

Appendix 2

Notes from Interviews with State Contacts

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We utilised 5 focus questions to steer data extraction and conversations with state representatives:

1. How do you classify the hydrogeology in your State? Do you have a map of this distribution? Is information available through GIS, jpeg, other?
2. What hydrogeological settings/types are irrigated in your State?
3. What are the key management issues related to irrigation on each type? Are these dependent on scale of irrigation – how sensitive are your types/settings?
4. What are the best case studies of this for your State? Do you have 3D cut-aways, conceptual models, cross-sections etc? Are these available within one week?
5. How do you communicate sustainable irrigation management principles to irrigators, investors and NRM groups? Is this done by hydrogeological type? If so how?

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NT (Alice Springs Southern)	Bob Reid ph (08) 8951 9211 (DIPE Conservation and Natural Resources Section)	<ol style="list-style-type: none"> 1. Groundwater occurrence maps, 100 km either side of Stuart Hwy, available electronically. 2. Ti Tree Basin is an extensive (3,000 sq km) multi-layered Tertiary Sand aquifer, Coffey Geosciences have developed a numerical groundwater MODFLOW model. Table grapes are the most significant crop. Minor other irrigation at Rocky Hill, 100 ha table grapes with groundwater from Amadeus Basin (Upper Proterozoic to Carboniferous). 3. Uncertainty in volume to allocate is the biggest issue (refer to Glen Harrington recharge work in the Ti-Tree Basin). To date, neither salinisation of groundwater nor shallow waterlogging are issues due to deep water table and well drained surface soils. Unlikely that these will become issues in the management timeframe, but degradation of supply due to inflows of higher salinity water will in time be an issue. 4. Ti Tree Basin, no other graphical resources readily available, refer to individual reports for resources (e.g. Ti Tree Basin modelling study). 5. The 100 km strip mapping provides the basis for reference and consultation material.
NT (Darwin)	Stephen Tickell ph (08) 8999 3613	<ol style="list-style-type: none"> 1. NLWA classifications at the detailed scale. See web site for general aquifer type map suitable for this study http://www.ipe.nt.gov.au/whatwedo/water-

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northern)	(Department of Infrastructure Planning and Environment)	<p>resources/ground/resources/aquifers.html</p> <ol style="list-style-type: none"> 2. Daly Basin Cambrian cavernous limestone around Katherine, used for irrigation of mangos and fodder crops, Proterozoic dolomite, mango irrigation. Extension (Stage 2) to Ord scheme into the NT (Keep River) proposed with surface water 3. Environmental allocations in the Daly Basin, Daly River is groundwater fed during dry season, will be the main limitation, see website links. Keep River proposal – will be irrigating high salinity estuarine sediments 4. Many technical reports available, simple graphics on the web sites e.g. http://www.ipe.nt.gov.au/whatwedo/water-resources/ground/people/katherine.html 5. Recent public meetings for the Daly Basin and also Ti Tree Basin (see reports on website) http://www.ipe.nt.gov.au/whatwedo/dalyregion/reports.html
South Australia	<p>Scott Evans ph 8463 6949</p> <p>(Department for Water Land and Biodiversity Conservation - Knowledge and Information Division)</p>	<ol style="list-style-type: none"> 1. See groundwater resource map. 2. All, ranges from fractured rock environments (e.g. Clare Valley) to extensive Limestone aquifer (e.g. Murray Group Limestone in the Riverland where irrigation is with imported surface water). 3. Usage beyond sustainable limits, reduction in pressures and impact on GDE's (GAB), cyclic concentration of groundwater (Upper South East), shallow waterlogging and water table rise due to water importation (Angas Bremer), drop in storage and ingress of surrounding saline water (NAP), leaking bores causing salinity rise in productive aquifers (NAP), off-site impacts of using imported water (River Murray salt loads in the Riverland) or salinisation of soils / watercourses (Clare Valley) 4. See above 5. Water Allocation Plans for Prescribed Areas with community consultation. The WAPS are available on the DWLBC website and document the management issues and actions in each area..
Western Australia	<p>Phil Commander ph 9278 0300</p> <p>philip.commander@environmentments.wa.gov.au</p> <p>(Department for</p>	<ol style="list-style-type: none"> 1. Irrigation areas fall into broad groundwater management units. Hydrogeological maps are produced for areas with high interest (1:250 000 scale). In the Perth basin the system is managed by layer, i.e. shallow unconfined Quaternary sediments, confined Leederville aquifer and confined Yaragadee aquifer. 2. Main settings include groundwater extraction in Perth basin,

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	Environment)	<p>shallow coastal limestone and from shallow alluvium at Carnarvon which is recharged annually by the Gascoigne River. Surface water is used in the Ord Scheme and from dams in the South West (Waroona to Bunbury).</p> <ol style="list-style-type: none"> 3. Water quality decline and falling water levels. 4. Perth basin is subdivided for management, Swan valley (extraction from Leederville Formation) would be a good study, Wararoo has many issues including urban development, also the Ord Scheme. 5. Most areas of intensive groundwater extraction have management plans from pre-1995 which are currently being revised with the assistance of Local Area Committees to provide a channel for community consultation.
QLD	Linda Foster DNRM 07 3896 91055	<p>In Qld most groundwater for irrigation is in unconfined/semi-confined alluvial aquifers with rainfall or river recharge.</p> <p>Reasonable GIS coverages for surface water irrigation systems but this is now with SunWater, although DNRM has access. The groundwater irrigation areas have less infrastructure and therefore less data – hence less GIS coverages. There are 4000 bores across state monitoring WLs and water quality and some special monitoring of saltwater intrusion. Contours of water levels in GIS – linked to models. Groundwater management occurs in Proclaimed areas such as Burdekin, Bundaberg, Lockyer and Pioneer.</p> <p>Key Management Issues – Surface water – Quality not an issue but demand is outstripping supply. Overland flow has to be regulated under Water Act 2000 and this is an issue. Also the Act allows entitlements to be separated from property once a Water Resource Plan is done. Water now allocated as a Development Permit. Some rising water tables in some parts of irrigation areas (eg Condamine & Pioneer) but not as big a problem as in other states. Conjunctive use (SW & GW) being developed to combat this problem. GW being made more attractive to use.</p> <p>Groundwater – In Proclaimed Areas demand is outstripping supply. In Pioeer there are significant restrictions and in the Lockyer the aquifer almost goes dry. This is seen as a short term problem, however, because the aquifers are unconfined and</p>

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		<p>recharge on an annual basis. Most irrigation occurs in shallow alluvial aquifers around coastal areas. In deeper aquifers, (ie confined) there is very little groundwater irrigation. In GAB, for eg, groundwater irrigation is only used for drought-proofing.</p> <p>Case Studies – 3D sections could be developed from conceptual models developed as part of the Water Resource Planning process – eg. At Burdekin, Bundaberg and Pioneer. They have groundwater data and contours and have developed MODFLOW models.</p> <p>Stakeholders – Are involved in Community Reference Panel which is formed when the Water Resource Plan is being developed. Under the Water Act everything goes to the community reference panel. DNRM produce models and define hydrogeological types during this process.</p> <p>Closing – There is a lot of this material in the National Land and Water Resources Audit but they are now moving away from the concept of sustainable yield through to Water Resource Management plan with integrated (SW & GW) models.</p>
Qld	John Hillier (Queensland)	<p>1. Hydrogeology is described in terms of the basic geology and then into subareas for management purposes. Management boundaries which relate to the extent of the hydrogeological boundaries are available as GIS layers.</p> <p>The Great Artesian Basin is a major regional aquifer system through much of Queensland but is not commonly used for irrigation supplies. With the exception of the recharge beds which outcrop adjacent to the Queensland Highlands the aquifer is too deep to be impacted by irrigation activities at the surface.</p> <p>2. Irrigation is undertaken using groundwater extracted from the following Hydrogeological Types:</p> <ul style="list-style-type: none"> • Shallow unconsolidated sediments • Semi-confined sedimentary basin • Basalts <p>Small scale irrigation supplies are drawn from GAB recharge beds or other fractured rock systems</p>

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		<p>3. Groundwater development generally occurred before estimates of sustainable yield were made. Aquifers in shallow unconsolidated sediments and semi-confined sedimentary basins are mostly fully or over committed (eg Callide Valley). Supply issues are therefore the major management issue in these hydrogeological settings. Supply is also an issue for irrigators in the Basalts due to the discontinuous nature of the aquifers in this area.</p> <p>Coastal irrigation areas commonly have problems with saline intrusion resulting from groundwater extraction and consequent lowering of the water levels in the aquifer.</p> <p>On the Atherton Tablelands some groundwater is extracted from basalts for irrigation and some from surface water supplies. Salinity problems are emerging salinity problems caused by increased recharge from irrigation on soils overlying a metamorphic terrain.</p> <p>In the Cattle Ck catchment rising watertable due to increased recharge from vegetation clearance and irrigation (compound problem).</p> <p>4. Referred to Department of Natural Resources and Mines.</p> <p>5. Estimates of sustainable yield are made by computer modelling followed by extensive community consultation until there is agreement on the most likely scenario. This then forms the basis of the management plan.</p> <p>The management plan for the GAB is currently being prepared and incorporates the current moratorium on all drilling in GAB. This will not be based on computer modelling of sustainable yield.</p>
Qld	Guy Bignell (NRM Mackay Queensland)	<p>1. Hydrogeology is communicated in terms of the geological aquifers</p> <p>2. In the Mackay area irrigation is undertaken using groundwater extracted from the following Hydrogeological Types:</p> <ul style="list-style-type: none"> • Shallow unconsolidated sediments

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		<ul style="list-style-type: none"> • Semi-confined sedimentary basin <p>3. Saline intrusion is the major issue in the Pioneer Valley at Mackay. Irrigation water is sourced from both groundwater and surface water on an approximately equal basis.</p> <p>4. Case studies are available upon request.</p> <p>5. The resource managers focus on the impacts to the resource alone. The resource is managed by reducing the allocations to ensure that groundwater levels are maintained at least 1m above mean sea level. Any changes to water allocations are communicated directly to irrigators' groups and associations. The irrigators' associations then communicate this to the irrigators.</p>
VIC	Greg Holland	<p>Most useable aquifers are alluvial systems or Basin sediments. Surface water irrigation occurs in large gravity-fed systems such as Shepparton IA and Kerang IA. These are defined in GIS coverages and water table levels are monitored across the region. Water table contours produced on an annual basis. Not much GIS coverage, but electronic maps and bore locations are in system. GMAs exist as polygons.</p> <p>Aquifers are in Riverine Plain, Alluvial aquifers and Fractured rock.</p> <p>Groundwater is managed through Groundwater Management Areas for which Permissible Annual Volumes have been determined. Diversion from streams occurs for small irrigation areas – on most major tributaries. Roster schedules are listed for unregulated streams. Water Management Planning with a more integrated approach is a requirement from the White Paper but GMW doesn't have the methodology to differentiate between GW and SW in integrated systems.</p> <p>New irrig. Developments need to conform with Irrigation Development Guidelines. DPI has Scoped these out with landowners and they focus on sustainability. In existing irrig. Areas water management planning focuses on sustainable use of water – Shep Irrigation Region Management Plan is the model. Key is conjunctive use but not conjunctive management. But this is only in Shep Irrig. Region. Needs to be extended to other</p>

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		<p>areas. Hydrogeological assessments must be done and the impacts of irrig. On the water table needs to be assessed. SIR has broad-based rules.</p> <p>Impacts must be assessed generically for a region – develop a Site Use Licence. Entitlements must be “unbundled” under the White Paper.</p> <p>Community groups are involved in development of Plans.</p>
Vic	Phil Dyson (Victorian uplands)	<p>1. The Groundwater Flow System approach has been adopted Statewide however in areas where regional groundwater systems apply a greater level of detail is required.</p> <p>Maps of groundwater flow systems have been compiled for each 1:250,000 scale mapsheet except Gippsland and the Mallee although in some instances the mapped scale is 1:500,000 or 1:1,000,000. These mapsheets are in the process of being standardised and merged into one dataset.</p> <p>2. Fractured rock aquifers are generally not suitable for irrigation supply. In upland areas water for irrigation is commonly taken from either surface water or from groundwater sources in Upland Alluvium and Basalt flow systems. Some minor development of water supplies in outwash fans around granitic bodies is starting to occur.</p> <p>3. The key management issues in irrigated upland areas typically focus on supply and drawdown issues due to the limited size of the resource.</p> <p>4. Referred to local water authority contacts.</p> <p>5. Communication of sustainable irrigation management principles is generally undertaken through workshops and presentations communicating the hydrogeological settings which apply in each instance. The presentations focus on GFS principles and commonly utilise cross-sections for explaining the hydrogeological framework and water level responses.</p>
NSW	Mike Williams (NSW)	<p>1. On the basis of aquifer type (alluvial, coastal sand, porous and fractured rocks).</p> <p>There is an incomplete project for a full salinity yield classification.</p>

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		<p>For management purposes the main GWMA (Groundwater Management Areas) have been defined. To allow the Water Management Act (2000) to be implemented we are current defining all aquifers in the state on this basis using classification above.</p> <p>Maps are available based on aquifer type. It is proposed to prepare a more detailed salinity yield map. Salinity yield, current GWMA and WMA classification (by mid year) are available as GIS layers.</p> <p>2. Major irrigated areas rely on alluvial aquifers. Minor for porous rocks and coastal sands. Local irrigation from fractured rocks (limestone included in this group) primarily for high value permanent planting.</p> <p>3. Issues that tend to be independent of aquifer type are management of environmental water share or requirement, impact on stream flow, impact on GDE and how the defined 'sustainable' yield will be shared among consumptive users.</p> <p>Horizontal groundwater quality decline in coastal aquifer, vertical in the inland.</p> <p>At the present time maintaining water access for all existing users through a prolonged drought particularly the basis rights to irrigations is a cause for 'noise' in aquifers where it has not occurred in the past (even if it was predicted and foreshadowed to users).</p> <p>Cumulative impact is a major issue with large groundwater users more able to modify management practice than small due to the viability base.</p> <p>4. Depends what you are trying to demonstrate. Given the current water sharing plan status for aquifers in NSW the use of appropriate case studies would need to be established. 3D cut-aways, conceptual models and cross-sections are available in various documents and media but not within one week.</p> <p>5. Communication with irrigators, investors and NRM groups is undertaken by issue and priority. Management principles are underpinned by an extensive technical basis and GWMA</p>

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		committee negotiation prior to community engagement.
TAS	Bill Cotching DPIWE	<p>1. In Tasmania we are using the groundwater flow systems framework developed in association with Phil Dyson. A map of the State has been produced at 1:250,000. An example pdf format map for the northwest NRM region is attached. A full state map and GIS is available from DPIWE. 1:100,000 scale mapping has been completed in parts of the Northern & Southern Midlands and this will be available later in 2005.</p> <p>2. Four formal irrigation schemes operate in Tasmania. At Winnaleah in the northeast, Cressy/ Longford in the Northern Midlands, Clyde River near Bothwell in central Tasmanian, and the Coal Valley from the Craighorne dam in the southeast.</p> <p>Further information is at: http://www.dpiwe.tas.gov.au/inter.nsf/ThemeNodes/LBUN-4YC7N5?open</p> <p>A new large storage dam is to be built on the Meander River in the north of the State that will allow for increased irrigation in the Meander Valley. Irrigation water is likely to be used for increased dairy, vegetable and crop (eg poppy) production.</p> <p>There are significant volumes of irrigation water applied in agricultural areas of the State including:</p> <ul style="list-style-type: none"> • The drained swamplands in the far northwest and northeast; • Basalt low hills and plateaux in the northwest and northeast; • Dissected terraces of the Launceston basin in central Tasmania; and • Low slopes and valley floors in the Derwent and Coal River valleys. <p>Irrigation is predominantly by spray methods. Historically this has been applied using travelling gun irrigators, both soft and hard hose.</p> <p>Over the past 5 years, there has been a significant adoption of centre pivot and linear move irrigators that have high water use efficiency.</p> <p>The dairy industry uses a variety of systems including movable</p>

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		<p>sprinklers on laterals, k-line systems and some use travelling guns or centre pivots. Irrigation of dairy effluent is undertaken on most dairy farms using various technologies. Small travelling irrigators are commonly used for this purpose but injection into the lines of broad acre irrigators is also practiced.</p> <p>Wastewater from municipal sewage treatment facilities is being made available for productive agriculture in many areas of the State. The most significant volumes are being produced in the Hobart area.</p> <p>Flood irrigation is rarely practiced in Tasmania with only limited use in the Derwent valley of Southern Tasmania.</p> <p>3. Monitoring of irrigation use in productive agriculture has revealed that many irrigators are not starting irrigation soon enough in the season, irrigation is not applied with enough frequency, and one or two irrigations could be eliminated at the end of the irrigation season.</p> <p>Some poor irrigation practice under intensive vegetable production results in off site impacts from the basalt soils of turbidity in local waterways. This is not widespread.</p> <p>Some poor irrigation practice of dairy effluent results in contamination of surface waters with nutrients and pathogens. This is not widespread. There has also been contamination of groundwater in intensive dairying areas but the relationships to the overall farming systems or any particular practice have not been established.</p> <p>Isolated areas of concern exist where dairy effluent is irrigated over karst systems which have sink holes and there is likely to be contamination of groundwater.</p> <p>In the Northern and Southern Midlands the risks of increasing soil salinity and increased discharge of salt to waterways resulting from changed land use, particularly from grazing to irrigated cropping, are currently being investigated.</p> <p>In the southeast of Tasmania, research is underway on the risks and consequences of irrigating with wastewater, particularly in relation to increased salinity.</p>

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		<p>4. The detailed ground water flow systems investigations currently being undertaken in the northern and southern midlands will provide good case studies and the detailed modelling of wastewater reuse in the southeast will provide considerable understanding.</p> <p>These studies will produce conceptual models with cross sections but these will not be available for several months.</p> <p>There is some rudimentary information and 3-D cross sections on the DPIWE website at: http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/RPIO-4YD88T?open</p> <p>5. A series of training courses were run and a publication was produced as part of a course on wise watering irrigation management held in 2001. It was designed to enable participants to conduct their own soil evaluations, and use the results in the operation of their irrigation program.</p> <p>Module notes include: what is soil?; mineral particles; soil water; calculating RAW; assessing soil texture; commonly irrigated Tasmanian soils; water infiltration into soil; testing for slaking; testing for sodicity and dispersion; impacts of irrigation on soils; indirect impacts on irrigation.</p> <p>There is currently a water use efficiency project being run in the vegetable and dairy industries but there is a short term staff resourcing issue limiting the effectiveness of the project. The project operates via farmer discussion groups with monitoring of water quantities and soil moisture being undertaken on a number of farms. The information gained is presented back to the farmer groups to influence their management practices.</p> <p>There is currently a program underway to provide best practice advice to dairy farmers on dairy effluent disposal. Trained consultants are available and a cash incentive for on-ground works.</p> <p>Information emanating from the current projects investigating ground water flow systems will be used in future training courses on irrigation and salinity management.</p>