Guarding the long-term sustainability of groundwater resources by defining aquifer characteristics and inter-aquifer leakage using airborne EM technologies

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The sustainable extraction of groundwater resources requires an understanding of aquifer integrity, geometry and quality, particularly where it is extracted from confined or multi-layered systems, and where shallow, unconfined aquifers are too saline for use either as a source of potable water or for irrigated agriculture or stock. In such situations, a major threat to the long-term sustainability of a groundwater resources is leakage of saline water from formations that overlie and/or underlie the target aquifers. From a hydrogeological perspective both situations demand information on the spatial variations in groundwater quality and information on surface water-groundwater interactions.

This paper presents results from an examination of hydrogeophysics, specifically airborne electromagnetics (AEM) data acquired by the SkyTEM time domain helicopter EM system, as a means for improving our knowledge of spatial patterns associated with inter-aquifer mixing where groundwater flow is complex. We were particularly interested the use of this technology to provide a spatial picture of mixing which would assist in conceptual hydrogeological model development and refinement. The study, focussing on the Loxton region in the Lower Murray of South Australia and considers both inter-aquifer mixing and surface water-groundwater interaction. Recent studies in this area provided hydrochemical evidence for upward and downward leakage between aquifers, and given the highly saline nature of the lower groundwater system we believe AEM have considerable potential to elucidate the nature of inter-aquifer leakage.