Facilitating Long-Term Outback Water Solutions – Combining some of the old with some of the new

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SUMMARY

Mining and energy development in South Australia's far north is set to have significant consequences for the water resources of the region. These sectors generate significant economic value to the State and their support remains a priority for the government. The scale of the planned developments and the potential from current exploration programs facilitated by the South Australian Government through the Plan for Accelerated Exploration (PACE) Program will result in a substantial increase in infrastructure requirements, including access to water resources and Aboriginal lands for exploration and potential mine developments. Presently, knowledge about the character and variability of groundwater resources, the sustainability of this resource, and its relationship to environmental and cultural assets remains very limited, particularly in the priority areas for development The FLOWS project is aiming to address some of these limitations by collating information on the location and characteristics of aquifers, their capacity, and the quality and variability of the contained groundwater resources initially for some priority areas. Key to this is the access and interpretation of historical geophysical data, particularly AEM data, acquired by exploration companies and government in priority areas identified by the State, including the Musgrave Block and the north and western parts of the Gawler Craton. This paper examines the approach being taken and challenges of adding complementary value to historical geophysical data sets.

Key words: South Australia, outback water resource assessment, technology, AEM, groundwater.

INTRODUCTION

Planned and potential mining and geothermal energy development in South Australia's arid regions, particularly in the far west and north, is set to have significant consequences for the water resources of the region. The scale of the planned developments and the potential from current mineral exploration programs facilitated by the South Australian Government through the Plan for Accelerated Exploration (PACE: http://www.pir.sa.gov.au/minerals/pace/pace2020) will result in a substantial increase in infrastructure requirements, including access to water resources, access to Aboriginal lands for exploration and potential mine developments. Given that these industry sectors generate significant economic value to the State; their support remains a priority for the South Australian Government.

The Facilitating Long-Term Outback Water Solutions (FLOWS) Project, funded through the Goyder Institute (http://goyderinstitute.org), is investing in research which will contribute to the development of an integrated water resource management strategy, thereby helping facilitate the economic growth potential of priority regions associated with mining and geothermal energy industry development. The initiative is drawing on the combined efforts of the indigenous community, industry and government to determine the location, accessibility and sustainability of the State's groundwater resources that are suitable for mineral processing and energy supply. It will also provide policy measures for access to water resources and the protection of dependant ecosystems and environmental assets.

Presently, knowledge about the character and variability of groundwater resources, the sustainability of this resource, and its relationship to environmental and cultural assets remains very limited, particularly in the priority areas for development as defined by PIRSA (Department of Primary Industries and Resources of South Australia). These areas include the Musgrave Block in the State's NW, and the north eastern and north western Gawler. Access to water is a key infrastructure need for mining and energy industry development in the aforementioned regions, and this initiative will help encourage and secure development where appropriate, providing the South Australian State Government Department for Water (DfW) with the tools to help provide advice on the viability of access and possible infrastructure arrangements where water resources may be shared.

The FLOWS Project has the following objectives:

1. For resource development priority areas, through the integrated analysis and interpretation of geological and airborne geophysical data, linked to targeted hydrogeological investigations:
    - *identify the location, geometry and characteristics of aquifers,*
    - *their potential capacity, and*
    - *the quality and variability of the contained groundwater resources;*
2. Develop a spatial understanding of the groundwater recharge and discharge processes and rates across the priority areas which have limited bores and data on groundwater age and character;

3. Desktop study groundwater dependant ecosystems, cultural assets and high value environmental assets in arid parts of State;
4. Deliver information packages for to provide guidance and advice on potential and viable water resources, including GIS compatible mapping products and models for distribution to industry through the relevant State agencies.

METHOD

For the first of the abovementioned objectives, a staged approach is being employed which builds on the analysis and interpretation of *existing* airborne geophysical data sets, particularly airborne EM data. The study is combining their re-processing and interpretation from a groundwater perspective, in other words aiming to add value to the data already acquired, by considering their relevance for providing spatial information on groundwater systems.

To that end CSIRO, the lead research partner in the FLOWS project, has been working with industry and PIRSA in accessing historical AEM data sets held in company or Government archives. In the first instance, access is being sought for data covering the priority regions. Their interpretation is now being undertaken to inform our understanding of the location, geometry and characteristics of aquifers, the quality and variability of the contained groundwater resources in these areas. We believe this approach will add value to the data sets held by the companies by helping us understand regional groundwater resource that could be critical should prospects move to mines.

The interpretation of existing geophysical data is incorporating geological and hydrogeological data for constraint and is being linked to existing knowledge for basins and overlying cover (regolith materials), including palaeochannel sediments. It is also drawing on information from previous and more recent resource investigations being undertaken by SA Government's Department for Water. These are summarised in a series of reports entitled 'Non-prescribed Groundwater Resources Assessment. Phase 1 – Literature and data review'. Initial reports have been prepared for the Natural Resource Management regions of Eyre Peninsula, Northern & Yorke and Alinytjara Wilurara and are the first in a series being produced by the Department's Non-Prescribed Groundwater Assessments project, under a program of works titled the 'Groundwater Program'. The FLOWS project is also building on PIRSA's Palaeochannels studies, it's basin modelling work, and outcomes from PACE activity, and on Geoscience Australia's projects (including their Gawler project work and the NWC funded Palaeovalley project, and the Frome EM survey).

As mentioned earlier, part of the investigative work being undertaken includes the quantitative interpretation of historical AEM geophysical data to provide information on groundwater quality and its spatial variability. The generation of these derived products from their further analysis and interpretation has necessitated research to understand the nature and characteristics of systems employed in the original data acquisition, an understanding of the processing used to generate data supplied to the client (in this case industry). This is particularly important if we are to combine outputs from different systems through their full inversion, linked with available bore data. The FLOWS project is now in the process of developing and documenting procedures and protocols for "correcting" or calibrating historical data sets. Potentially this allows their re-processing with a view to generating seamless coverages (when linked to more regional data sets), or maps of ground conductivity, from which groundwater and aquifer characteristics can be determined through reference to available bore and related analytical data in the manner shown in Figure 1.

Hitherto, the approach of "calibrating" and combining historical AEM data acquired from different systems over different dates has not been attempted using a common framework for processing and inversion.

Work relating to Objectives 2 and 3 are proceeding in parallel to the above mentioned activity but are also drawing on the outcomes from Objective 1. In the case of groundwater recharge and discharge studies, the work is proceeding to use state-wide information from a recharge and discharge database, to glean statistically significant relationships that link recharge/discharge to parameters that are easily and readily available. The methods being employed are discussed more fully in Crosbie et al. (2010)

RESULTS

Initial results from the project indicate that groundwater recharge in outback SA is very limited. Figure 2 indicates the estimated rates of recharge across South Australia defined using the Method of Last Resort (MOLR) which is described in Crosbie et al (2010). The results suggest much of SA's groundwater recharge in areas that are priorities for industry development – i.e. in the State's north and west, are very limited. They imply that in all likelihood, if groundwater resources were to be tapped for industry development, they would in essence be mined, as resources appear to be non-renewable. Further work is required to refine and upscale the results and to link it with an assessment of groundwater age and character. Acknowledgement that the estimates for groundwater recharge are so low, gives added importance to understanding the nature and distribution of existing groundwater resource which will come from a combination of sources, including AEM data and targeted bores.

CONCLUSIONS

The focus for the FLOWS project is in the Musgrave Block and north and western Gawler; priority areas for mineral and energy development. Increased knowledge of groundwater, its character and variation, coupled with information on aquifers will inform the accessibility and sustainability of the State's groundwater resources that are suitable for mineral processing and energy supply. By providing the State with an appropriate science base, information and tools, this project will contribute to secure development of the State's groundwater resources where appropriate, and enable prudent decision making and policies regarding water allocation, accounting, licensing and sustainable yields whilst ensuring the protection of dependent ecosystems and environmental assets.

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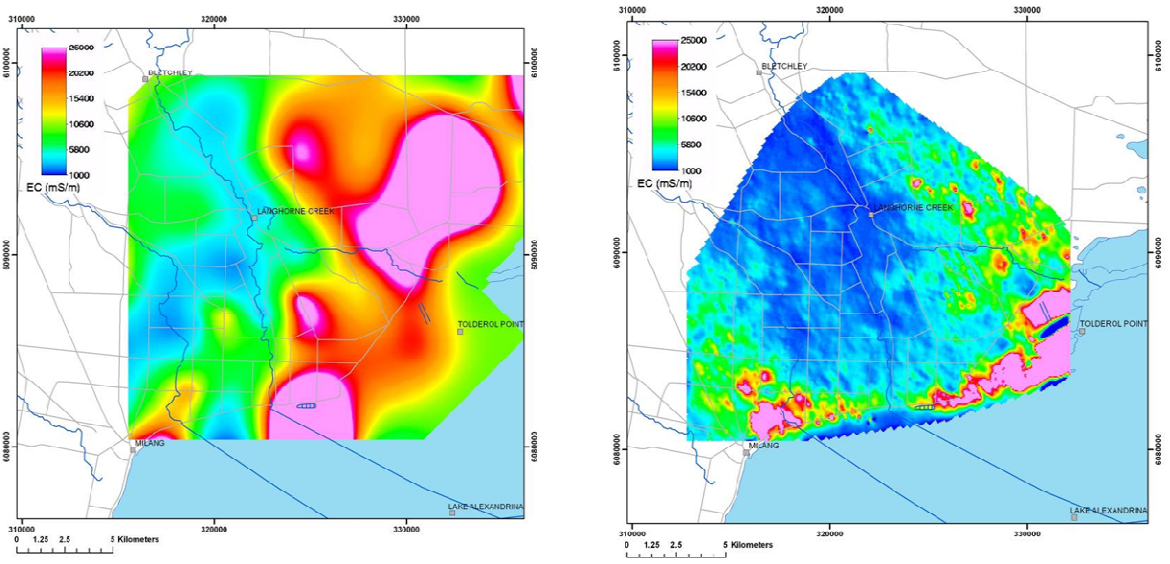

Figure 1: Regional groundwater quality maps derived from available bores often results in spatially coarse and sometimes misleading results (left). The potential benefit of taking historical AEM data and combining their interpretation with available bore data is shown in the figure on the right, which gives a more truthful and spatially consistent representation of groundwater quality of a shallow aquifer system.

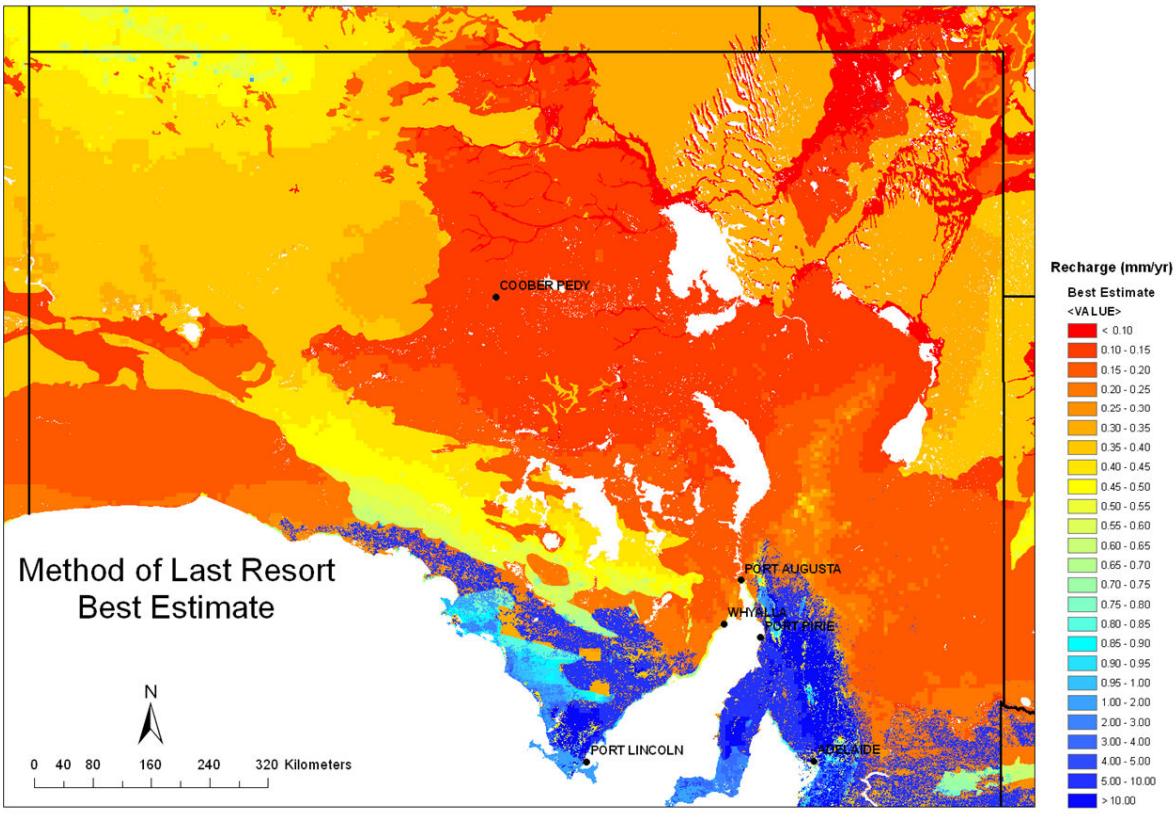

Figure 2: Estimated rates of groundwater recharge across South Australia.