Assessment of Groundwater Resources in the Western Davenport Plains Water Control District

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Appendices
A Water Planning Policy

A.1 National Water Initiative and Water Allocation Planning

The National Water Initiative (NWI) is seeking to achieve water resource security through planning as follows:

- assessment of water resources and impacts of ‘climate change’ and land use change, and limitations to the state of scientific knowledge underpinning resource estimates;
- assessment of health of natural systems;
- identification and consideration of environmental, cultural and other public benefits of the resource including surface and groundwater systems having high conservation value;
- assessment of connectivity between surface and groundwater systems;
- assessment of users and uses of water including indigenous water use;
- assessment of impacts of plan provisions on water interception activities and downstream water users including the environment;
- provisions that allow for adaptive management, factoring in knowledge improvements;
- periodic independent audit, review and reporting of water plans, including the adequacy of management arrangements; and,
- development of water allocation policies.

This study is aimed at assist assessing the resource to address outputs required by the NWI; viz.:

- determination of the consumptive pool;
- estimates of reliability of water access entitlements;
- management of the impacts of interception on water access entitlements;
- provisions for monitoring the performance of water plans, and a review process that addresses improved scientific knowledge and that allows adaptive management.

A.2 Consideration of Water Allocation Planning in the NT

Hamstead, (2008) recommended development of a ‘Territory Water Strategy’ that (in the context of this study) would address:

- sustainable use of water sources, including protection of important water dependent ecosystems;
- water for Indigenous people;
- water for rural properties;
- water for mining;
- framework and principles for water entitlements, water planning and water trading;
- supporting water entitlements through compliance and enforcement; and,
- adapting to droughts, long term climatic cycles and climate change.

Hamstead (2008) described a range of ‘tools’ for enhancing water planning practice in the NT, viz.:

- Planning initiation protocol;
- Stakeholder analysis;
- Consultation plan;
- Advisory committee protocol;
- Community engagement monitoring;
- Template plan;
- Use of future inflow/recharge scenarios;
- Standard rapid assessment methods;
- Risk assessment;
- Multi-criteria assessment protocols;
- Plan cross examination protocol; and,
- Plan effectiveness assessment.

### A.2.1 Declaration of Water Control Districts, Water Development Capacity and Water Security in the NT

Under the Northern Territory (NT) Water Act 1992, a water control district (WCD) can be declared that may invoke the preparation of a water allocation plan (WAP) and the declaration of beneficial uses of the water. These may include:

- agriculture - irrigation water for primary production including related research;
- aquaculture – water for commercial production of aquatic animals including related research;
- public / community reticulated water supply - source water for drinking purposes;
environment - water to maintain healthy aquatic ecosystems;

- cultural – water to meet aesthetic, recreational and cultural needs;

- industry - water for industry, including mining or petroleum activities; and,

- rural stock and domestic.

The WAPs must ensure that water is allocated within the estimated sustainable yield to beneficial uses, that such allocations include an allocation to the environment, and that the right to take or use water under a licence is able to be traded. Whilst a WAP must apply to a WCD, it does not have to apply to the entire extent of the WCD. Within WCDs greater constraints can be imposed.

A water allocation plan ensures that:

- water is allocated within the estimated sustainable yield to beneficial uses;

- the total water use for all beneficial uses (including those provided through rural stock and domestic use and licences granted) is less than the sum of the allocations to each beneficial use;

- the right to take or use water under a licence is able to be traded;

- ideally, the full cost for water resources management is to be recovered through administrative charges to licensees and operational contributions from licensees; and,

- requires that an allocation be made to the environment.

WAPs are also guided by the Integrated Natural Resource Management (INRM) Plan for the NT: Sustaining Our Resources – People, Country and Enterprises, (Landcare Council of the NT, 2005). The INRM Plan includes the following natural resource management targets for inland waters:

- long term aspirational targets (50 years);

- specific and measurable resource condition targets (10-20 years), and,

- short term management action targets (1-5 years).

The INRM Plan is built around the principles of ecological sustainable development, the precautionary principle, and adaptive management, and includes specific targets and actions relating to water allocation.

As a matter of policy, the NT government has adopted the following framework in relation to sustainable yield, articulated in the INRM Plan (Landcare Council of the Northern Territory, 2005):

All available scientific research directly related to environmental and cultural water requirements for the water resource will be applied in setting non-consumptive water
provisions as the first priority, with allocations for consumptive use made subsequently within the remaining available water resource. In the absence of scientific research directly related to environmental and cultural water requirements, the following contingent allocations are made:

For rivers (in the context of this study):

- in the southern two thirds of the NT at least 95% of flow at any time in any part of a river is allocated for environmental and cultural water provisions, and no more than 5% of flow may be diverted at any time in any part of a river; and,

For aquifers:

- in the southern two thirds of the NT there will be no deleterious change in groundwater discharges to wetlands, and total extraction over a period of not less than 100 years will not exceed 80% of aquifer storage at start of extraction.
B Remotely-sensed Imagery

B.1 Terrain

Water Resource Assessment Zones with Terrain B-1

Figure B-1
Western Davenport Plains - Figure B-2
Water Resource Assessment Zones with Total Magnetic Intensity

Legend

**Bores**
- Central Mount Stuart Fm
- granite, gneiss & schists
- Heddes Creek Group NE Cudmont Sandstone
- Hines Creek Group NE Esperance Volcanics
- Hines Creek Group NE Hovellia Sandstone
- Other
- Tomahawk Beds
- Warrumbungle Fm
- Chalabrowe Fm
- Water Control District
- WRAZ Boundaries

**Total Magnetic Intensity Value**
- High
- Low

Projection: Transverse Mercator
Datum: GDA04

1:700,000 1:24000

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All information and data are considered to be confidential and may only be used for the purposes of this study.
C Hydrochemical Facies

A hydrochemical project was undertaken to classify groundwater-types by their chemical signatures in an attempt to reinforce and confirm the hydrogeological-based WRAZ boundaries.

Various graphical plots were made and are presented and explained below.

- ‘Class scatter plots’ of the distribution of ionic concentrations (SO$_4$, Cl, Ca, Mg and TDS) on a northings versus eastings basis; interpretations thereof follow;

Figure C-1 regional TDS and SO4 Plots delineating Hydrochemical Zones

- TDS – a uniformly decreasing trend in concentrations towards the NE
- Sulphate – decrease in concentration towards the NE;
Chloride – lower concentrations in Zones 1, 2 and 4; and higher concentrations in Zone 5. Concentrations are variable in Zone 3;

Calcium – similar concentration distribution to that of chloride and sulphate. Concentrations appears to decrease in the NE;
Figure C-3
Regional Mg and HCO3/Cl ratio Plots delineating Hydrochemical Zones

- Magnesium – similar concentration distribution to that of chloride and sulphate. Concentrations appear to decrease in the NE.
- HCO3/Cl Ratio – ratio greater in the NE in Zone 3.
Ternary Plots were plotted to determine the dominant ionic concentrations, any distinct geochemical trends and signatures in the area. The plots produced and interpretations thereof follow:

- Anions (Cl, SO4, and HCO3+NO3) – chloride and sulphate are the dominant anions in groundwaters of the WDP;
- Cations (Mg, Ca and Na+K) – sodium and potassium are the dominant cations in groundwaters of the WDP.

A scatter plot of ionic concentrations (Ca, Cl, Mg, K, Na, SO4, NO3, and HCO3) against TDS concentrations was produced to ascertain patterns and significant differences in concentrations. Breaks between ‘clusters’ were easier to distinguish with the suites plotted on the one graph. However, only the chloride plot was used to outline the extent of the geochemical zones on the scatter plot to avoid overlapping and this plot was correlated with the ‘class scatter plots’ to outline the geochemical zones;
A Duorov plot was produced to illustrate the composition of groundwater in the WDP. (This plot is also useful to identify any chemical similarities between the cation and anion groups).
The above plots were used to make the following interpretations:

- There are five distinct geochemical zones in the WDP:
  - Hydrogeological units (Zones 1 and 2) are moderately concentrated in TDS in the SE; however, Zone 1 has higher concentrations than Zone 2;
  - A hydrogeological unit (Zone 3) in the NE varies in concentration, interpreted as a result of the geology in the area is comprised of interbedded lithological units and bores being screened in different aquifers;
  - A hydrogeological unit (Zone 5) in the SW that is high in TDS (and Cl, SO₄, etc.);
  - The limited geochemical data in the area makes it difficult to determine the exact outline of geochemical Zone 4. Zone 4 has a linear geochemical trend similar to
Zone 3, but has been differentiated as a separate hydrogeological facies due to its chloride concentrations being greater than Zone 3.

- Chloride scatter plot showed that concentrations decrease towards the NE (Zone 3). This indicates that the majority of recharge occurs in Zone 3, whereas discharge occurs in the NE downs-gradient of Zones 3, within Zone 4;

- The Durov plot indicated that the linear relationship between cations and anions is evidence for mixing and dissolution during the throughflow and circulation of groundwater (recharge mixing with older waters?) in the region. The plot also provides supporting evidence of chloride, sodium and potassium dominance in the groundwater.

The hydrochemical zones (facies) map is presented below as Figure C-7
The following graphs are time series chemical data that are used to illustrate the variability of ionic concentrations with time possibly related to recharge events (the 1974 recharge event is evident from large HCO3-Cl ratios at that time.)
Figure C-8
Ionic Concentrations & HCO#/CL Ratio for Bores at Alekarenge (RNs 1801, 5788, 10744)

Figure C-9
Ionic Concentrations & HCO#/CL Ratio for Bore RN 12698 at Blue Bush
Figure C-10
Ionic Concentrations & HCO#/CL Ratio for Bores at Wauchope (RNs 436 & 5950)
Figure C-11
Ionic Concentrations & HCO#/CL Ratio for Bore RN 2047 at Wycliffe Well
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