Geophysical Research Abstracts
Vol. 17, EGU2015-2035, 2015
EGU General Assembly 2015

A Multi-Methodology for improving Adelaide's Groundwater Management

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Groundwater is a strategic and vital resource in South Australia playing a crucial role in sustaining a healthy environment, as well as supporting industries and economic development. In the Adelaide metropolitan region ten different aquifer units have been identified, extending to more than 500 m below sea level. Although salinity within most of these aquifers is variable, water suitable for commercial, irrigation and/or potable use is predominantly found in the deeper Tertiary aquifers. Groundwater currently contributes only 9000 ML/yr of Adelaide's total water consumption of 216,000 ML, while in the Northern Adelaide Plains 17000 ML/yr is used. However, major industries, market gardeners, golf courses, and local councils are highly dependent on this resource. Despite recent rapid expansion in managed aquifer recharge, and the potential for increased extraction of groundwater, particularly for the commercial and irrigation supplies, little is known about the sources and ages of Adelaide's groundwater. The aim of this study is therefore to provide a robust conceptualisation of Adelaide's groundwater system. The study focuses on three important knowledge gaps:
1. Does groundwater flow from the Adelaide Hills into the sedimentary aquifers on the plains?
2. What is the potential for encroachment of seawater if groundwater extraction increases?
3. How isolated are the different aquifers, or does water leak from one to the other?
A multi-tool approach has been used to improve the conceptual understanding of groundwater flow processes; including the installation of new groundwater monitoring wells from the hills to the coast, an extensive groundwater sampling campaign of new and existing groundwater wells for chemistry and environmental tracers analysis, and development of a regional scale numerical model rigorously tested under different scenario conditions. The model allows quantification of otherwise hardly quantifiable quantities such as flow across fault zones and through aquitard. Risk assessment of water resources status by 2050 is achieved via uncertainty quantification of potential future scenarios. This includes several development scenarios (current or increased extraction rate) as well as different outputs from climate change predictions. It is shown that groundwater in the fractured aquifer bedrock in the hills is significantly younger than groundwater in the Adelaide plains area, indicating that the Adelaide groundwater system is, at least, partially recharged by lateral flow from water infiltrated in the hills. However, increasing ages with depth, are indicative of vertical infiltration from rainfall and possible inter-aquifer leakage. A better understanding of processes controlling these two sources of fresh groundwater, as well as evaluating their relative importance to Adelaide's groundwater budget is being thoroughly investigated using the regional numerical groundwater model. The salinity distribution along the coastline is shown not to be simply an equilibrium situation with an intruded seawater wedge extending inland. Tertiary aquifers can still contain old freshwater near the coast, and in deeper layers a hypersaline brine has been identified, which could constitute a previously-overlooked source of salinity. This study is the first comprehensive investigation of the groundwater resources within the Adelaide environment and supports strongly integrated water management of the resource.