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Executive Summary

This document, the Alice Springs Water Allocation Plan (the plan) has been developed to provide an adaptive management framework for the allocation of water resources. The plan applies to all surface water and groundwater within the Alice Springs Water Control District (the district), and incorporates the precautionary principle as far as possible.

The four principal objectives of the plan are to:

- Maintain public water supply
- Protect the environment
- Support Indigenous culture and communities; and
- Ensure sustainable development

There are currently no significant or licensed surface water extraction activities within the district. Surface water is important because of its environmental and cultural significance and as a source of recharge to groundwater. Groundwater is the primary consumptive water resource and is mainly extracted for use as public water supply. There are also licensed groundwater extractions associated with horticulture, tourism and irrigation of public green space, as well as unlicensed groundwater extraction for stock and domestic use.

The most significant groundwater resources within the district and the source for the town's water supply is the water within the Amadeus Basin Aquifers. The water drawn from the Amadeus Basin Aquifers is estimated to be between 10,000 to 30,000 years old and contemporary recharge is minimal in the context of the resource. This water resource is therefore considered a non-renewable water resource. The current water extraction regime acknowledges that this resource is effectively being mined in order to sustain the growth of the population of Alice Springs. The plan maintains the allocation of the majority of groundwater in the Amadeus Basin Aquifers for use as public water supply.

There are six management zones under the plan based upon the major consumptive resources of the Alluvial Aquifers and the Amadeus Basin Aquifers. Allocations available for surface water shall not exceed a volume more than 5% of flow at any time in any part of a river. Allocations from the individual Alluvial Aquifers are based on estimated average annual recharge. Allocations from the Amadeus Basin Aquifers shall not exceed a volume more than 25% of the estimated total aquifer storage over 100 years.

The rules and trading of licences is provided for by the Water Act. Further rules for the granting of licences and for the trading of licensed allocations (for water which has not been allocated for public water supply) are set out in detail in the plan. Licences will generally be granted for a period not exceeding 10 years and are renewable upon application.

In accordance with the Water Act, the plan must be reviewed at intervals of no longer than five years. Reviews will be informed by the outcomes of the monitoring program and research findings, as well as by community consultation.
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1. INTRODUCTION

The Water Act states the role of a Water Allocation Plan is to ensure:

- water is allocated within the estimated sustainable yield to beneficial uses;
- water is allocated to the environment;
- the total water use for all beneficial uses is less than the sum of the allocations to each beneficial use; and
- the right to take water under licence is able to be traded.

The Alice Springs Water Allocation Plan (the plan) should be considered a living document - it provides a clear, transparent and adaptive process to improve understanding and management of this important resource. The plan is informed by the best available science, socio-economic analysis and community input, and has been prepared to provide for the best long term use of Alice Springs water resources, balancing social and environmental protection while allowing for economic development. It aims to avoid economic costs and environmental losses due to over-extraction, salinity and poor water quality, and provides a framework for management and allocation decisions.

The plan has been reformatted, and incorporates new information where available. Since 2007, no revision of previous water availability estimates has been undertaken, and there have been no major adjustments made to the allocations available within the Management Zone Area.

The plan includes:

- detailed objectives;
- controls on water extraction from the Wanngardi Basin;
- revised management zone for the Outer Farm Basin reflecting current and potential locations of licensed extraction;
- updated information and estimates of unlicensed water extraction;
- streamlined Implementation Targets;
- the incorporation of diagrams and maps so that the plan is a single volume;
- a continuing role for the Alice Springs Water Advisory Committee in future review of the plan; and changed role in implementation of the plan.

1.1. Review

A Water Allocation Plan must be reviewed at intervals not longer than five years. A review shall consider the extent to which the plan has achieved its objectives, and may be modified to reflect improved science and understanding of the resource. It is anticipated that the review will be generally informed by the outcomes of the monitoring program, research findings, and community consultation. All public submissions, and any NT or regional policies or agreements coming into force after the initial declaration and with relevance to the plan, will be considered at the review.
2. WATER MANAGEMENT POLICIES AND PROCESSES

2.1. The Water Act

The NT Water Act guides all aspects of water use and management, including how water resources are investigated, allocated and protected in the Northern Territory. The Minister for Land Resource Management administers the Act through the Controller of Water Resources. The plan takes formal effect when it is declared as a Water Allocation Plan under Section 22B of the NT Water Act. The Minister may declare a water allocation plan in respect of a water control district for a period of up to 10 years, and the plan must be reviewed within five years.

Water allocation plans take their legal force from the Act, which remains the main source of legal rights and obligations affecting the use of water resources in the NT. The plan should be read in conjunction with the Act, and will be subject to any amendments which may be made to the Act after the declaration of the plan. The plan contains summaries of the effect of certain provisions of the Act, which have been provided for information only.

Total water use from an aquifer or waterway within a water control district must be within the estimated sustainable yield for that aquifer or waterway. The concept of sustainable yield is not defined in the Act. The National Water Initiative defines the environmentally sustainable level of extraction as ‘the level of water extraction from a particular system which, if exceeded would compromise key environmental assets, or ecosystem functions and the productive base of the resource.’

Beneficial Uses

Water allocation plans establish a framework to share water between human and environmental needs. A water allocation plan is declared to ensure water within a water control district is allocated to beneficial uses within the estimated sustainable yield. The various uses of rivers and groundwater are defined by the Water Act as ‘beneficial uses’, and include agriculture, public water supply, the environment, cultural needs, industrial needs, aquaculture and to provide water for rural stock and domestic purposes.

The declaration of beneficial uses is one of the key factors determining how water resources will be protected, managed, and used. In 2014, the beneficial uses associated with the plan were revised to retain all previously declared beneficial uses, and to allow allocation for industry within the Roe Creek, Rocky Hill and Wannngardi Basin management zones (Gazette G43).

2.2. National Water Initiative

The National Water Initiative 2004 (NWI) is the major policy document of the Federal, Territory and State governments in relation to water allocation and planning. Its basic premise is that governments have a responsibility to ensure water is allocated and used to achieve socially and economically beneficial outcomes in an environmentally sustainable manner. NT Planning Scheme

The NT Planning Scheme (the Scheme) generally applies to the whole of the Northern Territory and includes a number of “planning principles”, which are broad expressions of the Northern Territory Government’s commitment to outcomes of land use planning and development control. These principles as listed in Clauses 4.1(b) and (d), include that the administration of the Scheme is to promote urban/building design which is water efficient, and; contribute to the sustainable use and development of land and water resources so that the use and development of land is consistent with the principles of sustainable development and avoids pollution and minimises degradation of the environment or over commitment of water resources.

The Alice Springs Land Use Framework Clause 4.3(f) of the Scheme identifies the need to protect the Roe Creek and Rocky Hill borefields from inappropriate land uses and development. It includes a map showing water management areas within Alice Springs. A water management area does not restrict development, nor require any development in the zone be in accordance with the principles
for water management of the authority responsible for managing the public water supply – as applies to water management zones under s.5.25 of the Scheme.

2.3. Community Consultation

In developing the plan, the Department of Land Resource Management (DLRM) engaged with the general community and sought advice from the Alice Springs Water Advisory Committee. Community consultation is a key part of the water allocation planning process and helps identify the values to be protected by the plan, and is also required by the NWI. The public and key stakeholders were invited to participate in the planning process, by attending information sessions, and were kept informed of progress via the dedicated website; www.nt.gov.au/alicewaterplan.

Community consultation for the Strategy in 2007 (NRETAS, 2007) delivered three key messages;

• the need for improved water use efficiency in Alice Springs;
• that any water use should generate enough social, economic and environmental benefits for Alice Springs to justify the depletion of the resource; and
• conservative water use to extend the life of the major non-renewable water resources will help provide for the needs of future generations.

This resulted in an agreement to limit water use from the Amadeus Basin Aquifers to no more than 25% of estimated groundwater storage over the next 100 years - these key messages have continued to determine the outcomes of the plan.

Although there is general agreement on the desirability of sustainable water use, there are many interpretations of what sustainability is. Sustainable groundwater yield’ is defined by the National Groundwater Committee (2004a) as “the groundwater extraction regime, measured over a specified planning timeframe that allows acceptable levels of stress and protects dependent economic, social, and environmental values.”

Rather than the term ‘extraction volume’ – which is unlikely to adequately measure sustainability - the preferred term is ‘extraction regime’. ‘Management of extraction to achieve sustainability may involve varying the rate of extraction in response to triggers such as changes in water level or water quality.

The concept of ‘acceptable levels of stress’ recognises the need for a trade-off between environmental, social and economic needs - this approach acknowledges that groundwater extraction may result in some depletion of groundwater storage. Community consultation revealed a common understanding and acceptance that a portion of the water resources of Alice Springs is essentially being ‘mined’. In the context of an unsustainable use, the community did not consider the term ‘sustainable groundwater yield’ to be appropriate – the preferred term to describe the rate of groundwater depletion is ‘maximum allowable yield’.

Water Advisory Committee

The Water Act provides for the establishment of a Water Advisory Committee to advise on the effectiveness of the Water Allocation Plan in maximising economic and social benefits within ecological restraints. The committee liaises with and provides feedback from stakeholders; reports on progress in implementing the plan; and supports the periodic major review of the plan.
Priority Management Issues

The following priority management issues were identified through community consultation. Current and future work programs intend to address these issues, and others as identified by the Water Advisory Committee.

- **Sustainability**: The plan recognises that the main water resource for the population of Alice Springs is non-renewable. The water management framework for the resource will continue to examine appropriate techniques for sustaining this resource for the local population for the longer term.

- **Knowledge Gaps**: There are many knowledge gaps which remain and are identified in the plan.

- **Indigenous water rights and values**: The need to support Indigenous cultural rights to water is recognised in the Objectives. The plan also benefits from a new report completed on cultural values, which provides a starting point for further work on this issue within the local context.

- **Groundwater Dependent Ecosystems (GDEs)**: The National Water Commission has been involved in several key national projects such as the compilation of the GDE Atlas which will improve national understanding and knowledge about groundwater dependent ecosystems. The plan will be complemented by a new report which has been commissioned on environmental values associated with water within the district, which will provide baseline data that can underpin future work within the district.

- **Protection from Contamination**: Detailed work on pollution controls requires close cooperation with the agencies responsible for land use planning and environmental protection. The plan acknowledges for the first time the significance of the NT Planning Scheme in protecting catchments. A representative of the Department of Lands, Planning and Environment has also been appointed as a permanent observer to the Alice Springs Water Advisory Committee to facilitate knowledge exchange.

- **Salinity and Groundwater Quality**: This is a complex issue which continues to be monitored by DLRM. To date, water quality for all Management Zones has been consistent. The extraction regime recommended in 2001 (SKM, 2001) resulted in a greater proportion of the Town Basin being recharged with better quality water during the wet period of 2010. Monitoring of water quality remains a key implementation target in the plan.

- **Demand management and community education**: During 2011 to 2013 DLRM was a financial partner in the two year Alice Water Smart demand management project being coordinated by Power and Water Corporation. Alice Water Smart was a $15 million project jointly funded through the Australian Government’s *Water for the Future* initiative and the Alice Water Smart Consortium.

- **Non potable supply from the Alice Springs Water Re-use Project**: This project remains under the direction and control of Power and Water Corporation. The plan acknowledges that it is not the role of the DLRM to deal with source substitution for potable or non-potable reticulated water within Alice Springs; but it does provide for the allocation of water injected into the aquifer by this scheme as part of the consumptive pool.
3. THE ALICE SPRINGS WATER CONTROL DISTRICT

The district covers an area of 8 200 km² around Alice Springs. Alice Springs (Mparntwe in Arrernte) is in the heart of Australia’s arid zone, in the southern part of the Northern Territory approximately halfway between Darwin (1 508 kilometres north) and Adelaide (1 526 kilometres south). Alice Springs is the second largest population centre in the Northern Territory, outside of Greater Darwin, with a residential population of 28 449, of which 18.6% are Indigenous (ABS 2011). It is the major administrative and service provider for remote desert communities in South Australia and Western Australia as well as central Australia – a small number of communities and cattle stations are also situated in the Alice Springs Water Control District (the district). The water resources of Alice Springs have supported the Arrernte peoples for many thousands of years.

In addition to supporting the area’s unique environment and areas of cultural significance, water extracted is used for reticulated public water supply, irrigation of green space within the town, industry, indigenous art industry, defence, mining exploration, pastoralism and horticulture. The town depends on potable water sourced from the Amadeus Basin Aquifers at the Roe Creek borefield 15km from the town, which is a finite resource.

The Pine Gap Joint Defence Facility is located near Alice Springs and houses a significant number of American defence staff, Australian support staff and families. The district is also home to major tourist attractions including the MacDonnell Ranges. The West MacDonnell National Park and Owen Springs Reserve also occupy a significant portion of the district to the west of Alice. There are a number of small scattered Aboriginal Land Trust holdings and in the east the district extends over part of Santa Teresa Aboriginal Land Trust – although not over the actual community of Santa Teresa (Lyente Apurte). There are also a number of other small permanent landholdings excised from larger pastoral blocks which are associated with horticultural enterprises producing table grapes, dates, irrigated pasture, and other fodder and horticultural crops. The majority of the land within the district is under pastoral lease by cattle stations.

Broad scale mapping of soils has been completed for a large portion of the Alice Springs region, and the district encompasses a variety of land systems. North of Alice Springs it is dominated by the gneiss and granite hills and uplands of the Harts land system. The quartzite and sandstone ridges of the Heavitree, Waterhouse and MacDonnell Ranges stretching either side of Alice Springs represent the Gillen Land system. Immediately to the south east of Alice the Todd land system reflects the alluvial flood plains of the Todd River, which occupy a significant portion of the district. South of the Western MacDonnell ranges, the Muller land system represents low hilly terrain on unweathered folded sedimentary rocks. Most of the southern third of the district is covered by the undulating red dunefields and sand plains of the Ewaninga and Simpson land systems (Perry et al, 1962).

The district intersects four bioregions. A small section to the north covering the Todd River catchment on Bond Springs is covered by the Burt Plain Bioregion which is characterised by mulga and other acacia woodlands on red earth plains, with isolated rocky ranges. The area immediately around Alice Springs and the south-western third of the district is covered by the MacDonnell Ranges Bioregion. This bioregion is characterised by spectacular high relief ranges and foothills of diverse geology (mostly sedimentary rocks in the Amadeus Basin and crystalline metamorphic rocks in the Arunta Block). The dominant vegetation types are spinifex hummock grassland, sparse acacia shrublands and woodlands along watercourses. More than half the district to the south of Alice Springs is covered by the Finke bioregion which is characterised by arid sand plains with deeply cut elevations and valleys. Mulga woodland is the dominant vegetation there with various senna, eremophila and acacia species present. The area between the Ringwood and Santa Teresa roads to the east of the district is covered by the Simpson Strzelecki Dunefields Bioregion which contains dunefields, extensive salt pans, sand plains and dry watercourses, vegetated by sparse shrubland and spinifex grassland (DEWHA, 2002).

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1 The Arrernte are the traditional owners for Alice Springs and immediate surrounds.
Figure 1: Alice Springs Water Control District
3.1. Hydrogeology

The surface catchments and groundwater systems of the district are interconnected - flows in the Todd River provide recharge to the Alice Springs Town Basin, Inner Farm Basin and Outer Farm Basin; and flows in Roe Creek, a tributary of the Todd, recharge the Wanngaardi Basin and to a lesser extent the Mereenie aquifer. The abovementioned aquifers are the major source of groundwater within the district.

Almost all of the water supplies in the district are drawn from groundwater, either from alluvial sediments or from aquifers in the northern part of the Amadeus Basin. There is presently no known or significant surface water extraction activities in the district, as surface water retention is limited to relatively small dams used to water cattle. Rainfall patterns are unpredictable, in that rainfall can occur at any time of the year, and is extremely variable between years.

The dramatic landforms of the Alice Springs region reflect an ancient and complex geological history – further information about the geological eras and periods, and a description of the geological formations is available in Appendix 1. The region is dominated by two major geological units, the Arunta Block and the Amadeus Basin. The Arunta Block is composed of ancient rock, about 1 400 million years old which generally do not contain useful quantities of water, unless fractured by earth movements.

The Mereenie Aquifer System consists of the geologically connected formations; Mereenie, Ooraminna and Hermannsburg Sandstones. Other important aquifers within the northern part of the Amadeus Basin include the Pacoota Sandstone and Shannon and Goyder Formations. In these aquifers, groundwater flow is generally eastwards. Current hydrogeological understanding of the Amadeus Basin Aquifers associated with the Roe Creek area is far more advanced than near Rocky Hill. Although geologically and hydraulically connected, distinctions can be made between the aquifers of these two areas, particularly regarding aquifer porosity, permeability, recharge, size, and water quality.

By determining the rate and direction of groundwater flow, and by assessing aquifer characteristics, the quantity of water available for use can be estimated. The rate of groundwater flow indicates how quickly water moves to replace water that is pumped out. An aquifer’s ability to convey water is usually described as transmissivity, expressed as square metres per day. The storage coefficient indicates the volume of water available for extraction as a percentage of the total capacity of an aquifer - good aquifers generally range from 5% to 20%. The amount of water that flows from a bore, termed bore yield, is expressed in litres per second (L/s). A complete summary of the characteristics of the aquifers in the region is detailed in Appendix 2.

The relationship between groundwater recharge, throughflow and natural discharge may be altered by rural and urban development which increases the extraction of groundwater and has been known to cause dewatering of the aquifer or, as in the case of the Town Basin recently, may increase artificial recharge to the underlying aquifer.

The aquifers of the region are dynamic systems in which characteristics such as storage volumes, flow rates, yields and water quality vary over time. The volumes referred to in this document should be understood as approximations within a range of possible values. The following sections provide a summary of the most up-to-date scientific knowledge about the occurrence and behaviour of groundwater water resources in the Alice Springs region. The plan deals with selected parts of the regional geology because the aquifers contain known useful quantities of reasonable quality water, or are relied upon by existing users. Other unused or poorly understood aquifers may also contain small supplies or poorer quality water, are not addressed within the plan - this does not preclude their use in the future.

Groundwater Quality and Extent

The salinity (TDS) of groundwater provides an indicator of the water quality, and its potential uses. However, scope remains for more detailed assessment of other water quality parameters - for example hardness – to identify any other limits on the suitability of water quality in the region. Groundwater in the Alice Springs region contains naturally occurring dissolved salts. In shallow
alluvial aquifers; evaporation near the surface works to increase the residual concentration of salt, especially in areas where irrigation has taken place. Water quality is also affected by urban development. The concentration of salt in the deeper Amadeus Basin Aquifers is fairly constant, although it does vary spatially.

Figure 2: Geological Cross Section

Climate

The district has an arid climate, with variable temperatures:

- average summer maximum 35°C for three months of the year
- winter night-time temperatures fall below 0°C
- mean monthly minimum temperature ranges from 4°C to 21°C
- mean monthly maximum temperature varies from 19°C to 36°C
- typical variation within a day of 15-20°C

Rainfall is highly variable, which results in periods of extended drought, occasional years of higher rainfall, and rare years of very high rainfall such as 1974 and 2010. Average annual rainfall at the Alice Springs airport is 280 mm, and is highly variable from year to year. In 2009 the total rainfall was 76.8 mm, and in 2010 the total rainfall was 770 mm. On 31 March 1988, 204.8 mm - more than two thirds of the average annual rainfall – fell in a single day, resulting in the highest flood in the Todd River since contemporary records began in the 1960s.

Average monthly rainfall is higher during summer, particularly from October to March. However, rain can occur at any time of the year. The most intense rains occur as a result of localised thunderstorms associated with monsoonal activity in the tropical north during the summer. Infrequently there are periods of widespread winter rains due to the influence of fronts moving across the Great Australian Bight. Average annual rainfall over the entire region represents a total of 750 000 ML. Pan evaporation is very high, at approximately 3 000 mm per year, suggesting that much of the rainfall in the region is returned directly to the atmosphere.

The relationship between rainfall, surface water flow and groundwater recharge is complex and variable depending on such things as the timing, volume and geographical extent of seasonal rainfall events, topography, soil structure and underlying geology. Rainfall is significant as an indicator of groundwater recharge, particularly in the context of the Alice Springs Town Basin. The Town Basin is sustained and intermittently replenished by flows in the Todd River, with a long
period of smaller flows providing greater recharge than single large events. These flows in the Todd are fed from the rainfall-runoff in the catchment to the north of the town.

**Climate Change**

Allocation and licence limits in the plan have been determined based on historic climatic data and do not consider the possible effect of climate change on the long term availability of water from this water source. Although it is anticipated that temperature and therefore evaporation will increase in the district, an increase in intensity of storm events projected under current climate change modelling may also increase recharge to the groundwater resource. When the plan is reviewed, the latest climatic data will be used to take account of information on projected future climate change.

**3.2. Non Consumptive Water Use**

The plan assumes the provision for protection of environmental values will also maintain the condition of places that are valued by Indigenous people for cultural purposes. It recognises that any new research on specific environmental water requirements will be considered as part of the review process. It also recognises that cultural water requirements may not align entirely with environmental requirements, and that any new research on specific cultural water requirements will be independently considered as part of the review process.

**Cultural use**

Cultural use of water under the Act includes providing water to meet aesthetic and recreational needs in addition to cultural needs. In the context of the district, it includes town resident and tourist recreational use of water places, and broader community heritage values, as well as the cultural significance of water places to the Arrernte people.

Cultural use of water considered in the plan includes recreational visits to places such as Simpsons Gap, the Ilparpa claypans, Redbank and Wigley Waterholes and places along the Hugh River. It also includes sites such as the Telegraph Station waterhole and Owen Springs which were important to the history and development of Alice Springs as a town. Cultural needs also encompasses the values given to water sites and their associated ecosystems in Arrernte culture where many permanent and some temporary water sources such as claypans, soaks, waterholes, rockholes and springs were vital to the existence of a pre-settlement culture and continue to be deeply embedded with spiritual and cultural significance.

The entire Todd River is a site of major significance to *Mpwartne* custodians and other Arrernte people. All large River Red Gums along the banks and in the bed of the river are sacred sites. In addition, there are a large number of other sacred sites located within, on the banks of, or immediately adjacent to the Todd and Charles Rivers. Many of these sites have individual names and are associated with numerous Dreaming ancestors who created the greater Alice Springs area. Aboriginal custodians view themselves as the living embodiment of these ancestors and under Aboriginal Law have a responsibility to ensure that these sites are protected (AAPA, 2011).

There are also Arrernte names and Dreamings associated with, and sometimes linking many of the other significant water sites within the district, including *Lhere Totinjia*, the Hugh River, which has larger, and more dependable gorge rockholes and waterholes than the Todd River, *Lhere Mpartntwe*.2 Spencer and Gillen for example recorded 17 different names for different kinds of major Arrernte water supplies including different types of waterholes as well as claypans, soaks, rockholes etc. Major ceremonial gatherings were also held at particular water sites including the Telegraph Station waterhole, before the town developed, providing further cultural significance for the Arrernte people. The Hugh River was also followed by John McDouall Stuart in 1860 and John Ross in 1870-1 and the waterholes along its length enabled the survival of these important Heritage figures.

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2 This is the name of the Todd River near Alice Springs. The entire Todd River is called *Lhere Imatukua*. 
In 1999 the Arrernte people of Alice Springs were awarded the first successful Native Title claim in an urban area in Australia. The Federal Court recognised coexisting native title rights and interests on most parks and vacant Crown land and waters within Alice Springs, which includes the rights to access and to protect sites. These claims were based on estate groups including the Mparntwe (Alice Springs), Irlpm (Bond Springs), Antulye (Undoolya), Iwepatheke (Jay Creek) and Kweywenpe (Pine Gap area) estates. In each ‘estate’ there is a key totemic site and typically, a reliable water supply such as a spring, long lasting soak and/or rockholes, providing further illustration of the importance of water sites in traditional Arrernte culture. Arrernte peoples retain a spiritual association with the country and value its water resources.

**Environmental Use**

Most environmental use of water within the district is sustained by surface water systems and run-off. The dependence of plant communities on groundwater is indicated by the depth of the water level below the ground. For plant communities to be dependent on groundwater, water levels must be within the root zone. Given the depths to water in the Management Zone Area, only the Alluvial Aquifers are likely to support riparian vegetation. Central Australia contains unique examples of plant and animal communities that depend partly or completely on groundwater. River red gums (*Eucalyptus camaldulensis*) are an iconic example of species growing along watercourses and in areas where groundwater is close to the surface. Other vegetation communities including those within Coolibah Swamp, Conlon’s Lagoon, Ilparpa Swamp and other smaller ephemeral swamps and claypans are supported by surface water drainage depressions and flood outs. These swamps and claypans typically have higher recorded biodiversity values for wetland plants and waterbirds.

The predominantly intermittent springs are all close to rocky hills and are most probably fed by fractured rock aquifers within the hills. Some of these springs are seepages. Springs or seepages in the gullies on the south side of Mt Gillen have been recorded as running for weeks to months after prolonged rain periods (e.g. in 2001 and 2010). There are no documented springs caused by discharge from the Alluvial Aquifers. There are no springs or known natural ecosystems dependent on groundwater from the Amadeus Basin Aquifers within the district, and because of the depth below surface of these aquifers, groundwater extraction from them is unlikely to affect the long term health of the known wetlands within the area.

**Groundwater Dependent Ecosystems**

Groundwater dependent ecosystems are plant and animal communities that depend - partly or completely – on groundwater. In Central Australia ecosystems can include spring-fed wetlands, vegetation growing along watercourses, animal and plant communities in areas where groundwater is close to the surface, and animal communities that may live in aquifers.

Some species which are groundwater dependent have cultural significance, e.g. river red gums along sandy watercourses. The Northern Territory government has obligations in law and through intergovernmental agreements to protect biodiversity and provide water for environmental needs.

It is possible that the near permanent waterholes in the district may be fed by groundwater seepage however there has been no scientific research on this. Other groundwater dependent ecosystems may include stygofauna (microscopic animals which live in aquifers). Sampling in the Town Basin aquifer did find invertebrate stygofauna, but this is the only known sampling of stygofauna in an aquifer in Central Australia (Tomlinson, 2008). At this stage knowledge about groundwater dependent ecosystems remains limited, and there is uncertainty about which ecosystems are groundwater dependent, how much water is needed to maintain groundwater dependent ecosystems, or how sensitive they may be to changes in water quality or availability. However, there is sufficient qualitative understanding of the links to the main groundwater resources for allocations to be made.

The plan adopts a conservative approach and recognises further research and data is required to improve understanding.
4. SURFACE WATER

Surface water in the district is ephemeral and an unreliable or opportunistic consumptive water resource. Connectivity between groundwater and surface water is important because the surface water flows recharge the groundwater system and support terrestrial biodiversity in the district. The two main river systems within the district are the Todd River and the Hugh River (Figure 3). Flows in the Todd River provide recharge to the Alice Springs Town Basin, Inner Farm Basin and Outer Farm Basin; and flows in Roe Creek, a tributary of the Todd, recharge the Wanngardi Basin and to a lesser extent the Mereenie aquifer.

The Todd River flows south through the town, passing through Heavitree Gap and eventually moves east along the Emily Plain. Charles Creek is a tributary of the upper Todd River and flows east from Simpson’s Gap National Park. Gillen Creek flows east from Mt Gillen and joins Chinaman Creek which drains into the Todd River just north of Heavitree Gap. On the eastern side of the Todd River, Emily Creek, Jessie Creek and Red Range Creeks travel south through a series of gaps in the Heavitree Range and individually join the Todd River on the Emily Plain. To the west is Roe Creek, which runs in a south-easterly direction through the MacDonnell Ranges, before channelling through Honeymoon Gap and Temple Bar to join the Todd River on the Emily Plain. The lower part of the catchment, south of Heavitree Gap, opens out to a broad alluvial plain.

Stream records have been collected for the Todd River and a number of its tributaries since the 1960s. River height records confirm the highly episodic nature of surface water flow within the district. Flows have occurred in the Todd River 160 times since 1972. Roe Creek responds to rainfall quite differently, partly because it has a much smaller catchment, and has only flowed 41 times since 1967. Few of the flows in the Todd have reached as far as the eastern edge of the Emily Plain. When the Todd flows south of Heavitree Gap it usually floods out into minor channels and either evaporates or provides recharge to the groundwater of the Farm Basins. The maximum recorded flow since 1972 is 1.2 ML/sec in 1988 at the Anzac Oval gauge on the Todd River. The maximum height of 3.985 m recorded since 1952 was also during the 1988 flood.

The district also contains a substantial part of the upper Hugh River, which is predominantly a broad sandy single channel fed by runoff from the Chewings Ranges. It runs the length of the district past where it joins Orange Creek in the south. In some sections the river is very broad, such as south of the Waterhouse Range. The river passes through three substantial ranges (Heavitree Range, Waterhouse Range and James Range) in the district but none of these ranges host long-lasting waterholes. Several short to medium term waterholes occur after flows, including Redbank Waterhole on Owen Springs Reserve. The longest lasting waterhole (between the Waterhouse Range and the Owen Springs Ranger Station) can hold water for many years without normally drying out – an exception to this is when the waterhole became dry in 2008.

Wetlands and semi-permanent water bodies within the district include Wigley Waterhole, Junction Water Hole, and the Telegraph Station and Heavitree Gap Waterholes on the Todd River; Simpsons Gap on Roe Creek, and the Emily Gap waterhole on Emily Creek. Most of the substantial waterholes within the district are found in gaps between ranges. Simpsons Gap and Bond Gap waterholes are near permanent (may dry up in extended droughts), whereas others such as Emily Gap waterhole typically last several months unless topped up by subsequent river flows. Various other waterholes occur in the rivers and creeks of the district. After large or sustained river flows many short lasting shallow waterholes occur along sandy river beds.

Various claypans and swamps also occur within the district - notable swamps include Coolibah Swamp, Conlon’s Lagoon, and Ilparpa Swamp, which are supported by surface water drainage depressions and flood outs. Where the swamps and claypans are not obviously associated with major river channels, they are assumed to be filled by local rainfall, by runoff from nearby elevated areas and from sheet-flow across the landscape.

The amount of vegetation cover in the catchment varies from year to year in response to rainfall. Reduced vegetation cover during drier periods results in reduced rainfall capture and a greater proportion of surface water runoff. Changing burning practices and total grazing pressure further modify runoff. Because of the steep slopes within the catchment there is a potential for large flash floods to occur in Alice Springs.
Figure 3: Surface Water Catchments
4.1. **Surface Water Allocations**

At the time of preparation of the plan, only one surface water extraction licence is issued in the southern region of the NT, and none within the district. Because of the ephemeral nature in the arid zone, surface water is generally considered an opportunistic rather than a reliable consumptive resource. Surface water is most likely to be used in the southern region for dams for stock and domestic use. Stock and domestic use does not require a licence under the Act.

The following approach is a conservative approach which allows limited surface water use while still protecting the environmental and cultural values that are often associated with riparian areas in the arid zone.

1. All surface water taken from the Upper Alice Springs Catchment Area and Lower Alice Springs Catchment Area will only be used for the following declared beneficial uses; Environmental; Cultural; and, Rural Stock and Domestic.

2. 95% of flow will be allocated for environmental and cultural use (non consumptive use).

3. No more than 5% of any river flow at any time can be extracted for consumptive use (stock and domestic) from any river or watercourse.

4. Only minor extractions, diversions or damming of streams for homestead and stock water supplies will be permitted, and approved extractions, diversions or damming of streams will not divert more than 5% of stream flow or catchment runoff.

5. Water quality will continue to be protected against waste discharge and pollution to preserve the natural water quality as far as possible.

6. Water allocations for harvesting surface water runoff will be prepared when adequate information is obtained and informed decisions can be made in consultation with the Water Advisory Committee.

7. Any construction of dams or water-intercepting/diverting works may require a permit under other Acts (particularly the Sacred Sites Act). As such it is the land owner’s responsibility to ensure all appropriate permits and approvals have been granted before any construction begins. This would include ensuring the proposed works comply with the Water Act.

8. Rural dams of less than 3 m bank height and a catchment area of less than 5 km² are exempt from permit and licensing requirements.

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3 Northern Territory Government Gazette S35, 30 June 1992
5. **TOWN BASIN**

The Town Basin primarily supplies non potable water for the irrigation of parks, schools and other public facilities reducing pressure on public water supplies from the Roe Creek borefield.

The Town Basin is an aquifer comprised of alluvial sediments associated with the Todd River and extends north from Heavitree Gap. The aquifer is about 7 km². The Basin is generally 20 m thick but reaches a maximum depth of 30m at Heavitree Gap. Most of the Basin is filled by low permeability silt and clay. The deepest part of the Town Basin is west of the current river bed.

Groundwater salinity in the Town Basin increases with depth and distance from the Todd River. Closer to the river, water quality can be less than 500 mg/l TDS, and further away it can exceed 4000 mg/l TDS. The best quality water is located in strips of sand and gravel which mark buried courses of the former Todd and Charles rivers. The water quality in the Town Basin south of Traeger Park deteriorates after major recharge events, which flush out salts from the northern section of the Basin. The Shallow alluvial beds (gravel, sand, silt and clay) has an estimated water quality of 1 200 mg/L, and the weathered basement rock fracture zones (sandy clays, fractured granite & other rock) has an estimated water quality of > 5 000 mg/L. Between 2001 and 2013 groundwater levels in the Town Basin ranged from 1.2 to 7.4 metres below ground level (mbgl) getting deeper further away from the river. The average depth between 2001 and 2013 was 4.6 mbgl, with an average depth of 5 mbgl in 2013.

5.1. **Recharge**

Recharge of groundwater to the Town Basin occurs from rainfall, and surface water flow. The relationship between rainfall, surface water flow and groundwater recharge in the Town Basin is complex and variable. It depends on such factors as the quantity and intensity of rain, topography (i.e. slope in the catchment), existing soil moisture levels at the time of rain, duration of streamflow, and geographical extent of the rainfall. Storage volumes and depths to water table are highly variable in response to seasonal and annual rainfall patterns.

5.2. **Groundwater Throughflow**

Within the Town Basin, the groundwater moves through the Todd River bed and old paleochannels in a southerly direction to Heavitree Gap. The amount fluctuates markedly in response to annual rainfall variation and streamflow.

5.3. **Natural Discharge**

Natural discharge of groundwater from the Town Basin occurs as evaporation from the soil where water levels are close to ground or riverbed surfaces, through evapotranspiration by vegetation, and by throughflow to the Inner Farm Basin.

5.4. **Current Use**

The Town Basin aquifer originally supplied the drinking water for Alice Spring until increasing demand and deteriorating water quality prompted the establishment of the Roe Creek borefield in 1964. The Town Basin now supplies non potable water under licence for the irrigation of parks, schools, ovals and the golf course. The Town Basin also supports the culturally important river bed vegetation, including mature river red gums, some of which have traditional significance to the local Arrernte people. Refer to the table below for current water use in the Town Basin:

<table>
<thead>
<tr>
<th>Licences issued</th>
<th>Net amount licensed</th>
<th>Reported licensed use (2013-14)</th>
<th>Estimated number of unlicensed bores</th>
<th>Estimated unlicensed water use</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1262 ML/year</td>
<td>903 ML/year</td>
<td>40</td>
<td>10.5 ML/year</td>
</tr>
</tbody>
</table>
5.5. Future Demand

Projected demand from the Town Basin is not expected to increase in the near future. Future demand on the Town Basin will reflect policy decisions regarding source substitution of non-potable and possibly potable urban demand. However, issues of water quality including salinity and pollution would need to be addressed if potable use was considered in the future.

5.6. Water Balance and Sustainable Yield

The water balance provides the basis for decisions on the amount of water available for allocation.

<table>
<thead>
<tr>
<th>Available storage</th>
<th>Total Recharge (direct rain; river recharge; throughflow)</th>
<th>Evapotranspiration</th>
<th>Groundwater Outflow</th>
<th>Maximum Available Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Rural and Urban Development (1964)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 540</td>
<td>240</td>
<td>160</td>
<td>80 to Inner Farm Basin</td>
<td>-</td>
</tr>
<tr>
<td>Current Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 540</td>
<td>1 200</td>
<td>160</td>
<td>40 to Inner Farm Basin</td>
<td>1 000</td>
</tr>
<tr>
<td>Future Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 540</td>
<td>1 200</td>
<td>160</td>
<td>40 to Inner Farm Basin</td>
<td>1 000</td>
</tr>
</tbody>
</table>

* all figures ML/year

5.7. Allocations and Licensing

1. The figures that the water allocations are based on were derived from water balance calculations. 160 ML has been allocated to the non-consumptive pool each year. Total licensed volume for the Town Basin, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below;

<table>
<thead>
<tr>
<th>Agriculture</th>
<th>0 ML/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>1262 ML/year</td>
</tr>
</tbody>
</table>

2. Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The plan allocates the amounts estimated for evapotranspiration and outflow to the environment and non-consumptive cultural needs.

3. Total extraction beyond the Maximum Allowable Yield will be subject to the outcomes from ecosystem studies detailed in the work plan and determination by the Controller of Water Resources.

4. Extraction from the Town Basin in excess of net recharge is considered temporarily desirable to lower water tables underlying the Alice Springs township, to assist mitigation of possible salinity issues and to encourage recharge by better quality waters. However excessive decline in groundwater levels may impact on the health of the river red gums. Extraction from the Town Basin therefore requires careful management.

5. Groundwater levels in the river corridor must not be permitted to decline beyond 8 mbgl

6. Refer to Chapter 16 for the licensing framework.
6. **INNER FARM BASIN**

The Inner farm Basin supports small scale agriculture and a caravan park. The Inner Farm Basin is located between Heavitree Range and Mt Blatherskite, and is a continuation of the southern alluvial sediments of the Town Basin associated with the Todd River. The Inner Farm Basin comprises alluvial and Tertiary sediments, overlying the Bitter Springs Formations (which consists of dolomite, limestone and siltstone). Bores within the Inner Farm Basin intersect this Formation, the alluvial sediments, ancient river channels of the Todd River and minor basement aquifers in the Arunta Block. The alluvial sediments are up to 50 m deep at the southern end of the basin. Between 2001 and 2013 groundwater levels in the Inner Farm Basin ranged from 3.4 to 8.7 mbgl. The average depth between 2001 and 2013 was 5.4, with an average depth of 6.4 mbgl in 2013. In 2004, TDS in the Inner Basin ranged from 1 120 to 5 620 mg/l, with higher results over 4 800 mg/L in the bores to the south and southwest of Blatherskite Park. Moderately high TDS (1500-4 800 mg/L) were found in the remainder of Blatherskite Park, in Heavitree Gap and near Mt Blatherskite. The lowest TDS (less than 1500 mg/l) were found in some bores closer to the Todd River (Jeucken, 2004). In 2011, sampling of two bores located in the Inner Farm Basin showed water quality of 380 mg/l to 1 070 mg/l, indicating recent recharge.

6.1. **Recharge**

Recharge of groundwater to the Inner Farm Basin occurs from rainfall, surface water flow, and throughflow from adjacent geological formations. The relationship between rainfall, surface water flow and groundwater recharge is complex and variable, and depends on such factors as the quantity and intensity of rain, topography (i.e. slope in the catchment), existing soil moisture levels at the time of rain, duration of streamflow, and geographical extent of the rainfall.

Storage volumes and water table depths are highly variable in response to seasonal and annual rainfall patterns. The Inner Farm Basin also receives recharge from leakage beneath the Alice Springs sewerage treatment ponds⁴, irrigation at Blatherskite Park and overflow into Ilparpa swamp.

6.2. **Groundwater Throughflow**

Groundwater moves in a southerly direction from the Town Basin, through Heavitree Gap, and into the Inner Farm Basin. The Groundwater continues to move towards Mt Blatherskite and then east across the Emily Plain floodout. The amount fluctuates in response to annual rainfall variation.

6.3. **Natural Discharge**

Natural discharge of groundwater from the Inner Farm Basin occurs as evaporation from the soils (where water levels are close to ground or riverbed surfaces), through evapotranspiration by vegetation, and by throughflow to the Outer Farm Basin.

6.4. **Current Use**

The Inner Farm Basin provides licensed water supplies for irrigation of tourism businesses including caravan parks. The aquifer remains unstressed with relatively stable and high groundwater levels.

<table>
<thead>
<tr>
<th>Licences issued</th>
<th>Net amount licensed</th>
<th>Reported licensed use (2013-14)</th>
<th>Estimated number of unlicensed bores</th>
<th>Estimated unlicensed water use</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>60 ML/year</td>
<td>24 ML/year</td>
<td>16</td>
<td>5.9 ML/year</td>
</tr>
</tbody>
</table>

⁴ This leakage is a potential source of pollution to the aquifer but water sampling to date has not found any evidence of contamination.
6.5. Future Demand
Projected demand from the Inner Farm Basin is not expected to increase in the immediate future.

6.6. Water Balance and Sustainable Yield
The water balance provides the basis for decisions on the amount of water available for allocation.

<table>
<thead>
<tr>
<th>Available Storage</th>
<th>Total Recharge (direct rain; river recharge; throughflow)</th>
<th>Evapotranspiration</th>
<th>Groundwater outflow</th>
<th>Maximum Available Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Rural and Urban Development (1964)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>300</td>
<td>50</td>
<td>250 to Outer Farm Basin</td>
<td>-</td>
</tr>
<tr>
<td>Current Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>430</td>
<td>50</td>
<td>310 to Outer Farm Basin</td>
<td>70</td>
</tr>
<tr>
<td>Future Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>430</td>
<td>50</td>
<td>310 to Outer Farm Basin</td>
<td>70</td>
</tr>
</tbody>
</table>

*All figures ML/year, and represent water with salinity <1 000mg/L TDS

6.7. Allocations and Licensing
1. The figures that the water allocations are based on were derived from water balance calculations. 50 ML has been allocated to the non-consumptive pool each year. Total licensed volume for the Inner Farm Basin, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

<table>
<thead>
<tr>
<th>&lt;1 000mg/L TDS</th>
<th>Agriculture</th>
<th>30 ML/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>40 ML/year</td>
<td></td>
</tr>
</tbody>
</table>

2. Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The plan allocates the amounts estimated for evapotranspiration and outflow in the Water Balances.

3. Total extraction beyond the Maximum Allowable Yield will be subject to the outcomes from ecosystem studies detailed in the work plan and determination by the Controller of Water Resources.

4. Groundwater levels in the river corridor must not be permitted to decline beyond 8 mbgl.

5. Refer to Chapter 16 for the licensing framework.
7. OUTER FARM BASIN

The Outer Farm Basin is used for irrigation of the Arid Zone Research Institute and racecourse. The Outer Farm Basin (Appendix 3) extends south and southeast of Mount Blatherskite and is associated with the Emily Plain floodout. It comprises alluvial and other sediments (predominantly relatively low yielding clays and sandy clays) overlying the northern part of the Amadeus Basin. The sediments are.

In the northern section (under the racecourse) there are aquifers within the Bitter Springs Formation and Arumbera Sandstone. In the southern section (south of Arid Zone Research Institute) there are deep Cainozoic sand aquifers. Below these aquifers are other Amadeus Basin Aquifers including the Goyder and Shannon Formations. In the eastern section of the Outer Farm Basin area there are alluvial aquifers connected to the Todd River flood out. There is also water mounding in the paleochannel underlying the artificial recharge zone of the Soil Aquifer Treatment recharge basins.

In 2004, water quality in the Outer Farm Basin had TDS of 490 - 1 910 mg/l. Generally groundwater in the underlying Tertiary Sediments (TDS 1030 - 1 060 mg/l) were less saline than the overlying Quaternary samples (490-1 910 mg/l) and salinity increased with distance from the Todd River (Jeucken, 2004). Recent analysis of water quality in the vicinity of the racecourse indicated TDS of 530 mg/l; whereas water quality at the Arid Zone Research Institute was recorded at 1 820 mg/l. Along the Todd River bed, the water table in the Outer Farm Basin ranges from 3 - 7 mbgl. In the vicinity of the Soil Aquifer Treatment ponds at Arid Zone Research Institute the water table drops from 17 to 20 mbgl.

7.1. Recharge

Recharge of groundwater to the Outer Farm Basin occurs from rainfall and surface water flow. The relationship between rainfall, surface water flow and groundwater recharge in the Outer Farm Basin is complex and variable. It depends on such factors as the quantity and intensity of rain, topography (i.e. slope in the catchment), existing soil moisture levels at the time of rain, duration of streamflow, and geographical extent of the rainfall. Storage volumes and depths to water table are highly variable in response to seasonal and annual rainfall patterns.

In 2008 and 2009, over 320 ML of treated wastewater from the Alice Springs sewage treatment plant was recharged into a shallow alluvial aquifer in the Outer Farm Basin via the Soil Aquifer Treatment recharge basins (Breton, 2010). However, regional water levels have not been noticeably affected. A plume of lower salinity water has been observed which indicates that this recharged water is now moving slowly south of the recharge basins. Power and Water Corporation has expanded the number of recharge basins and increased their capacity for recharge to reach a maximum of 600 ML/year in 2011-13.

7.2. Groundwater Throughflow

Groundwater moves into the Outer Farm Basin from the Inner Farm Basin at Mt Blatherskite, and in an eastern direction across the Emily Plain floodout. The amount fluctuates in response to annual rainfall variation.

7.3. Natural Discharge

Natural discharge of groundwater occurs as evaporation from the soil (where water levels are close to ground or riverbed surfaces), through evapotranspiration by vegetation, and by throughflow to adjacent aquifers.

7.4. Current Use

Current extraction from the Outer Farm Basin (Western zone), supports small-scale agriculture at the Arid Zone Research Institute and irrigation of the racecourse. The aquifer remains unstressed with stable groundwater water levels.
7.5. Future Demand

Any increased extraction from the Outer Farm Basin (Western Zone) may partially depend on extraction of the water currently being artificially recharged via the Soil Aquifer Treatment basins at the Arid Zone Research Institute, which is expected to be suitable for horticultural purposes or for non-potable supplies to new subdivisions or other large users. The recharge basins were expanded in 2012 to enable a maximum capacity for recharge of 600 ML/year to be achieved. Power and Water Corporation expects that the amount available for extraction from the aquifer will be equal to the volume artificially recharged.

7.6. Water Balance and Sustainable Yield

The water balance provides the basis for decisions on the amount of water available for allocation.

<table>
<thead>
<tr>
<th>Available Storage</th>
<th>Total Recharge (direct rain; river recharge; throughflow)</th>
<th>Evapotranspiration</th>
<th>Groundwater outflow</th>
<th>Maximum Available Yield (from the Western Zone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Rural and Urban Development (1964)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 000</td>
<td>550</td>
<td>200</td>
<td>350 to Eastern Outer Farm Basin</td>
<td>-</td>
</tr>
<tr>
<td>Current Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 000</td>
<td>810 + SAT</td>
<td>200</td>
<td>500 to Eastern Outer Farm Basin</td>
<td>110 + SAT</td>
</tr>
<tr>
<td>Future Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 000</td>
<td>810 + SAT</td>
<td>200</td>
<td>500 to Eastern Outer Farm Basin</td>
<td>110 + SAT</td>
</tr>
</tbody>
</table>

*All figures ML/year, and represent water with salinity <1 000 mg/L TDS.

Note: SAT refers to the amount recharged through the Soil Aquifer Treatment basins by Power and Water Corporation. It is assumed that the amount available for extraction from the resulting water plume will be equivalent in amount.

7.7. Allocations and Licensing

1. The figures that the water allocations are based on were derived from water balance calculations. 200 ML has been allocated to the non-consumptive pool each year. Total licensed volume for the Outer Farm Basin (Western Zone), and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>Agriculture</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 000 mg/L TDS</td>
<td>50 ML/year + SAT</td>
<td>60 ML/year</td>
</tr>
</tbody>
</table>

2. Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The plan allocates the amounts estimated for evapotranspiration and outflow in the Water Balances.

3. Total extraction beyond the Maximum Allowable Yield will be subject to the outcomes from ecosystem studies detailed in the work plan and determination by the Controller of Water Resources.

4. Future volumetric allocations in the Outer Farm Basin (Western Zone) may account for the water artificially recharged into the Basin through the Water Reuse Scheme at Arid Zone Research Institute which uses a process of soil aquifer treatment.

5. Groundwater levels in the river corridor must not be permitted to decline beyond 8 mbgl

6. Refer to Chapter 16 for the licensing framework.
8. WANNGARDI BASIN

The Wanngardi Basin supports two caravan parks and the community within the White Gums subdivision. The Wanngardi Alluvial Basin (Figure 4) is situated 12km south east of Alice Springs, and is a shallow aquifer associated with Roe Creek that fans outwards from Honeymoon Gap to a maximum width of 2km, and then reduces in width to 400m at Temple Bar Gap. These alluvial sediments extend more than 6km beyond Temple Bar Gap. The thickness of the alluvium is locally over 30m but mostly less than 20m. The basin comprises sand, clay, silt and gravel, and overlies weathered granite.

This basin provides water to the Wanngardi and the White Gums area, and the majority of bores extract water from underlying weathered granite. However, it is likely that the alluvial sediments are in hydraulic connection with the granite and so could be considered to form a single aquifer. Downstream of the ridge of Arumbera Sandstone water is located in bedrock formations and the alluvium is unsaturated. Water quality analyses of the White Gum area were mainly carried out when the bores were drilled and show TDS ranging from 179 to 7 920 mg/l. A 2011 chemical analysis of a bore located in the Bitter Springs Formation at Temple Bar, which is hydraulically connected to the alluvial sediments, had a TDS of 700 mg/l.

![Figure 4: Wanngardi Basin](image)

8.1. Recharge

Recharge of groundwater in the region occurs from rainfall, surface water flow, and throughflow from adjacent geological formations. Storage volumes and depths to water table are highly variable in response to seasonal and annual rainfall patterns. The Wanngardi Basin is mainly recharged by flows in Roe Creek and also by rainfall. The relationship between rainfall, surface water flow and groundwater recharge is complex and variable. It depends on such factors as the quantity and intensity of rain, topography (i.e. slope in the catchment), existing soil moisture levels at the time of rain, duration of streamflow, and geographical extent of the rainfall.

North of the Arumbera Sandstone water levels show a pattern of irregular recharge events marked by sudden rise; separated by periods of no recharge for up to eight year, during which water levels gradually declined. In the White Gums area water levels vary between 5 to 22 mbgl. Downstream or south of the Arumbera Sandstone water levels are deeper than 40 m.
8.2. Groundwater Throughflow

Throughflow in the Wanngardi Basin cannot currently be estimated due to lack of data. This has been identified as an area of work to be undertaken prior to next reviewing the plan.

8.3. Natural Discharge

Natural discharge of groundwater occurs as evaporation from the soil (where water levels are close to ground or riverbed surfaces), through evapotranspiration by vegetation, and by throughflow to adjacent aquifers.

8.4. Current Use

The Wanngardi Basin provides licensed water supplies to two caravan parks, which are down gradient from the White Gums subdivision. The alluvial aquifer may be unable to maintain the current supply during extended drought periods.

8.5. Future Demand

It is believed that the Wanngardi Basin in the White Gums area could not sustain an expansion of current water extraction from the Basin. It is likely that any new subdivisions in this area will need to access reticulated water supplies to ensure reliable supplies (Tickell, 2011).

8.6. Water Balance and Sustainable Yield

The sustainable yield for the Wanngardi Basin over the last 20 years is estimated to be 30 ML/yr. However it is likely to be much less during a period of extended drought (Tickell, 2011).

<table>
<thead>
<tr>
<th>Licences issued</th>
<th>Net amount licensed</th>
<th>Reported licensed use (2013-14)</th>
<th>Estimated number of unlicensed bores</th>
<th>Estimated unlicensed water use</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>50 ML/year</td>
<td>43 ML/year</td>
<td>32</td>
<td>101.5 ML/year</td>
</tr>
</tbody>
</table>

8.7. Allocations and Licensing

1. The figures that the water allocations are based on were derived from water balance calculations. Total licensed volume for the Wanngardi Basin, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

<table>
<thead>
<tr>
<th>Industry</th>
<th>50 ML/year downstream of White Gums</th>
</tr>
</thead>
</table>

2. Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The plan allocates the amounts estimated for evapotranspiration and outflow in the Water Balances.

3. Total extraction beyond the Maximum Allowable Yield will be subject to the outcomes from ecosystem studies detailed in the work plan and determination by the Controller of Water Resources.

4. Refer to Chapter 16 for the licensing framework.
9. **ROE CREEK MANAGEMENT ZONE:
MEREEINIE AQUIFER SYSTEM**

The Mereenie Aquifer within the Roe Creek area provides the majority of Alice Springs public water supply and supports the Pine Gap Joint Defence facility.

9.1. **Recharge**

Groundwater in the Mereenie Aquifer System is estimated to be from 10,000 to 30,000 years old and current day recharge is minimal in the context of the broader regional system. Major flood flows in Roe Creek recharge the Mereenie Aquifer System in this management zone, at an estimated long term average rate of 100 ML/per year. (Jolly et al, 2005).

9.2. **Throughflow**

While water extraction from Roe Creek Borefield has significantly lowered local groundwater levels, average throughflow rates of 1,700 ML/year entering from the west and 1,800 ML/year (carrying additional annual recharge) leaving to the east are still considered to pass through the Mereenie Aquifer System in this management zone (Jolly et al, 1994).

9.3. **Discharge**

There is no natural discharge of groundwater from the Mereenie Aquifer System in this management zone due to the depth below ground level of the aquifer water table.

9.4. **Storage**

Before groundwater extractions from this aquifer began in 1964, total groundwater storage is estimated to have been 1,314GL to 300m below ground level. Of this total storage volume, 780 GL had water quality of less than 500mg/L Total Dissolved Solids (TDS). The remaining 534 GL of stored water was of water quality between 500 – 1,000mg/L TDS.

Under the plan, extractions from the aquifer over not less than 320 years (from 1964) will not exceed 80% of the pre-development storage (to 300m below ground level). The initial consumptive pool comprised;

- 624 GL for groundwater with TDS less than 500mg/L; and
- 427.2 GL for groundwater with TDS between 500 – 1,000mg/L TDS.

At the beginning of 2005, total estimated storage volumes to 300m below ground level were;

- 530 GL with TDS less than 500mg/L TDS; and
- 530 GL with TDS between 500 – 1,000mg/L.

This indicates that the volume of better quality groundwater reduced by 250 GL due to public water supply extractions since 1964. In comparison, there had been a 4 GL reduction in the stored volume of the higher TDS groundwater for stock & domestic use and for use at the Pine Gap Joint Defence Facility.

After accounting for the changes in storage volumes since 1964, the consumptive pool remaining at the start of 2005 comprised;

- 374 GL with TDS less than 500mg/L; and
- 423.2 GL with TDS between 500 – 1,000mg/L.

Between 2005 and 2014, total extraction of 72.582 GL from the better quality groundwater has been reported. In this same period, reported extractions plus estimated stock & domestic use of groundwater with TDS between 500 – 1,000mg/L totalled 2.355 GL.

After accounting for these extractions, the remaining consumptive pool at the start of 2015 comprised;

- 301.418 GL of less than 500mg/L TDS; and
- 420.845 GL at between 500 - 1,000mg/L TDS.
9.5. Current Use

**Groundwater Quality: <500mg/L TDS:**
From 1964 until the mid-1980s, groundwater with TDS less than 500mg/L from the Mereenie Aquifer System in this management zone provided 100% of the Alice Springs public water supply. Since the mid-1980’s, higher TDS groundwater from other aquifers in this management zone have contributed to a blended water supply for Alice Springs.

Between 2005 and 2014, 79% of the Alice Springs public water supply was taken from the better quality groundwater in the Mereenie Aquifer System. Average extraction over this 10 year period was 7,023ML/year (ranging between 5,361ML/year in 2011 and 8,063ML/year in 2005).

Power and Water Corporation is currently licensed to extract up to 8,000ML/year for public water supply from the better quality groundwater in the Mereenie Aquifer System in this management zone.

**Groundwater Quality: 500 – 1,000mg/L TDS:**
The Joint Defence Facility at Pine Gap is currently licensed to extract up to 250 ML/year from the Mereenie Aquifer System in this management zone; drawing groundwater of between 500 – 1,000mg/L TDS. Average extraction over the 10 year period from 2005 to 2014 was 219ML/year; ranging from 155ML/year in 2005 up to 245ML/year in 2008.

Unlicensed stock & domestic extraction in this management zone is estimated to total 17ML/year, all drawing groundwater of between 500 – 1,000mg/L TDS from the Mereenie Aquifer System.

9.6. Future Demand

**Groundwater Quality: <500mg/L TDS:**
Current planning by Power and Water Corporation assumes that public water supply demand for water from the better quality groundwater available from the Mereenie Aquifer System in this management zone will grow at 0.4% per year, from a 2015 starting level of 7,200ML/year.

Accounting only for this projected growth in public water supply demand, the remaining consumptive pool of better quality water (to 300m below ground level) would be unable to meet this demand in 2052.

The plan allows for the additional extraction of 800ML/year from the better quality water, for uses other than public water supply. This additional supply would be provided by Power and Water Corporation, subject to negotiations and commercial considerations including the longer term costs associated with bringing forward the development of a new public water supply source.

If extraction at 800ML/year from the better quality water commences in 2015, in addition to the extractions for the projected 0.4% annual growth in public water supply demand, the remaining consumptive pool of better quality water (to 300m below ground level) would be unable to meet this demand in 2050.

It should be noted that investigative drilling and hydrogeological assessment is yet to be completed to confirm the viability of continued extraction to 300m below ground level in the Mereenie Aquifer System in this management zone. Reduction in the viable depth of water extraction will reduce the size of the consumptive pool, and bring forward the dates for effective full depletion of the consumptive pool, given above. Clarification on this issue will be completed during the lifetime of the plan.

**Groundwater Quality: 500 – 1,000mg/L TDS:**
The current remaining consumptive pool of groundwater with TDS between 500 – 1,000mg/L in the Mereenie Aquifer System to 300m below ground level in this management zone is sufficient to maintain ongoing supplies of 250ML/year to the Joint Defence Facility at Pine Gap Joint and 17ML/year for stock & domestic use until beyond 2284 (the overall 320 year lifetime set for the consumptive pool). It is estimated that the remaining consumptive pool in 2284, after continuous extraction at 267ML/year, would be approximately 350,000ML.
The plan allows for the additional extraction of 2,000ML/year from the remaining consumptive pool of groundwater with TDS between 500 – 1,000 TDS; for uses other than public water supply. This additional extraction would be undertaken by private investors, subject to land development approvals and relevant environmental clearances and in recognition that there would be no reduction in the surety of supply to 2284 for the Joint Defence Facility at Pine Gap Joint and for stock & domestic users.

If additional extraction at 2,000ML/year was to commence in 2015 and continue until 2188 (173 years), the remaining consumptive pool with TDS between 500 – 1,000mg/L in the Mereenie Aquifer System to 300m below ground level in this management zone would be less than 1,000ML.

### 9.7. Water Balances

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflow</th>
<th>Consumptive Pool</th>
<th>Extraction</th>
<th>Outflow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;500 mg/L TDS</td>
<td>500-1,000 mg/L TDS</td>
<td>&lt;500 mg/L TDS</td>
</tr>
<tr>
<td>&lt;1964</td>
<td>1,700 (Throughflow from west)</td>
<td>624,000</td>
<td>427,200</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>100 (Recharge from Roe Ck)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>1,700 (Throughflow from west)</td>
<td>374,000</td>
<td>423,200</td>
<td>8,063</td>
</tr>
<tr>
<td></td>
<td>100 (Recharge from Roe Ck)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>1,700 (Throughflow from west)</td>
<td>301,418</td>
<td>420,845</td>
<td>8,200</td>
</tr>
<tr>
<td></td>
<td>100 (Recharge from Roe Ck)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>1,700 (Throughflow from west)</td>
<td>2,703</td>
<td>339,233</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>100 (Recharge from Roe Ck)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2189</td>
<td>1,700 (Throughflow from west)</td>
<td>&gt;2,703 (Aquifer storage recovering)</td>
<td>26,120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>100 (Recharge from Roe Ck)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2284</td>
<td>1,700 (Throughflow from west)</td>
<td>&gt;2,703 (Aquifer storage recovering)</td>
<td>755</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>100 (Recharge from Roe Ck)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* all figures are ML/year

### 9.8. Allocations

Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The figures that the water allocations are based on were derived from water balance calculations. 1800 ML is allocated to the non-consumptive pool each year. Total licensed volume for the management zone, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

<table>
<thead>
<tr>
<th>TDS Range</th>
<th>Use</th>
<th>Allocated Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 500 mg/L TDS</td>
<td>Public Water Supply</td>
<td>8 000 ML/year</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>800 ML/year</td>
</tr>
<tr>
<td>500 – 1 000mg/L TDS</td>
<td>Stock &amp; Domestic</td>
<td>17 ML/year</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>250 ML/year (Pine Gap Joint Defence Facility)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 000 ML/year</td>
</tr>
</tbody>
</table>

Refer to Chapter 16 for the licensing framework.
10. ROE CREEK MANAGEMENT ZONE: PACOOTA SANDSTONE AQUIFER

The Pacoota Sandstone Aquifer within the Roe Creek Management Zone is used by the Power & Water Corporation to supplement the Alice Springs public water supply through blending with extractions from the Mereenie Aquifer to extend the operational life of the Roe Creek borefield.

10.1. Recharge

Most of the available water in the Pacoota Sandstone Aquifer was deposited tens of thousands of years ago. Current day recharge to the aquifer in this management zone through infiltration of rainfall and Todd River flows is estimated to be 650ML/year.

10.2. Throughflow

Groundwater throughflow from the Pacoota Sandstone Aquifer to the east, enters this management zone at an estimated average rate of 150ML/year. With the addition of recharge inflows, throughflow from this aquifer across the western boundary of the management zone is estimated to be 600ML/year.

10.3. Discharge

There is no natural discharge of groundwater from the Pacoota Sandstone Aquifer in this management zone due to the depth below ground level of the aquifer water table.

10.4. Storage

Before groundwater extractions from this aquifer began in the mid-1980s, total groundwater storage is estimated to have been 430 GL.

Under the plan, extractions from the aquifer over not less than 320 years (from 1964) will not exceed 80% of the pre-development storage. The initial consumptive pool was, therefore, 344 GL.

At the beginning of 2005, the remaining storage volume in the Pacoota Sandstone Aquifer in this management zones was estimated to be 400 GL. This indicates that the initial storage volume had been reduced by 30 GL due to public water supply extractions. After accounting for this change in storage volume, the consumptive pool remaining at the start of 2005 was 341GL.

Between 2005 and 2014, total extraction of 15.451 GL from the better quality groundwater has been reported. After accounting for these extractions, the remaining consumptive pool at the start of 2015 was 298.549 GL.

10.5. Current Use

From 1964 until the mid-1980s, groundwater from the Mereenie Aquifer System in this management zone provided 100% of the Alice Springs public water supply. Since the mid-1980’s, the Pacoota Sandstone Aquifer in this management zone has contributed to a blended water supply for Alice Springs.

Between 2005 and 2014, 17% of the Alice Springs public water supply was taken from the Pacoota Sandstone Aquifer. Average extraction over this 10 year period was 1,545ML/year (ranging between 718ML/year in 2007 and 2,309ML/year in 2006.

Power and Water Corporation is currently licensed to extract up to 4,000ML/year for public water supply from the Pacoota Sandstone Aquifer in this management zone.

10.6. Future Demand

Current planning by Power and Water Corporation assumes that public water supply demand for water from the Pacoota Sandstone Aquifer System in this management zone will grow at 0.4% per year, from a 2015 starting level of 1,350ML/year.

Accounting only for this projected growth in public water supply demand, the remaining consumptive pool would be unable to meet this demand in 2070.
### 10.7. Water Balances

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflow</th>
<th>Consumptive Pool</th>
<th>Extraction</th>
<th>Outflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1964</td>
<td>150 (Throughflow from west) 650 (Recharge from Todd River and Rainfall)</td>
<td>344,000</td>
<td>0</td>
<td>800 (Throughflow to east)</td>
</tr>
<tr>
<td>2005</td>
<td>150 (Throughflow from west) 650 (Recharge from Todd River and Rainfall)</td>
<td>314,000</td>
<td>1,221</td>
<td>800 (Throughflow to east)</td>
</tr>
<tr>
<td>2015</td>
<td>150 (Throughflow from west) 650 (Recharge from Todd River and Rainfall)</td>
<td>298,549</td>
<td>1,350</td>
<td>800 (Throughflow to east)</td>
</tr>
<tr>
<td>2070</td>
<td>150 (Throughflow from west) 650 (Recharge from Todd River and Rainfall)</td>
<td>1,680</td>
<td>0</td>
<td>800 (Throughflow to east)</td>
</tr>
<tr>
<td>2284</td>
<td>150 (Throughflow from west) 650 (Recharge from Todd River and Rainfall)</td>
<td>&gt;1,680 (Aquifer storage recovering)</td>
<td>0</td>
<td>800 (Throughflow to east)</td>
</tr>
</tbody>
</table>

* all figures are ML/year

### 10.8. Allocations

Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The figures that the water allocations are based on were derived from water balance calculations. 800 ML is allocated to the non-consumptive pool each year. Total licensed volume for the management zone, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

| Public Water Supply | 4 000 ML/year |

Refer to Chapter 16 for the licensing framework.
11. ROE CREEK MANAGEMENT ZONE: SHANNON & GOYDER FORMATION AQUIFER

The Shannon and Goyder Aquifer within the Roe Creek Management Zone is used by the Power & Water Corporation to supplement the Alice Springs public water supply through blending with extractions from the Mereenie and Pacoota Aquifer to extend the operational life of the Roe Creek borefield.

11.1. Recharge

There is no recharge into the Shannon & Goyder Formation Aquifer from rainfall or streamflows in this management zone.

11.2. Throughflow

Before extraction began at the Roe Creek borefield, the groundwaters of the Shannon & Goyder Formation Aquifer flowed from east to west at an estimated average rate of 80ML/year through this management zone.

11.3. Discharge

There is no discharge from this aquifer through soil evaporation or evapotranspiration by vegetation in this management zone.

11.4. Storage

Before groundwater extractions from this aquifer began in the mid-1980s, total groundwater storage is estimated to have been 302 GL. Under the plan, extractions from the aquifer over not less than 320 years (from 1964) will not exceed 80% of the pre-development storage. The initial consumptive pool was, therefore, 241.6 GL.

At the beginning of 2005, the remaining storage volume in the Shannon & Goyder Formation Aquifer in this management zones was estimated to be 300 GL. This indicates that the initial storage volume had been reduced by 2 GL due to public water supply extractions. After accounting for this change in storage volume, the consumptive pool remaining at the start of 2005 was 339.6 GL.

Between 2005 and 2014, total extraction of 3.179 GL from the better quality groundwater has been reported. After accounting for these extractions, the remaining consumptive pool at the start of 2015 was 236.421 GL.

11.5. Current Use

From 1964 until the mid-1980s, groundwater from the Mereenie Aquifer System in this management zone provided 100% of the Alice Springs public water supply. Since the mid-1980’s, the Shannon & Goyder Formation Aquifer in this management zone has contributed to a blended water supply for Alice Springs.

Between 2005 and 2014, 4% of the Alice Springs public water supply was taken from the Pacoota Sandstone Aquifer. Average extraction over this 10 year period was 318ML/year (ranging between 0ML/year in 2005 & 2008 and 640ML/year in 2010.

Power and Water Corporation is currently licensed to extract up to 1,000ML/year for public water supply from the Shannon & Goyder Formation Aquifer in this management zone.

11.6. Future Demand

Current planning by Power and Water Corporation assumes that public water supply demand for water from the Shannon & Goyder Formation Aquifer in this management zone will grow at 0.4% per year, from a 2015 starting level of 450ML/year.

Accounting only for this projected growth in public water supply demand, the remaining consumptive pool would not be depleted until beyond 2284.
11.7. Water Balance

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflow</th>
<th>Consumptive Pool</th>
<th>Extraction</th>
<th>Outflow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80 (Throughflow from west)</td>
<td>241,600</td>
<td>0</td>
<td>80 (Throughflow to east)</td>
</tr>
<tr>
<td>&lt;1964</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>80 (Throughflow from west)</td>
<td>239,600</td>
<td>0 (344 in 2006)</td>
<td>80 (Throughflow to east)</td>
</tr>
<tr>
<td>2015</td>
<td>80 (Throughflow from west)</td>
<td>236,421</td>
<td>450</td>
<td>80 (Throughflow to east)</td>
</tr>
<tr>
<td>2284</td>
<td>80 (Throughflow from west)</td>
<td>16,607</td>
<td>1,317</td>
<td>80 (Throughflow to east)</td>
</tr>
</tbody>
</table>

* all figures are ML/year

11.8. Allocations

Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The figures that the water allocations are based on were derived from water balance calculations. 80 ML is allocated to the non-consumptive pool each year. Total licensed volume for the management zone, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

| Public Water Supply | 1 000 ML/year |

Refer to Chapter 16 for the licensing framework.
12. ROCKY HILL MANAGEMENT ZONE: MEREENIE AQUIFER SYSTEM

The Mereenie Aquifer within the Rocky Hill area is identified to provide the long term Alice Springs public water supply once the Roe Creek borefield ceases to be viable for public water supply extraction.

12.1. Recharge

Long term average recharge into the Mereenie Aquifer System from the Todd River as it spreads across the Emily Plain in this management zone is estimated at 3,000 ML/year (Jolly et al, 2005).

12.2. Throughflow

Before extraction began at the Roe Creek borefield, the Mereenie Aquifer System flowed in an easterly direction through this management zone. While the hydraulic gradient has reversed locally because of water extraction at the Roe Creek borefield, throughflow still enters this aquifer at the western boundary of the management zone at an estimated average rate of 1,800 ML/year, and exits at the south-eastern boundary at an estimated average rate of 900 ML/year (Jolly et al, 1994).

12.3. Discharge

Natural discharge of groundwater from the Mereenie Aquifer System occurs largely through evapotranspiration by vegetation in the eastern extremity of this management zone at an estimated average rate of 3,000 ML/year (Read and Paul, 2002).

12.4. Storage

There were no significant groundwater extractions (other than for stock & domestic use) in this management zone before 2005. Total groundwater storage at the beginning of 2005 is estimated to have been 4,695GL to 300m below ground level. Of this total storage volume, 755 GL had water quality of less than 500mg/L Total Dissolved Solids (TDS); 3,000 GL was between 500 – 1,000mg/L TDS; and 940 GL was greater than 1,000mg/L TDS.

Under the plan, extractions from the aquifer over not less than 320 years (from 1964) will not exceed 80% of the pre-development storage (to 300m below ground level) with water quality of less than 1,000mg/L TDS.

The initial consumptive pool (in 1964, and unchanged in 2005) comprised:

- 604 GL for groundwater with TDS less than 500mg/L; and
- 2 400 GL for groundwater with TDS between 500 – 1,000mg/L TDS.

Between 2005 and 2014, total extraction of 5.471 GL from the groundwater with TDS between 500 – 1,000mg/L was reported. In this same period, estimated stock & domestic use of this same quality groundwater was 0.87 GL. No extraction from the better quality groundwater is considered to have occurred. After accounting for these extractions, the remaining consumptive pool at the start of 2015 comprised:

- 604 GL of less than 500mg/L TDS; and
- 2 394 GL at between 500 - 1,000mg/L TDS.

12.5. Current Use

All current extractions in this management zone draw groundwater from the Mereenie Aquifer System consumptive pool with water quality between 500 – 1,000mg/L TDS.

Extraction of up to 1,000 ML/year is licensed for agriculture, with approximately 48.5 ha currently irrigated. Average extraction reported under this licence from 2005 to 2014 was 547 ML/year (ranging between 303 ML/year in 2005 and 999ML/year in 2014).

5 ML/year is licensed for industry. Average extraction reported under this licence between commencement in 2009 and 2014 was 0.3 ML/year (ranging between 0 ML/year in 2013 and 0.98ML/year in 2011). Unlicensed stock & domestic extractions are estimated to total 87ML/year.
12.6. Future Demand

**Groundwater Quality: <500mg/L TDS:** The Plan recognises that extraction for public water supply from the Mereenie Aquifer System in this management zone will be necessary in the future; when the current sources in Roe Creek Management Zone can no longer meet demand.

Current planning by Power and Water Corporation assumes that Alice Springs public water supply demand from 2015 onwards will grow at 0.4% per year. On this basis, it is expected that extraction for Alice Springs public water supply from the Mereenie Aquifer System in Roe Creek Management Zone will cease in 2050.

Continued public water supply extraction would then commence from the Mereenie Aquifer System with water quality less than 500mg/L in this management zone, and continue until 2113 when the available consumptive pool will be unable to meet this demand.

**Groundwater Quality: 500 – 1,000mg/L TDS:** The plan allows for total extractions from the Mereenie Aquifer System in this management zone with water quality between 500 – 1,000mg/L TDS of 87ML/year for stock & domestic use and 3,600ML/year for agriculture.

It will be necessary to commence extraction for public water supply from the Mereenie Aquifer System with water quality between 500 – 1,000mg/L in this management zone in 2113, in addition to the ongoing extraction of 3,687ML/year for agriculture and stock & domestic.

Also on the basis of assumed continued growth in public water supply demand, it is expected that extraction from the Pacoota Sandstone Aquifer in Roe Creek Management Zone will cease in 2171, requiring additional extraction from this management zone. The remaining consumptive pool for the Mereenie Aquifer System in this management zone would be able to sustain the combined total demands for public water supply and agriculture until 2224. Continuous extraction of 87ML/year for stock & domestic use would be sustained from 2224 until beyond 2284.

12.7. Water Balances

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflow</th>
<th>Consumptive Pool</th>
<th>Extraction</th>
<th>Outflow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;500 mg/L TDS</td>
<td>&lt;500 mg/L TDS</td>
<td>500-1,000 mg/L TDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500-1,000 mg/L TDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1964</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and</td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td>604,000</td>
<td>2,400,000</td>
<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>604,000</td>
<td>2,393,659</td>
<td>0</td>
</tr>
<tr>
<td>2050</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>595,720</td>
<td>2,260,927</td>
<td>8,280</td>
</tr>
<tr>
<td>2113</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;12,109</td>
<td>2,028,646</td>
<td>0</td>
</tr>
<tr>
<td>2171</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;12,109</td>
<td>1,137,435</td>
<td>0</td>
</tr>
<tr>
<td>2224</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;12,109</td>
<td>22,731</td>
<td>0</td>
</tr>
<tr>
<td>2284</td>
<td>1,900 (Throughflow from west)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000 (Recharge from Todd R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;12,109</td>
<td>17,511</td>
<td>0</td>
</tr>
</tbody>
</table>

* all figures are ML/year
12.8. Allocations

Non-consumptive uses are taken into consideration before any water is allocated for consumptive purposes to ensure community values associated with those uses are protected as much as possible. The figures that the water allocations are based on were derived from water balance calculations. 3,900 ML is allocated to the non-consumptive pool each year. Total licensed volume for the management zone, and its respective consumptive beneficial uses, will not exceed the allocations, as shown in the table below:

<table>
<thead>
<tr>
<th>TDS</th>
<th>Use</th>
<th>Allocation (ML/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;500mg/L</td>
<td>Public Water Supply</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(Preserves better quality groundwater for future Alice Springs water supply)</td>
<td></td>
</tr>
<tr>
<td>500 – 1 000mg/L</td>
<td>Stock and Domestic</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
<td>3,595</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>5</td>
</tr>
</tbody>
</table>

Refer to Chapter 16 for the licensing framework.

13. ROCKY HILL MANAGEMENT ZONE: PACOOTA SANDSTONE AQUIFER

Insufficient information is available on this aquifer for inclusion in the plan. The Department intends to undertake further investigation into this resource, to enable a water balance to be included in the next version of the Alice Springs Water Allocation Plan.

14. ROCKY HILL MANAGEMENT ZONE: SHANNON AND GOYDER FORMATION AQUIFER

Insufficient information is available on this aquifer for inclusion in the plan. The Department intends to undertake further investigation into this resource, to enable a water balance to be included in the next version of the Alice Springs Water Allocation Plan.

15. OTHER AQUIFERS

15.1. Current Use

There are two licences issued for extraction of water from aquifers within the water planning area, but outside of the declared management zones. One licence is for the extraction of up to 50ML/year for roadwork construction and maintenance. The other licence is for extraction of 10ML/year for the purpose of industry. Total reported usage for 2014 was 7ML.

15.2. Future Demand

The Department is not aware of any proposed increase in extraction. However, it is possible that further groundwater extraction licences applications could be submitted.
16. LICENSING

There are management zones (Appendix 5) for the purpose of licensing groundwater. Due to the absence of licensed surface water use, there are no management zones for surface water extraction.

Under s.22B (5) (a) of the Act, water allocated to beneficial uses under a WAP is limited to estimated sustainable yield. Sustainable yield has a range of interpretations within a hydrogeological and/or water management context, and in many water plans around Australia it has been interpreted as a proportion of recharge to the system. For the purposes of the plan sustainable yield should be taken to mean ‘maximum allowable yield’, which was the term used in ASWRS to describe the rate of depletion of the groundwater resource acceptable to the community.

Groundwater extraction licence applications will be considered in the context of licences already issued within, and any other existing knowledge about the relevant management zone. The total licensed volume in each management zone will not exceed the available annual allocation.

With the exception of the Amadeus Basin aquifers, the figures that the water allocations are based on were derived from water balance calculations. Most of the components of all of the water balances are not able to be measured directly and are estimates based on a probable range of values. The resulting allocations are by their nature only broad estimates. In the absence of more accurate figures, conservative values for the components have been chosen to avoid over allocation.

16.1. Licensing Framework

<table>
<thead>
<tr>
<th>Surface Water (Rivers)</th>
<th>Groundwater (Alluvial Aquifers)</th>
<th>Groundwater (Amadeus Basin Aquifers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>at least 95% of flow at any time in any part of a river is allocated to the environment; and no more than 5% of flow may be diverted at any time in any part of a river.</td>
<td>there will be no deleterious change in groundwater discharges to dependent ecosystems; and total extraction will be based on estimated average recharge, including urban and rural activities, less evapotranspiration and outflow.</td>
<td>there will be no deleterious change in groundwater discharges to dependent ecosystems; and total extraction over a period of no less than 320 years will not exceed 80% of the total aquifer storage of the combined volume of the Amadeus Basin Aquifers at the start of extraction.</td>
</tr>
</tbody>
</table>

In the event that current and/or projected consumptive use exceeds threshold levels or discharges to dependent ecosystems are impacted, then:

**New Surface Water Licences**
will not be granted unless supported by directly related scientific research into environmental water requirements.

**New Groundwater Licences**
will not be granted unless supported by directly related scientific research into the requirements of groundwater dependent ecosystems.
16.2. Water Licensing and Water Trading Rules

1. Licensed water entitlements will identify the beneficial use(s) of extraction and must be used only for the purpose(s) stated in the licence.

2. Licensees will be required, at the discretion of the Controller of Water Resources, to report the volume of water pumped, water levels, water quality, management regimes and infrastructure installed, subject to location and scale of extraction. Where required pumpage for each month shall be recorded by a meter supplied, installed and maintained by the licence holder to the satisfaction of the Controller of Water Resources. The record of pumpage for each month shall be supplied to the Controller of Water Resources within two (2) weeks following the end of each month or as otherwise agreed between the licensee and the Controller of Water Resources.

3. Total licensed water entitlements granted cannot exceed the maximum allowable yield of a designated aquifer or management zone.

4. Non-use or underutilisation of licenced water entitlement(s) may result in full or partial revocation of the licence by the Controller of Water Resources.

5. Immediately following the completion of the review of the plan, all groundwater extraction licences granted within the Alice Springs Water Allocation Planning area will be amended to include the following condition;
   
   In the event that the total extraction reported under this licence is less than 90% of the Extraction Limits determined for three consecutive 12 month period, then the licence holder must provide a written report to the Controller of Water Resources that explains why the Extraction Limits were not reached and provides a projection of water requirements under this licence for the next three years or remaining term of the licence, whichever is the lesser.

6. Licences may be revoked, suspended or modified by the Controller of Water Resources, in accordance with section 93 of the Water Act.

7. All applications for new groundwater extraction licences should be accompanied by a business plan for review and determination by the Controller of Water Resources, clearly demonstrating:
   - Feasibility of the project
   - Estimates of initial and ongoing volumetric and water quality demands
   - Efficient use of water, including the incorporation of water-efficient technologies and techniques appropriate for the particular purpose and best-practice
   - Economic and social benefits to the Territory, consistent with existing environmental and cultural values

8. All approvals for new groundwater extraction licences and trade in water licences rest with the Controller of Water Resources in accordance with the requirements of the declared Water Allocation Plan.

9. Records of all licences and water trades will be contained in a publicly-accessible water register. The register will include the identity of the licensee, third party interests, entitlement volumes, location, and trade history.

10. All failures to meet licence conditions will be investigated and reported to the Controller of Water Resources. Prosecution will be considered and any investigation initiated by the Controller of Water Resources.

11. A licence granted in accordance with the plan may be traded in part or in full in accordance with the following provisions. The procedure to be followed when trading depends upon whether the trade is intended to be temporary or permanent.

12. Temporary trades are effective for a defined period (as requested by the licence holder and applicant), or until expiration of the licence. If the applicant does not already hold a licence, a water extraction licence will need to be applied for, and the process for public advertising in Part 6A of the Act will apply.
13 Trade in licensed entitlements to groundwater is permitted only within a single management zone and where extraction will continue to be from the same aquifer.

14 Trade in water licence entitlements is permitted within a single management zone.

16.2.1. Additional Water Licensing and Trading Rules

Alluvial Aquifers

15 All licensees in the Town Basin will be required to submit samples to the Department from each bore every six months for water quality analysis.

16 There is currently no access to reticulated water supply in the Wanngardi Basin, and water from the Wanngardi Basin is used within the White Gums subdivision for unlicensed domestic purposes. Licensed extraction from the Wanngardi Basin upgradient (south-east) of the White Gums area (33 blocks delineated and named White Gums in Figure 4) will only be permitted once the applicant can prove to the satisfaction of the Controller of Water Resources, that extraction would cause no detriment to existing users.

17 There is an exemption from licensing requirements for extracting water from an alluvial aquifer, located within the Alice Springs Water Control District; and on a parcel of land separately held by an owner, where the combined groundwater use from all bores located on that land is less than 5 megalitres per year.

Public Water Supply

18 Leakage and demand reduction measures will be a condition of licences for extraction for public water supply.

Aquifer Storage and Recovery

19 The Controller is responsible for the issuance of any aquifer recharge licence and will monitor compliance with the terms and conditions on any licence issued, including rigorous monitoring and reporting requirements.

20 New groundwater extraction licences may be issued for any amount, up to the maximum volume recharged, on application from an appropriate end user.

21 Any application for a groundwater extraction licence for reuse of non-potable water would be subject to standard assessment procedures and any licence issued will be subject to standard conditions for monitoring and reporting.

Agriculture

22 Annual reporting of irrigated crop areas for all licensed irrigation is compulsory.

23 Unless otherwise approved, micro irrigation techniques shall be used for all irrigation.

24 Chemical and/or fertiliser injection systems shall not be installed into the pump discharge lines without approval from the Controller of Water Resources.

16.2.2. Permits for Groundwater Extraction

a) Bore construction permits are required for the construction of all water bores within the water control district irrespective of their intended use or capacity.

b) The Controller will impose mandatory conditions on all bore construction permits issued in the plan area, to achieve the provisions in the plan.

c) Bores must be constructed by an NT licensed driller, and will require compliance with the minimum construction requirements for water bores in Australia (at time of publication, the construction requirements are as outlined in the Minimum construction requirements for water bores in Australia 3rd ed. (NUDLC, 2011)), and other requirements as referred to by the Controller.

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5 Refer to Northern Territory Government Gazette S35, 30 June 1992 for any exemptions which may apply. Permits are not required for mining or petroleum activity, as outlined in Section 7 (3) of the Water Act.
16.2.3. Subdivision

A subdivision of land subject to a water extraction licence is likely to result in the need for the licence to be varied. There may also be the need for a replacement licence or licences to be issued. The need for variations, or replacement licences, will depend upon the details of the proposed subdivision and will therefore be assessed by the Controller on a case by case basis.

The types of steps that may be necessary following subdivision include:

- variations of the existing licence and/or the issue of new licences to reflect the fact that bores may now be located on legally distinct properties;
- re-evaluation and redistribution of the extraction entitlements under the original licence according to the intended use of the subdivided lots.

If a subdivision results in the need for a licensed entitlement greater than under the original licence, then an application will be necessary.

16.2.4. Assignment of Risk

It must be understood by all water users in the Northern Territory that their rights to extract and use water, whether under the Act (for example for stock and domestic purposes) or under a licence, are not, and cannot be, guaranteed by the Territory, and they bear the risks of any reductions to water availability under their licence resulting from seasonal or long term changes in climate, and periodic natural events such as drought or contamination; and they bear the risk of reduced water availability under a water licence arising as a result of bona fide improvements in the knowledge about the water sources capacity to sustain particular extraction levels.
### 17. OBJECTIVES, STRATEGIES AND PERFORMANCE INDICATORS

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>STRATEGIES</th>
<th>PERFORMANCE INDICATORS (CLAUSE 16.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAINTAIN PUBLIC WATER SUPPLY</strong></td>
<td>Regional groundwater quality and water levels will be monitored for long and short term changes. (cl. 17.2)</td>
<td>Changes in water quality in aquifers that are being used for licensed water extraction. (Action 1)</td>
</tr>
<tr>
<td>- To ensure a secure water supply, sufficient in volume and quality for essential services to the community of Alice Springs as well as for rural stock &amp; other domestic water requirements</td>
<td>- There will be compliance monitoring of conditions on water extraction licences and bore construction permits (cl. 17.2).</td>
<td>- Incidence of disruption to water supply for communities and pastoral properties (Action 1, Action 6).</td>
</tr>
<tr>
<td>- Consider the needs of future generations by adopting a conservative approach to water allocation.</td>
<td>- Legal action may be taken to effect compliance with these conditions at the discretion of DLRM (cl.16.2).</td>
<td>- Change in groundwater levels (Action 1).</td>
</tr>
<tr>
<td>- Encourage best practice water efficiency measures and innovations</td>
<td>- General rules will be developed for buffer zones around potential sources of pollution and for the siting of production bores, subject to the requirements of the Act or any other relevant legislation</td>
<td>- Incidence of pollution events (Action 6).</td>
</tr>
<tr>
<td>- Integrate land-use, infrastructure and natural resource management planning with water planning</td>
<td>- Any reports of bore field interference or contamination of aquifers will be investigated (cl. 17.2)</td>
<td>- Compliance with installation of appropriate backflow prevention and metering devices (Action 4).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ENSURE SUSTAINABLE DEVELOPMENT</strong></td>
<td></td>
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<tr>
<td>-----------------------------------</td>
<td></td>
<td></td>
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<tr>
<td>• Development of sustainable water consumptive industries to form a significant part of the region’s economy will be conducted within a sustainable framework.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ensure that the quantity and quality of water is appropriate for the purpose for which it is being used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Maximise the economic and social benefits from water extraction for the Alice Springs Water Control District</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Water extraction licences will be available for amounts within the estimated maximum allowable yield of the relevant aquifer (cl.16).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Water trading of water not allocated for public water supply will be permitted (cl.16).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Whether sustainable regional development projects have been impeded by lack of access to water resources (Action 9).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Whether commercial development projects on Aboriginal owned land have been impeded by lack of access to water resources (Action 9).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PROTECT THE ENVIRONMENT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• To maintain and protect the long term health of water dependent environmental sites, including waterways, aquifers, wetlands, springs and flood-outs.</td>
</tr>
<tr>
<td>• Preserve 95% of surface water flows for the environment and non-consumptive cultural needs (cl. 16.1).</td>
</tr>
<tr>
<td>• Continued documentation and assessment of environmental values of water dependent ecosystems within the Alice Springs Water Control District (cl. 17.2).</td>
</tr>
<tr>
<td>• Reported incidence of environmental degradation that can be attributed to water extraction (Action 6).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RECOGNISE INDIGENOUS CULTURE AND OTHER COMMUNITY VALUES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Recognise and support Aboriginal and other non-consumptive heritage and cultural values through the protection of culturally significant water dependent sites.</td>
</tr>
<tr>
<td>• Preserve 95% of surface water flows for the environment and non consumptive cultural needs (cl. 16.1).</td>
</tr>
<tr>
<td>• Strive towards documentation, identification and assessment of cultural values to traditional owners of culturally significant water dependent sites (cl.17.2).</td>
</tr>
<tr>
<td>• Reported incidence of environmental degradation of culturally significant water dependent sites that can be attributed to water extraction (Action 6).</td>
</tr>
</tbody>
</table>
17.1. Monitoring and Performance Evaluation

The Territory Government maintains a network of monitoring bores and surface water gauging stations and is responsible for water resource investigation studies and water resource modelling. The monitoring program for the district will be further developed in line with the implementation targets below. The implementation targets will be used to help tailor the monitoring program to ensure it adequately assesses the performance of the plan as well as identifying where further research is required to better inform the five year review of the plan. Performance evaluation of the plan, in particular for the five yearly review of the plan, will take into consideration the degree to which the actions listed in the implementation targets have been achieved.

Extraction licences issued under the plan will carry conditions including appropriate metering and reporting of usage. Most licences are required to report usage on at least an annual basis. Reported usages are checked against licensed volumes and major variations investigated.

17.2. Implementation

The Department will consult with the Alice Springs Water Advisory Committee and stakeholders to work towards the achievement of water resource management outcomes identified in the plan, and will exercise due diligence in the implementation of regulatory and licensing powers. The Department will also undertake water resource assessment within available resources and provide the technical advice needed for informed decision-making.

Irrigators, the Power and Water Corporation, and other licensees will monitor and report in accordance with regulatory requirements under the Act, to; aid in the effective use of water; and provide data for more sustainable extraction of water.

The implementation of the work plan will be coordinated by the Department of Land Resource Management, assisted by other agencies where appropriate. The activities are consistent with management actions and detailed in the Integrated Natural Resource Management Plan for the Northern Territory 2006. The work program is adaptive and will be reviewed and modified over time.
<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>RESPONSIBLE</th>
<th>TIMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assess and report on regional rainfall, surface water flow, groundwater levels and water quality in each of the management zones.</td>
<td>DLRM</td>
<td>2020</td>
</tr>
<tr>
<td>2. Report annual regional water balances for each management zone.</td>
<td>DLRM</td>
<td>annual</td>
</tr>
<tr>
<td>3. Review licensed entitlements.</td>
<td>DLRM</td>
<td>following 2021 review</td>
</tr>
<tr>
<td>4. Conduct compliance inspections for all licences and permits issued under the Water Act.</td>
<td>DLRM</td>
<td>Licences - annual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permits - as required</td>
</tr>
<tr>
<td>5. Provide advice to stakeholders on backflow prevention and metering devices.</td>
<td>DLRM</td>
<td>as required</td>
</tr>
<tr>
<td>6. Assist in the investigation of reported pollution events and reported degradation to water dependent ecosystems.</td>
<td>DLRM</td>
<td>as required</td>
</tr>
<tr>
<td>7. Consider improved knowledge of environmental and cultural water requirements, and provide recommendations for renewal of the Plan.</td>
<td>DLRM</td>
<td>2020</td>
</tr>
<tr>
<td>8. Inform stakeholders and the public about investigation and monitoring updates (e.g. through NTG websites, reports and public information sessions).</td>
<td>DLRM</td>
<td>ongoing</td>
</tr>
<tr>
<td>9. Review and advise on the sustainability of proposed water resource extraction by proposed development projects.</td>
<td>DLRM</td>
<td>as required</td>
</tr>
<tr>
<td>10. Undertake a detailed hydrogeological study of the Mereenie Aquifer, including development of a numerical model.</td>
<td>DLRM</td>
<td>2017</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>allocation</td>
<td>ongoing access to a share of water from a specified consumptive pool. The total licensed entitlements for a particular beneficial use cannot exceed the specified allocation as defined in the relevant water allocation plan.</td>
<td></td>
</tr>
<tr>
<td>aquifer</td>
<td>A body of permeable rock or sediment that is porous, which can contain or transmit groundwater.</td>
<td></td>
</tr>
<tr>
<td>beneficial use</td>
<td>legal recognition of the values of a water resource and determines how water may be used, managed and protected as declared under the NT Water Act. Beneficial uses include: agriculture, aquaculture, public water supply, environment, cultural, industry, rural stock and domestic uses.</td>
<td></td>
</tr>
<tr>
<td>bore</td>
<td>a bore, hole, well, excavation or other opening in the ground, or a natural or artificially constructed or improved underground cavity, which is or could be used for the purpose of intercepting, collecting, obtaining or using ground water or for the purpose of disposing of water or waste below the surface of the ground, or which extends to an aquifer;</td>
<td></td>
</tr>
<tr>
<td>catchment</td>
<td>a drainage basin that 'catches' rainfall to supply a river, aquifer, or lake.</td>
<td></td>
</tr>
<tr>
<td>consumptive pool</td>
<td>the amount of water resource that can be made available for consumptive use in a given water system under the rules of the relevant water plan. Within the Strategy region, the consumptive pool is determined by the physical characteristics of the aquifer, the limits of current pumping technology and waters remaining after environmental, cultural and other public benefit requirements are met. It represents the total volume of water that can be made available for consumptive use in a given water system, subject to the maximum allowable yield.</td>
<td></td>
</tr>
<tr>
<td>consumptive use</td>
<td>use of water for private benefit consumptive purposes including irrigation, industry, urban and stock and domestic use</td>
<td></td>
</tr>
<tr>
<td>Controller</td>
<td>the Controller of Water Resources appointed under Section 18 of the NT Water Act.</td>
<td></td>
</tr>
<tr>
<td>dip</td>
<td>slope of rock layers relative to the horizontal.</td>
<td></td>
</tr>
<tr>
<td>entitlement</td>
<td>the specific volume of water licensed under the NT Water Act for extraction in a given period, according to rules established in the relevant Water Allocation Plan (see water allocation (NWI)).</td>
<td></td>
</tr>
<tr>
<td>environment</td>
<td>all aspects of the surroundings of man, including the physical, biological, economic, cultural and social aspects;</td>
<td></td>
</tr>
<tr>
<td>evapotranspiration</td>
<td>quantity of water transferred from the soil to the atmosphere by evaporation and plant transpiration.</td>
<td></td>
</tr>
<tr>
<td>environmentally sustainable level of extraction</td>
<td>the level of water extraction from a particular system which, if exceeded would compromise key environmental assets, or ecosystem functions and the productive base of the resource (NWI)</td>
<td></td>
</tr>
<tr>
<td>ephemeral</td>
<td>not permanent.</td>
<td></td>
</tr>
<tr>
<td>environmental water requirements</td>
<td>descriptions of flow regimes (e.g. volume, timing, seasonality, duration) that are needed to sustain the ecological values of aquatic or floodout ecosystems, including their processes and biological diversity.</td>
<td></td>
</tr>
<tr>
<td>floodout</td>
<td>area of extensive alluvial plains formed by successive overflowing of a river channel.</td>
<td></td>
</tr>
</tbody>
</table>
flow in relation to water, includes the discharge, release, escape or passage of water;

groundwater water occurring or obtained from below the surface of the ground (other than water contained in works, not being a bore, for the distribution, reticulation, transportation, storage or treatment of water or waste) and includes water occurring in or obtained from a bore or aquifer;

groundwater dependent ecosystem (GDE) ecosystem that is dependent on groundwater for its existence and health.

hydrogeological the study of the interrelationship between geology and water, particularly groundwater.

hydrographs a graph showing the properties of water.

licence a licence to extract water granted to a person by the Controller under the Act, subject to such terms and conditions as are specified in the licence document.

licensed entitlement the specific volume of water licensed under the Act for extraction in a given period (typically annually), according to rules established in the relevant water allocation plan and offered within the sustainable yield. Subject to change if sustainable yield is altered during review periods (5 or 10 years).

maximum allowable yield the maximum rate of extraction of water from an aquifer allowed for under the plan considering public acceptance, current values, future opportunities and intergenerational equity. The maximum allowable yield, in the case of alluvial aquifers, equates with recharge and, in the case of the Amadeus Basin Aquifers, is the maximum proportion of water that can be permanently removed from aquifer storage over a given period (see NWI Definitions – environmentally sustainable level of extraction).

over allocation refers to situations where with full development of water access entitlements in a particular system, the total volume of water able to be extracted by entitlement holders at a given time exceeds the environmentally sustainable level of extraction for that system.

palaeo-channel buried river course.

permeability ability of a rock to allow water to flow through it.

pollution in relation to water, means the physical, thermal, chemical, biological or radioactive properties of the water that render it less fit for a prescribed beneficial use for which it is or may reasonably be used, or to cause a condition which is hazardous or potentially hazardous to – (a) public health, safety or welfare; (b) animals, birds, fish or aquatic life or other organisms; or (c) plants.

porosity proportion of a rock made up of pores, through which liquid or air may pass.

recharge process by which water is added to an aquifer.

surface water the water found in rock holes, rivers, creeks and floodouts sometimes called free water, to distinguish it from water in soil; springs are places where discharging groundwater becomes surface water; in the arid zone, nearly all surface water is the result of rainfall that has run off rather than infiltrated soil.

sustainable yield the level of water extraction from a particular system which, if exceeded would compromise key environmental assets, or ecosystem functions and the productive base of the resource.

take in relation to water, includes to withdraw, pump, extract, use or re-use, and to divert for the purposes of using or re-using, that water and,
where it is artesian water occurring in a bore, to allow the artesian water to flow from the bore.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>throughflow</td>
<td>the movement of groundwater which enters and leaves an aquifer from/to an adjacent aquifer, or from/to the same aquifer across the boundary of a study area. Throughflow into an aquifer is included as part of the total recharge, while throughflow out of an aquifer is added to the total discharge.</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>total dissolved solids (TDS) – a measurement of water salinity measured in mg/l</td>
</tr>
<tr>
<td>transmissivity</td>
<td>the rate at which water is transmitted horizontally through a unit width of an aquifer.</td>
</tr>
<tr>
<td>water balance</td>
<td>a method of accounting for the inputs and outputs of water to an aquifer.</td>
</tr>
<tr>
<td>water management zone</td>
<td>part or all of an aquifer system that is treated as a single unit for regulatory purposes.</td>
</tr>
<tr>
<td>water system</td>
<td>a system that is hydrologically connected and described at the level desired for management purposes (e.g. sub-catchment, catchment, basin or drainage division and/or groundwater management unit, sub-aquifer, aquifer, groundwater basin).</td>
</tr>
<tr>
<td>Water Advisory Committee</td>
<td>in relation to a Water Control District, means a committee established by the Minister, under Section 23 of the NT Water Act.</td>
</tr>
<tr>
<td>Water Allocation Plan</td>
<td>means a document prepared for a particular Water Control District and declared by the Minister, under Section 22B of the NT Water Act (see NWI Definitions - water plan)</td>
</tr>
<tr>
<td>Water Control District</td>
<td>includes any part of the Territory declared by the Minister to be a water control district under Section 22 of the NT Water Act.</td>
</tr>
<tr>
<td>water allocation (NWI)</td>
<td>the specific volume of water allocated to water access entitlements in a given period, defined according to rules established in the relevant water plan (see Glossary - entitlement).</td>
</tr>
<tr>
<td>water access entitlement (NWI)</td>
<td>a perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan. Total entitlements cannot exceed the specified allocation nor consumptive pool.</td>
</tr>
<tr>
<td>water plan (NWI) -</td>
<td>Statutory plan for surface and/or groundwater systems, consistent with the Regional Natural Resource Management Plans, developed in consultation with all relevant stakeholders on the basis of best scientific and socio-economic assessment, to provide secure ecological outcomes and resource security for users.</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Act</td>
<td>Water Act 1992 (NT)</td>
</tr>
<tr>
<td>ADWG</td>
<td>Australian Drinking Water Guidelines</td>
</tr>
<tr>
<td>AHD</td>
<td>Australian Height Datum – national standard for height above sea level</td>
</tr>
<tr>
<td>ALT</td>
<td>Aboriginal Land Trust</td>
</tr>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Environment and Conservation Council</td>
</tr>
<tr>
<td>ASWAC</td>
<td>Alice Springs Water Advisory Committee</td>
</tr>
<tr>
<td>ARMCANZ</td>
<td>Agriculture and Resource Management Council of Australia and New Zealand</td>
</tr>
<tr>
<td>Controller</td>
<td>NT Controller of Water Resources appointed under s.18 of the Act</td>
</tr>
<tr>
<td>CW</td>
<td>Commonwealth</td>
</tr>
<tr>
<td>°C</td>
<td>Degrees Celsius</td>
</tr>
<tr>
<td>District</td>
<td>Alice Springs Water Control District</td>
</tr>
<tr>
<td>DLRM</td>
<td>NT Department of Land Resource Management (formerly NRETAS)</td>
</tr>
<tr>
<td>GL</td>
<td>Gigalitre (1 gigalitre is 1 000 000 000 litres or 1,000 megalitres)</td>
</tr>
<tr>
<td>GDE</td>
<td>groundwater dependent ecosystem</td>
</tr>
<tr>
<td>ha</td>
<td>Hectare (10 000 m²)</td>
</tr>
<tr>
<td>KL</td>
<td>kilolitre (1 kilolitre is 1 000 litres)</td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>km²</td>
<td>square kilometres (1 000 000 m²)</td>
</tr>
<tr>
<td>l/s</td>
<td>litres per second.</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>m²/d</td>
<td>square metre per day</td>
</tr>
<tr>
<td>Mereenie AS</td>
<td>Mereenie Aquifer System</td>
</tr>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>mbgl</td>
<td>metres below ground level (water table depth)</td>
</tr>
<tr>
<td>mg/l</td>
<td>milligrams per litre ~parts per million (ppm)</td>
</tr>
<tr>
<td>ML</td>
<td>Megalitre (1 megalitre is 1 000 000 litres)</td>
</tr>
<tr>
<td>NT</td>
<td>Northern Territory</td>
</tr>
<tr>
<td>NTG</td>
<td>Northern Territory Government</td>
</tr>
<tr>
<td>NWC</td>
<td>National Water Commission</td>
</tr>
<tr>
<td>NWI</td>
<td>National Water Initiative</td>
</tr>
<tr>
<td>PWC</td>
<td>Power and Water Corporation</td>
</tr>
<tr>
<td>SWL</td>
<td>standing water level (water table)</td>
</tr>
<tr>
<td>TDS</td>
<td>total dissolved solids</td>
</tr>
<tr>
<td>WAP</td>
<td>Water Allocation Plan</td>
</tr>
<tr>
<td>WCD</td>
<td>Water Control District</td>
</tr>
</tbody>
</table>
REFERENCES

Aboriginal Areas Protection Authority (AAPA) (2011) Material about Sacred Sites in the Todd River supplied for Public Information Session held at Andy McNeil Room on 15 February 2011


Appendix 1: Geological Eras and Periods

The oldest rocks of the Alice Springs region are the Precambrian rocks of the Arunta Block, formed about 1400 million years ago (Mya). The Arunta Block underlies the Alice Springs township and the catchments of the Todd River. The Arunta Block formed the bed of an ancient sea on which was deposited successive layers of sediment and later the minute bodies of single celled marine organisms to form limestone. These layers compose the Northern Amadeus Basin.

The oldest rock of the Amadeus Basin is Heavitree Quartzite which today tops the Heavitree Range to the south of the Alice Springs township. Heavitree Quartzite (silicified sandstone) and Bitter Springs Formation (dolomite, limestone and siltstone) represent the start of an ancient sedimentary sequence from the Late Proterozoic period (1000 Mya). Later carbonate and shale deposition during the Cambrian period resulted in the Shannon formations (510-570 Mya) amongst others. Marine conditions during the subsequent Ordovician period led to the deposition of sandstones, shale and limestone of the Goyder Formation and Pacoota Sandstones (510-435 Mya). A period of estuarine and terrestrial conditions during the Silurian and Devonian Periods (435-410 Mya) deposited the Mereenie Sandstone. The deposition of the Brewer Conglomerate and the Hermannsburg Sandstone marked the end of the development of the Amadeus Basin.

During the upper Devonian and early Carboniferous periods (355 Mya) a major earth movement known as the Alice Springs Orogeny folded the strata in the region resulting in deep troughs and ridges. Subsequent erosion and deposition of alluvial sediments in-filled the valleys during the Tertiary (65 Mya) and more recent Quaternary periods (from 1.6 Mya).

<table>
<thead>
<tr>
<th>Era</th>
<th>Period</th>
<th>Millions of years before present</th>
<th>Geological formation/event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cainozoic</td>
<td>Quaternary</td>
<td>1.6 - present</td>
<td>Deposition of shallower alluvial basins - sands, gravels &amp; silts</td>
</tr>
<tr>
<td></td>
<td>Tertiary</td>
<td>65 – 1.6</td>
<td>Deposition of deeper alluvial basins - clays, sands &amp; silts</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>Cretaceous</td>
<td>135 – 65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jurassic</td>
<td>205 – 135</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triassic</td>
<td>250 – 205</td>
<td></td>
</tr>
<tr>
<td>Palaeozoic</td>
<td>Permian</td>
<td>290 – 250</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carboniferous</td>
<td>360 – 290</td>
<td>Brewer Conglomerate Hermannsburg Sandstone Alice Springs Orogeny - ranges formed in Strategy region</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td>420 – 360</td>
<td>Mereenie</td>
</tr>
<tr>
<td></td>
<td>Silurian</td>
<td>440 - 420</td>
<td>Mereenie</td>
</tr>
<tr>
<td></td>
<td>Ordovician</td>
<td>510 - 440</td>
<td>Goyder Pacoota</td>
</tr>
<tr>
<td></td>
<td>Cambrian</td>
<td>570 - 510</td>
<td>Shannon</td>
</tr>
<tr>
<td>Late Proterozoic</td>
<td>Adelaidian</td>
<td>1 000 - 570</td>
<td>Bitter Springs Formation Heavitree Quartzite</td>
</tr>
<tr>
<td>Mid-Proterozoic</td>
<td></td>
<td>1 600 – 1 000</td>
<td>Arunta Block</td>
</tr>
</tbody>
</table>
## Appendix 2: Geology and Groundwater Summary

<table>
<thead>
<tr>
<th>Groundwater System</th>
<th>Main Aquifers</th>
<th>Water quality Notional (mg/L)</th>
<th>Typical Bore Yields (L/s)</th>
<th>Current Water Level BGL (m)</th>
<th>Typical Transmissivity (m²/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Town Basin</strong></td>
<td>1. Shallow alluvial beds - gravel, sand, silt and clay</td>
<td>1 200</td>
<td>1 -10</td>
<td>6</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>2. Weathered basement rock fracture zones – sandy clays, fractured granite &amp; other rock</td>
<td>Greater than 5 000</td>
<td>Less than 0.5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>Inner Farm Basin</strong></td>
<td>1. Shallow alluvial beds - gravel, sand, sandy clay</td>
<td>1 500</td>
<td>1-5</td>
<td>6</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>2. Fracture zones in basement rock – weathered granites 3. Solution cavities &amp; beds in Bitter Springs Formation –</td>
<td>1 500 800</td>
<td>5 5</td>
<td>6 6</td>
<td>40 200</td>
</tr>
<tr>
<td><strong>Western Outer Farm Basin</strong></td>
<td>1. Alluvial sediments- boulders, gravel, sand, sandy clay limestone, fractured sandstone 2. Thin fine sand beds in upper Tertiary aged clays – fine sand and sandy clays 4. Sandstone beds in Pertatataka formation - 3. Solution cavities &amp; beds in Bitter Springs Formation – limestone, fractured sandstone</td>
<td>700 1 000 2 000 1 500 1 200 1 500</td>
<td>1 - 5 1 2 5 12 30 15 12</td>
<td>400 30 30 400</td>
<td></td>
</tr>
<tr>
<td><strong>Amadeus Formations Pine Gap Borefield</strong></td>
<td>1. Mereenie Aquifer System (including Mereenie Sandstone, Hermannsburg Sandstone) – fractured quartz sandstone</td>
<td>600</td>
<td>25</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>2. Upper Pacoota Sandstone yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>3. Lower Pacoota Sandstone yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>4. Goyder Formation – yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>5. Upper Shannon Formation – yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Amadeus Formations Roe Creek Borefield</td>
<td>1. Mereenie Aquifer System (including Mereenie Sandstone, Hermannsburg Sandstone) – fractured quartz sandstone</td>
<td>450</td>
<td>50</td>
<td>155</td>
<td>1,000</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2. Upper Pacoota Sandstone Interbedded sandstones, siltstone and shales</td>
<td>500</td>
<td>40</td>
<td>130</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>3. Lower Pacoota Sandstone Interbedded sandstones, siltstone and shales</td>
<td>500</td>
<td>40</td>
<td>100</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>4. Goyder Formation - sandstone</td>
<td>550</td>
<td>25</td>
<td>90</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>5. Upper Shannon Formation – solution cavities in fractured dolomite</td>
<td>650</td>
<td>25</td>
<td>84</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>Amadeus Formations Alice Springs Airport area</td>
<td>1. Mereenie Aquifer System (including Mereenie Sandstone, Hermannsburg Sandstone) – fractured quartz sandstone</td>
<td>400</td>
<td>25</td>
<td>90</td>
<td>300</td>
</tr>
<tr>
<td>2. Upper Pacoota Sandstone Interbedded sandstones, siltstone and shales</td>
<td>500</td>
<td>20</td>
<td>100*</td>
<td>200*</td>
<td></td>
</tr>
<tr>
<td>3. Lower Pacoota Sandstone Interbedded sandstones, siltstone and shales</td>
<td>500</td>
<td>20</td>
<td>98*</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>4. Goyder Formation - sandstone</td>
<td>500</td>
<td>20</td>
<td>36</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>5. Upper Shannon Formation – solution cavities in fractured dolomite</td>
<td>650</td>
<td>25</td>
<td>36</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>Amadeus Formations Rocky Hill Borefield</td>
<td>1. Mereenie Aquifer System – fractured quartz sandstone (including Mereenie Sandstone, Hermannsburg Sandstone and Ooraminna Sandstone)</td>
<td>400-6 000</td>
<td>25</td>
<td>110-23</td>
<td>300</td>
</tr>
<tr>
<td>2. Upper Pacoota Sandstone yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>3. Lower Pacoota Sandstone yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>4. Goyder Formation</td>
<td>500</td>
<td>20</td>
<td>36</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>5. Upper Shannon Formation – yet to be drilled in this area</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: Alluvial Aquifers: Town Basin, Inner Farm, and Outer Farm Basins
Appendix 4: Amadeus Basin Aquifer
Appendix 5: Alice Springs Water Planning Area Management Zones

[Map showing the management zones around Alice Springs]
Appendix 6: Interaction between groundwater systems

Water Balance for Alice Springs prior to urban and rural development:

**Groundwater throughflow from Mereenie Aquifers to the west:**
- 1800 ML

**Groundwater throughflow from Mereenie Aquifers:**
- 350 ML Ground Water to Outer Farm Basin Eastern Portion

**Mereenie Aquifer System:**
- Amadeus Basin
- 5,399,000 ML

**Pacota Sandstones:**
- Amadeus Basin
- 430,000 ML

**Shannon & Goyder Formations:**
- Amadeus Basin
- 302,000 ML

**Water In:**
- Direct Rainfall
- Todd River Recharge

**Water Out:**
- Evapotranspiration

**Water Qualities:**
- Town Basin
  - 0-2000 ng/L Salinity
- All other Aquifers
  - 0-1000 ng/L Salinity
Water Balance for Alice Springs subject to urban and rural development:

- Direct Rainfall
- Todd River Recharge
- Irrigation return
- Reticulation Leakage

Water In (ML/yr)
- 1,170 ML

Ground Water Thru
- 30 ML

Water Out (ML/yr)
- 180 ML Evapotranspiration
- 250 ML Inflows to sewers
- 740 ML Extraction

- 50 ML Evapotranspiration
- 70 ML Extraction

- 200 ML Evapotranspiration
- 110 ML Extraction

Groundwater throughput from Mereenie Aquifers from the west
- 1,000 ML

Meramee Aquifer System
- Amadeus Basin
- 4,300,000 ML

(Annual Reduction in Storage: -7,300 ML/yr)

Paceotta Sandstones
- Amadeus Basin
- 400,000 ML

(Annual Reduction in Storage: -1,365 ML/yr)

Shannon & Goyder Formations
- Amadeus Basin
- 300,000 ML

(Annual Reduction in Storage: -100 ML/yr)

500 ML Ground Water to Outer Farm Basin Eastern Portion

Water Qualities
- Town Basin
  0-200 mg/mL Salinity
- All other Aquifers
  0-1000 mg/mL Salinity

500 ML Ground Water from Outer Farm Basin Eastern Portion