

桃園地區地下水模擬與管理：紅土層與埤塘補注的影響

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摘要

在極端氣候加劇導致降水時空分布不均的情況下，使得地下水成為穩定供水的重要來源。飽和層與非飽和層之間的交互作用是地下水流動與補注過程中的關鍵機制，然而，桃園地區因獨特的地層結構—低滲透性的紅土層與高傳導性的礫石層，使地下水補注過程更為複雜。其中該地區特有的埤塘，作為潛在的地下水補注來源，其補充機制與效率尚不明確，為水資源管理帶來更大的不確定性。為此，本研究採用 THMC 軟體，建立一個同時考慮紅土與礫石層空間分布特性影響的地下水流模型，來模擬不同地層條件下的地下水流動態，探討飽和區與非飽和區間的水流交換機制，並量化埤塘補注的影響。研究首先收集並整理桃園地區的水文地質資料，分析紅土與礫石層的分布特性及相應水力參數，並將區域降水、抽水量等關鍵數據納入數值模擬的輸入，模擬不同降雨及地下水位變化情境，以探討不同地層結構如何影響地下水補注過程中水分的流動與交換，對地下水位變化與補注效率的影響。將提供更精確的地下水補注評估方法，為桃園地區的水資源管理提供關鍵的科學依據，提升水資源永續利用能力。

關鍵字: THMC 軟體、地下水水流模型、桃園、地下水、紅土層、埤塘。

Groundwater Simulation and Management in Taoyuan: The Impact of Laterite Layers and Pond Recharge

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Abstract

Under intensifying extreme climate events, the uneven spatiotemporal distribution of precipitation has made groundwater a crucial source of stable water supply. The interaction between saturated and unsaturated zones is key to groundwater flow and recharge. However, Taoyuan's unique geological structure—low-permeability laterite and high-conductivity gravel—complicates this process. The region's ponds serve as potential groundwater recharge sources, yet their recharge mechanisms and efficiency remain unclear, adding uncertainty to water resource management. This study employs THMC software to develop a groundwater flow model that considers the spatial distribution of laterite and gravel layers. The model simulates groundwater dynamics under different geological conditions, exploring saturated-unsaturated zone exchange and quantifying pond recharge. Hydrological and geological data of Taoyuan are analyzed to determine the distribution and hydraulic properties of laterite and gravel layers. Key inputs, including precipitation and pumping rates, are incorporated into numerical simulations to examine how geological structures influence water flow and recharge efficiency. The findings will provide a more precise assessment of groundwater recharge, offering essential scientific support for water resource management in Taoyuan and enhancing the sustainability of water resources.

Keywords: THMC, Groundwater, Laterite, Taoyuan, Groundwater flow model, Ponds.