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Anatomy of a barrier island beach ridge aquifer, Eastern Florida

The purpose of the study is to examine the fresh groundwater flow within a dune ridge of the eastern Florida barrier island. These dune deposits contain fresh groundwater and are the primary water source of numerous domestic supply wells along this coastal area that are being threatened by development. In some areas, this groundwater movement is restricted by the presence of silt and fine silty clays. It is thought that these low permeability layers and dune bedding planes that control water movement within the watertable or surficial aquifer. The project area is located on a barrier island that skirts the eastern Florida coast that is bordered on the western boundary by an Indian River tributary while the Atlantic Ocean forms the eastern boundary. The site is covered by Pleistocene and Recent unconsolidated, white to brown, medium to fine, quartz sand, containing sandy coquina beds. These dune deposits are the primary water source of domestic wells, however, in some areas the potential is restricted by the presence of silt and clays. It is these low permeability layers and dune bedding planes that control water movement within the surficial aquifer. The surficial aquifer contains three primary layers determined from 15 split-spoon and 6 Shelby tube borings. The hydraulic conductivity averages 5,949,500 m/d (14,600 gpd/ft^2) with 232,275 m/d (570 gpd/ft^2) Kh and 83,537.5 m/d (205 gpd/ft^2) Kz. Daily tidal cycles have a significant effect upon groundwater movement, with a maximum piezometric head of 0.7 m (2 ft) that varies from 0.3 m (1 ft) in drier months with extra-low tide to 1.2 m (4 ft) in wet months. The average groundwater movement ranges from 39.42 x 10^{-4} to 175.2 x 10^{-4} m^3/sec (90,000 to 400,000 gpd) away from the site. Initial groundwater flow is strongly influenced by tidal effects with the initial flow to the highly-permeable shell-beds, then about 70% of the outflow moves towards the ocean, while the remainder flows towards Mullet Creek and tidal mangroves. Using ratios of K_h/K_z, the sand-shell ratio is 10, while that of the sand-shell-clay units is 48: but the published regional accepted value is 100, based on the assumption of anisotropy of layered heterogeneous sediments, however, this standard value may not be acceptable when permitting. The results show that threatened groundwater supplies must be carefully examined in permitting to assess potential damage by development.