

# Berry Springs Dolostone Aquifer Situation Analysis Report

August 2011



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Natural Resources Division**

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## Executive summary

This report has been written to introduce water planning and provide background information about the current health and status of the Berry Springs Dolostone Aquifer, which is a small localised aquifer located forty-seven kilometres south of Darwin in the Northern Territory.

This report provides information about the following:

- Water planning in Australia, the Northern Territory and the Darwin rural area
- Water sources covered by the Berry Springs water allocation plan
- Characteristics of the Berry Springs Dolostone aquifer and current use
- Community involvement in the development of the plan
- The planning process and schedule
- Technical assessments that will support the development of the plan

Water allocation plans are a tool used across Australia to set guidelines for the allocation and management of water. They are now being developed in the Territory to ensure adequate provision of water for environmental, social and cultural purposes whilst fostering sustainable water use and development.

The Berry Springs Dolostone Aquifer, in the Northern Territory is a small, localised groundwater aquifer that underlies parts of the Berry Springs and Darwin River areas. This aquifer currently provides reliable, good quality water supply for many rural residents, horticultural activities and maintains ecosystem health by contributing to base flows in Berry Creek. Furthermore water from the Dolostone aquifer also maintains the condition of places that are culturally important to Larrakia and Kungarakan people.

A water allocation plan is now being developed for the Berry Springs Dolostone Aquifer to ensure water is shared equitably and sustainably.

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# 1. Introduction

## 1.1 Groundwater

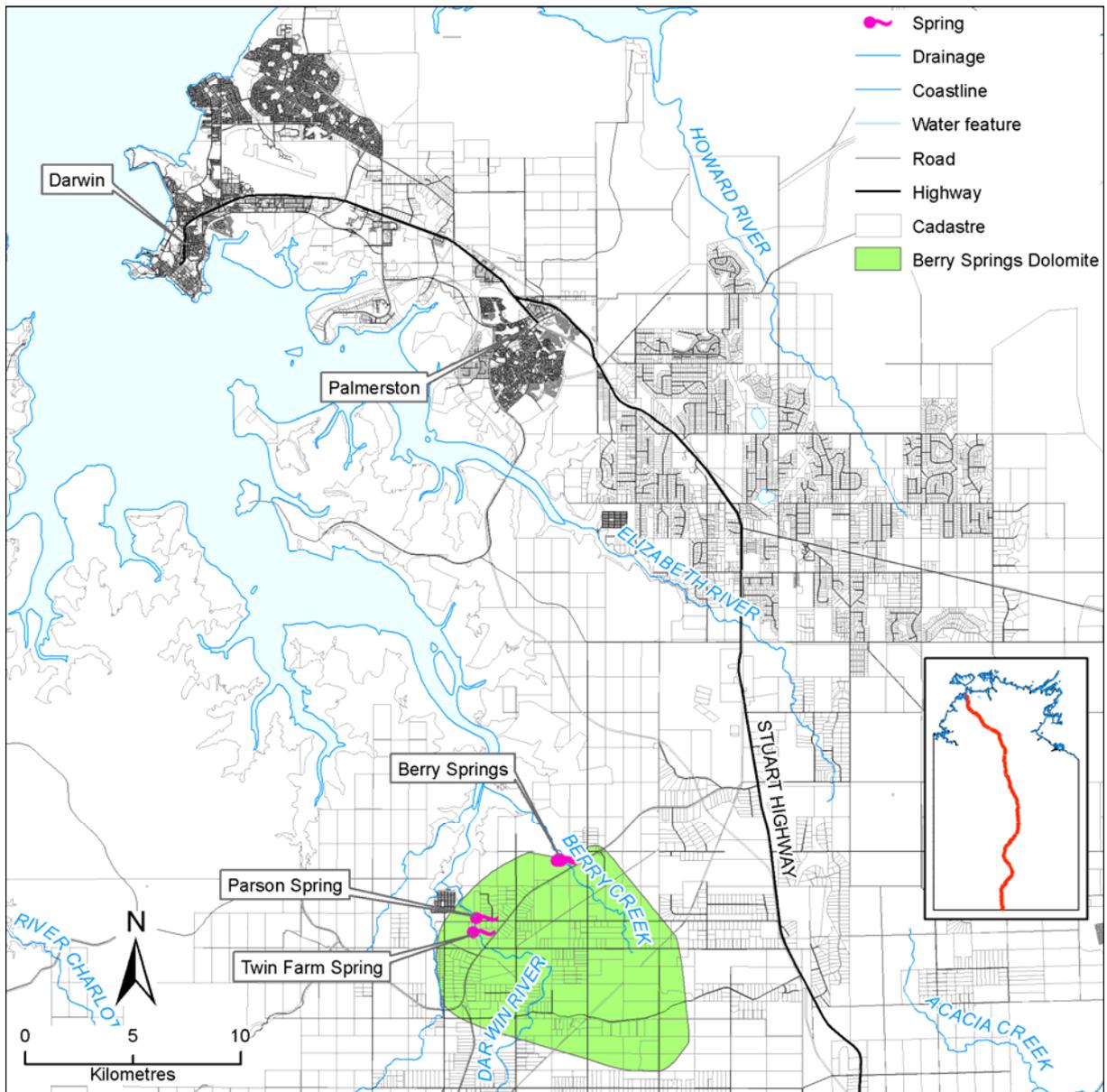
The Northern Territory is fortunate to have a range of near pristine, unique ecosystems supported by connected surface water and groundwater systems. Groundwater can be found in all areas of the Northern Territory, although its yield and quality vary widely. Currently groundwater use accounts for 90% of the freshwater use in the Northern Territory. This is largely due to the limitations associated with the capture and storage of surface water flows. In the Top End, storage yields are generally poor because high temperatures and regional geology result in significant losses through evaporation and seepage.

Groundwater is an important resource for many landholders who extract water from aquifers such as the Berry Springs Dolostone aquifer for domestic and stock purposes, water based industries such as aquaculture, and irrigators who rely on groundwater extraction to support their activities.

Groundwater is also important for the environment. Whilst significant rainfall occurs in the wet season from November to April, the remainder of each year is completely dry. When the rain stops, waterways keep flowing due to their connection to groundwater aquifers which naturally discharge via springs, rivers and creeks.

The Berry Springs Dolostone Aquifer is a small, localised groundwater aquifer that underlies parts of the Berry Springs and Darwin River areas. The aquifer naturally discharges via Parson Springs, Twin River Farm Springs and Berry Springs which are located on a fault at the geological contact between the Dolomite and Burrell Creek Formation.

Water allocation planning has now commenced for the Berry Springs Dolostone aquifer. Water allocation plans are a tool used across Australia to set rules for the allocation and management of water. They are now being developed across the Territory to ensure adequate provision of water for environmental, social and cultural purposes whilst fostering sustainable water use.



**Figure 1: Location of the Berry Springs Dolostone Aquifer, Darwin rural area.**

## 2. Context

### 2.1 National water reform

The National Water Initiative (NWI) is a blueprint for water reform and was established by the Council of Australian Governments in 2004 to create a more cohesive national approach to water resource management. All States and Territories are signatories to the NWI which seeks to achieve the following:

- Transparent, statutory based water planning
- More confidence for investment through defined water licence security
- Provision of water for environmental flows and other public benefit outcomes
- Provision of water to meet the needs of Indigenous people
- Water trading for more profitable use of water
- Enhanced water use efficiency in urban and rural areas
- Water use metering to provide accurate information for planning and management
- Recognition of the connectivity between surface and groundwater

### 2.2 Water planning in the Northern Territory

In accordance with the NWI, the Northern Territory Government will undertake water planning supported by the best available information. Water allocation plans have been created, are underway or proposed in places where current or potential water use could pose a possible risk to the ongoing availability and health of the resource.

To date, priorities for water allocation planning in the Territory have been focused on groundwater resources that support reticulated urban water supply systems and agricultural development. The Northern Territory *Water Act 1992* is the legislation which provides for the investigation, allocation, use, control, protection, management and administration of water resources. The Water Act allows the declaration of water allocation plans (WAP) within water control districts and requires that such plans allocate water to beneficial uses. Water control districts and beneficial uses are described in section 3 of this document.

Within the Territory water allocation plans have been declared for the Alice Springs and Ti Tree regions in Central Australia and for the Tindall Limestone aquifer in the Katherine region. In the Top End planning is currently underway for the groundwater aquifers underlying the Douglas Daly, Mataranka, Tiwi Islands and Howard East areas.

### 2.3 Water allocation planning for the Berry Springs Dolostone Aquifer

The Berry Springs Dolostone aquifer along with the Howard East Aquifer in the Darwin rural area have been identified as priority areas due to the existing water use and increased growth in the region over the past 10 years. It is believed that current use in the Dolostone aquifer is quickly reaching its limits of sustainability (pers comm. D. Yin Foo).

The Berry Springs water allocation planning area boundaries are defined by the underlying geology of the Dolostone aquifer. Geology plays a fundamental role in defining aquifer types, their characteristics and flow mechanisms. Accordingly, the plan area is defined by the geology and hydro geological connectivity. The plan area is approximately 90km<sup>2</sup> and is situated within the Litchfield Shire. The average aquifer depth is 20m below the ground and has been found up to 199m below ground level.

## **2.4 Why is the Berry Springs Dolostone Aquifer important?**

Water is an integral part of life. Top Enders have seldom had to think about it. It comes to our taps when called. It drains away to somewhere else. Most of us have been able to swim when we want, bathe when we choose, water our gardens, and like good health, we ignore water when we have it. But like health, when water is threatened, it's the only thing that matters. Freshwater is the blood of the land, where there is no water, there is no life.

### **Kungarakan values**

Water is central to Aboriginal culture, society and livelihoods. Traditional use of lands has always included the use and management of fresh and salt waters.

They have a spiritual, customary and economic relationship with land and water within the planning area. Kungarakan have 9 Recorded Sites and 1 Registered Sacred Site with the Aboriginal Areas Protection Authority located within the planning area. These sites are predominately linked with groundwater dependent ecosystems such as Berry Creek, Lake Deane, Woodfords Lagoon and the Darwin & Blackmore Rivers.

The Kungarakan and in particular the descendants of Alyandabu's are freshwater people and are known as Paperbark people. Kungarakan are the recognised traditional owner custodians of a large area of country south west of Darwin, which extends from Berry Springs to Batchelor and beyond into Litchfield National Park. Some significant freshwater places include Berry Springs, Darwin River, Wangi Falls, Coomalie and Bulley Rockhole.

*"Koongurukan people believe that the land known to them as Lok Koongurukan is the place or country of their beginning. They were born to the land as Koongurukan people. The land nurtures and provides for them as a mother would and the culture that the land provides is passed on through the language which is the voice of the land. The country or land is regarded as their mother and has claim over them as mothers do. This is their birth right. We belong to the land"* (Kath Mills, nee McGinness 10th March 2002)

The water places throughout Kungarakan lands hold cultural significance that link Kungarakan stories and values for Kungarakan people.

**Larrakia** (Sourced: Larrakia Nation Aboriginal Corporation website <http://www.larrakia.com>).

Larrakia is the language group name for the Aboriginal people of Darwin, of the greater Darwin Region of the Northern Territory. Traditionally, Larrakia lands include the Cox Peninsula, most of Gunn Point and much of rural Darwin, Darwin Harbour is also recognised as being within Larrakia country.

Larrakia people are often referred to as 'Saltwater People' although their boundaries extend up to approximately 50km inland. Larrakia have a strong connection to the Southport Township area.

The Larrakia Nation Aboriginal Corporation commenced operation in July 1998 as a focal point for Native Title and Aboriginal Land Right discussion affecting Larrakia people. Incorporated under the *Aboriginal Councils and Associations Act 1976*, Larrakia Nation continues to be the peak body in relation to land matters in the greater Darwin region.

Larrakia Nation's purpose is to protect Larrakia lands for Larrakia people, culture and country, to promote and teach Larrakia language, law and culture, to secure the Larrakia Nation for the future, our children, our people and our Country and to alleviate social and economic disadvantage for Larrakia.

#### Darrandarra

The Darrandarra Aboriginal Corporation have a holding of land named Twin Rivers, which is located between the Blackmore and Darwin Rivers at 60 Southport Road. The land holding is approximately 156.5 Ha in size. It currently has a number of dwellings, large tracts of cleared land and some natural woodland stands plus wetland habitats located along the eastern boundary.

#### European history

During WWII , Berry Springs was part of a Rest and Recreation Camp set up by the armed forces for the 100 000 personnel based in the area. A number of huts and weir were built at Berry Springs during this time. The remains can still be seen around the main pool. Berry Springs has always been popular with locals and tourists as a place for rest and recreation and to cool off (sourced from the 'About Darwin' website).

Water from the Berry Springs Aquifer is predominately consumed and used as drinking water for many rural landholders. Riparian use is considered to be the public right to take water for stock and domestic purposes. There are currently 326 registered water bores extracting water from the Berry Spring Dolostone aquifer for this purpose. 110 of these water bores are also used for irrigation activities.

Freshwater flow and flushing from the Blackmore and Darwin River contribute to the health of Darwin Harbour which is a popular recreational fishing spot for many Darwin anglers. Freshwater flow into these estuaries of Darwin Harbour is essential for maintaining nursery, feeding and breeding habitats of the wide variety of marine and terrestrial plants and animals.

A number of tourism enterprises are located within the planning area and include the Northern Territory Wildlife Park, Berry Springs Nature Park and The Lakes Caravan Park. Whilst not located in the planning area Tumbling Waters Tourist Park and the Litchfield Pub promote the surrounding natural beauty, abundant bird life, bushwalking, wildlife park and iconic swimming holes at Berry Springs Nature Park.

### 3. Scope

#### 3.1 Berry Springs Dolostone Aquifer water allocation planning area

The Berry Springs Dolostone Aquifer is a small groundwater water system that underlies a small portion of Darwin rural area, 47 kilometres south of Darwin. The Berry Springs Dolostone Aquifer lies wholly within the Darwin Rural Water Control District.

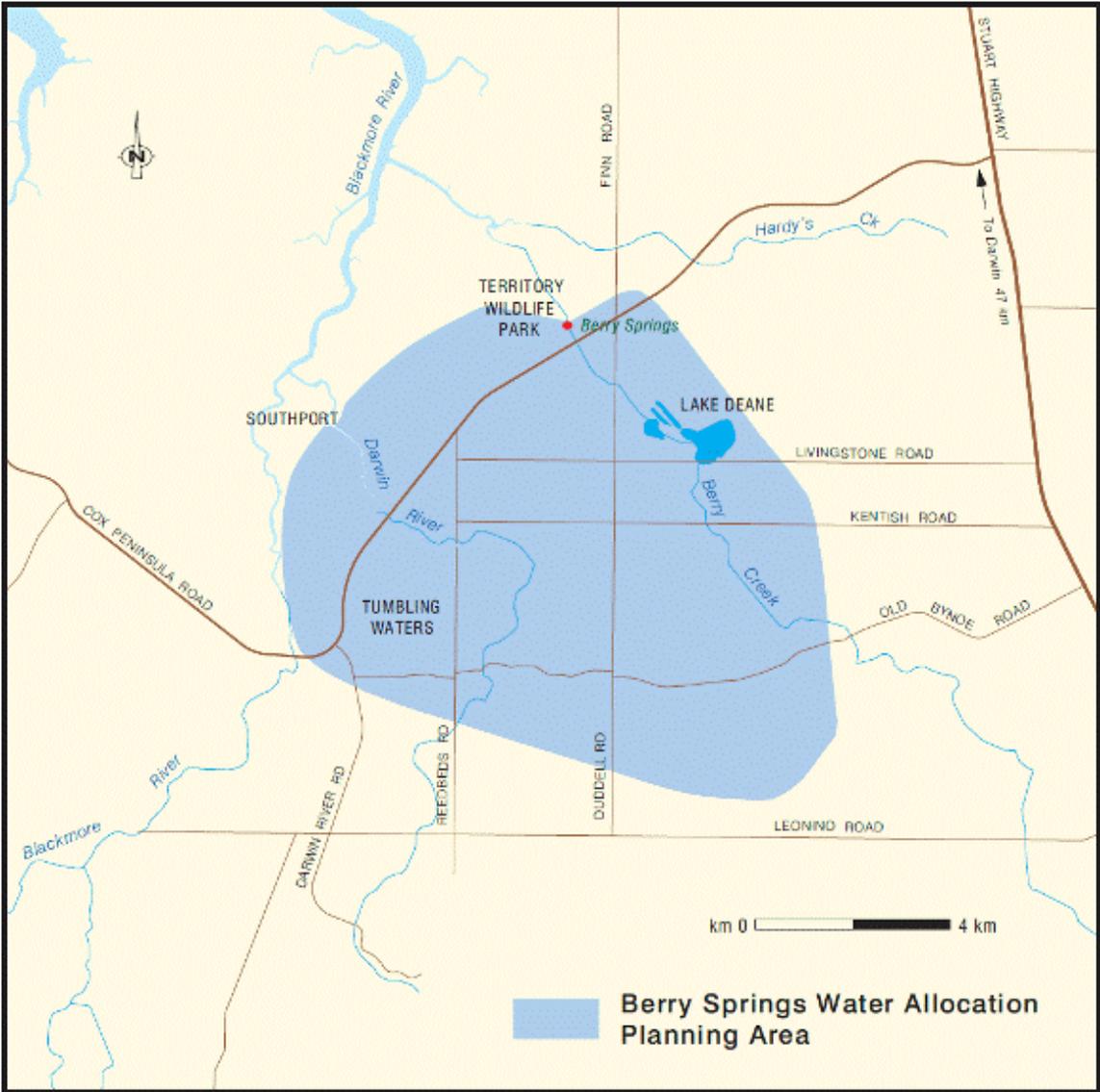


Figure 2: Berry Springs water allocation planning area.

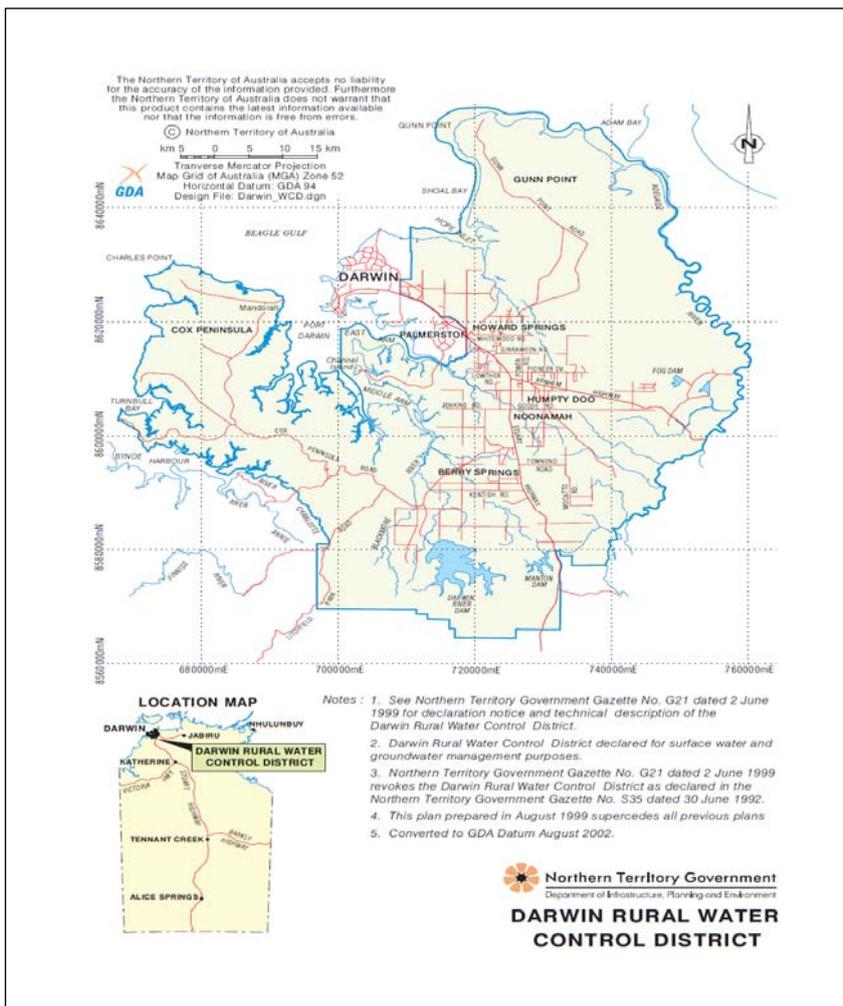
### 3.2 Darwin Rural Water Control District

The Darwin Rural Water Control District (WCD) was declared in 1999 and encompasses the Litchfield Shire and Cox Peninsula and includes the Darwin, Blackmore, Howard and Elizabeth rivers as well as many ephemeral and perennial creeks. The hydrogeology of the area is complex and holds over 10 significant aquifers, some of which are high yielding (>5L/s) while the majority are low yielding (<5L/s) with reduced capacity for successful bores.

Within a WCD:

- All groundwater and surface water extraction must be licensed unless an exemption allows otherwise; though extraction for stock and domestic (riparian right) purposes does not require a license;
- Bore construction permits are required;
- Water allocation plans may be declared.

In the Darwin Rural WCD an exemption applies where extraction rates not exceeding 15L/s for use for any purpose does not require a license. This 15L/s exemption allows for large water use to go unmonitored and measured and will be a topic for discussion during the planning process.



### 3.3 Beneficial uses

As specified within the Water Act 1992, a WAP must allocate water to beneficial uses to ensure all users, including the environment, are accounted for and managed appropriately. Beneficial uses are a way of describing the different purposes for which water is valued. They are separated into two categories, non consumptive uses and consumptive uses.

Non consumptive

- Environmental (ecosystems that depend on water)
- Cultural (such as indigenous living, ceremony, subsistence and recreational activities for both indigenous and non indigenous Australians)

Consumptive

- Public water supply (drinking water delivered through a reticulated system)
- Rural stock and domestic (rural household use and water for stock)
- Agricultural (irrigation for crops or forestry).
- Industry (commercial uses other than primary production)
- Aquaculture (commercial production of fish and other aquatic species)

## 4. Groundwater and the Berry Springs Dolostone Aquifer

### 4.1 The water cycle and groundwater

Groundwater is an integral part of the water cycle. The water cycle is the endless movement of water from the atmosphere to the earth and back again. When rain falls on land, some water evaporates, some flows to creeks and rivers, and some seeps into the soil and is absorbed by plant roots or moves further downward through to the water table and aquifer. Water that reaches the aquifer is known as recharge.

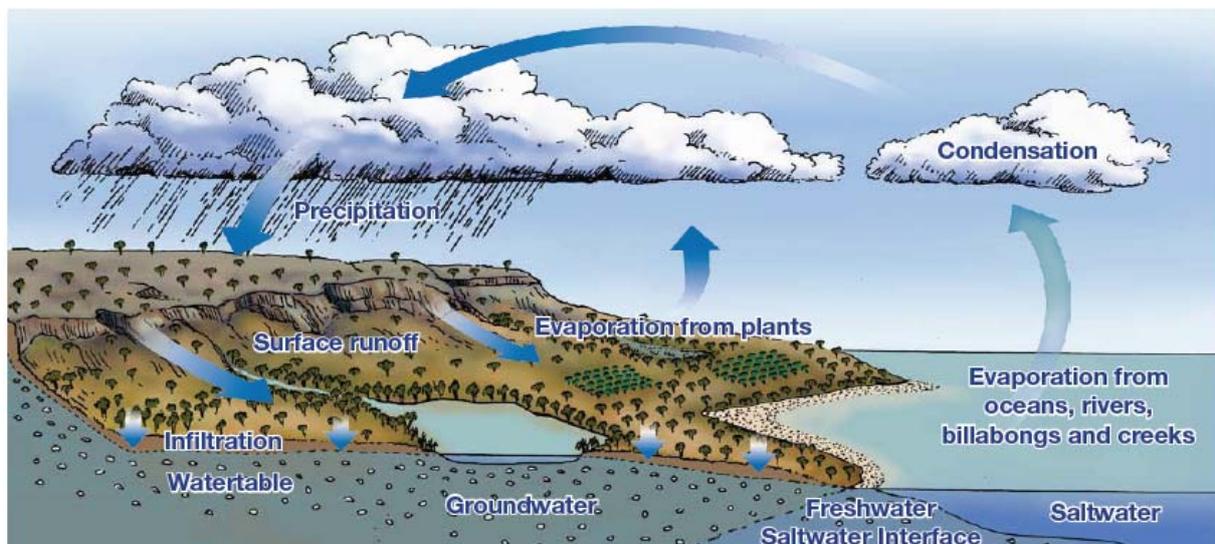
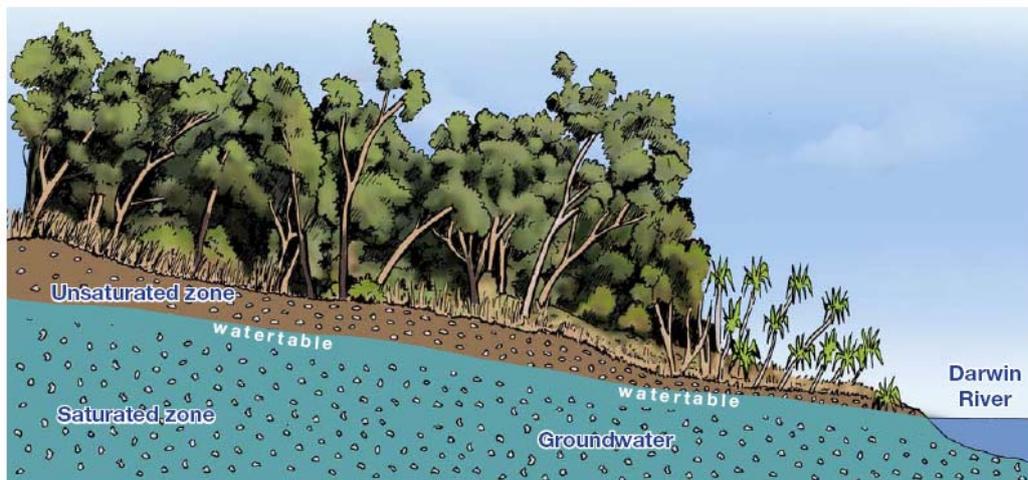


Figure 3: The water cycle

An aquifer is a body of rock or sediments that holds water, much the same way a sponge holds water. Groundwater is often perceived as flowing underground streams similar to surface streams. In reality groundwater is the water that fills pores and fractures within rock



**Figure 4: Groundwater aquifer rock types**

Once water enters an aquifer, it is constantly moving underground due to gravitation pull. Groundwater generally flows towards the lower parts of the aquifer, where it often discharges back to the ground surface through springs. When recharge occurs during the wet season the volume of water stored in the aquifer increases and the water table rises. When the rain stops, the groundwater levels begin to decline because groundwater continues to drain to discharge zones.

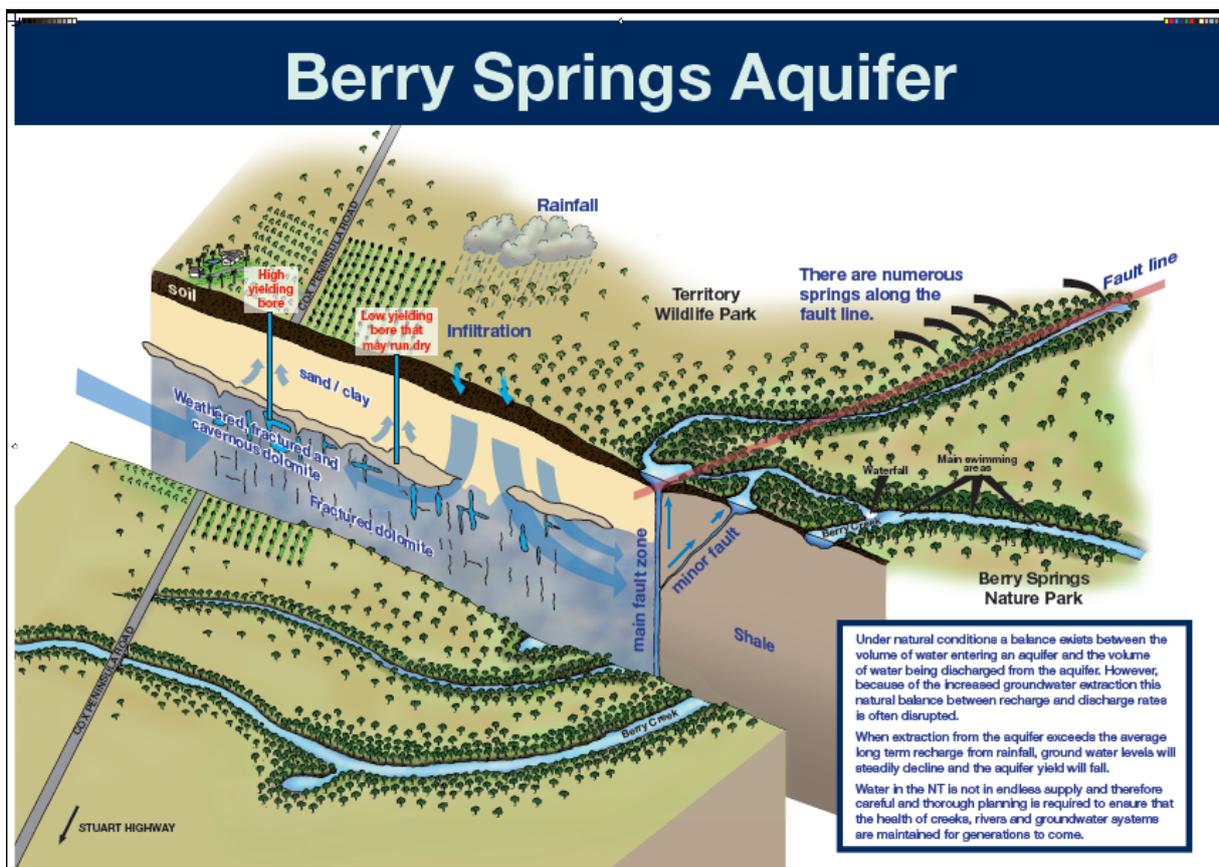
#### **4.2 The Berry Spring Dolostone Aquifer**

The Berry Springs Dolostone aquifer is a small oval shaped basin structure made up of calcium magnesium carbonate sedimentary rock type, similar to limestone. Rainwater percolates and dissolves into the dolostone creating fractures and small caves. The water then is contained within these fractures.

Groundwater yield from the aquifer is typically 5L/s or greater, the highest yield recorded was 32L/s from RN26686. Depth of this aquifer varies from 10 to 100m below ground level because this aquifer is in a small basin and its depth varies with the geographic location. Average thickness of the aquifer is approximately 50m and it is exposed in the northern region where the Berry and Parson's springs flow.

Parson's and Twin Farm springs are located within the tidal zones. Lake Deane is a groundwater window through which discharge occurs. The water level from south of Lake Deane to the north of Berry Springs is nearly constant and therefore, in this region wetland condition prevails until almost mid dry season. In the northern region, the Goose Lagoon and surrounding areas are also groundwater discharge points, which have created wetland conditions. Numerous discharges are in the southern part of Darwin River and Woodfords Lagoon in the southwest corner. The dolostone aquifer can be seen along the Darwin River in the northern region in the dry season (Verma, 1995).

Groundwater movement is to the north (to Berry Springs) and northwest (to the Parson's and Twin River Farm Springs area).



**Figure 5: Cross section of the Berry Springs Dolostone Aquifer**

### 4.3 Water Quality

Water quality data recorded shows a typical calcium, magnesium and bicarbonate dolomite water type with electrical conductivity ranging from 300 – 420 uS/cm (Tien, 2006). Sodium and Chloride contents are very low indicating that the water is recent (Verma, 1995).

In the catchments of Darwin and Bynoe Harbours development and the use of groundwater for consumptive purposes, could have a marked effect on stream water quality during the dry season by altering the relative contribution of water from aquifers with differing quality (Tien, 2006).

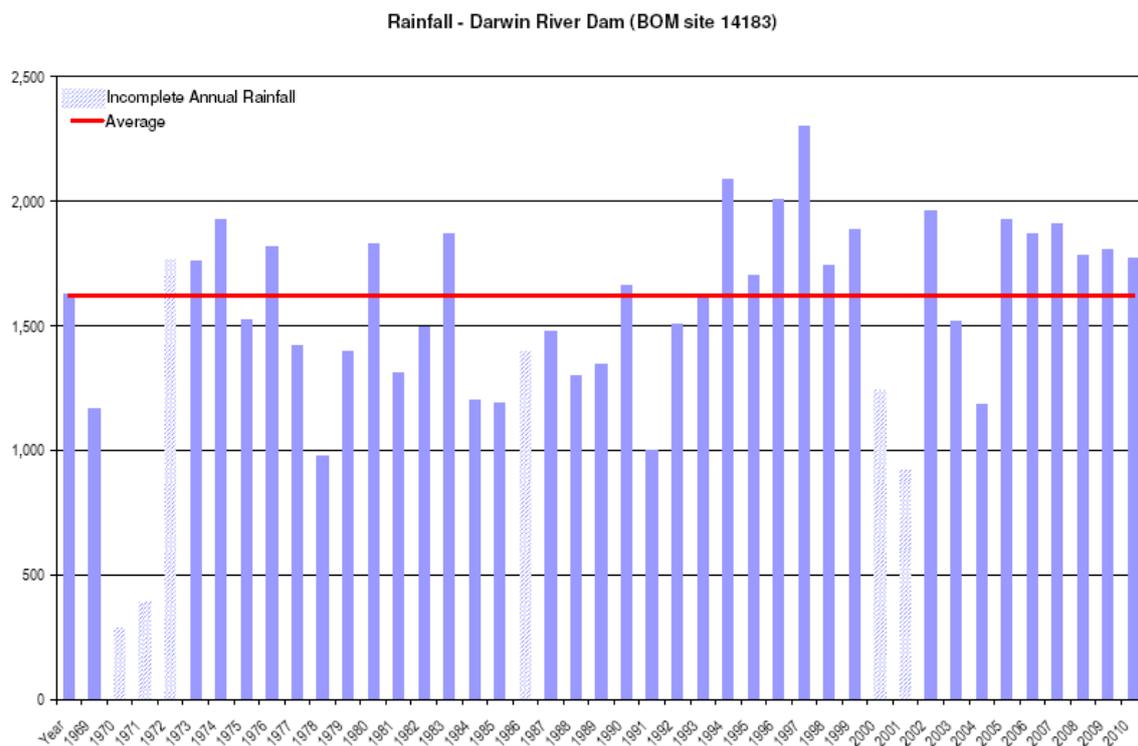
The Departments Aquatic Health Unit, have monitored up to five surface water sites within the planning area. Water quality monitoring sites are located on Darwin River, Berry Creek and Fly Creek. Generally the water quality at these freshwater monitoring sites is in good condition. Further information can be found from the Darwin Harbour Region Report Cards webpage <http://www.nt.gov.au/nreta/water/reportcards/index.html>

Additional Darwin River water quality information collected as a part of the Cabomba eradication program can be found at: [http://www.nt.gov.au/nreta/natres/weeds/find/cabomba/pdf/Cabomba\\_erad\\_0506.pdf](http://www.nt.gov.au/nreta/natres/weeds/find/cabomba/pdf/Cabomba_erad_0506.pdf)

## 5. Water availability and use

### 5.1 Climate and rainfall

The planning area lies in the tropics, which has two distinctive seasons, the *wet* and the *dry* with temperatures ranging from an average minimum of 22.8C to a maximum of 31C. Average annual rainfall measured at Darwin River Dam is approximately 1600mm. The majority (80%) of this rainfall occurs during the wet season between December and March. The dry season period extends from May to October, when little or no rainfall is recorded. River and creek flows correspond with rainfall activity and are seasonal in nature.

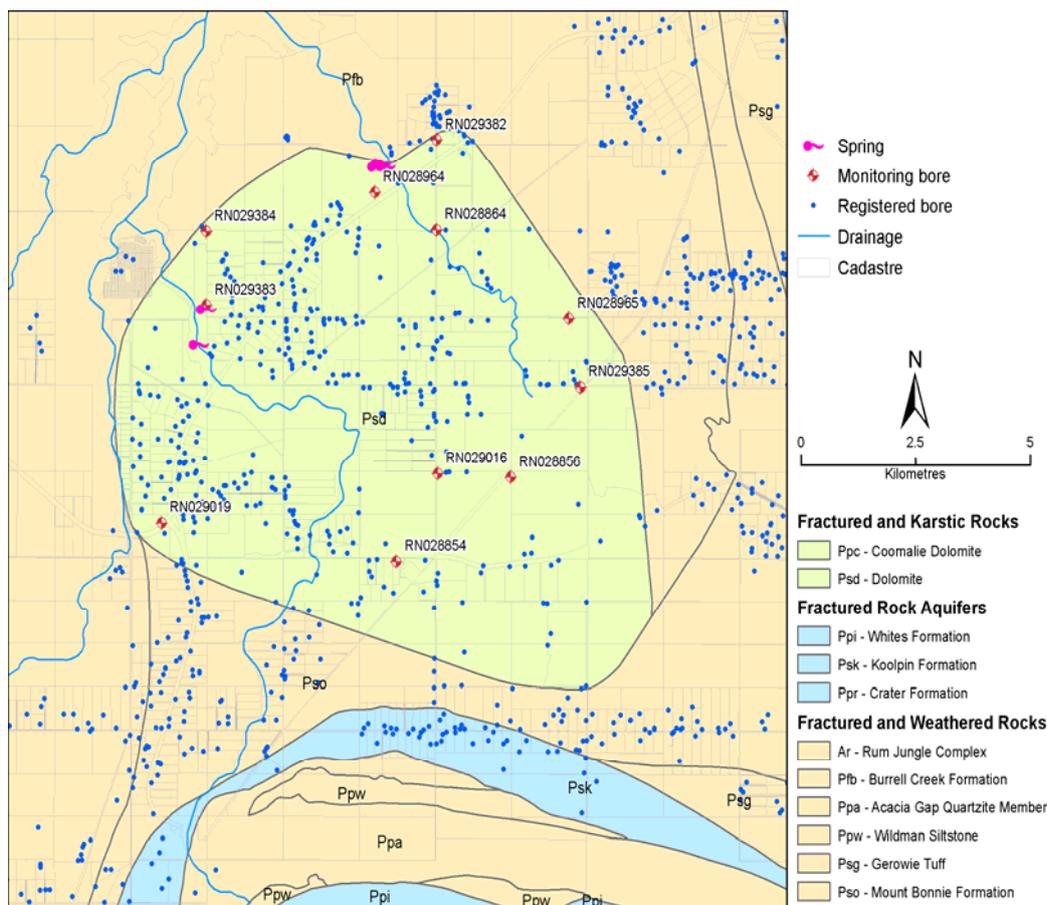


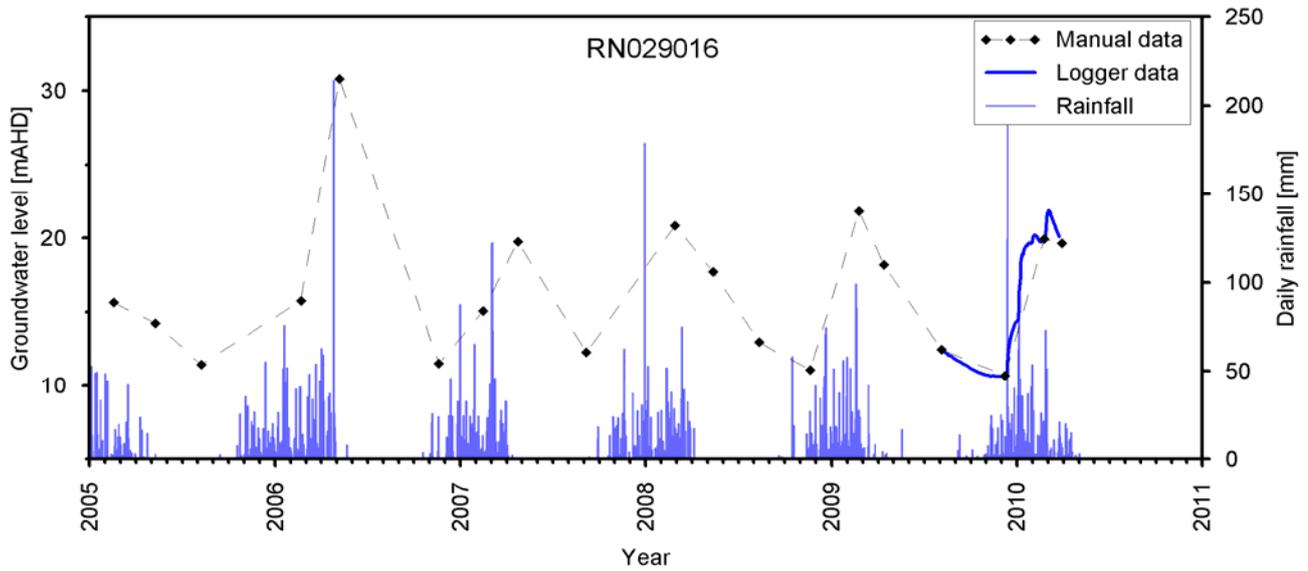
**Figure 6: Monthly average rainfall at Darwin River Dam (Source: Commonwealth of Australia 2011, Bureau of Meterology)**

## 5.2 Berry Springs Dolostone Aquifer recharge

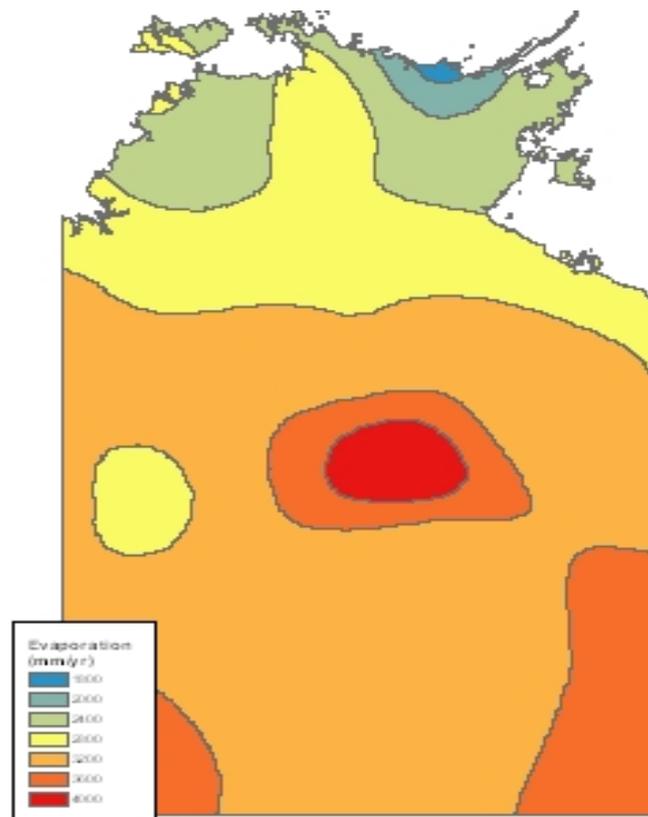
Recharge is the addition of water to an aquifer. It is expressed as a volume in megalitres per year (ML/year). One ML is approximately equivalent to an olympic-sized swimming pool or 1 million litres. Recharge comes from rainfall and surface water bodies, such as river recharge. Significant recharge can be expected only during rainy periods. The water table will rise or fall depending on seasonal and annual variations in rainfall/recharge. The greatest changes will be observed during prolonged dry spells (dry wet season) or periods of heavy rainfall (above average wet seasons). In many areas recharge from rainfall may be sufficient to maintain groundwater levels. However in some cases groundwater can be used more rapidly than it is being replaced which may cause the aquifer to run dry. Approximately 20 – 30% of the total rainfall filters through to recharge the aquifer.

Ten bores are monitored within the planning area for standing groundwater levels as marked on the below map. On the following page there is a groundwater hydrograph for RN029016 in relation to daily rainfall. The lag time between initial rainfall and the corresponding increase in groundwater levels is relatively short. Similarly groundwater levels begin to decline just before or soon after rainfall ceases (Knapton, 2010).





Evaporation is the process by which water is converted from its liquid form to its vapour form and thus transferred from land and water masses to the atmosphere. Evaporation usually exceeds rainfall throughout the year, except in the wet months (Tien, 2006). Open 'A' class pan evaporation for the region is approximately 3000mm/yr.



**Figure 8: Territory Evaporation rates**

### 5.3 Evapotranspiration

Evapotranspiration (ET) is the combined value of evaporation and transpiration from plants and is a major component of the water balance. Cook et al, 1998 found that savannah woodland of the Howard East area (approximately 20km to the North East of Berry Springs) transpired approximately 1110mm (approximately 65% of rainfall). The ET from wetlands/swamps was found to be similar however the actual transpiration from vegetation was estimated at 540mm.

### 5.4 Current use

#### 5.4.1 Licensed water use

There are currently six groundwater extraction licenses using a total of 2,017ML/yr. There is also one surface water extraction license utilising water from Berry Creek, this licence allows for 1688ML/yr.

#### 5.4.2 Voluntary Bore meter program

A voluntary bore metering project has been running in the Darwin rural area for over two years. The project has seven volunteers in the Berry Springs Dolostone aquifer who have been assisting water resources in gaining a better understanding of water use in the area. Below is a summary of use for one calendar year, 2010.

Water use	ML/year
Stock and domestic, 9Ha	0.8
School	26.4
Stock and domestic 23Ha	3.8
Horticulture Mango 8Ha	80
Stock and domestic 8Ha	4.7
Stock and domestic plus small orchard 8Ha	4.8
Horticulture Mango 43ha	110

**Table 1: Summary of water use by voluntary bore meter participants**

### 5.4.3 Stock and domestic use

There are 316 registered bores within the Berry Springs Dolostone Aquifer it is assumed that all would be used for this purpose if not entirely or are dual purpose with irrigation activities. Under section 14 of the NT *Water Act* landholders in the Territory who own or occupy land can take groundwater without a licence from beneath the land for stock and domestic purposes. Current total use is unknown, estimations can be made from limited voluntary bore data however these would be relatively conservative amounts due to the nature of the program and participants.

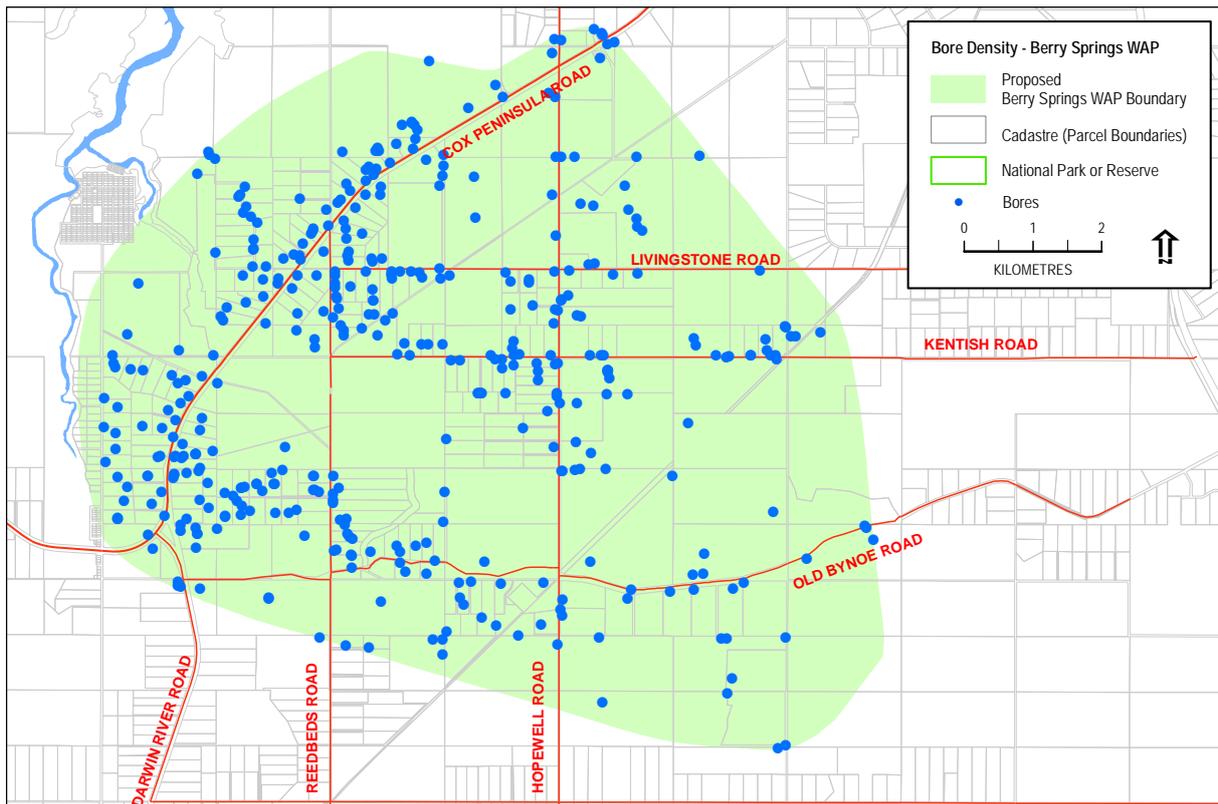


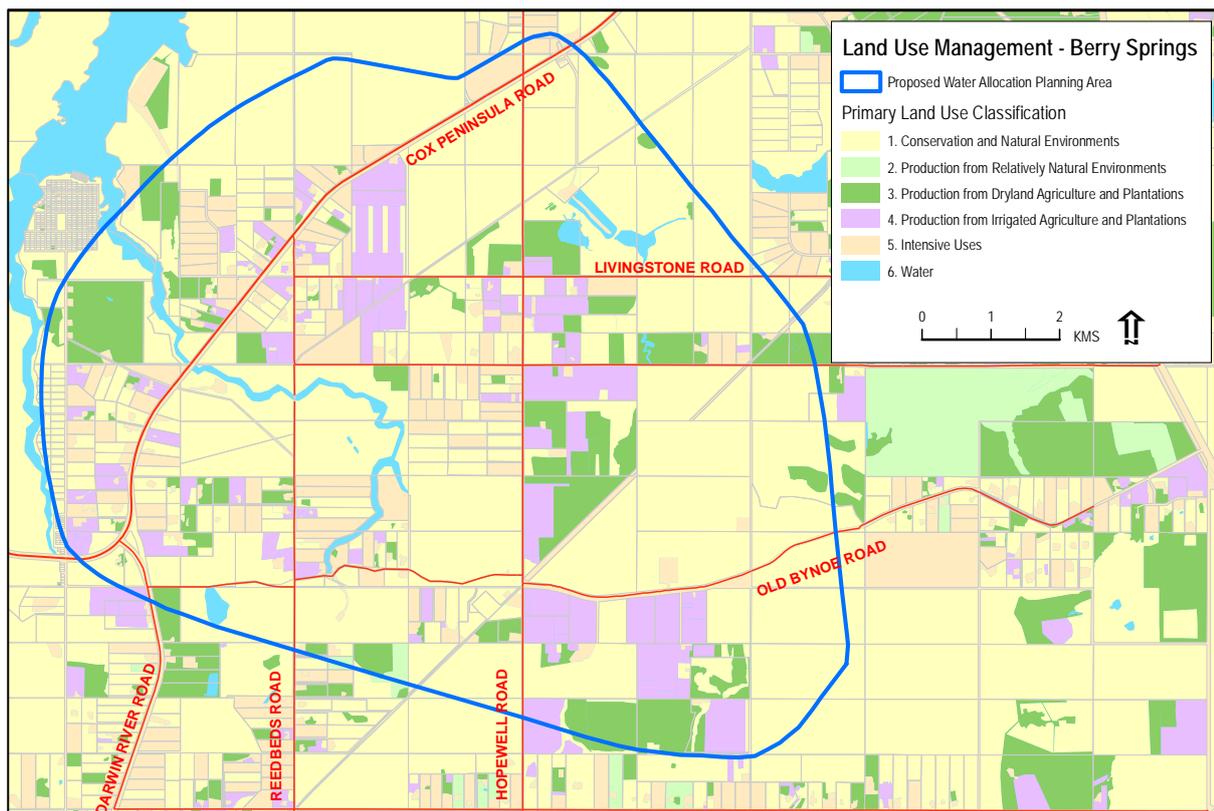
Figure 8: Bore density in the Berry Springs Dolostone Aquifer

### 5.4.4 Reticulated water supply

Power and Water Corporation have 3 properties accessing and 2 utilising the town water supply. All other users rely on bores accessing the Berry Springs Dolostone aquifer.

### 5.4.5 Irrigation activities

Approximately 35% of the total bores within the Berry Spring Dolostone Aquifer have been identified as being used for irrigation activities. These bores were identified using aerial photography and land use mapping within the planning area. Land use has been mapped using the Australian Land Use Management classification at 1:25000 (Berghout, et al.,2008). Land use mapping is an important tool which is used to estimate the area of irrigated land, when combined with annual crop usage information supplied by the Department of Resources, annual groundwater usage can be estimated.



Land Use Description	Properties	Area (Ha)
Conservation and Natural Environments	360	5603.1
Intensive Uses	226	1027.2
Production from Dryland Agriculture and Plantations	96	975.3
Production from Irrigated Agriculture and Plantations	119	864.3
Production from Relatively Natural Environments	2	28.2

**Figure 9: Land use within the Berry Springs Planning Area (Sourced: Knapton, 2010)**

### 5.5 Future use

It is important that we understand how much water can be extracted from Berry Springs Dolostone aquifer without adverse environmental impacts. It is equally important for water users that future developments are based on sustainable water supply. Through the planning process, we will determine the long term availability of water from the Berry Springs Dolostone Aquifer based on environmental, social and economic needs.

### 5.6 Water trading

Water trading is the exchange of water access rights between users and is being introduced through water allocation plans across Australia. It is a way of accommodating new or expanding water dependent developments without increasing the total volume of water

allocated within a system. Creating an environment in which individual water access entitlement holders are able to trade water quickly and easily will contribute to a more productive and efficient use of Australia's water over time (Aust. Government, 2011). Arrangements for water trading will be included in the Berry Springs Water Allocation Plan and trading will be available once the WAP is declared.

## 5.7 Environmental water requirements

The reservation of environmental water is a requirement of section 22B (6) of the NT *Water Act*. Section 22B specifies that:

*A water allocation plan is to ensure in the water control district that water is allocated within the estimated sustainable yield to beneficial uses (including) an allocation to the environment.*

There are two zoned conservation areas within the planning area, Berry Springs Recreation Reserve and the Blackmore River Conservation Reserve. The planning areas natural areas are predominately eucalypt woodland, dominated by *Eucalyptus miniata* and *Eucalyptus tetradonta* there are also two major rivers (*Darwin & Blackmore*), two major creeks (*Berry and Ella*), two lagoons (*Lake Deane and Woodfords Lagoon*) and three perennial springs (*Berry, Parsons and Twin Farm*) that utilise the groundwater from the Berry Springs Dolostone Aquifer. Wetland areas and lagoons support a wide range of birdlife, are essential habitats for fish, turtles, macro-invertebrates and aquatic plants (Whitehead & Chatto, 1996).



**Figure 10: Downstream of March Fly Weir, Berry Creek.**

Research has shown that monsoon vine forests associated with water, or rainforest patches are 'island' habitats that provide important links in the preservation of flora and fauna biodiversity across the Top End (Holmes, 2005).

Currently there is limited scientific understanding of the environmental water requirements of these areas. To improve the scientific knowledge and inform NTG and the BWAC funding has been sought and gained through the National Water Commission program 'Raising National Water Standards' to provide the following:

- Identify any ecological impacts associated with existing water resource development and use;
- Provide a commentary on the implications of increased water resource development eg Darwin public water supply, rural residential, horticultural and agricultural development.
- Identify critical aquatic ecosystems and areas of high conservation value that are dependent on ground and connected surface water;
- Identify; assess and where possible, prioritise, the key ecological and geo-morphological values of the ecosystems and areas in relation to water;
- Identify flow characteristics (including key flow events) required to maintain or to restore (where appropriate) the key ecological and geo-morphological values; and
- Provide recommendations and priorities on areas requiring future research including identification of existing knowledge/data gaps.

The report for this project is due at the end of 2011 or early 2012.

In the absence of detailed scientific knowledge, the Northern Territory Government uses a precautionary principle approach to allocate 80% - 95% of the water resource to the environment. The lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

## **5.8 Aboriginal interests, values, rights and cultural obligations in relation to water**

Aboriginal people have occupied the lands of the Northern Territory for upward of 60,000 years. Throughout this time, Aboriginal people have left many traces of their culture and occupation across the landscape. Both Larrakia and Kungarakan peoples have strong cultural associations and obligations to the water within the Berry Springs Planning Area.

Sourced from Kungarakan Culture & Education Association website <http://kungarakan.org.au>

As many other Aboriginal tribal groups before the arrival of Europeans, Kungarakan culture was ancient and pure; un-weakened by invasion and dispossession. Kungarakan language, song, dance and social structures were distinctive and strong. For the Kungarakan people long life, health and well-being was assured by the fresh waters of the Nungalakoo (Finniss River) and its multiple estuaries and pools. Kungarakan shared life with tribal allies in the region with whom were shared marriage, hunting and ceremony rites. Kungarakan have not forgotten culture and still practice culture through juluk (ceremony), passing on language and naming our children in the tradition of our ancestors. The Paperbark People have traditionally been powerful and well respected with access to plentiful supplies of fresh water, wildlife and bush foods to sustain them and share with neighbours.

## 6. The planning process

Water planning is about developing and deciding on what the ground rules are for water based developments, use and preservation of water resources within a management area. It is an important process that will ensure sustainable water supplies for rural residents and industries, protect water dependent ecosystems and places of cultural significance in the Darwin Region.

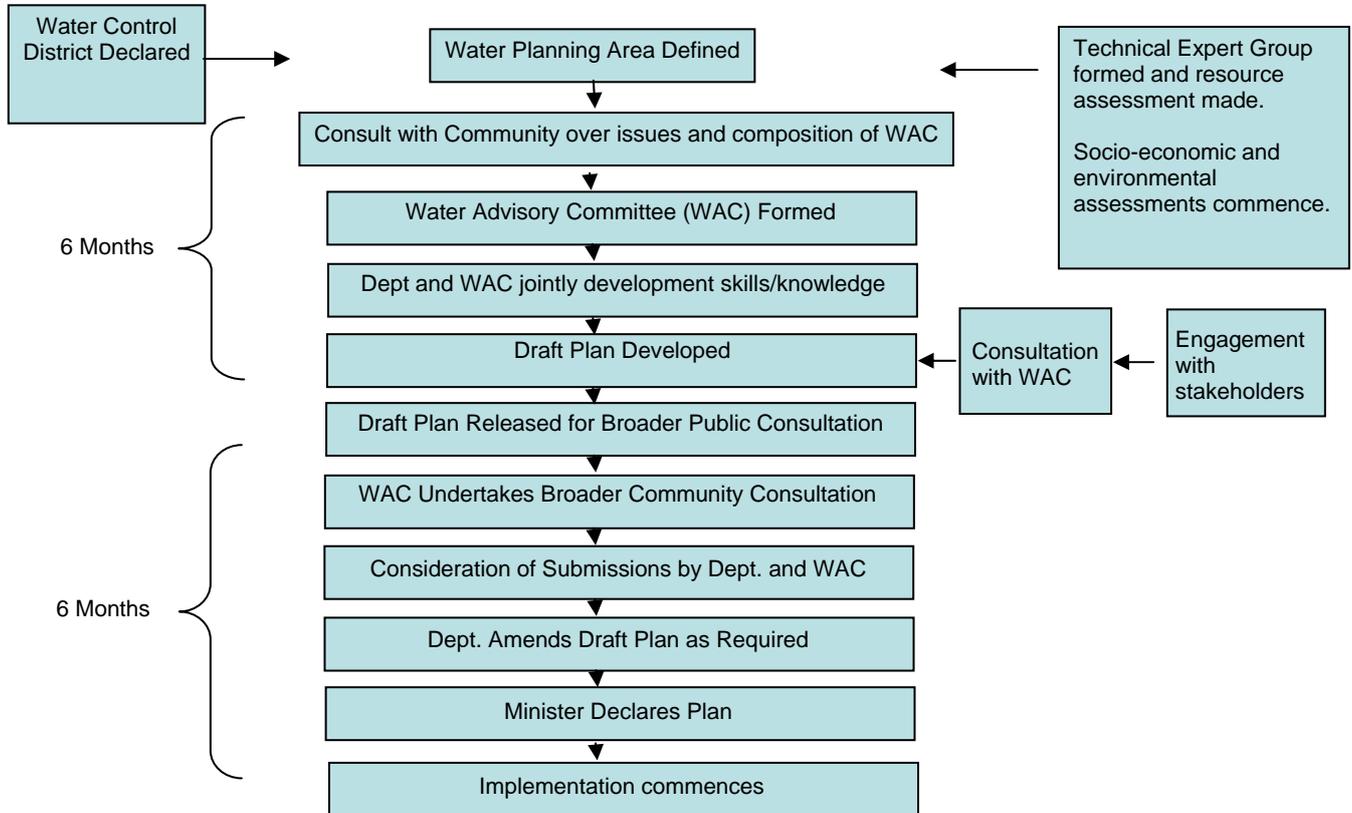
### 6.1 Matters to be considered

The Water Advisory Committee will meet regularly to discuss and advise on the development of the water allocation plan. Matters that are considered include (but are not limited to):

- 15L/second exemption
- Environmental water provisions
- Water requirements for users (eg. stock and domestic, irrigators, aquaculture).
- Water for future development
- Water trading guidelines
- Guidelines for licensing
- Water use accounting and ecosystem monitoring

## 6.2 Planning Schedule

The time it takes to develop a water allocation plan depends on the complexity of the resource and its range of uses. Generally, the process is expected to take approximately two years and includes a series of key stages.



A draft water allocation plan is developed over the planning period and released for broader public comment. As part of the public comment period submissions will be sought from any interested individuals and groups. Community meetings, public displays and targeted consultation with key stakeholder groups will also occur at this time.

All submissions received during this period are analysed and reviewed. Issues raised are validated and recommendations for addressing those issues are presented to the WAC for consideration during the preparation of the final plan.

Once the plan is finalised and declared by the Minister for Natural Resources, Environment and Heritage an implementation strategy is developed to ensure the plan's outcomes, objectives and strategies are achieved. The implementation strategy includes arrangements for the day to day management of the plan, including a detailed monitoring and compliance program. Ongoing monitoring and assessment of the Plans performance will be used at the five year review and ten year renewal of the plan where changes to the plan may occur.

## 7. Community involvement

A stakeholder analysis was conducted before the commencement of the Berry Springs planning process to identify all stakeholders that may be affected by the water allocation plan. It was decided to establish a water advisory committee as this structure would allow for effective and efficient deliberation amongst interests. Whilst the primary stakeholder groups are represented through the BWAC membership supporting communication will ensure that all groups with an interest in the Berry Springs Dolostone aquifer have an opportunity to have input into the development of the plan.

### 7.1 Berry Springs Water Advisory Committee

On the 9<sup>th</sup> May 2011, the Minister for Natural Resources, Environment and Heritage established and appointed members to the Berry Springs Water Advisory Committee (BWAC) to advise on issues related to the sustainable and conservation of the natural resources of the whole Berry Springs Dolostone Aquifer. BWAC is responsible for providing advice in regards to all water allocation planning in the Berry Springs Dolostone Aquifer and have agreed to act as the water advisory committee and participate directly in the development of the Berry Springs WAP.

BWAC membership reflects equity and diversity with representatives from major stakeholder groups within the region and community. The members of BWAC have skills, knowledge and experience in the Berry Springs region and will be able to incorporate community values and beliefs in to the water allocation planning process. The following stakeholder groups and organisations are represented on BWAC: Representatives from the tourism sector were invited as apart of the nomination process however no nominations were received and feedback from some operators was that they were time poor and unable to commit to the process. Involvement of these stakeholders will be sort through direct discussion and consultation, invitations to attend meetings when available will also be encouraged.

Name	Representing	Organisation
Libby Benson	Independent Chair	
Rena Stanton	Indigenous	Kungarakan Culture & Education Association
Leslie Gordon	Indigenous	Larrakia Nation Aboriginal Corporation & Darrandarra Aboriginal Corporation
Bell Huang	Aquaculture	TAAU Aust. Australian Spirulina
Dion Wedd	Territory Parks	Territory Wildlife Park
Allan McKay	Community	
Kate Peake	Horticulture	Northern Territory Horticultural Association
Trevor Lake	Horticulture	

<b>Name</b>	<b>Representing</b>	<b>Organisation</b>
Lissa Herrmann	Local Government	Litchfield Shire Council
Peter Ebsworth	Environment	Top End Native Plant Society

## **7.2 BWAC Terms of Reference**

- Openly and honestly participate in the development of a water allocation plan for the Berry Springs Dolostone Aquifer;
- Identify, discuss and make recommendations to the Controller of Water Resources on matters regarding the assessment, management and use of water from the Berry Springs Dolostone Aquifer;
- Provide input and advice to Government on the information and communication requirements of respective stakeholder groups and the general community;
- Share information about the water allocation planning process with respective stakeholder groups and general community and seek their values and interests, ensuring these are communicated back to Government;
- Participate in the development of water management strategies for the Berry Springs Dolostone Aquifer that are consistent with the requirements of the *Water Act* and as far as practicable, the National Water Initiative;
- Consider any other matters referred to the committee by the Minister or Controller of Water Resources.

There is no obligation on the Committee to reach consensus in its recommendations. The most important contribution sought from Committee members is the identification of issues and options that may not be apparent to those operating within the public sector. Members are expected to critically evaluate information and analyses presented to them by public officials and offer suggestions for innovative water management strategies that support a range of opportunities.

## **7.3 Communications Strategy**

A communication strategy has been developed for the Berry Springs Dolostone Aquifer, Water Allocation Plan. The strategy outlines how the Department will facilitate engagement and deliver communication objectives in regards to the development of the plan. To ensure this process is conducted in collaboration with the community and ultimately accepted and implemented by the water users, water allocation planning will occur in parallel to the delivery of community education about local water resources and water conservation.

Key communication objectives include:

1. Promote water allocation planning as an important process that will ensure sustainable water supplies for rural residents and industries in the area.
2. Promote water allocation planning as important for the provision of long term protection of water dependent ecosystems and places of cultural significance.
3. Promote water allocation planning as an effective way to equitably share water and manage annual water variables (Wet Season and Dry Season).
4. Increase community awareness about resource limitations and competing demands for water.
5. Increase community understanding of the proposals within the WAP, through consultation, communication and education.
6. Encourage stakeholder and community ownership, with appropriate opportunities for community input and feedback.
7. Increase stakeholder awareness of the National Water Initiative objectives and the Territory's commitment to achieving these objectives.
8. Provide transparency and accountability during the process and in how decisions are reached.
9. Demonstrate government's commitment to taking a serious regulatory approach to water allocation planning, ensuring it is undertaken in a practical and equitable manner.

## 8. Identified knowledge gaps

Knowledge Gap	Proposed Investigation
Current water use	<ul style="list-style-type: none"> <li>• Investigate pumpage data on all licensed and metered use;</li> <li>• Estimate demand based on existing property development where use is not currently licensed or metered;</li> <li>• Estimate stock and domestic demands based on rural households and stocking rates.</li> </ul>
Future water use	<ul style="list-style-type: none"> <li>• Assess the future development proposals of existing and proposed water users;</li> <li>• Estimate future stock &amp; domestic use;</li> <li>• Quantify non-consumptive environmental/cultural requirements.</li> </ul>
Groundwater dependent ecosystem requirements	<ul style="list-style-type: none"> <li>• Consultancy funded through National Water Commission See Appendix 1 - Environmental assessment to inform water resource planning in the Darwin Region.</li> </ul>
Risks associated with changes in groundwater levels and surface water flows associated with extractive use	<ul style="list-style-type: none"> <li>• Model various extraction scenarios to predict impacts of a range of possible extraction levels on groundwater dependent ecosystems.</li> </ul>
Possible effects of climatic variability on availability of groundwater	<ul style="list-style-type: none"> <li>• Use of computerised model;</li> <li>• CSIRO North Australian Sustainable Yields Project</li> </ul>
Social and economic values of the resource	<ul style="list-style-type: none"> <li>• Consultancy funded through the National Water Commission. See Appendix 2 – Socio-economic assessment to inform water resource planning in the Darwin Region.</li> </ul>
Cultural (Indigenous & European) water requirements	<ul style="list-style-type: none"> <li>• Consultation with community &amp; Indigenous Traditional Owners</li> </ul>
Indigenous aspirations for future water dependent development on Aboriginal Land	<ul style="list-style-type: none"> <li>• Consultation with Indigenous Traditional Owners</li> <li>• Consultation with relevant Indigenous organisations (NLC, NAILSMA)</li> </ul>

## 9. Definitions

**Aquifer** - An aquifer is a geological structure or formation that is permeated with water or capable of being permeated with water.

**Bore** – a deep hole drilled through geological material that reaches an underground water source.

**Confined aquifer** – an aquifer that has confining beds as upper and lower boundaries.

**Ecologically Sustainable Development** - Uses the definition of the Australian Government (1990) that ecologically sustainable development is “using, conserving and enhancing the community’s resources so that ecological processes on which life depends are maintained, and the total quality of life now and in the future can be increased”.

**Hydrograph** – a graph of groundwater levels from one bore measured at regular intervals over a period of time.

**Groundwater** - Groundwater is the water that occurs beneath the ground surface in the saturated zone.

**Groundwater dependent ecosystem (GDE)** - An ecosystem relying on groundwater for their species composition and their natural ecological processes.

**Landholder** - The owner or occupier of specified lands.

**Precautionary Principle** - Uses the definition of the Rio Convention on Environment and Development (1992), that the precautionary principle is “where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”. This is recognised as a principle of Ecologically Sustainable Development.

**Recharge** – replenishment to an aquifer due to the infiltration of rain. Recharge can also occur from water seeping through beds of river, lakes and swamps.

**Saturated** – all the voids or fractures in the geological material are filled with water.

**Seepage** – the movement of water between the groundwater aquifers and the surface water bodies.

**Surface water** – any body of water on the surface, such as rivers, wetlands and creeks.

**Unconfined aquifer** – an aquifer that has the water table as its upper boundary and a confining bed as its lower boundary.

**Water control district** - A district declared under statute when there are signs that groundwater reserves, river flows or wetlands may be at risk of becoming stressed due to water extraction. Legislation covers all aspects of sustainable water resource management in water control districts, including the investigation, use, control, protection and allocation of the water resource.

**Water allocation plan** - A water allocation plan directs the management of water in a declared water control district. It provides the planning framework for determining consumptive and environmental shares and trading rules.

**Water allocation plan area** - An area for which a statutory water allocation plan must be developed, defined by hydrogeological boundaries based on one or more aquifers that share common characteristics. A water allocation plan area can include an entire water control district or only part of one.

**Water licence** - The statutory instrument for managing access to the water resource. It is an authority to take and use surface or groundwater for purposes other than stock and domestic, subject to conditions.

**Water table** – the surface of an unconfined aquifer where the groundwater is at atmospheric pressure.

**Yield** - The amount of water that can be pumped from a bore, measured in litres per second.

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# Appendix 1: Environmental assessment to inform water resource planning in the Darwin Region

## Background

In accordance with the National Water Initiative, the Northern Territory Government is undertaking water planning supported by the best available information. Water Allocation Plans have been created, are underway or proposed in places where current or potential water use could pose a possible risk to the ongoing availability and health of the resource.

To date, priorities for water allocation planning in the Territory have been focused on groundwater resources that support reticulated urban water supply systems and/or increasing agricultural development. Groundwater accounts for 90% of freshwater use in the Territory, largely due to limitations associated with the capture and storage of surface water flows. In Central Australia, rivers flow infrequently and cannot provide a secure water supply. In the top end, storage yields are generally poor because high temperatures and regional geology result in significant losses through evaporation and seepage.

The Northern Territory *Water Act 1992* (the Water Act) is the legislation which provides for the investigation, allocation, use, control, protection, management and administration of water resources. The Water Act allows the declaration of water allocation plans within water control districts and requires that such plans allocate water to beneficial uses. Water control districts and beneficial uses are described in section 3 of this document.

## Overall Objective or Purpose

### Objectives

- Provide independent guidance to water planners and water advisory committees as to the current environmental condition of the Howard East and Berry Springs Water Allocation Planning Areas.
- Provide a baseline to evaluate environmental impacts of future water extraction scenarios and assist in the development of economically and socially acceptable water resource plans for these areas.
- Provide recommendations regarding environmental flow requirements and identify knowledge gaps to assist in the framing of an effective monitoring program under these Plans.

## Specific Objectives

### Outcomes

- Use of the best available of environmental information for the Berry Springs and Howard East planning areas for which to base trade off discussions/decisions
- Enhanced community trust through the use of independent assessments to inform these planning processes
- Educate the NTG with a framework for undertaking similar environmental assessments specific to other water allocation planning processes in the Northern Territory in future



### **Assess current condition**

The consultant will be required to perform a broad scale assessment of the current condition of the study area. The study area should be divided into reaches for assessment and management purposes, and should be based on available geomorphological and ecological information (literature search and validation), field investigations and the consultant's professional judgement. The condition of the system should include consideration of hydrology (including groundwater and surface water interactions), water quality, riparian vegetation, aquatic ecology including fish, floodplain and wetland ecology.

The assessment should relate the current condition to the expected natural condition and identify the likely degree of impact that might result from a particular future level of water resource development resulting in changes to the flow regime. Whilst the focus is on identifying flow-related impacts, the relative importance of other impacts on ecological and geomorphological condition (for example, land use practices) should be noted.

### **Aquatic ecosystems and areas of high conservation value**

These areas may have high biodiversity, unique geomorphological forms, rare/and or threatened species or be areas of regional, Territory, National or international significance. They should be identified by their characteristics, spatially (where practicable) and in terms of their susceptibility to water resource development or changes in the flow regime.

Specifically, any water resource management related impact on 'endangered' or 'of concern' regional ecosystems, rare or threatened species and other conservation areas like National Parks should be considered. Points of interest may include, but are not confined to:

- Any surface water or groundwater dependent ecosystems that are rare, unique or may have limited resilience to changes in hydrology;
- Significant ecological refugia (including springs);
- Recreational and commercial freshwater and estuarine fisheries;
- National Parks, conservation areas and important wetlands;
- Intake (recharge) areas of regional aquifers;

### **Key Ecological and Geomorphological values**

In performing the ecological assessments, the consultant will be required to identify specific values dependent on freshwater flows. Such values may be specific to particular areas of high conservation value or may be of a more general nature. These values should be identified through the literature review, field investigations and consultation with representatives of NRETAS.

### **Required flow characteristics**

Relate the health and ongoing maintenance of identified ecosystems and associated values to flow characteristics. Consideration of all components of flow regime should be made including seasonality and variation, low, medium and high flows and their relationship to the ecosystems. For example:

- Changes to the frequency of base flows;
- Low flows may be considered in terms of adequate base flow necessary to maintain springs for particular flora or fauna;
- Medium flows and the impact on integrity of riparian vegetation and stream geomorphology;
- High flows including the impact of any water resource development on the functioning and flora and fauna of floodplains and wetlands of significance both locally and downstream;
- Relationship between overland flow and ground water and surface water flows.

## **Deliverables**

1. Provision of environmental assessment report for the Howard East Aquifer Water Allocation Planning area
2. Provision of environmental assessment report for the Berry Springs Dolomite Aquifer Water Allocation Planning area
3. Provision of a recommended framework for undertaking similar assessments in other planning areas in the Northern Territory.

## Appendix 2: Socio economic assessment to inform water resource planning in the Darwin Region

### Background

In accordance with the NWI, the Northern Territory Government is undertaking water planning supported by the best available information. Water Allocation Plans have been created, are underway or proposed in places where current or potential water use could pose a possible risk to the ongoing availability and health of the resource.

To date, priorities for water allocation planning in the Territory have been focused on groundwater resources that support reticulated urban water supply systems and/or increasing agricultural development. Groundwater accounts for 90% of freshwater use in the Territory, largely due to limitations associated with the capture and storage of surface water flows. In Central Australia, rivers flow infrequently and cannot provide a secure water supply. In the top end, storage yields are generally poor because high temperatures and regional geology result in significant losses through evaporation and seepage.

The Northern Territory *Water Act 1992* (the Water Act) is the legislation which provides for the investigation, allocation, use, control, protection, management and administration of water resources. The Water Act allows the declaration of water allocation plans within water control districts and requires that such plans allocate water to beneficial uses.

### Overall Objective or Purpose

#### Objectives

- Provide Independent guidance to water planners and water advisory committees as to the current social and economic condition of the Howard East Water Allocation Planning Area.
- Provide Independent guidance to water planners and water advisory committees as to the current social and economic condition of the Berry Springs Water Allocation Planning Area.
- Provide a baseline to evaluate social and economic impacts of future water extraction scenarios and assist in the development of economically and socially acceptable water resource plans for the Howard East Water Allocation Planning area.
- Provide a baseline to evaluate social and economic impacts of future water extraction scenarios and assist in the development of economically and socially acceptable water resource plans for the Berry Springs Water Allocation area.

### Specific Objectives

#### Outcomes

- Use of the best available of social economic information for the Howard East planning area for which to base trade off discussions/decisions.
- Use of the best available of social economic information for the Berry Springs planning area for which to base trade off discussions/decisions.
- Enhanced community trust through the use of independent assessments to inform these planning processes
- Educate the NTG with a framework for undertaking similar socio-economic assessments specific to other water allocation planning processes in the Northern Territory in future

## Scope

The project will assess the current social and economic situation, focussing on but not limited to the area defined by the Howard East Water Planning Area and Berry Springs Water Allocation Planning area. Notwithstanding this, the project will be limited to the local government areas totally or partially within the Plan area. Similarly, the project should focus on issues that are of direct relevance to Water Allocation Planning.

The social assessment will entail basic community profiling and presentation of relevant data.

The economic assessment will identify local industries:

- Reliance upon water resources,
- Contribution to output and employment, and
- Current condition and longer term trends.

Condition and trend information (where available) is required for the following in the planning areas:

- Population (including an indigenous component if available)
- Age
- Employment (including by industry)
- Unemployment rates
- Income
- Education qualifications
- Agricultural industries and their relative water dependence
- Fishing (commercial and recreational)
- Tourism
- Cultural (Aboriginal and European)
- Recreational & aesthetics
- Industrial/mining
- Urban/residential

For water using/dependent industries such as irrigated agriculture and fishing, a brief market outlook is required to provide an indication as to what their future water demands may be (in qualitative terms, for example, decreasing/stable/increasing) over the 10 year life of any prospective Water Allocation Plan for the Howard East and Berry Springs Aquifers.

Some indication of the relative importance of each industry/water using sector to the area's economy and society is required. For example, this could be done through each sector's contribution to employment or through alternative means depending on data availability.

The Department will provide the necessary base water supply information to the consultant to undertake this consultancy as some assessment of current water supply is required.

Generally the focus of the work will be on use of secondary data sources with the possibility of some stakeholder consultation and focussing any information and forecasts to a Darwin Water Control District perspective. Time series data should be used where robust and readily available while snapshot data can be used in other situations.

## Deliverables

1. Provision of socio-economic assessment report for the Howard East Aquifer Water Allocation Planning area.
2. Provision of socio-economic assessment report for the Berry Springs Dolomite Aquifer Water Allocation Planning area.

3. Provision of a recommended framework for undertaking similar assessments in other planning areas in the Northern Territory.

It is intended that the socio-economic assessments provide an indication of the relative importance of each industry/water using sector to the area's economy and society. This, in conjunction with recommendations made about environmental water requirements, will be used by the water planner and water advisory committee to inform discussions about the potential impacts of a range of water allocation scenarios.