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Modeling Flow and Transport for Sustainable Yield Estimation of Groundwater Resources in the Bangkok Aquifer System

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Possible ways for groundwater management to remediate the effects of over- pumping from the Bangkok aquifer system, Thailand, and to guarantee that the aquifer is sustainable to deliver groundwater resources for the future with respect to both quantity and quality are being investigated. The concept of sustainable yield is of fundamental importance as it can aid groundwater management activities to identify and design viable water supply alternatives. A groundwater and solute-transport model for the Bangkok aquifer is setup and applied to estimate the sustainable yield using a forward iterative approach and/or inverse modeling.

The complex Bangkok coastal multi-layer aquifer system has been tremendously exploited over the last decades in the wake of dramatic economic growth in that region. As a consequence, the piezometric heads in the aquifer system have dropped significantly, especially in the second, the third and the fourth aquifer layer and head gradients have built up that appear to conduct intrusion of saltwater from its source regions into the producing areas of the aquifers system, leading to saltwater contamination there. Furthermore the land has been subsiding locally in the study area.

In the present analysis, the sustainable groundwater yield is determined by targeting the specified minimally acceptable head and/or quality levels in the various aquifer layers through variation of the pumping rates of the discharge-wells in the model. The sustainable yield is then defined as “the maximal groundwater yield that may be withdrawn so that the water levels in the second, third and fourth layers do not decrease by more than 25% of their current water levels (Dec, 2002) and/or their

chloride concentration stay beneath 250 mg/liter." The maximum sustainable yield will be estimated under two conditions of pumping in the sixth to ninth aquifer, namely (1) by projecting the acceleration rate of pumping between 1983 to 2002 for the next 30 years into the future, and (2) by doubling the average 1983-2002 pumping rate over the next 30 years.

For the named two pumping conditions the 30 years transient-state-simulation (2003 to 2032) will be carried out to achieve the specified acceptable head levels and/or water quality goals. The transient simulation will disclose information on the response of the aquifers during the specified time period which can then be used to determine the difference between the water demand and the yield, or the so-called "unmet demand" in the study area during the next 30 years. This unmet demand may be supplemented by alternative water supplies from other sources, namely surface water. Finally, a steady-state-simulation will be performed to see if these acceptable head and water quality levels can be sustained eternally, providing a long-term criterion to the governmental authorities for sustainable groundwater management.