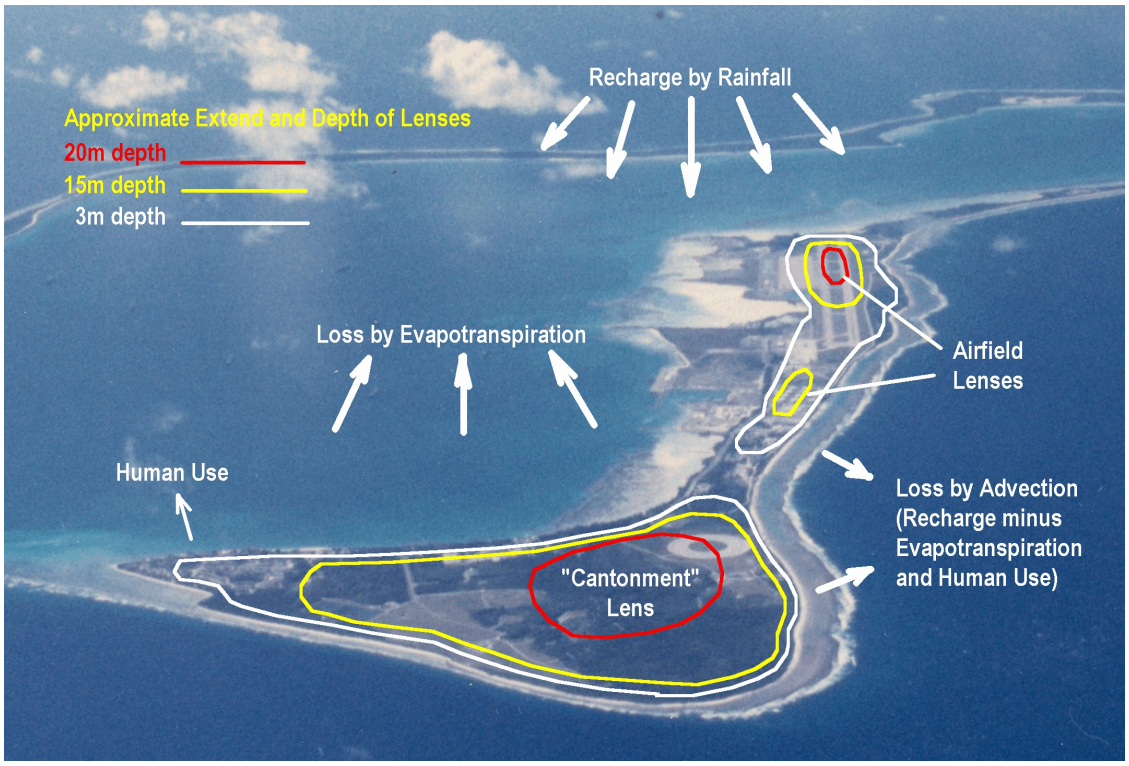

Approximate extent and depth of the fresh water lenses of northwest Diego Garcia

Ghyben-Herzberg (Fresh Water) Lenses in the Chagos

The islands of the Chagos Archipelago consist of low-lying cays on the rim of coral atolls composed of Holocene coral rubble and sand overlaying Pleistocene limestone. These porous sediments are saturated with sea water, and any rain falling on such islands quickly percolates through the surface sand and mixes with the salt water underneath. However, if the island is of sufficient width to minimize tidal fluctuations in the aquifer, and the rainfall is sufficient in amount and periodicity, the lighter fresh water forms a convex *Ghyben-Herzberg* lens floating on the heavier salt water in the saturated sediments. The horizontal structure of the lens is influenced by variations in the type and porosity of the sub-surface deposits. In its depths, the lens is globular; near the surface it generally conforms to the shape of the island.

At depth the lens is globular; near the surface it generally conforms to the shape of the island. When a lens is fully formed, its floating nature will push a freshwater head above mean sea level, and in ideal conditions the depth of the lens below mean sea level will be 40 times the height of the water table above sea level. However, tidal activity on the boundaries of the aquifer results in some mixing, creating a brackish transition between the fresh and salt water. The actual size and depth of the lens is dependent on the width and shape of the island, the permeability of the aquifer, and the equilibrium between recharging rainfall and losses to evapotranspiration, tidal advection, and human use.

Lenses mean life for human habitation on all the formerly inhabited islands of the Chagos. In the Plantation period, shallow wells, supplemented by rainwater collected in cisterns, provided sufficient water for a pastoral life style. On Diego Garcia today, the military base uses over 100 shallow "horizontal" wells to produce over 560,000 litres per day from the "cantonment" lens on the northwest arm of the island—sufficient water for western-style usage for a population of 3,500. It is estimated that this 3.7 km^2 lens holds 19 million m^3 of fresh water and has an average daily recharge from rainfall of over 10,000 m^3, of which 40% enters the lens, 60% being lost through evapotranspiration.[1]

Managing a lens for human consumption requires careful calculation of the sustainable yield, and a lens is susceptible to corruption by salt-water intrusion caused by over use or drought, and pollution. Overwash by tsunamis and tropical storms has corrupted lenses in the Maldives and several Pacific islands. Vertical wells can cause salt upconing into the lens, and over-extraction will reduce fresh water pressure, resulting in lateral intrusion by seawater. Because the porosity of the surface soil results in virtually zero runoff, lenses are easily polluted by faecal waste, burials, and chemical spills. Corruption of a lens can take years to "flush out" and reform, depending on the ratio of recharge to losses, so care must be taken when disposing of any liquids on these islands.

[1] Hunt, C. (1997). Hydrogeology of Diego Garcia. In, Vacher, H.L. and Quinn, T. (eds), Geology and Hydrogeology of Carbonate Islands, Developments in Sedimentology 54.

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