Understanding groundwater-surface water interaction in the Ruataniwha Basin, New Zealand using chemical signature, environmental isotopes and numerical modelling

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The Ruataniwha Basin in Hawke's Bay, New Zealand is one of the main sources of water for agriculture, domestic and industrial needs. Water demand in the area has doubled in the last decade, which has put significant stress on the water resources in the basin. This prompted a need to understand the groundwater–surface water interaction to enable sustainable management of water resources.

A total of thirty-three samples from groundwater, surface water and springs in the area were collected and analyzed for major chemistry, age tracers and gases. The selection of sampling sites was based on historical sampling for age tracers, to provide a continuous time series to reduce ambiguity.

Results of aging and chemistry analysis show the majority of samples have a mean residence time (MRT) greater than 30 years. Some sites, especially in the southern part of the basin, have MRT more than 100 years, which implies a slow flow and recharge. The results show that recharge is a mixture of rainfall and river flow. There is no consistency between increasing depth and MRT, which supports the finding from limited hydrogeologic indicators that the basin has a heterogeneous structure. Areas with no or little connection between groundwater and surface water were identified in the western part of the basin and in the south around Takapau Township. Areas with high surface water interaction are in the lower part of the basin along Waipawa and Tukituki rivers.

Results of aging and chemistry data analysis have been compared with the results of a numerical transient finite difference model that has been developed for the area. The model covers the period from 1990 to 2010, and it simulates both groundwater and surface water flow. Results of the numerical model are consistent with the age tracer and chemistry results. In addition, model results show that stream-aquifer gain/loss relationship varies spatially, but the volume of stream and river gain from the groundwater system is more than the stream loss to the basin.