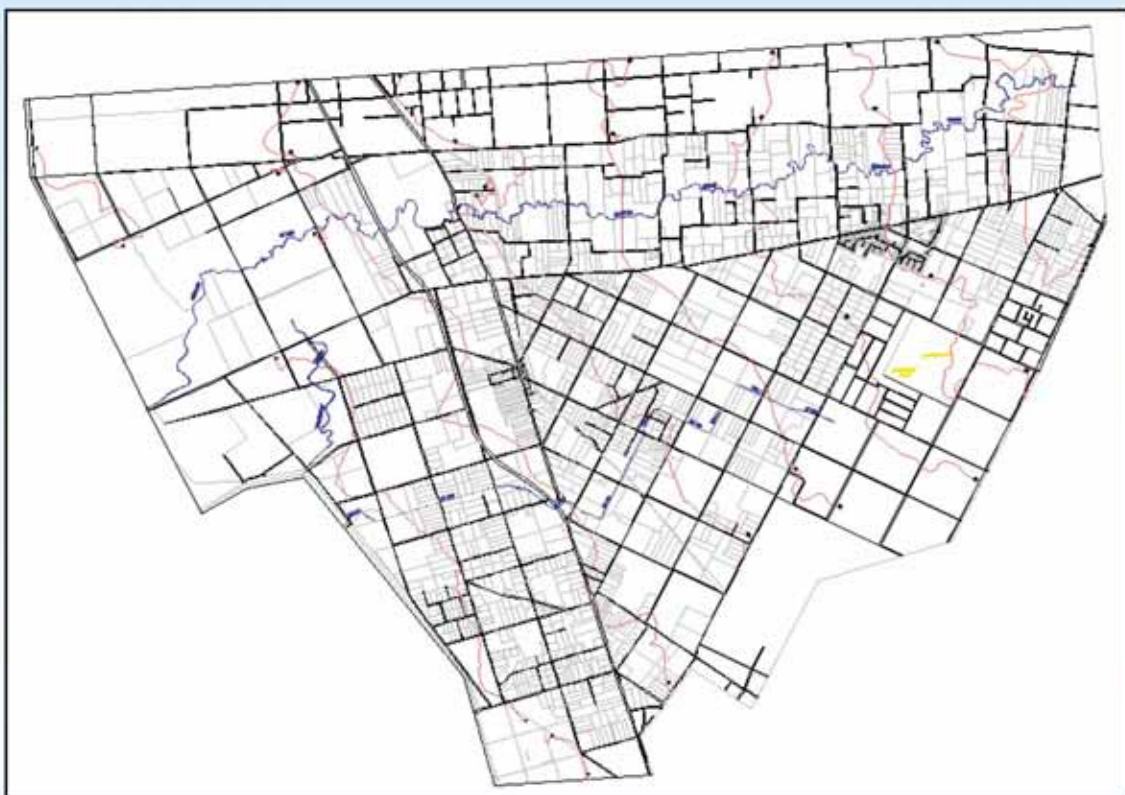




CSIRO

Groundwater on the Northern Adelaide Plains

*Prioritising research and related
communication requirements*



A summary of the Waite Campus Workshop

28th November 2002

Compiled by Daryl Stevens, with the assistance of
Sandra Wildman, Peter Dillon and Kym Good

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Abbreviations

DWLBC South Australia Department of Water Land and Biodiversity Conservation	LWMP Land and Water Management Plan
EPA SA Environment Protection Agency	NABCWMB Northern Adelaide Plains Catchment Water Management Board
IMP Irrigation Management Plan for reclaimed water use	NAP Northern Adelaide Plains
INRM Intergrated Natural Resource Management	NHT National Heritiage Trust
	WRSV Water Reticulation Services Virginia

Executive summary

The aim of this workshop was to determine the current state of research and communication on the NAP regarding the surface water table and set the scientific and communication priorities for the region, that will best address these current water table concerns.

The group achieved consensus that the unequivocal major cause of rising water tables near Virginia was excessive leaching of water beneath irrigation areas. This can be addressed by improving water use efficiency or by decreasing the proportion of area irrigated. Primary information required to assist with management of shallow water tables, that is missing or is not collated in a suitable way, are:

1. Water use patterns -The real-time crop-water table-linked use of bore and reclaimed water on the NAP, monitored through satellite imagery (crop) and a surface ground water piezometer network (water table), to understand water use patterns and identify potential inflows into the surface water table and where improvements in water use efficiency could be made. This was also considered an important part of a communication strategy.
2. Leaching losses beneath irrigated crops with and without management systems – need measurements to identify whether irrigation management alone can prevent salinisation/water table rises.
3. Groundwater monitoring and natural tracer studies to understand the inter aquifer flows and in particular effects on contribution of lower aquifers to the surface water table and rates of downward seepage.

Two other research areas were also identified as high research priorities to refine the modelling of the regions water balances:

1. Understand nutrient and salt fluxes linked with irrigation practices to determine treatment and disposal options necessary for subsurface drainage in future – can be included in (2) above.
2. Quantification of evapotranspiration demand at different times of year for different crops grown in the region and perennial vegetation, to determine water requirements and best management practices.

Participants suggested and agreed that information from the above and a proposed communication workshop should help form, and be part of, a Land and Water Management Plan (LWMP) for the region. It was proposed that the water management strategy should be lead by the EPA and NABCWMB (or the equivalent). The meeting recognised that a combined holistic approach to understanding the water balance in the area, and an extensive communication, training and education program is required to foster the improvement and adoption of best farming practices and surface water management strategies, which should ultimately ensure the NAP is a sustainable irrigation district.

Introduction

The aim of this workshop was to determine the current state of research and communication on the NAP regarding the water table concerns in the area, and set the scientific and communication priorities for the region that will best address these concerns.

This initial workshop focused on determining the scientific gaps and priorities for the region, and related communication required. Research conducted so far was summarised, research/issues that still need to be addressed (Gaps) identified, and a research and related communication plan identified to address these issues adequately.

It is envisaged that a second workshop is required to focus on communication issues and strategies, taking into account communication issues raised in the initial science workshop (described within this document) and broadening out to the communication, education and training requirements that could assist in managing water tables on the NAP. Such a workshop is the next crucial step in the development strategy for the region, and should be lead by the EPA, NABCWMB and communication specialist.

Attendance

Name	Organisation
Kym Good	NABCWMB
Wayne Meyer	CSIRO Land and Water
Peter Dillon	CSIRO Land and Water
Graeme Greene	Flinders University
Dallas Baird	Flinders University
Corinne Le Gal La Salle	Flinders University
Jim Kelly	Adelaide University
Daryl Stevens	CSIRO Land and Water
Nabil Gerges	Hydrology Consultant
Ray Ledger	SA EPA
Gerrit Schrale	Dept Water Land & Biodiversity Conservation (DWLBC)
Barry Philp (1:00pm)	PIRSA
Scott Evans	DWLBC
Trevor Dooley	PIRSA – Dryland Salinity Manager
Ed Collingham	SA Water
John Hutson	Flinders University
Tony Thompson	(DWLBC - Irrigation Engineer)
Wayne Brown	PIRSA
Lester Sickerdick	SA Water
Tony White	WRSV (Water Reticulation Services Virginia)
Phil Murray	DWLBC

Background

Wayne Meyer (Presentation)

Research and extension for sustainable irrigation.

- Wayne outlined processes to sustainability using the Coleambally Irrigation Scheme as an example.
- The majority of groundwater in the Coleambally Irrigation Scheme in '95 was at 0-2m depth, which led to problems such as waterlogging, soil structural decline, salinity and water extraction and drainage returns. The area was developed for irrigation in the early 1980s.
- The initial response from:
 - Researchers - was to request more time and dollars for research
 - End users – there no problem, it hasn't changed. Then to, maybe there's a few problems, BUT its not us that's is causing it. It's the government's fault! Just give us the money and we will fix it.
- There was an urgent need to manage irrigation in the Coleambally region for the future sustainability of the area. A draft LWMP and institutional arrangements to support this plan were required.
- Actions which were taken to manage the Coleambally water tables issues were:
 - scientific measurement (use of tools such as GIS, remote sensing, DSS),
 - education programs (inform people what they will be managing), and
 - policy development.
- The first steps were to determine who was responsible to coordinate the process, measure and understand the extent of the problem, educate/communicate and define operating rules.
- To undertake this process you must work with producers to look at their particular area and look into environmental constraints that need to be followed whilst maintaining economic viability. Design the LWMP to suit your community and conditions. Environmental management at Coleambally is ONE model for groundwater sustainability.
- Research must involve geology, climate hydrology, soils, crops, agronomy and economics.
- Extension/communication must engage, involve, promote, implement and refine with ALL the community, industry and government.
- Modelling programs can help people listen, understand, participate and the whole process required persistence, policy incentives and leadership.
- Remember with actions/issues:
 - One model does not satisfy all needs
 - Education of researchers and end users is integral part of the process
 - Continuous promotion/selling of the message is essential
 - Change is slow and incremental.
 - The landholder is key to the process.

Aim

Kym Good (Presentation)

- Water Catchment Board's role is to ensure appropriate research agency and end user response to the NAP water tables. Most research to date has involved the tertiary aquifers, research must be expanded on to the shallower aquifer systems.
- Researchers need to collaborate in order to take management of issue to growers.
- A project proposal has been submitted to the National Action Plan for Salinity and Water Quality Priority Projects – Stage 1 needs development/refinement.
- NAP - Water balance system needs investigating and should form an integral part of the LWMP.

Comment:

Gerrit Schrale commented that the Murray-Darling Basin has an action plan outlining the development of a LWMP which could be made available to the Virginia Horticulture Board and NABCWMB.

Groundwater

Scott Evans (Presentation)

- Hydrology of NAP – presented data to date from a summary of a, soon to be released, report assessing the current ground water data available from observation bores in the quaternary aquifers (particularly Q1 and Q2).
- Two unconfined surface watertable observation bore networks have been installed to date. One network was installed as part of the Bolivar reuse scheme (Anon 1999; ~14 observation bores). Another more intense piezometer networks was installed by Jim Kelly and Nabil Gerges to assess a designated shallow watertable area (Gerges, Kelly 2002; ~12 observation bores). These piezometer networks are currently monitored every three months, with continuous logging at 4 piezometers.
- Where there has been some good data logging for the last 30 years, at some observation well, data suggests that groundwater was higher in the early 70s, than the recent peak observed (2001).
- The intense piezometer network just north of Virginia is a cross with piezometer spaced every approx 500 m – continuous logging at each point of the cross over the last several months indicate localised circumstances leading to watertable peaks. Some recharge could be attributed to rainfall – but not all.
- There is a need to select future monitoring sites carefully and monitor on a regular basis as changes occur over short period of time and conditions may be localised.

Knowledge gaps:

- Hydrological data is not being compared against other data (land use, etc..).
- Hydrological data is now available at www.DWLBC.sa.gov.au, but there are no resources to interpret these data.
- The Virginia area and watertable issue doesn't seem to have high priority in DWLBC.
- Water use on the NAP needs to be linked spatially with remote sensing techniques to assess simultaneously, water usage, crops grown, rainfall and watertable fluctuations.
- There is limited long-term data on the NAP surface water table.

Comments:

There is an inherent problem with low public profile of groundwater problem on the NAP. The “to the best of our knowledge” calculations (Gerges, Kelly 2002) previously collected have been conveyed to various ministers and senior government officials, but it has been the experience of Virginia Horticulture Centre that these letters are largely ignored. There is a need for persistence.

Irrigation Water Use

Jim Kelly (Presentation)

The first approximation of water tables (Gerges, Kelly 2002) on the NAP investigated possible causes of rising of the water table. Possible inputs to and output from the water table were identified from several community meetings. Potential sources of inflows were:

- Rivers (Para, Gawler) – direct recharge
- Irrigation infiltration (domestic water)
- Irrigation infiltration (groundwater)
- Irrigation infiltration (reclaimed water)
- Rainfall
- Irrigation dams leakage (leaky storage)

- Wetlands (leakage)
- Drainage from well and/or trenches
- Upward leakage from Q1 Aquifer
- Upward leakage from other aquifers (leaky wells)
- Stormwater drainage (shadehouse structures)
- Stormwater drainage (Urban runoff)
- Lateral inflow
- Domestic water (sewage/septic)
- Wastewater dumping (hydroponics and nursery industry)
- Sewage lagoons and channel at Bolivar
- Salt pans

Potential source of outflows were:

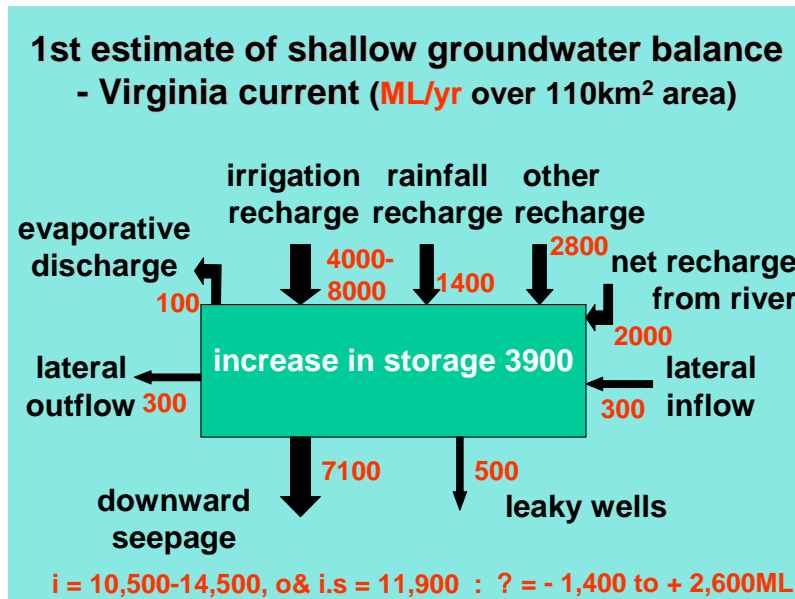
- Pumping of perched water tables
- Evapotranspiration
- Soil moisture deficient (soil storage)
- Downward leakage into Q1 aquifer and beyond
- Downward leakage into other aquifers (leaky bores)
- Stormwater drainage (Urban runoff)
- Stormwater drainage (Shadehouse structures)
- Surface runoff (rainfall)
- Lateral outflow (Barriers at sea/aquifer interface, seepage into creeks and rivers)
- Rivers (Para, Gawler) summer drains back into rivers

• Results from the first approximation are summarised as Table 1 or Figure 1. The greatest potential inflow identified was from irrigation sources (approx 60% from bore and reclaimed water) and many of the other major sources should be manageable with an effective LWMP.

Table 1. Estimated contribution of inflows to water table assuming runoff from intense rainfall events contribute to the water table.

Source	Amount (ML/yr)	Amount (ML/yr)	% Contribution
Excess Irrigation (leached)	8831		
Appropriate leaching fraction	2154		
Net irrigation contribution to water table		10985	60%
Rainfall (includes intense runoff calc)		3675	20%
Mains Water Domestic		2000	11%
Glass Houses		785	4.3%
Virginia, MP and AV Storm Water		559	3.0%
Water Dumping		170	0.9%
Q1 Aquifer Leakage		124	0.7%
Wetlands		87	0.5%
Irrigation Dams		26	0.1%

Figure 1. Schematic diagram of the water fluxes on the NAP (Dillon's summary)



It was noted in the workshop that Nick Meccossi – has photos of salt scald in the region taken during WW2, this information could identify areas of the NAP which may be natural surface discharge areas when the surface water table has been high in the past.

Drainage Scheme & Surface Drains

Kym Good (Presentation)

- A Sub-surface Drainage Scheme Committee was established to determine the feasibility of establishing a preliminary sub-surface drainage scheme. This scheme has been designed for possible expansion in the future if successful. Such a scheme also gave growers, affected by the high water tables, some short-term relief from the shallow surface water table.
- There seems to be a lack of stormwater drainage infrastructure in Virginia area.

It should be noted that marine or freshwater disposal of stormwater and subsurface drainage water may not be allowed by the EPA as there is concerns of the quality of the water. The NABCWMB are investigating the possible use marine wetlands for the appropriate treatment of drainage waters.

There are also still concerns that growers need to manage water rather than rely on drainage to solve problems. In many schemes where drains have been installed (at great cost) as irrigation practice improve in the area the drains became redundant after the irrigators adopted improved management practices.

Workshop Session

Participants supported that the idea that information from the following workshop session should become part of a LWMP for the NAP. The development of the LWMP is crucial for the coordinated, sustainable development of the NAP. The prime drivers for preparing a LWMP should be NABCWMB and VHC in close collaboration with the irrigation community. The workshop followed

this context with the understanding that there is a need for a clear and shared view of the science behind the water tables on the NAP and a need for convergence of research, communication and training projects in the region. The LWMP should also embrace the Irrigation Management Plan (IMP) for reclaimed water use on the NAP and the IMP also requires modification (SA Water, WRSV and EPA) to form an integral part of the LWMP for the region.

Broad overview of current activities or general comments volunteered by workshop participants:

Wayne Brown - DWLBC

Several projects

- Education/training of olive growing and vineyards eg. irrigation, soil and crop management. Results: Highlighted raised water table issues, and changes in irrigation practices by some growers.
- Ray Farrelly (Virginia Hort Centre) involved in communication with community.
- Brian Hughes & Trevor Doyle – liaised with landowners on what could be done, different concepts proposed to set up best management practice properties in Virginia area – still waiting on funding.
- Training of community seen as key issue.
- Tony White and Trevor Doyle looked at community revegetation, proposal with WRSV – approval pending.

Nabil Gerges – Hydrology Consultant

- Investigating the use of the Q2 aquifer for draining water table, but is a temporary measure.
- Disappointed with the delay in the installation of a comprehensive observation bore network, which is very important to understanding and obtaining a water balance on the NAP.

Phil Murray - DWLBC

- Working with NABCWMB to examine production wells (1400) for rehabilitation. Identify those leaking and undertake rehabilitation program - ¾ complete.
- Salinity sampling program – all wells sampled for salinity – looking at yearly samples.
- Water allocation plan – conditions include operational rules of groundwater for irrigation – eg. trading water, growers to provide information for annual irrigation report, Bolivar water users to have permits. However, not all conditions were enforced, as it was too difficult.
- Relationship between farmers and authorities need to be improved.
- For progress to be made changes need to be initiated by farmers rather than enforced by authorities.

Tony Thompson - DWLBC

- Irrigation annual reporting should be part of a water allocation plan or the LWMP.
- You must measure the depth of water table and you need to involve growers in these measurements so they get instant feedback and are more involved so take ownership of looking after their region.

Corrine Le Gal La Salle - Flinders University

Has to research proposals

- Tertiary system – geochemical approach identified trends in salinity.
- Inter aquifer processes.

John Hutson – Flinders University

- Need to ensure data shared – collated and disseminated.

Peter Dillon - CSIRO

- Scientist meetings in 1998 identified 13 projects (see Appendix).
- The project on sources of salinity in reclaimed water has been completed.
- Priority work – modelling of upper quaternary aquifer, determine groundwater recharge intensity and measurement of drainage fluxes – currently developing application (post-grad scholarship).

Ed Collingham - SA Water

- No current projects.
- Users must be licensed – make piezometers (observation bores) part of license.
- Looked at the impact of the Bolivar treatment lagoons and saltpans on NAP water tables several years ago – data available from Ed. They concluded that these potential sources were not likely to have a big impact on the groundwater of the NAP.

Scott Evans - DWLBC

- In association with licensing – observation bores network – monitored 3 monthly, salinity monitoring program.

Dallas Baird – Flinders University

- Research student on Corrine’s project – improve knowledge on tertiary system, inter-aquifer leakage.

Gerrit Schrale - DWLBC

- Investigated water level fluctuations at Virginia School about 30 years ago. This data should be looked at as part of the hydrological assessments.
- Completed a LWMP for Qualco-Sunlands district near Waikerie, about 5 years ago.

Jim Kelly – University of Adelaide

- Compiles annual IMP report for WRSV.
- Concerns about effectiveness of the IMP and meetings are proposed to develop a new IMP for the reuse scheme on the NAP.
- New project – funding is being sort for the appointment of National Recycled Water Development Coordinator - funded by industry.
- New project – funding is being sort for the appointment of a State Irrigation Development Officer for SA – needs discussions with Horticulture Centre Board supported by the proposed Irrigation CRC (Meyer), partly funded by the Irrigation Association of Australia and Irrigation Association of SA.

Ray Ledger – EPA

- Implement IMP annually – review relevancy of plan.
- Discussions with WRSV (Tony White) to impose certain conditions on growers. Trying to set up Environment Performance Agreement – agreement for people to take responsibility and implement tasks.

Kym Good - NABCWMB

- Catchment board sees need to develop LWMP – challenge is to coordinate government activity and ensure the issues are community driven and understood.

Barry Philp – PIRSA

- Manage horticulture program across state.
- Grower servicing, ensures regional programs are developed.

Trevor Dooley - PIRSA

- DWLBC Dryland Salinity Program Manager
- NHT funded project – salinity management plan for Upper Gawler River (completed) and saline industry options.
- NHT funding for assistance to INRM groups.
- Produced regional salinity plan for Mt Lofty Ranges.
- Water Catchment Management Board represented on INRM group by Alan Ockenden. (Kym Good sometimes proxy for him).

Tony White - WRSV

- Operators of Virginia pipeline scheme who would like to use the NAP scheme as showpiece.
- Looking at crop and water usage and way to define and record this on a time and spatial distribution.

Daryl Stevens - CSIRO

- Research on reclaimed water usage – impact on soils.
- Community involvement from start was, and still is, an integral part of irrigation region management.
- Have been trying to get an appropriate watertable monitoring system, with the cooperation and involvement of the community established for 4 years now. Recognising that it is a crucial part of any irrigation district and best irrigation practices.

Research Prioritisation

The workshop then discussed the research priorities of the area and prioritised them with respect to their cost and benefit to making the NAP irrigation district a sustainable irrigation district. These priorities are summarised in Table 2 below.

Table 2. Research Priorities identified and ranked

No	Gap/Task	Priority	Timeframe	Notes / Benefit	Approx cost \$k/year	Approx. total cost
Above Ground						
1	Irrigation (bore and reclaimed water) recharge	High	Data is available now, but needs interpretation.	- PIRSA should re-look at land use on NAP ie. Crop type and turnover - PIRSA has data on deliveries of water to land users. Need to find out how that water allocation has been used – currently being done. satellite imagery could be used in conjunction with info on water usage - imagery should provide info on crops produced. - this is the controllable issue - address/educate on this issue in best management practice properties	Need dollars to collate and interpret. \$100K per year for 3 years.	\$300K
2	Nutrient Loadings Drainage (Fluxes)	High	4 years to obtain data (should be done in conjunction with the project above)	- concentrations of nutrients and salt - water that recharges aquifers can be high in nutrients and salt. Possible to limit subsurface drainage in future - needs to link in with land use and irrigation	Potential \$50-100K per year for 4 years	\$400K
3	Evaporation	High	3-4 yrs	- need to know evaporation at different times of year for different crops (crop factors). - perennial vegetation needs to be looked at – proliferation.	Potentially high, \$50k per year for 3-4 years years.	\$200K
4	Rivers and lagoons	Medium	- some info is available - 1-2 yrs for relationship between river and groundwater levels - need to look at flow rate of water from rivers in different years	- gives certainty of recharge from river	Piezometers, monitoring, interpreting: \$20 per year – mainly establishment costs	\$40K
5	Glasshouses – development issue Re water runoff	Medium		- Reuse/recycle of runoff - EPA plans to investigate		
6	Rainfall	Low	Data available now			
7	Runoff – limited	Low		- small component, not weighted enough		
8	Salt Lagoons /Wetlands	Low	Some data available from Ed Collingham	- considered low by scientists, if accepted by public then research not required	Low	
9	Munno Para community drainage	Low		- poor drainage infrastructure, basically runs onto land - Kym Good to raise issue on Virginia Hort board – Playford Council rep on board could respond		

Summary

(Wayne Meyer)

- Although impressed by the amount of work and good will and potential to do what is best for the NAP, there seems to be a lack of focus. This process should ideally be driven through the development and implementation of the LWMP for the region.
- Given the data presented and experience of other irrigation schemes around Australia, irrigation is most likely the dominant contributor to groundwater recharge.
- It seems that current levels of irrigation on NAP are close to sustainable at current water use efficiency and with current stormwater and irrigation management.
- Inevitably, expansion of irrigation in the region will result in shallower water tables unless water use efficiency increases. If water tables get too shallow, soil salinity and water logging will increase and production will drop.
- Improving water use efficiency is a much cheaper than installing groundwater drainage systems.
- We don't know yet what net groundwater accession will be sustainable, but current data and future studies will assist to define this accurately.
- Irrigation reporting needs more direct feed back/information on groundwater levels.
- Maximum irrigation intensity depends on irrigation practice, soil and depth to groundwater.
- Crop selection may be one method of reaching a sustainable water balance.
- A Land and Water Management Plan (LWMP) needs to be implemented immediately.
- Models are a beneficial tool to assess possible management scenarios and as educational tools.

Comments

- Education needs to commence immediately whilst the research is being conducted – the problem is immediate so some immediate action is required. However motivation is a key factor in changing behaviour.
- There seems to be a general lack of knowledge in community – information must be conveyed to public.
- Suggestion for statement to be issued by this independent group of experts on action that needs to be taken (eg. Wentworth Group) as opposed to an individual agency to lobby government.

Emailed comments received after the workshop

Jim Kelly

It should be noted that the cost of a drainage scheme, compared with the costs for adoption of best management practice, is considerably higher. Current estimates also suggest that a drainage scheme would be obsolete, if a number of the above ground inflows identified were decreased.

Tony Thompson

The report from which Scott Evans extracted the material that he presented is a comprehensive, soon-to-be-released collation (in a large part by Hajrudin Zulfic) of the existing hydrogeological data. It would be useful if this information were distilled into a few overhead transparencies (maps and charts) designed to present to growers a clear picture displaying what we do know?

Trevor Dooley

1. Most are aware of other areas/regions experiencing problems that are not too dissimilar (eg Angas-Bremer, Padthaway), and the current and proposed actions in these areas may provide

valuable info for NAP initiatives (eg. Angas-Bremer code of practice suggests offsetting increase in water licences with planting of trees)

2. As Wayne Brown mentioned, Brian Hughes has submitted a project for “Sustainable Regional Communities” funding – targeting Playford and Salisbury Councils. Apparently there is political will to get things happening in the area – maybe value add/piggyback NAP initiatives on this?
3. The MLR INRM Board has a Salinity Working Group currently progressing their proposed Investment Strategy – NAP has been identified as a priority area.
4. The understandable emphasis re salinity impact is the adverse impact on irrigated horticulture – other impacts are recognised but they have not really been objectively assessed (roads/infrastructure/native veg/river salinity).
5. If watertable levels were indeed higher in the early 70’s, this needs to be put in context along with the historical wetland/salt patch/primary salinity photos – ie the NAP is historically an area of shallow watertables and as such is at risk when irrigated. Also adds more credence to drainage options.
6. No real mention of identifying broadacre “high recharge” areas where irrigation/rainfall/runoff preferentially enters and recharges the shallow aquifer (point sources identified as roadside/glasshouse concentration)
7. Agronomic tweaking of the system (use of cover cropping, soil ameliorants, ?)
8. Essential that an agreed “simple conceptual model” describing the surface/groundwater water balance interactions be worked out and presented in a community-friendly form.
9. Modelling “what if” scenarios is a useful tool, unfortunately, it is based on a lot of necessary assumptions hidden in a black box.
10. Can the “Waite Group” state they are currently (50%) certain of the water balance processes and management changes required, and two years and #\$\$ down the track will be (75%) certain? Management changes are currently occurring, what level of certainty is required for full implementation of a program?
11. A very useful meeting, congratulations.

Peter Dillon

Concerning irrigation recharge (drainage to water table beneath irrigation areas), we rated it as high priority, but I don’t think it made it onto the whiteboard at the end. Graham Green can start Jan 2003, need operating resources, at this stage suggest allow \$200K to \$400K for studies with lysimeters suction cups on a few soils/crops at least one and preferably three with pairs of sites in adjacent plots that are irrigated as per normal practice and with an irrigation control system eg full stop or envirosan or similar. Would include water, nutrients (N,P) and salt flux measurements and modelling.

Appendix

Projects proposed in 1998

Notes of meeting 2 on the Northern Adelaide Plains Reclaimed Water Irrigation and Groundwater, 9am, Friday the 6th of November 1998, CSIRO Land and Water, Waite Road, Urrbrae. (Chaired by Peter Dillon)

Proposed new NAP activities suggested for the NAP:

	Activity / Outcome	By	Support?	Comments
<i>Meeting 1: 6/8/98</i>				
1	subsoil mapping - (technique development), to determine potential for waterlogging/salinity	PIRSA (Sandy Dodd), FUSA Graham Heinson	LWRRDC ARC	geophys eg CSIROTEM, GPR, EM to detect clays in stratigraphically controlled site with piezos - poss student projects - extend successful technique to broader area
2	baseline piezometry in upper quaternary aquifer- enables before and after view of levels and quality	PIRSA Russell Martin	State, Nat Land & Water Audit	water level, salinity, nutrient status determined in new wells to enable water table sampling - needs to happen soon, net over effluent irrig area
3	ephemeral perched water table observations -need for drainage where subsurface clays are present?	PIRSA / FUSA Nabil Gerges, Daryl Stevens	as for 2	arises out of 1 and 2 add from meeting 2: Dispersion of subsurface clays
4	modelling of upper quaternary aquifer, determine W/T rise wrt irrig intensity/ need for drainage	PIRSA (Nabil Gerges /Kwadwo Osei-Bonsu)	State, CMB	scale issues, sensitivity analysis, mosaic of intensities, long time sequence water meteorology affecting demand and recharge
5	measurements of drainage flux of water, salt, nutrients in representative soils/crops/management	Daryl, Mike, Ravi, Peter, John Hutson	HRDC LWRRDC	baseline measurements to determine fluxes to refine models (4 and 6) ideally to be on Daryl's sites and help close balances
6	model of water & solutes in effluent irrigation - to enable extrapolation from 5 to wider range of cases	Chris Smith (APSIM Waste), Wayne Meyer (SWAGSIM), John Hutson (LEACHM), Rengasamy, Mike	HRDC, LWRRDC	models may be used in design of experiments (5), and in interpretation of results R&D incorp: sodicity (affects on K, porosity), Boron, Cadmium risk model
<i>Meeting 2: 6/11/98</i>				
7	water and salt balance for NAP	Gerrit Schrale, Kim Good, Phil Murray	CMB	on subarea/mapped basis taking account of spatial intensity of irrigation, current and proposed
8	techniques to detect inter-aquifer leakage via wells, and to measure rates of seepage in the absence of	Corinne Le Gal La Salle, Andrew Love	LWRRDC	natural tracers, changes in concentrations during pumping, hydraulic evaluation

	wells Activity / Outcome	By	Support?	Comments
	<i>(continued)</i>			
9	monitoring soil moisture and soil salinity to improve crop performance and irrigation efficiency with relatively saline irrigation water	John Hutson , Peter Buss	SENTEK, Hons. Student	Use of new SENTEK probe in lab columns and field installation (perhaps on one of Daryl's sites?) and coupled with modelling to determine best irrigation practice
10	beneficial use mapping of the Q1 aquifer on NAP	CB, EPA, DEHAA, PIRSA Peter Dillon	at left, LWRRDC	to account for effects of salt and nitrate leaching to g/w especially where groundwater at the watertable is fresh. This should take account of groundwater salinity and domestic use from Q1 aquifer.
11	sources of salinity of reclaimed water	SA Water, PIRSA, FUSA (GIS) Peter Dillon	at left, NHT, Hons. Project	GIS overlays of piezometric surface and salinity of upper quaternary aquifer and of sewer inverts in the Adelaide area, and relating historical sewer salinity trends with piezometer hydrographs and leakage repairs, to identify temporal and spatial variations in salt inputs, with a view to determining what is preventable/reducible
12	Fate of endocrine disruptors in food crops and groundwater	Pascale Sztajnbok , (United Water)	CGE, SPIRT, OECD?	evaluate fate of endocrine disruptors (hormones and hormone-like substances) and pharmaceuticals in reclaimed water in food crops and in groundwater.
13	Fate of pathogens in food crops.	Pascale Sztajnbok , (United Water), Simon Toze (CSIRO)	CGE, SPIRT, OECD?	studies of the fate of pathogens on food crops eaten raw. Presumably there is a sound literature base, but for chlorine-resistant pathogens, such as protozoan cysts, some local studies are warranted to provide greater consumer confidence.

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