National Groundwater Committee

Issue Paper 4

Water Level Response Management as a Micro-Management Tool

The Problem

The sustainable yield approach to groundwater management defines the bulk volume of water that can be sustainably extracted on an annual basis from a defined groundwater management unit (GMU) or zone over a specified time period. However, as hydrogeological conditions are seldom uniform within a GMU, climate is not constant, and bores are not evenly distributed across the aquifer, there may be local problem areas requiring additional management. These local problem areas occur where groundwater levels continue to decline even when overall extraction for the GMU is within the sustainable yield. Such areas are generally caused by a high density of pumping bores and/or variable hydrological/climatic conditions.

As groundwater development intensifies across Australia, many GMUs are becoming allocated up to their estimated sustainable yield. Once fully developed, there is heightened potential for these systems to have **local areas** with unsustainable levels of extraction and resultant unacceptable impacts. Local impacts and consequences of unsustainable levels of extraction can include:

- lost ability to access the resource when water levels fall below pumping bores, particularly shallower stock and domestic bores and wells;
- increased pumping costs;
- deterioration of water quality;
- release of acid drainage from acid sulphate soils;
- saline water intrusion or upconing;
- inability of the aquifer to fully recover between pumping seasons;
- reduction in water for groundwater dependent ecosystems such as wetlands or rivers;
- interference with springs;
- in extreme cases, land subsidence.

The increasing potential for unacceptable local impacts has led to a recent recognition that micro-management of groundwater resources is needed in addition to broad-scale management to sustainable yield. Micro-management refers to finer control of the spatial distribution and timing of groundwater extraction at a local or even individual farm scale.

Background

A relatively new approach to the problem, has been put forward by groundwater users. Referred to as 'Water Level Response Management (WLRM)' it warrants serious consideration as a valid and useful management tool for those groundwater resources that are at or nearing full allocation.

Water level response management refers to the management of groundwater at a local scale based on the response of the aquifer to pumping. In practice, it may be possible to manage an aquifer within a locally agreed 'band-width' of water levels that has been negotiated with the local community and other stakeholders. The upper band is the recovery level that must be achieved at the end of the pumping season and the lower band is the maximum drawdown that must not be exceeded during the pumping season.

Water level response management should be considered when there is a threat that continued pumping at high rates will result in:

- loss in access to water by a significant number of groundwater pumpers; or
- salinisation of the aquifer; or
- loss of a priority groundwater dependent ecosystem; or
- local land subsidence caused by excessive groundwater extraction.

Water level management to pre-determined targets is a management response that protects both priority ecosystems and water users rights, through protecting both water quality and the physical integrity of the aquifer system.

In situations where groundwater levels are already outside locally agreed levels, for example where the maximum drawdown has been exceeded, a reduction in pumping volume or rate, and/or a change in the spatial pattern of pumping may be required. In other situations where the current water level is relatively high, and potentially threatening land salinisation, additional extraction in excess of the annual allocation could be allowed provided water levels return to, or remain within the agreed band-width. Both situations may occur at the same time in different parts of the aquifer within a GMU. Areas that have continuous or excessive water level declines are called 'hot spots' and areas where water levels are rising are referred to as 'cool spots'.

Problems with multiple objectives and constraints are typical in groundwater management studies and lend themselves to optimisation solutions. The 'Hotspots' software tool, linking a groundwater flow model to an optimisation routine, has recently been developed in Australia for application to water level response management (Merrick 2002). 'Hotspots' aids in finding allocation solutions that maximise productivity while meeting specified groundwater level constraints at critical locations. Water level constraints can be set for purposes such as protecting groundwater dependent ecosystems, ensuring that groundwater access is retained for critical users such as town water supplies and preventing areas of excessive drawdown.

Policy and Management Directions

The use of the optimising approach is being trialed over three years on falling water level problem areas in NSW (Namoi Valley, Lower Murrumbidgee Valley and Lower Murray Valley). The development of operational policy for application of water level response management will be a product of the study. Other outcomes should include:

- water trading from hot spots to cool spots;
- local area restriction on groundwater access where necessary;
- increased security of access to groundwater through annual allocation announcements occurring at the beginning of the water year;
- better management of water for groundwater dependent ecosystems; and
- potential increases in economic productivity through trading.

The following are some of the management challenges of WLRM:

- requires adequate monitoring networks for water level and water use monitoring;
- more demanding of agency resources;
- difficulty with the community agreeing on appropriate target water levels;
- technical problems with defining management zone boundaries
- not always practical to implement an optimal solution to resource management so trade-offs may have to be made

The Way Forward

To fully test the water level response management (WLRM) approach and 'Hotspots' software, additional trial sites should be selected across Australia. These sites should represent a wider range of groundwater allocation problems. Sites with salt water intrusion problems or significant groundwater dependent ecosystems that need protection from pumping stresses would be particularly good candidates as such problems have not been addressed in the initial NSW trials.

To progress this work NGC will:

- promote the use of WLRM and the 'HotSpots' software as a management tool;
- distribute the software freely to jurisdictions;
- coordinate and disseminate the results of any wider studies; and
- keep Land, Water and Biodiversity Committee informed of progress