

Vadose Zone Fluxes at a Coastal Land Reclamation Site in a Tropical Environment

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The vadose zone is the critical junction between surface and atmospheric hydrology and the ground water system. Ground water itself is a critical resource that is often used as a fresh water supply and is an important part of regional ecosystems. To protect this valuable resource, planners must understand the influxes of water, energy, contaminants, and nutrients to the groundwater system, including infiltration recharge. Many factors influence vadose zone fluxes, including atmospheric conditions, precipitation patterns, sediment depositional structure, tides, and overlying land use. Human developments, such as transportation infrastructure, have the potential to compromise ground water quality by introducing contaminants at or near the ground surface that then percolate through the vadose zone with the infiltrating water. There are an increasing number of coastal land reclamation projects in the tropics. These projects create subsurface environments, and the water in them must be managed and protected as carefully as in other urban development areas. To date, little has been documented about unsaturated water flow and contaminant transport in these settings. We present results from a study which combines field measurements of atmospheric conditions, precipitation, moisture content, soil water suction and water temperature from a coastal land reclamation site in eastern Singapore with models of flow and transport to explore the dynamics of infiltration, recharge, and contaminant transport through the vadose zone. With more land reclamation projects being constructed and developed in Asia, and fresh water becoming scarcer, it is increasingly important to understand these dynamic relationships and take actions to protect the underlying ground water from urban contamination.

Keywords: Vadose zone; unsaturated moisture fluxes; contaminant transport; landfill sites; land reclamation; tropical climate; urban groundwater protection.