Submission to the House of Representatives Standing Committee on Science and Innovation inquiry into coordination of the science to combat the nation's salinity problem

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15th October 2003

Summary

Although the Airborne Electromagnetic method (AEM) can provide an unparalleled visualization subsurface conductivity it has not been adopted for *treating the causes* of salinity. This is probably related to the marginal benefit of available treatment options and the lack of direct relevance of the data to the implementation of those options. On the other hand, when AEM is applied to *ameliorating symptoms* of salinity, it is proving very useful and is likely to be highly cost effective.

Although this situation has been suspected for some time, this has not prevented the majority of the emphasis being placed on treatment rather than amelioration. This misplacement of resources exposes our tendency to allow wishful thinking about salinity to blind us to logical conclusions based on scientific and economic considerations.

1. Introduction

This submission is a personal perspective of the use of Airborne Electromagnetic (AEM) methods in the mapping of salinity in Australia. Over the past 10 years I have participated in a series of studies to evaluate the applicability of AEM to Australia's salinity problems. This involvement commenced when I was Director of the CRC for Australian Mineral Exploration Technologies, the CRC that developed TEMPEST, the AEM system that has been described as providing "Ultrasound of the Earth". Since leaving CSIRO my involvement has continued through a number of projects associated with the National Action Plan.

I think that the history of AEM and salinity in Australia provides a fascinating insight into the scientific, sociological, and political processes whereby new technology is introduced.

2. AEM and Salinity in Australia

AEM technology was first developed as a tool for mineral explorers to look for ore bodies deep in the earth. However, because it measures electrical conductivity, it has always been recognized as having the potential to contribute to the monitoring of salinity in the landscape.

Seeking to capitalize on this potential, enterprising geophysical survey operators endeavoured to persuade anyone who would listen that their technology would be useful. Not unreasonably the response was "Let's conduct some tests to see if this thing works". These initial tests, while proving that the system could indeed map deep conductivity, exposed a weakness of the technology in the mapping of near-surface conductivity variations and in the overall accuracy of the results.

In response to the need for better performance there has been a continuing effort to improve the technology. This is now bearing fruit and, although still not perfect, the near-surface information is much improved and the overall accuracy is perhaps 10 times better. This rapid evolution in the performance of AEM systems has meant that the there have been continual calls to re-test the technology for its salinity applications. In general, while each new test has endorsed these improvements, it is true to say that that the operational use of AEM in salinity management remained virtually nil. This, in spite of the over-enthusiastic endorsement of the technology in the National Action Plan.

To a naive technologist, bent on optimising his technology to perceived needs, this lack of uptake was both surprising and disturbing. It was, then, of little comfort to read the opinion of a long-time worker in salinity management, Richard George.

> *Airborne Geophysics has been developing as a tool for catchment management for at least 15 years. However, today its value is being debated as the data has largely failed to alter either the current trajectory of salinity, or the plans that have ensued in any catchment in which it has been used. Why, when we acknowledge that the technology has developed and now provides unparalleled insight into soils, geology and regolith structure have we failed to use it successfully...?*

George[1] argues that the information could not be used because *"a gulf remains between the collection and interpretation of the data and the application of the interpretations to land management problems"*.

In retrospect the truth of this statement is all to clear. In fact, I suspect that the difficulty was even greater. Instead of a *gulf,* the impression was sometimes one of a *precipice* where, replete with sophisticated geo-scientific information, we were stranded with no cost effective land management options to which we could bridge.

David Pannell[2] has reinforced this impression

> *It is remarkable the extent to which one still hears the view expressed that there must surely by now be sufficient information out there, and we just need to make sure it gets to farmers. In reality, the problem is not lack of information, but lack of options. We have enough information about the existing options to know that in most cases they are not sufficiently beneficial to individual farmers even in the long run to offset their direct and indirect costs.*

In this situation it is not unexpected that relatively expensive data, such as that provided by AEM, should be difficult to justify as a tool for salinity management strategies that were themselves of marginal benefit.

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[1] George, R and Woodgate, P., (2002) Crucial factors affecting the adoption of airborne geophysics for management of dryland salinity. Exploration Geophysics, v33 p 84-89.

[2] Pannell, D.J. (2001). Explaining non-adoption of practices to prevent dryland salinity in Western Australia: Implications for policy. In: A. Conacher (ed.), *Land Degradation*, Kluwer, Dordrecht, 335-346.

These depressing conclusions relate to experiences where AEM was expected to assist in "*treating the causes* of salinity by managing the amount of recharge into the groundwater"[3]. In general these were in areas of board-acre agriculture where the introduction of perennial crops or agro-forestry was regarded as the only feasible management strategy.

More recently where there has been focus on "*ameliorating symptoms* by intercepting and storing salt, and reducing groundwater levels by methods including engineering interventions"[4] , experience with AEM has been much more positive.

In particular, I have been associated with a project where there were very clear geo-scientific objectives that related directly to decisions that were an important part of a strategy to manage the salinity of the Lower Murray. Here, in contrast to previous studies, there was a well-defined salinity management strategy to protect a major, economic and environmental asset. Because there were clear technical objectives it was possible to reconfigure the way we used AEM to provide increased accuracy and greater relevance to the key objectives. Moreover, we were also able to discover unsuspected geological information that may have important implications for the design of salt interception schemes in this area.

I think we can now distinguish the situations were AEM (and probably many other data acquisition technologies) should be considered in salinity management.

There *must* be:

- Realistic, cost effective options for action,
- Genuine commitment to, and mechanisms for action
- A need for hard geo-scientific information to enable successful action
- Recognition that AEM is the most cost effective way of getting the information

That these entirely unremarkable conclusions need to be highlighted as some kind of revelation says volumes about the inefficiencies and wishful thinking inherent in our attack on salinity.

AEM provides an unparalleled way of visualizing the subsurface distribution of conductive groundwater. It is an incredibly seductive tool and, for many, it is hard to believe that the insights it delivers may not always have a major impact on the way we manage salinity. The whole idea of "Ultrasound of the Earth" is testament to its seductive power.

Its incorporation, as an almost mandatory requirement, in early versions of the National Action Plan was, in part, a result of naive enthusiasm but there was also an element of inter-organizational and inter-jurisdictictional rivalry that enhanced the pressure. The heady mixture of power, expanded funding and exciting technology has

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[3,4] House of Representatives Standing Committee on Science and Innovation. Inquiry into coordination of the science to combat the nation's salinity problem. Inquiry information document. August, 2003

sometimes obscured the need for a hard-nosed, economics-based approach to the application of AEM to salinity.

This is not to say that imposing new technology from above is always inappropriate. The successful project mentioned above would, almost certainly, not have taken place but for the incentives in the National Action Plan.

The spectrum of possible actions to mitigate dryland salinity ranges from broad-acre recharge reduction strategies to very focussed engineering in the vicinity of high value assets. My experience would suggest that *current AEM technology* is highly applicable for the protection and management of assets but application at the other end of the spectrum awaits greater clarity among the available management options.

However, AEM technology should not be ignored while this clarity is achieved. On the contrary, it should be incorporated into the urgently needed research on groundwater flow systems and cost-effective recharge management. If it is integrated into a complete, end-to-end approach there is every possibility that *new, salinity-optimised AEM technologies* will make an important contribution to the final outcome.

3. Conclusions

What lessons can we learn from this story? The most obvious is the need for sound, common sense application of well-understood management principals. To restate them verges on banality. Nevertheless I will do so.

Utilization of knowledge and technology:

- Unless clear, attractive salinity management strategies are available there is little point in expending resources on activities that are unlikely to result in salinity management action.
- New technology should be introduced in response to a well thought out demand for the information/capability it can provide.
- Successful application of new technology can be imposed from above but it must be carefully integrated into a realistic action agenda.

Linkages:

- Collaboration and coordination work well when there is a clear vision, well articulated objectives and adequate funding.
- They fail in the face of competition for funding, inter-agency rivalry and jurisdictictional turf wars.

Support:

- The role of AEM in salinity is still being defined. It is probably premature to make comment at this stage.