REGOLITH-GROUNDWATER INTERACTIONS IN THE UPPER BILLABONG CREEK CATCHMENT, SOUTHEAST NSW

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This study aims to assess the accumulation and distribution of salts with respect to landforms and regolith materials in the Upper Billabong Creek catchment. Such information can be used to assist in land and water resource decision-making within the catchment, particularly with regards to prominent environmental issues such as soil acidity, soil sodicity, waterlogging and dryland salinity (Woodward-Clyde 1999, NLWRA 2001).

The Upper Billabong Creek catchment is located between the Murrumbidgee and Murray River catchments in south-east NSW (Figure 1). Covering an area of approximately 300,000 ha upstream of Walbundrie, the catchment provides a physiographic transect from the Riverine Plain in the west to the bedrock-dominated uplands of the Western Slopes in the east. A comparative study of two sub-catchments from the respective ends of the catchment, Simmons Creek in the west and Ten Mile Creek in the east (Figure 1), has revealed differences in groundwater chemistry and associated regolith materials in two areas with similar geology but differing climate and topography.

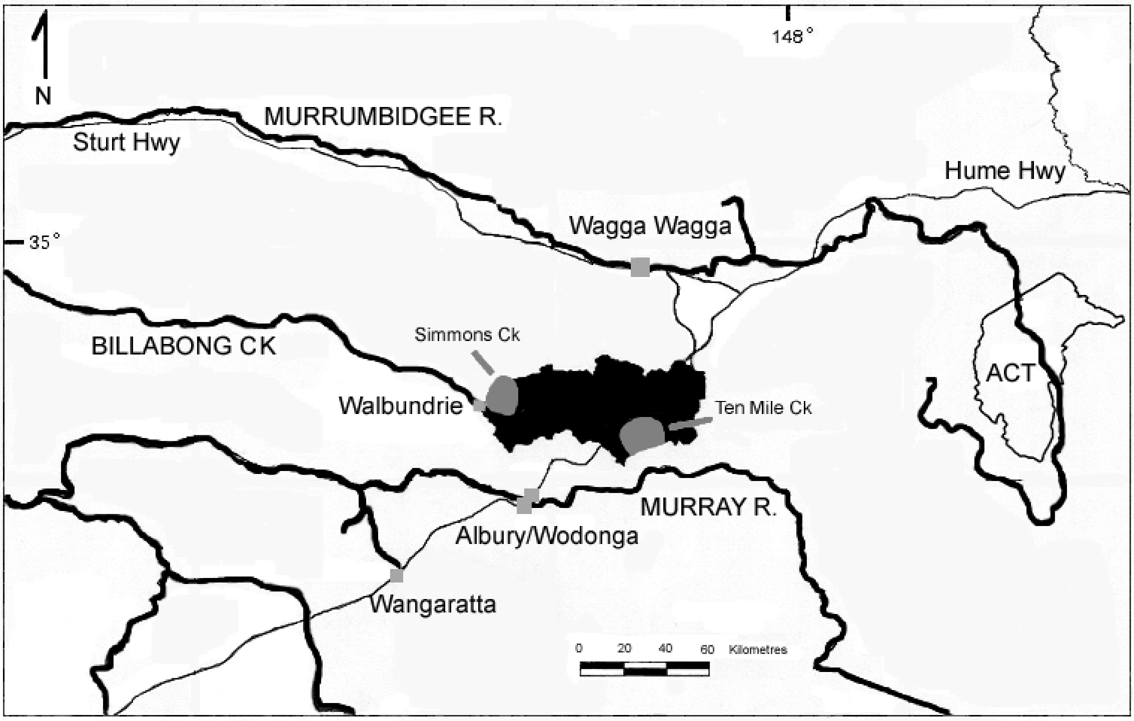

Figure 1: Upper Billabong Creek catchment (black) showing Ten Mile Creek and Simmons Creek sub-catchments (after NLWRA, 2001).

The distribution and variation of regolith materials across the landscape has been determined by regolith-landform mapping. Colluvial and alluvial deposits, with minor occurrences of *in situ* materials, dominate landforms in the Upper Billabong Creek catchment. Materials of possible aeolian origin have been identified across a variety of landforms, a situation similar to those around Wagga Wagga (Butler & Hutton 1956, Chen 2001) and on the Southern Tablelands (Broughton 1992, Melis & Acworth 2001). In the Ten Mile Creek sub-catchment, debris flow deposits, colluvial sheet flow deposits and materials on gentle rises commonly contain large quantities of silts and clays, derived from either bedrock weathering or possible aeolian input. Alluvial materials are characteristically mixed with sands and silts.

In the Simmons Creek sub-catchment the majority of landforms have substantial clay content with lesser silt. Regolith carbonates are common at depth. Preliminary regolith $pH_{1:5}$ and electrical conductivity ($EC_{1:5}$) analyses show trends representing leaching conditions in better-drained materials associated with good quality groundwater, while materials associated with poorer quality groundwater indicate less efficient drainage and accumulation of major ions.

In both the Ten Mile Creek and Simmons Creek sub-catchments the low-relief landforms dominated by silts and clays exhibit comparatively high regolith EC's and increased concentrations of major ions in shallow groundwater (Table 1), with minimal seasonal variation. It is in these landforms that issues of salinisation and poor quality groundwater have arisen.

Table 1: Comparison of regolith and groundwater chemistry for two sites on similar landforms.

Catchment	BoreID	Regolith Characteristics			Groundwater Major Ion Concentrations (mg/L)			
		Texture	Approx. Clay%	$EC_{1:5}$ (uS/cm)	Na	Ca	Mg	K
Ten Mile Creek	AnnSth	Sandy Clay	30-40	143	24	16	8	6
Simmons Creek	Hazeldene	Heavy Clay	>50	1,030	4,657	296	658	11

Comparison of shallow with deeper groundwater also suggests that the concentration of major ions is occurring in the zone of interaction with the regolith. Deeper groundwater is characterised by lower conductivities and lesser concentrations of major ions (Table 2).

Table 2: Subset of shallow and deep groundwater characteristics from the Simmons Ck sub-catchment.

		Groundwater Characteristics		Groundwater Major Ion Concentrations (mg/L)			
BoreID	Depth (m)	EC (uS/cm)	pH	Na	Ca	Mg	K
Hazeldene Shallow	6.4	24,900	7.55	4,657	296	658	11
Hazeldene Deep	15.1	25,800	6.96	4,999	321	550	21
GW088538/1*	13.6	11,400	7.50	2,000	240	320	21
GW088538/2*	41.0	4,770	7.30	640	150	120	10
GW088538/3*	68.0	1,440	7.30	220	41	29	6

*GW088538/1-3 (DLWC, unpublished data.)

The abundance and distribution of finer regolith materials (i.e. silts and clays) in the landscape appear to exert a major influence on the groundwater chemistry of the Ten Mile Creek and Simmons Creek sub-catchments, or parts thereof. Shallow groundwater associated with low-relief landforms dominated by finer-textured regolith contains greater quantities of major ions than deeper groundwater or shallow groundwater associated with coarser regolith. This has implications for the movement and storage of major ions that are associated with environmental hazards like salinity and sodicity, with such landforms potentially acting as either sources or sinks of salt in the landscape depending on other variables such as land use and climate.

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