Updated inversion of SkyTEM data using downhole a-priori for new conceptual model and groundwater management targets at Toolibin Lake

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Toolibin Lake is located southeast of Perth in the WA Wheatbelt. Land clearing since the early 1990’s changed the hydrologic balance, which has produced rises in groundwater levels, water logging and salinisation.

SkyTEM data acquired over Toolibin Lake in October 2006 (Reid et al. 2007), were reprocessed and re-inverted using borehole elevation and conductivity data as a-priori information, with the aim of improving the accuracy of the interpretation. The SCI were also run applying downhole conductivity from ~ 30 logs as extra a-priori input. Bedrock elevation was extracted querying the resistivity 3D model. In September 2012 thirteen monitoring bores were logged with the Vista Clara Javelin tool (Walsh et al 2013). The NMR technology provides direct measurement of total water content (total porosity in the saturated zone or moisture content in the unsaturated zone), and estimates of relative pore-size distribution (bound vs. mobile water content). It also yields information on the hydraulic conductivity of the materials being logged.

The bedrock topography map derived from the newly inverted SkyTEM data indicates that a deeply incised valley system developed, which was subsequently filled with sediment. Toolibin Lake sits atop that sedimentary package. The modelled basement-regolith boundary accords well with available borehole information. Results from a constrained SCI inversion are shown in Figure 1. A conductivity-depth section is shown for a transect across the lake, with borehole log resistivities superimposed. The match between the AEM and the logs is good in all bores, apart from the one of the far left. The SCI results reflect capture the variability contained in the bores and effectively extend that in a lateral sense. In this dataset, the role of the a-priori is to locally improve the resolution of subtle conductivity variations that would have been poorly resolved by interpreting the AEM data alone.

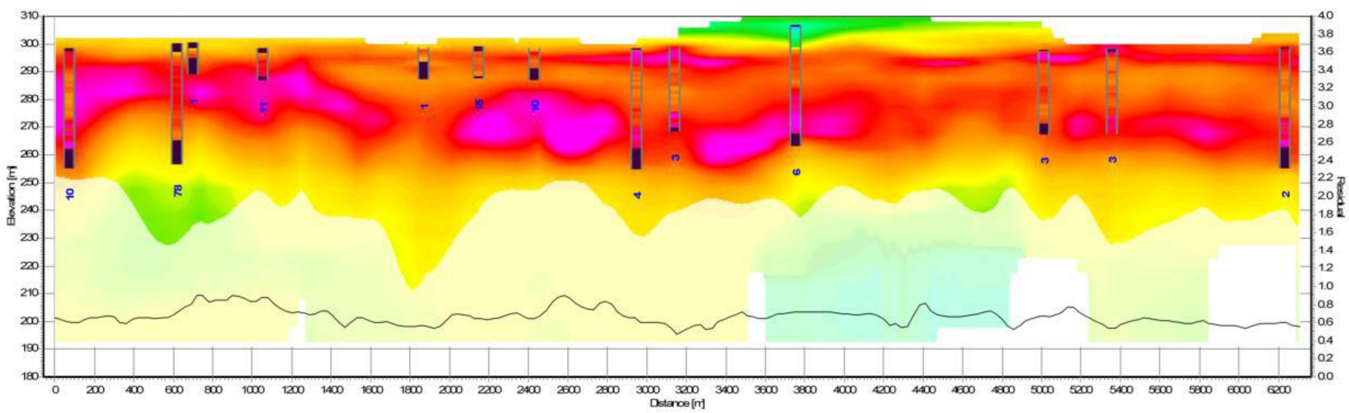

Figure 1

The palaeodrainage and palaeovalley extent was refined using the bedrock elevation surface. The combined use of this boundary and the interval conductivities from the inversion enabled the mapping of a deeper channel system at depths of around 40 to 60 metres below ground level. Previous investigations found the palaeovalley sediments to have higher hydraulic conductivities and this new map provided the information to plan a borehole NMR program to locate higher yielding aquifers.

A conductivity depth slice of the interval 18 to 20m from the SCI is presented in Figure 2. In this figure, the valley fill sediments are seen to be generally more resistive and the valley form has a greater extent than the deeper channel. Subtle conductivity patterns are noted and are likely to map the complex sequence of sediments deposited within a braided channel network variably connected to flood plain sediments with higher conductivities, or to deeply weathered or immature regolith derived from weathered Granitoid rocks

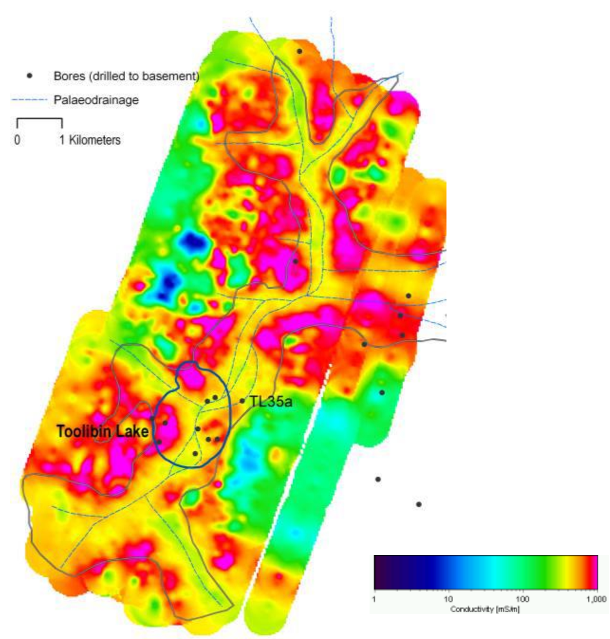

Figure 2