length increases with increasing permeability. After studying the intrusion in different formations of layers, it was concluded that the intrusion is restricted to the individual layer until it encounters an impervious layer and follows a proportional pattern with an increasing intrusion area as the opening area increases. After application of mixed barrier, the intrusion was delayed by 86.67% in parallel stratification and 28.22% in perpendicular stratification after comparing the time period for the base case and the mixed barrier installed condition. A parabolic profile of intrusion was observed in the low-permeability layer, while a convex-outward profile was observed in the higher-permeability layer. For sea level rise, a comparison of increasing intrusion area ranged from 8.3% to 206% for all layering cases, with less time needed to reach the vertical boundary. The results derived from the research may be applied to real-life scenarios for estimating the effectiveness of coastal protection structures such as cutoff walls, under-surface barriers, and subsurface barriers. Applicability of results is subjected to upscaling (Froude's similitude), temporal dynamics, heterogeneity, and the understanding of boundary conditions under case-specific scenarios having heterogeneous formations, such as the eastern coastline and western coastline of India.