



# **Northern Territory Strategic Water Information and Monitoring Plan**

**Prepared by the Department of Natural Resources, Environment, The Arts and Sport**

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## Contributing Agencies:

The Department of Natural Resources, Environment, The Arts and Sport; the Power and Water Corporation; and the Department of Resources.

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## Foreword

<i>The issue</i>	In recent years water has become a pressing public policy issue for Australian society. As water demand increases and supply dwindles, the strain on existing water supplies has reached new heights. Protracted drought and mounting evidence of climate change have added momentum behind a growing community and political will to see improvements in both our understanding of water resources and the way we manage them.
<i>The challenge</i>	Better management of water poses a national challenge, requiring a coordinated response. Our ability as a community to reach agreement on the tough issues relies on access to accurate, reliable water information that is freely available and of the highest standards. Key to making these decisions and arriving at sound policy is a definitive water data source that stands above reproach
<i>Australian Government response</i>	Aligned with this need, the Australian Government assigned the Bureau of Meteorology (the Bureau) responsibilities under the <i>Water Act 2007</i> to compile and deliver comprehensive water information for the country. As part of the Australian Government's long term framework for water security, Water for the Future, \$450 million was allocated to the Bureau over 10 years to deliver the Improving Water Information Program. This program includes development and maintenance of an integrated, national water information system which will be freely accessible to the public. Details of the full suite of Bureau objectives and deliverables can be found at <a href="http://www.bom.gov.au/water">www.bom.gov.au/water</a> .
<i>A partnership model...</i>	Vital to the success of the Bureau's mission is the partnership and cooperation of all State and Territory Governments and all water data collecting organisations in each jurisdiction. One of the vehicles for effective collaboration is the Jurisdictional Reference Group for Water Information (JRGWI), established to provide regular input to the Bureau's activities, and bringing to the table the experience and wisdom of respected senior officials from across the water sector.
<i>...and putting it into practice</i>	The Modernisation and Extension of Hydrologic Monitoring Systems Program (the M&E Program) is an \$80 million fund administered by the Bureau and available to organisations named under the Water Regulations 2008. The M&E Program is aimed at improving technologies employed by those who collect water information, and enabling better approaches to data transfer and standardisation. Coordination activities are also supported through the M&E Program via funding for Strategic Water Information Coordinators (SWICs) in each State and Territory. SWICs have been tasked with bringing together key stakeholders in their jurisdiction to distil State/Territory priorities in water data collection, and to set these out in a series of Strategic Water Information and Monitoring Plans (SWIMPs).

- Strategic plans...* The SWIMPs provide a framework for describing where we are going and how we will get there. Each SWIMP has been produced with a whole of jurisdiction focus to encapsulate the current state of play in water information and monitoring, describe the gaps, issues and opportunities that exist, and articulate a series of priorities, strategies and actions that will bring us closer to the end vision of better water information for all.
- ...and how they contribute to the solution* Through the M&E Program the Bureau is able to assist the States and Territories to get closer to our agreed view of what constitutes a fit-for-purpose hydrologic observing system in each jurisdiction. The Bureau looks to the SWIMPs to provide guidance on how best to invest M&E Program funds to achieve this goal. In this regard, the SWIMPs are a vital product.
- The future* In closing, the Bureau appreciates the energy and expertise that has been applied in the preparation of this SWIMP, and thanks all of the officers that have participated in its development and review. Our special thanks go to the lead author of the SWIMP, Aidan Smith.



Dr Rob Vertessy  
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Table 1

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## Executive Summary

The Strategic Water Information Management Plan (the Plan) is a Northern Territory Government publication which has been primarily funded by the Australian Government through the Bureau of Meteorology. Publication of a Strategic Water Information Management Plan is a national requirement as part of the National Water Initiative. This document may be considered as the first version of an integrated plan for water information and monitoring in the Northern Territory.

The Plan is a strategic document that will be one of the primary documents which guides the development of water management, information and monitoring in the NT. The Plan identifies the NT's drivers for water information current at the time of development and provides an analysis of monitoring and data requirements to address these drivers. (see Section 1A)

The Plan outlines the drivers for water information and water information and data requirements. These are identified on a regional basis with a gap analysis of the information requirements and the data requirements at Section 2A. From this process, an exercise to identify information and data priorities will emerge. This process leads to a Strategic Action Plan for water management over the next five years with a review and update process incorporated into the plan to ensure this is a living working document.

The drivers and subsequent water information requirements identified in the Plan are bound by the primary drivers for water management priorities and activities in the NT. These primary drivers are the NT Water Act 1992 and floodplain management and flood forecasting and warning protocols, and the National Water Initiative.

There are three Northern Territory parties identified under the NT Water Act 1992 as partners in the delivery of Water Management in the Northern Territory. These partners are the Department of Natural Resources, Environment, the Arts and Sport (lead agency), the Department of Resources and the Power and Water Corporation. All of these groups have contributed towards the development of the Plan.

## Background

This Strategic Water Information Management Plan (SWIMP) is a key deliverable for the Bureau of Meteorology's Modernisation and Extension of Hydrologic Monitoring Program (M&E Program) of 2009-10. The Plan is written in two sections and provides a detailed description of water monitoring activities in NT rivers and aquifers to support water resources planning, management and environmental protection.

The approach of this Plan is to clearly recognize the difference between water information and water data within the NT. This Plan identifies the different information drivers and deliverables and provides a gap analysis and priority assessment of these information requirements (in Section 1). At the same time the Plan identifies the different data and monitoring requirements and has been designed to address the gaps between data currently being monitored and data identified as a priority of the NT but not currently being monitored (see Section 2).

It is intended that this Plan will be a key tool to be applied when making resource decisions for water management in the NT. An NT Water Resource Strategy is proposed to be developed over the coming year and will utilise information and data collected and provided in developing this Plan.

Section 1 collates water information within the NT.

Section 1.A identifies the drivers for water information.

Section 1.B provides an inventory for identified information currently provided through key water monitoring agencies.

Section 1.C describes an information gap analysis of strategically important water reporting and assessment activities. It links the information gaps with the information drivers and provides a summary of the current gaps.

Section 1.D outlines the NT water information priorities at this time.

Section 2 identifies the key data and monitoring undertaken in the NT.

Section 2.A identifies the priority data and monitoring requirements.

Section 2.B provides an inventory of the data and monitoring sites currently monitored by key water monitoring agencies. It describes the surface water and groundwater data being collected within Water Control Districts and within remote communities throughout the NT.

Section 2.C identifies and prioritises the data gaps in current monitoring activities with identified priorities for information requirements.

Section 2.D outlines the NT water data and monitoring priorities at this time.

## Introduction

### NT Water Resources

The Northern Territory's water resources may be described as largely intact and under relatively little pressure. However, the Northern Territory is also considered to be in a development and growth phase in terms of population and industries and, consequently, pressure on these water resources is expected to grow.

These development pressures are expected to continue to be localised to a small number of regions within the NT. Subsequently, water management activities and priorities focus on less than 30% of the NT via water control districts and flood warning and forecasting service areas.

Due to the NT being characterised by arid, semi arid and wet dry tropics, water use comprises primarily groundwater extraction with only limited surface water extraction, mostly used for stock and domestic purposes. High yielding aquifers suitable for large scale irrigation are limited and already provide for a comprehensive range of ecosystem services and culturally significant water dependant sites. Although there is a reasonable level of information about the ground water resources currently available, the impact of extraction can only be estimated and consequently a precautionary principle is applied to all water allocation.

## Scope

All water activities in the NT are, to a greater or lesser extent, bound by the NT Water Act (the NT Act). The noted exceptions are flood warning and forecasting and floodplain management that provide services to protect and plan for communities, infrastructure and assets. Mining licences are also excluded from the NT Water Act.

There are two other named parties under the Water Act and these are the Power and Water Corporation and the Department of Resources. These organisations and their primary functions are listed in the table below. Each of these has sections within their own legislation that cover elements of water resource activities. The relevant legislation for these two organisations is:

- Water Supply and Sewerage Services Act (1992) administered by the Power and Water Corporation.
- NT Mining Act administered by the Department of Resources.

The scope for this Plan, are the objectives and obligations of named NT persons in the Regulations bound by the Commonwealth Water Act and obligations under agreement for the provision of flood warning and forecasts.

That is, the Plan will address water information and monitoring priorities and requirements of the named NT persons in the Regulations. Named NT persons at the time of development of the Plan are:

Name	Category	Primary Functions/Objectives
The Department of Natural Resources, Environment, The Arts and Sport	A	Administrators/Regulators of the NT Water Act 1992. To ensure sustainable development of the NT's water resources. Water assessment. Flood forecasting and warning. Regulators of waste water discharge licences for mine leases in the Northern Territory.
The Department of Resources	B	Regulators of mining activity for all mine leases in the Northern Territory
Power and Water Corporation	D, F	Providers of potable water to urban centres and remote communities. Compliance under licence to the NT Water Act 1992.

The Power Water Corporation is the utility in the Northern territory responsible for the provision of power, water and sewerage services to cities towns and communities. Further information regarding the corporation can be found at:

<http://www.powerwater.com.au/>

The primary role for the corporation, in regard to the provision of data under the Commonwealth Water Regulations 2008, is associated with some of the groundwater level monitoring undertaken by the corporation as a condition of license, and the provision of metering data associated with each of the licenses issued to extract water for urban water supplies. All of this information is already provided to the primary agency NRETAS, as a condition of licence, and consequently the information will be provided directly from NRETAS.

The Department of Resources is the third named entity in the NT. The Department of Resources (DoR) is the government agency responsible for facilitating industry development in three vital economic sectors, ensuring the optimal use of the Territory's fisheries, primary industries, mineral and energy resources. Further information regarding the department can be found at: <http://www.nt.gov.au/d/>

The Department of Resources (thru their Mines Division) are responsible for the collection and collation of mine water usage data, supplied as a condition of mine management plans. This information is not yet provided to NRETAS, due to ongoing claims of commercial in-confidence, and as such this data will be supplied directly by Mines Division to the BoM.

## SWIMP Structure and Document Plan

The structure of the Plan follows the guidelines provided by the Bureau in the *Jurisdictional Strategic Water Information and Monitoring Plan: Framework Guidance* document (*ref*) (The Guidelines). The Guidelines prescribe a logical and structured approach to develop regional plans and have been interpreted for the NT Plan as illustrated in figure 1. It should be noted however that there has been a significant level of work undertaken in relation to the information technology component of the NT Plan and it is this complementary tool which is seen as being of most use to the jurisdiction.

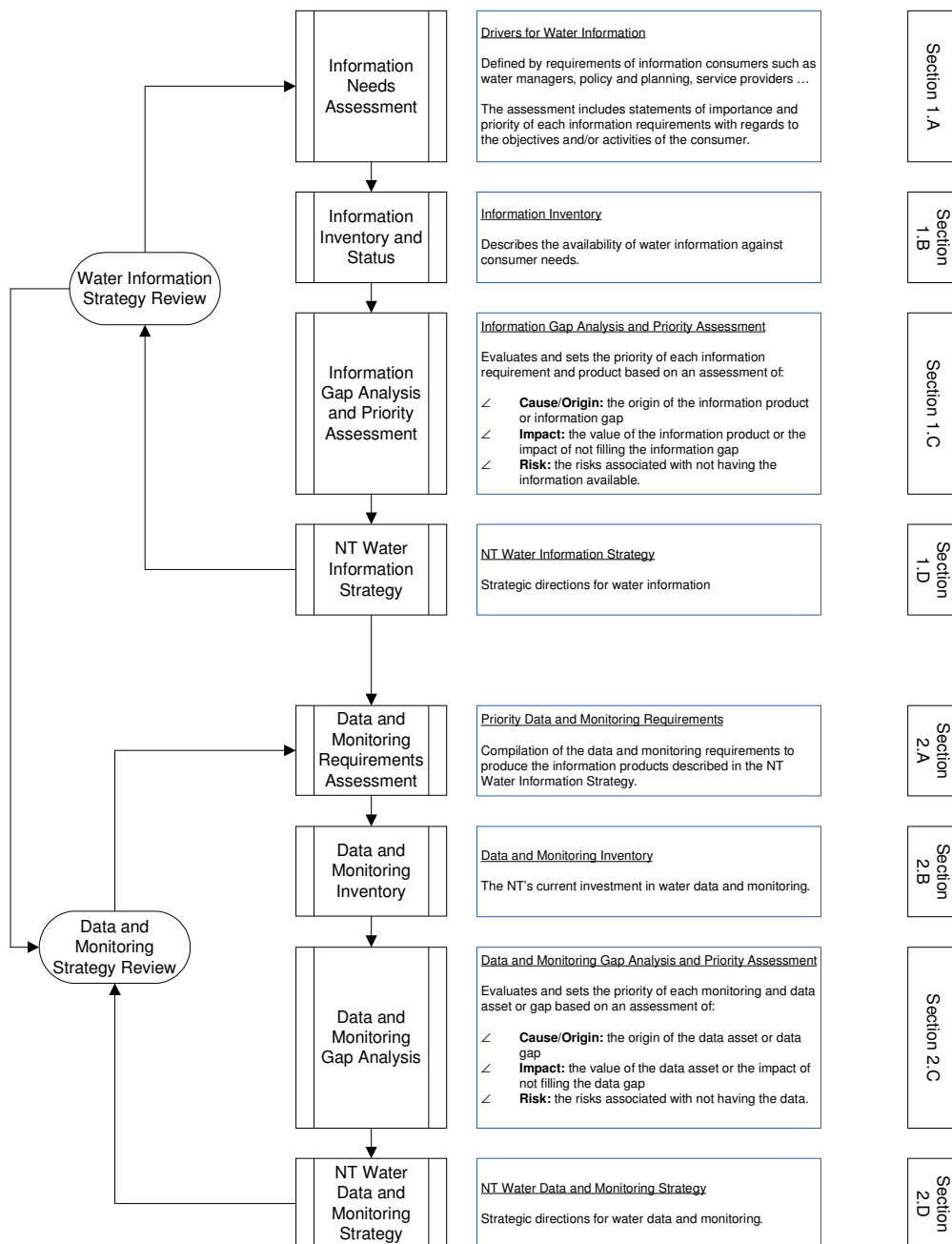


Figure 1. NT Plan Structure and Document Outline



A key feature of the Plan is the distinction between water information and water data which is reflected the Plan's design. Hence, water information and water data are managed distinctly yet in an integrated fashion.

Part 1 – Water Information

Part 2 – Data and Monitoring

### Operational Model – The NT Water Information Management System.

The operational model constructed for the Plan is a cascading scheme representing relationships and paths from data to management outcomes, as illustrated in figure 2. This model has been implemented as an information system that includes a prioritisation scoring framework to relate water management priorities to on ground data collection. That is, the system provides a mechanism to identify NT information priorities to determine the value of information products and programs and thus ultimately to assess the value of individual sites and datasets.

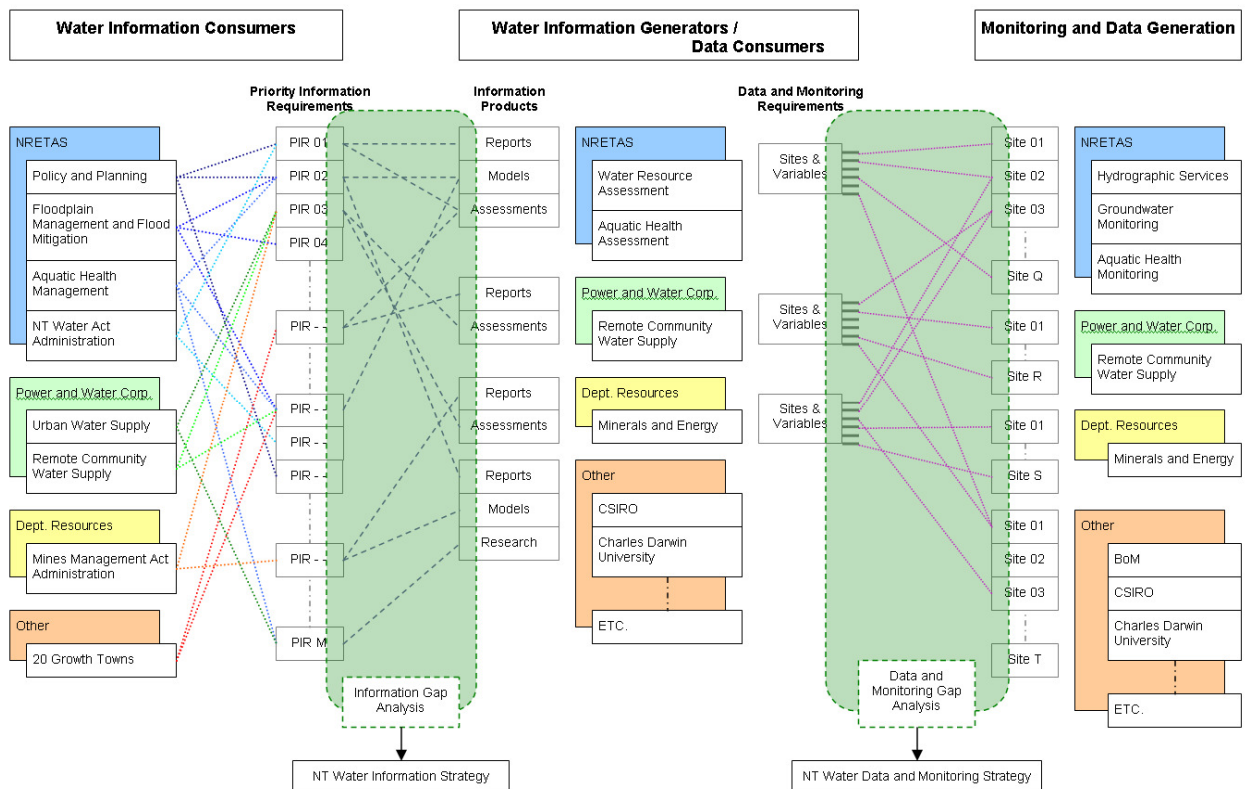


Figure 2. NT SWIMP Operational Model

The NT Water Information Management System (WIMS) is implemented as follows:

### Water Information Consumers and Priority Information Requirements

Water Information Consumers are responsible for water management outcomes and undertake water management activities. These are represented in WIMS as *Management Activities* (MAs). Subsequently, each MA has an associated set of water (and non-water) information requirements which are represented as Priority Information Requirements (PIRs).

#### *Scoring Management Activities and Priority Information Requirements*

Management Activities have been allocated a prioritisation rank between one (highest) and five (lowest). PIRs have also been ranked, however, only within the context of the MA for which they are associated and their range is from one (highest) to three (lowest).

A PIR score is determined by weighting the MA priority (MAP) and the PIR priority (PIRP) and then combining them. As an initial implementation the weighting is such that MAs are evenly distributed between 0 – 140, and PIRs are distributed evenly between 0 – 43.

MA Priority	MAP Weight
1	140
2	112
3	84
4	56
5	28
Not-prioritised	0

PIR Priority	PIRP Weight
1	43
2	28.7
3	14.3
Not-prioritised	0

The MAP and PIRP weights have been tuned in order to arrive at a PIR ranking that the Water Management Team thought appropriate. Tuning was an iterative process whereby weighting for both MAPs and PIRP started at an even distribution from 0 – 100, and then the ranges adjusted independently until the desired rankings were achieved.

The resultant combination that forms the PIR scoring table is shown below:

MA Priority	MAP Wgt	PIR Priority	PIRP Wgt	PIR Score
1	140	1	43.0	183.0
1	140	2	28.7	168.7
2	112	1	43.0	155.0
1	140	3	14.3	154.3
2	112	2	28.7	140.7
3	84	1	43.0	127.0
2	112	3	14.3	126.3
3	84	2	28.7	112.7
4	56	1	43.0	99.0
3	84	3	14.3	98.3
4	56	2	28.7	84.7
5	28	1	43.0	71.0
4	56	3	14.3	70.3
5	28	2	28.7	56.7
5	28	3	14.3	42.3

Future versions of the SWIMP and WIMS will see the introduction of risk analyses to provide a more sophisticated scoring system.

To illustrate this scoring system, consider the following extract from WIMS as a practical example.

Management Activity	MA Priority	MAP Weight	Priority Info. Requirement	PIR Priority	PIRP Weight	PIR Score
Alice Springs Water Account Report	3	84	Assessments of water assets to clearly identify baseline information for water assets.	1	43	127
			Identification and assessment of changes in water assets.	1	43	127
			Assessment of existing demands on water resources and identification of future changes due to environment and growth in demand by current and future users of water resources within the Alice Springs Water Resource Strategy Area.	2	29	113
Berry Springs Water Allocation Plan	3	84	Environmental Water Requirements and locations for identified GDEs.	1	43	127
			Surface water and groundwater water quality response to extraction	1	43	127
			Water Quality trigger values	2	29	113
			Relationship between groundwater levels and springflow	2	29	113
Flood Forecasting	1	140	Modelled outputs - Direct Predictions: Upper Adelaide River	1	43	183
			Flood categories and classifications	1	43	183
			Catchments' Characteristics	3	14	154
			Spatial variation of soil moisture	3	14	154
			Modelled outputs - multiple peaks	4	0	140
Katherine Tindall Water Allocation Plan	2	112	Relationship between groundwater levels and springflow	2	29	141
			Surfacewater and groundwater water quality response to extraction	1	43	155
			Katherine River Water Quality trigger values	2	29	141

### **Water Information Generators and Priority Information Products**

Water Information Generators are represented in WIMS by the information products and programs they deliver. Information products may deliver to one or many PIRs either entirely or partially. An information product that delivers to one or many PIRs is then recognised as a Priority Information Product (PIP).

#### *Scoring Priority Information Products*

Subsequently, PIPs are scored according to the PIRs to which they meet. That is, a PIP score is the sum of the PIR scores for each priority information requirement the PIP delivers to.

$$\text{PIP Score} = \sum [\text{PIR Score}]$$

In the first implementation of WIMS, no assessment is made to quantify how far an information product goes to meeting the PIR. That is, there is no partial scoring or tallying of PIR scores according to 'fit-for-use' in the first instance of WIMS. This is to be developed and implemented in future versions of WIMS.

As an example, consider the PIP that is the Katherine Tindal Limestone Assessment undertaken by the lead water agency, NRETAS. The following table is an extract from WIMS and demonstrates the scoring process for PIPs.

PIP	Description	Management Activity	Priority Information Requirement	PIR Score	PIP Score
Katherine Tindal Limestone Assessment	This project aims to provide annually updated monitoring data for model input. The model output is required to advise planners and provide basis for announcement of seasonal allocations from this aquifer system.	Katherine Tindal Water Allocation Plan	Total discharge into Katherine River within WAP area	155	2060
			Surfacewater and groundwater water quality response to extraction	155	
			Recharge Modelling	155	
			Model output (cumecs) for Katherine Railway bridge.	155	
		Ooloo Water Allocation Plan	Model flow in the Daly River.	99	
			Determine annual extraction limits.	99	
			Identify environmental water requirements for GDE's.	85	
			Identify environmental water requirements for the Daly River.	85	
			Determine further benefits associated with the Ooloo aquifer and interconnected Daly River and associated ecosystems	85	
		WRCP	Determine locations and magnitude of flow from the major springs.	127	
			Ongoing baseline data for assessment of recharge processes, seasonal response.	127	
			Current and historical water usage from aquifer(s)	113	
			Maintain baseline data for assessment of recharge processes, seasonal response.	113	
			Identification of discharge process and locations.	113	
			Establish relationship of recharge (infiltration) to soil, vegetation type and land systems.	113	
			Ongoing baseline data for assessment of recharge processes, seasonal response.	98	
		Flood Forecasting	River conditions - cross sections, primary and secondary levee levels.	183	

### Data Consumers and Monitoring and Data Requirements

Water Information Generators are, consequently, data consumers. That is, information products have monitoring and data requirements and are captured in WIMS such that each PIP identifies and prioritises parameters and sites as well as specific requirements such as currency, accuracy, etc. Subsequently, a site's priority is determined by the PIPs that have identified them as required.

*Scoring Priority Data Sites*

PIPs detail their data requirements with a list of sites and parameters where each site is allocated a priority level between one (highest) and five (lowest) which are then weighted by an even distribution between 100 – 0. Scoring a site is then a simple process of summing the PIP Score with the Site priority weight (PIPSP) for each PIP identifying that site, i.e.:

$$\text{Site Score} = \sum [\text{PIP Score} + \text{PIPSP Weight}]$$

For example, consider the WIMS extract for the NT highest priority site, G9140535 – Ironwood Station on the Katherine River.

Site	Priority Information Product	PIP Score	PIP Site Priority	PIPSP Weight	Site Score
G8140535	Baseline SW Monitoring SWMA 814 Daly River Region	4119	1	100	17082
	Katherine Tindal Limestone Assessment	2060	2	80	
	Flood Forecasting Katherine River	1715	3	60	
	Sustainable Development and Management of Water Resources in Northern Australia: A Model Approach (NWC)	1398	3	60	
	Baseline GW Monitoring Northern Region	6557	1	100	
	Floodplain Mgt Assessments Katherine Town and Rural	733	1	100	

## Definitions

**Data Consumer** – Data is used by information generators to produce meaningful information for Information Consumers. Data can be used in data modeling of water resources or to inform managers on resource availability and suitability.

**Information Consumer** – uses information generated by information generators. This information can be in the form of reports or water resource models. The consumer can then use the reports etc to make informed decisions on water resources including allocation announcements and predictions on flood forecasting.

**Information Generator** – produce reports, water resource models for stakeholder information and use. Examples of information generated include models for use by water planners, reports on statistical information for flood forecasting and flood modeling.

**Monitoring** - the observation and measurement assets, equipment and capital works on ground at a measurement site. This would incorporate supporting site infrastructure, telemetry hardware, repeater stations etc. It is acknowledged that some may consider this only part of the full description of the term 'monitoring'.

**Water Allocation Plan** – The NT Water Act allows the enforceable allocation of water to various declared beneficial uses including; agriculture, aquaculture, public water supply, riparian and industry while ensuring that adequate provisions are made to maintain cultural and environmental requirements. This is done through the declaration of **water allocation plans** within water control districts, ensuring water is equitably managed to preserve quality of life and the integrity of the water dependent ecosystems in the region. Water control districts are geographical areas declared under the Water Act by the relevant Northern Territory Government minister to allow for more intensive management of the water resources.

**Water Information** – Water information may be derived from an array of sources – it is needed to gain insight in the face of water challenges and to answer water related questions. In many cases a variety of components are needed, contained in the progression from observation and measurement, obtainment of data, data capture, delivery and administration and associated ICT infrastructure. Components of evaluation, reporting on and understanding data are also embedded in the term 'water information'.

## Acronyms

**BUD** – Beneficial use declarations

**FPM** - Floodplain management

**FFW** - Flood forecasting and warning

**GDEs** – Groundwater dependant ecosystems

**GMU** – Groundwater Management Unit

**JRGWI** – Joint Reference Group for Water Information

**MNL** - Mine leases (waste water discharge)

**The Plan** - This Strategic Water Information Management Plan

**The Team** – The Water Management Team (outlined on page 13)

**WAP** – Water allocation plans

**WCD** – Water control district

**SWMA** – Surface water management areas

**TRaCK** – Tropical Rivers and Coastal Knowledge

**UWS & RWS** - Urban water supply and remote water supply



## Governance, Review and Future Development

### Governance

The Strategic Water Information Management Plan (the Plan) is a Northern Territory Government publication which has been primarily funded by the Australian Government through the Bureau of Meteorology. Publication of a Strategic Water Information Management Plan is a national Initiative of the Joint Reference Group for Water Information (JRGWI) a construct of the Bureau of Meteorology. This document may be considered as the first version of an integrated plan for water information and monitoring in the Northern Territory.

The Water Management Team of the Department of Natural Resources, Environment, the Arts and Sport, is the primary custodian of the Plan. This team is responsible for the implementation of the Plan, the review and update process.

The Water Management Team (the Team) consists of the Managers of the following Branches:

- Director, Water Management Branch
- Strategic Water Information Coordinator
- Water Monitoring
- Water Assessment
- Water Allocation
- Aquatic Health Unit
- Power and Water Corporation representative

Governance in this context encompasses frameworks of authority, accountability, stewardship, leadership, direction and control exercised by the members of the Water Management Team. Significant guidance regarding the national information identification, data monitoring and reporting is provided by the Bureau of Meteorology through the Joint Reference Group on Water Information (JRGWI). The Team is also guided by the Agency's internal governance framework.

A new Oracle based database will be implemented to collate all the data and information collected for the development of this Plan and to assist with reporting and gap analysis of data and information. This system will be used to ensure that the appropriate data and information is collected at the commencement and completion of any programs undertaken by the Agency.

To ensure that the Plan and associated IT component remain current, it is intended that all new programs undertake the gap analysis process prior to commencement to clearly identify where new data may be required to enable the information to be collated for that program. At the same time an equivalent amount of data gathering effort is required to be identified for termination, unless new recurrent resources are identified to allow the expanded network to be maintained. It is also intended that the process of updating the Plan documentation and running the gap analyses IT process will be

incorporated into Water Resources business plan and undertaken on at least an annual basis.

### **Risk and Review**

As stated above, Risk Management undertaken by the Team includes implementing an annual review process to revisit the Plan and to ensure that all information and data monitoring requirements are reviewed and evaluated. A gap analysis and review of information and data priorities will take place as part of this annual review. In order to ensure the review occurs on a timely basis it will be added to the agency's internal business planning, audit and risk processes.

As this Plan identifies the NT's priority data monitoring sites, this will assist in identifying the infrastructure requirements for the Team. Priority sites will ensure more efficient targeting of infrastructure installation and maintenance. This is particularly important to the Territory's flood forecasting sites.

The NT faces unique challenges to data collection and infrastructure maintenance due to the many remote localities where these sites are located. Other factors impacting on the achievement of the Agency's infrastructure activities include climate extremes and natural disasters.

The governing legislation for the Plan is the NT Water Act 1992 and this legislation provides an overriding direction for the lead Agency to use in implementing the Plan. The agency has developed a program of review aimed at ensuring its legislation remains relevant to its functions and incorporates best practice in the areas it administers.

Dissemination of information across the strategic partners is paramount for effective governance. There are several mechanisms that have been developed to ensure effective internal and external communication. These include use of the Internet and Intranet, through participation in national meetings, through meetings between the NT partners to discuss progress, reporting and future directions as well as identification and funding of associated projects that address the outcomes in the Plan.

### **Towards the Future**

The Northern Territory Government has identified priority areas for the distribution of Territory funding under the Territory Government Initiative of "Territory Growth Towns".

This initiative has been developed to ensure that our biggest and strategically placed remote communities become proper towns. Twenty of our indigenous communities will be transformed over time into Territory Growth Towns that:

- Are properly planned and designed;
- Have services, buildings and facilities like any other country town; and
- Benefit from targeted investment in infrastructure.

Under this initiative, these towns will need proper infrastructure including water, sewerage, electricity, and community facilities. This will have a future impact on the priorities identified in this Plan.

Another initiative that will impact on water resources in the NT is “Territory 2030” policy. The Territory 2030 Strategic Plan is the Government’s road map for the future. Developed in consultation with the Territory community. Territory 2030 contains 129 targets linked to six key priorities: education, society, economic sustainability, health and wellbeing, the environment, and knowledge, creativity and innovation.

The key priority that will impact on future water resources is the environment. This outlines a number of objectives and targets and the main ones that relate to the future of water resources with a possible impact on this Plan are the following:

- reduce the amount of water that Territory households use by 20% by 2015 and a further 10% by 2020, compared to 2009 consumption levels.
- ensure efficient use of water by business and industry.
- Manage the Northern Territory’s natural resources according to the principles of ecologically sustainable development.

Future Plans will contribute to the identification of water resources available to each of the 20 Towns and will assist with setting limits on the water allocations across the NT through the identification of information priorities and data priorities. New Government initiatives and the associated data and information requirements will be addressed in the annual review of the Plan.

## Section 1 – Water Information

### 1.A Drivers for Water Information

The Bureau of Meteorology has developed eight questions that will enable it to fulfill its mandate under the Commonwealth Water Act and Regulations to evaluate reform across the water sector, allowing greater confidence in Australia's water management. These questions are:

- How much water is there right now and where is it?
- How does it compare with history?
- How much water will we have tomorrow, next month, next year?
- Who has the rights to use water?
- How much are they using?
- How much water is being traded and to where?
- How much water is the environment getting?
- What quality is the water, and how is water quality changing?

While these questions are generic in form they are guided towards providing scope for water accounting and medium to long range resource forecasting. In addition, the Commonwealth Water Act, which dictates the Bureau's terms, is primarily designed to deal with the Murray-Darling system under crisis. These crisis conditions are due largely to severe drought and over allocation of the resources - conditions not generally experienced by the NT's water resources.

In this context, the NT is still very much in its infancy and is still a considerable way from producing jurisdictional water accounts. Furthermore, while it is possible for the NT to generate medium to long term water resource forecasts, i.e. we have the technology, the outputs are questionable or considered "rubbery" due to a lack of sufficient data and gaps in knowledge of the resource(s).

It is more appropriate and relevant for the Plan to consider drivers for water information from a more local perspective; drivers relating to NT water management priorities and activities, and current knowledge and data holdings from a relatively short history of water resource assessments and study. Given the nature and status of the NT's water resources and climate as discussed in the introduction of this Plan, the NT's water resource management activities are geared more towards sustainable development rather than amelioration.

The Plan identifies water management activities which have been prioritised and this is listed in Appendix 1.A.1.

For each management activity, information requirements have been subsequently prioritised in Appendix 1.A.2.

Management activities have been scored from one to five. Information Requirements have similarly been scored one to three within the context of the management activities.

Together they form a Priority Information Table with weighted scoring combining both of the above elements into a PIR Score. This table is show below.

Table 1 Priority Information Scoring System

<b>Activity Priority</b>	<b>AP Wgt</b>	<b>Info Priority</b>	<b>IP Wgt</b>	<b>PIR Score</b>
1	140	1	43.0	<b>183.0</b>
1	140	2	28.7	<b>168.7</b>
2	112	1	43.0	<b>155.0</b>
1	140	3	14.3	<b>154.3</b>
2	112	2	28.7	<b>140.7</b>
3	84	1	43.0	<b>127.0</b>
2	112	3	14.3	<b>126.3</b>
3	84	2	28.7	<b>112.7</b>
4	56	1	43.0	<b>99.0</b>
3	84	3	14.3	<b>98.3</b>
4	56	2	28.7	<b>84.7</b>
5	28	1	43.0	<b>71.0</b>
4	56	3	14.3	<b>70.3</b>
5	28	2	28.7	<b>56.7</b>
5	28	3	14.3	<b>42.3</b>

### 1.A.1 Water Resource Management and Asset Planning and Protection

Drivers for water information in the Northern Territory are centered on the region's water management priorities and activities bound by the NT Water Act and obligations to the provision of floodplain management and flood forecasts and warning. These priorities are categorised as:

1. Water Management
  - a) Water Control Districts – (WCD)
  - b) Beneficial use declarations – (BUD)
  - c) Water Allocation Planning Areas – (WAP)
  - d) Urban and remote community water supply – (UWS & RWS)
  - e) Mine leases (waste water discharge) – (MWL)
2. Regional Planning and Asset Protection
  - a) Floodplain Management – (FPM)
  - b) Flood Forecasting and Warning – (FFW)

## 1.A.2 Water Management

### Water Control Districts, Beneficial Uses and Water Allocation Planning Areas

Declarations are made under Section 22 and 73 of the NT Water Act 1992 and constitute the primary driver for water information and monitoring in the Northern Territory. Specifically:

*Water Control Districts (WCD) and Water Allocation Planning Areas (WAPA) are declared by the Minister under section 22 and 22B of the NT Water Act 1992.*

And;

*Beneficial Use Declarations (BUD) are declared by the Administrator under sections 22A for water extraction with in a WCD and 73 for general declarations to maintain and protect water quality.*

These declarations are made to ensure sustainable development of NT water resources and to protect its natural assets.

### Water Control Districts

There are seven WCDs declared in the NT with stated purposes for surface water and groundwater management:

DARWIN RURAL

GOVE

DALY/ROPER

TENNANT CREEK

WESTERN DAVENPORT

TI TREE

ALICE SPRINGS

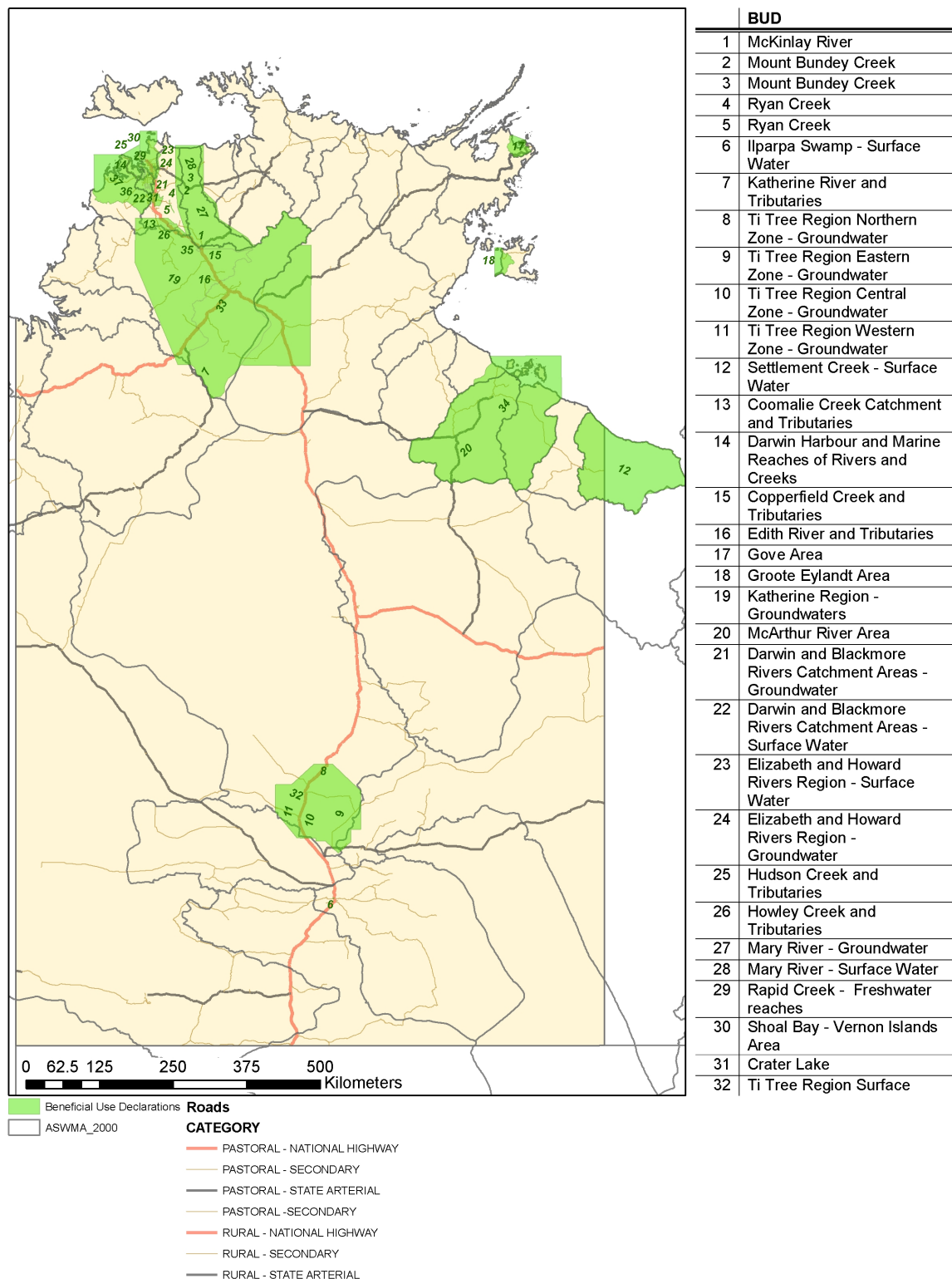
These are shown on the map on the following page.

### Beneficial Use Declarations

There are currently 25 separate locations with Beneficial Use Declarations across the Northern Territory of which 3 have been declared in relation to Section 22 of the NT Act for water extraction purposes and the remaining 26 declarations in relation to section 73 for water quality purposes. The declarations are made to ensure water qualities in such areas remain compliant with the standards and targets set down by the National Water Quality Management Strategy. A full list of Beneficial use Declarations can be found at: <http://www.nt.gov.au/nreta/water/beneficial/pdf/bud.pdf>

Whilst Beneficial Use Declarations do not necessarily trigger monitoring, there remains a requirement for the monitoring of any activity within the area to ensure that the water quality of the resource is not adversely affected by that activity.

# NT Beneficial Use Declarations



### **Water Allocation Planning Areas**

There are three declared WAPs in the NT.

- Alice Springs Water Resources Strategy;
- Katherine WAP;
- TiTree WAP.

There are another further five WAPS in various stages of development including:

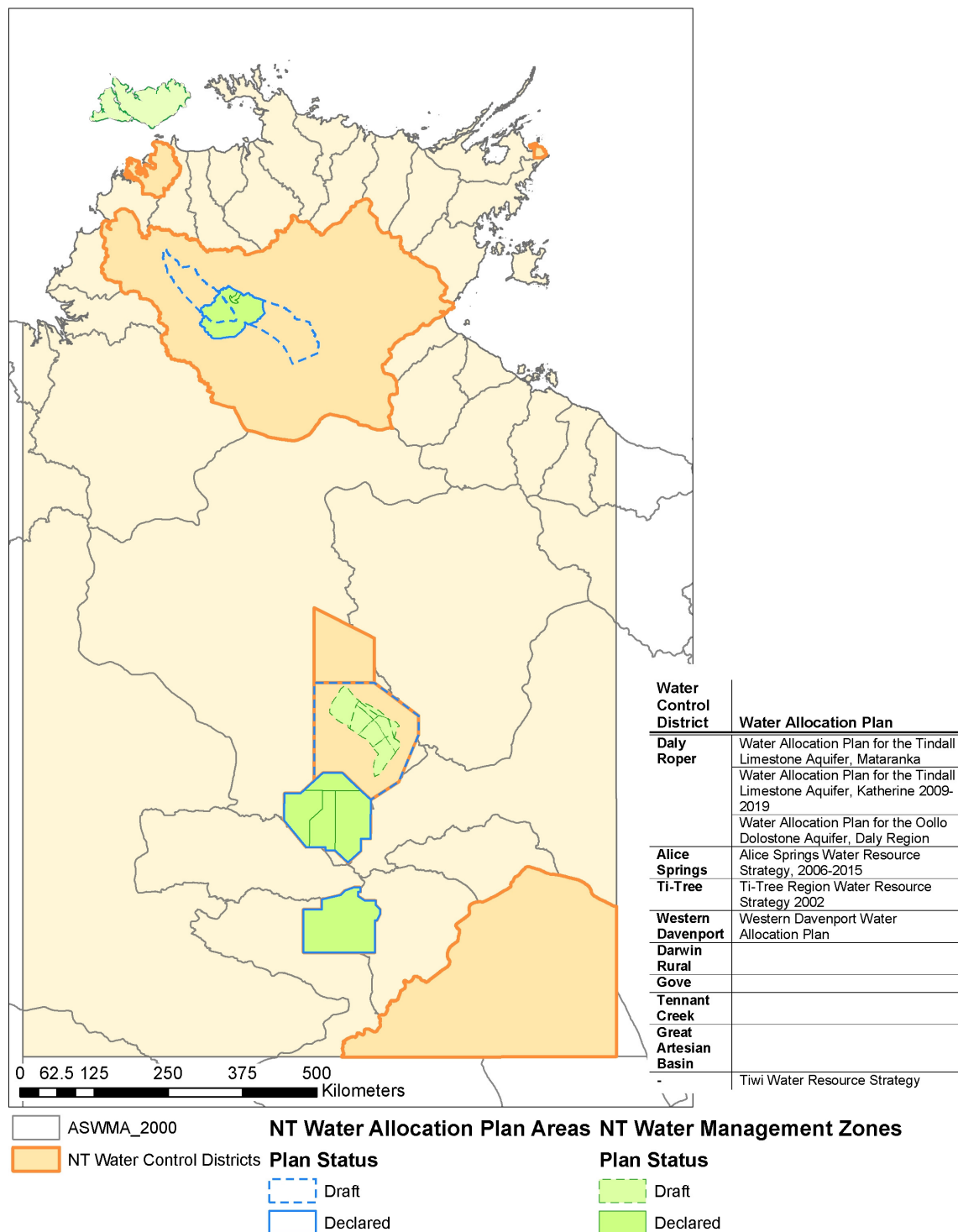
- Mataranka Groundwater Plan;
- Howard East WAP;
- Western Davenport WAP;
- Tiwi WAP;
- Oolloo Groundwater Plan.

Within each of the currently declared Water Allocation Plans are statements of objectives and purpose to protect and manage the resource in order to sustain its delivery of water to the competing demands of environmental and non-environmental elements. These objectives define the drivers for water information.

The WAP's are also equipped with a set of developed indicators to enable Management to assess progress towards the declared objectives. These indicators define the nature and characteristics of water information required.



# NT Water Management Areas



## **Water Resources Investigation**

To enable effective planning for water resource development and environmental protection, Section 34 of the NT Water Act provides that a continuous program for the assessment of water resources of the Territory is carried out, including the investigation collection, collation and analysis of data concerning the occurrence, volume, flow, characteristics, quality, flood potential and use of water resources. To serve this purpose, the following work is undertaken -

- gauging of stream flow, recording of climatic data and monitoring of groundwater levels;
- construction, operation, repair, maintenance of gauging, recording and monitoring stations and investigation and monitoring bores;
- sampling and analysis of water and waste; and
- cross-border investigation of water resources.

## **Water Supply**

Water supply in the context of the NT Act is a regulatory and compliance issue as well as a considerable influential factor in water allocation planning.

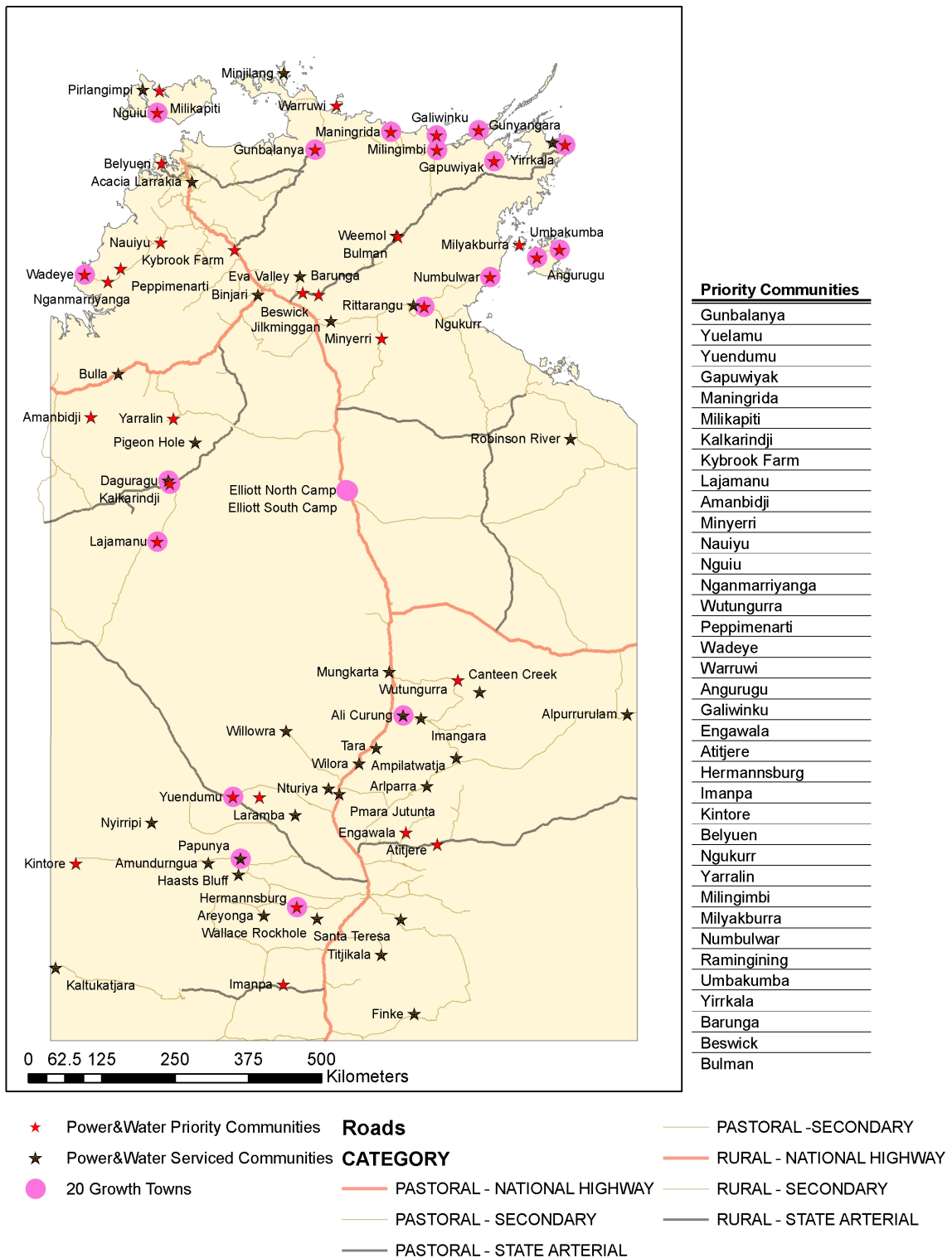
### **Urban Supply**

Power and Water Corporation manage and operate 2 main reservoirs and a significant number of bore fields to supply the Northern Territory's urban centres with potable water.

### **Remote Community Supply**

There are currently managed water supplies for 72 remote communities throughout the NT of which 28 are located outside the declared WCD's.

# Power & Water Remote Operations



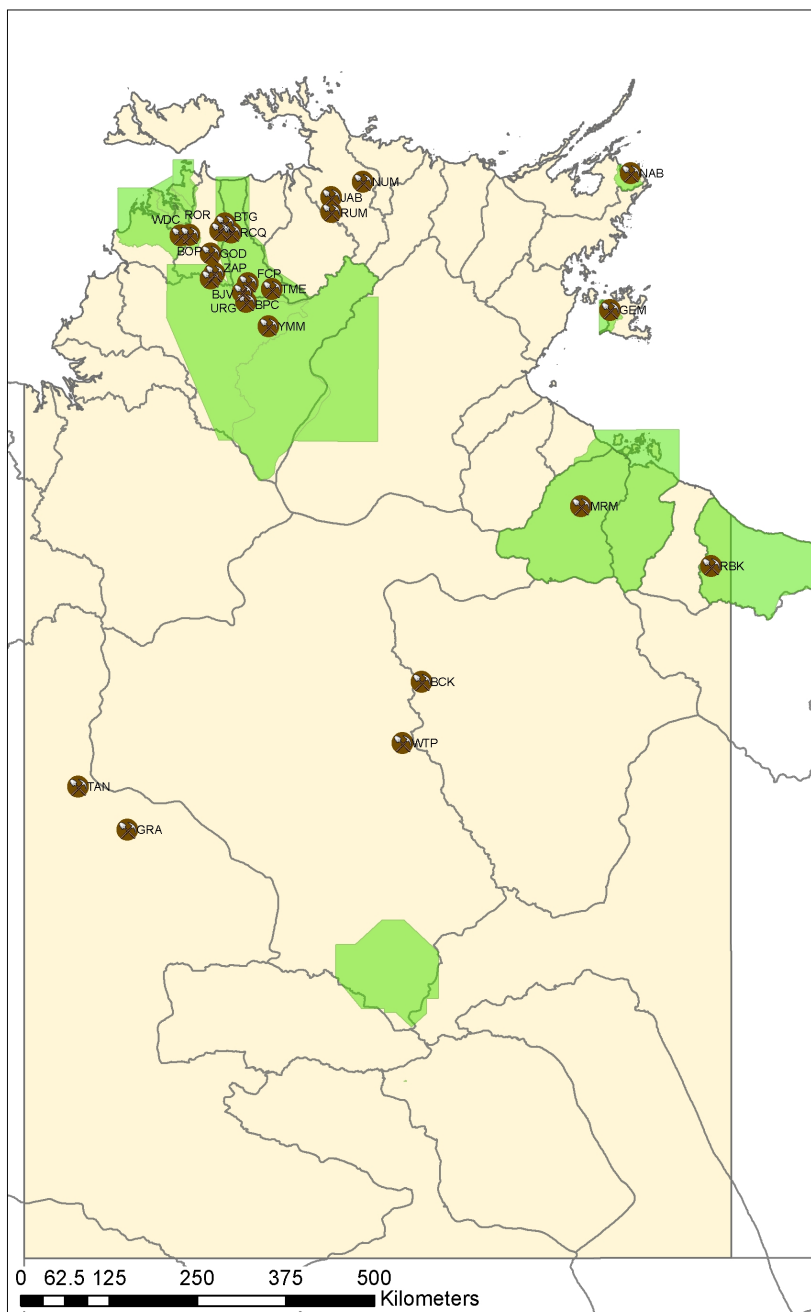
## **Mine Leases**

While extraction and water quality on mine leases are exempt from regulation under the NT Water Act, lease operators have obligations under mining licence to ensure minimal impact on water resources and the environment off lease.

The Minerals and Energy Group of The Department of Resources (DoR) are regulators of all operational or authorised mine sites in the Northern Territory. DoR are responsible for regulation of all activities on mine sites including environmental compliance but are not responsible for issuing or policing Waste Water Discharge licences granted under the Water Act to ensure regulation of offsite impacts.

The Environment Heritage and Arts Division of NRETAS is responsible for administration of Waste Discharge Licences as mine water discharges will usually be directed off the mineral lease and thus be subject to regulation under the Water Act.

## NT Monitored Mines



	Mine Name
BCK	Bootu Creek
BJV	Cosmo-Howley
BOP	Browns Oxide
BPC	Pine Creek Gold
BTG	Toms Gully
FCP	Frances Ck
GEM	Gemco Mine
GOD	Goodall
GRA	Granites
JAB	Jabiluka
MRM	McArthur River
NAB	Alcan Gove
NUM	Nabarlek
RBK	Sandy Flat (Redbank)
RCQ	Quest 29
ROR	Rustlers Roost
RUM	Ranger
TAN	Tanami Goldrush
TME	Moline
URG	Unions Reef
WDC	Woodcutters
WTP	Warrego Tails Project
YMM	Mt Todd
ZAP	Brocks Ck

Beneficial Use Declarations
  ASWMA\_2000
  Mines

### **1.A.3 Regional Planning and Asset Protection**

#### **Floodplain Management**

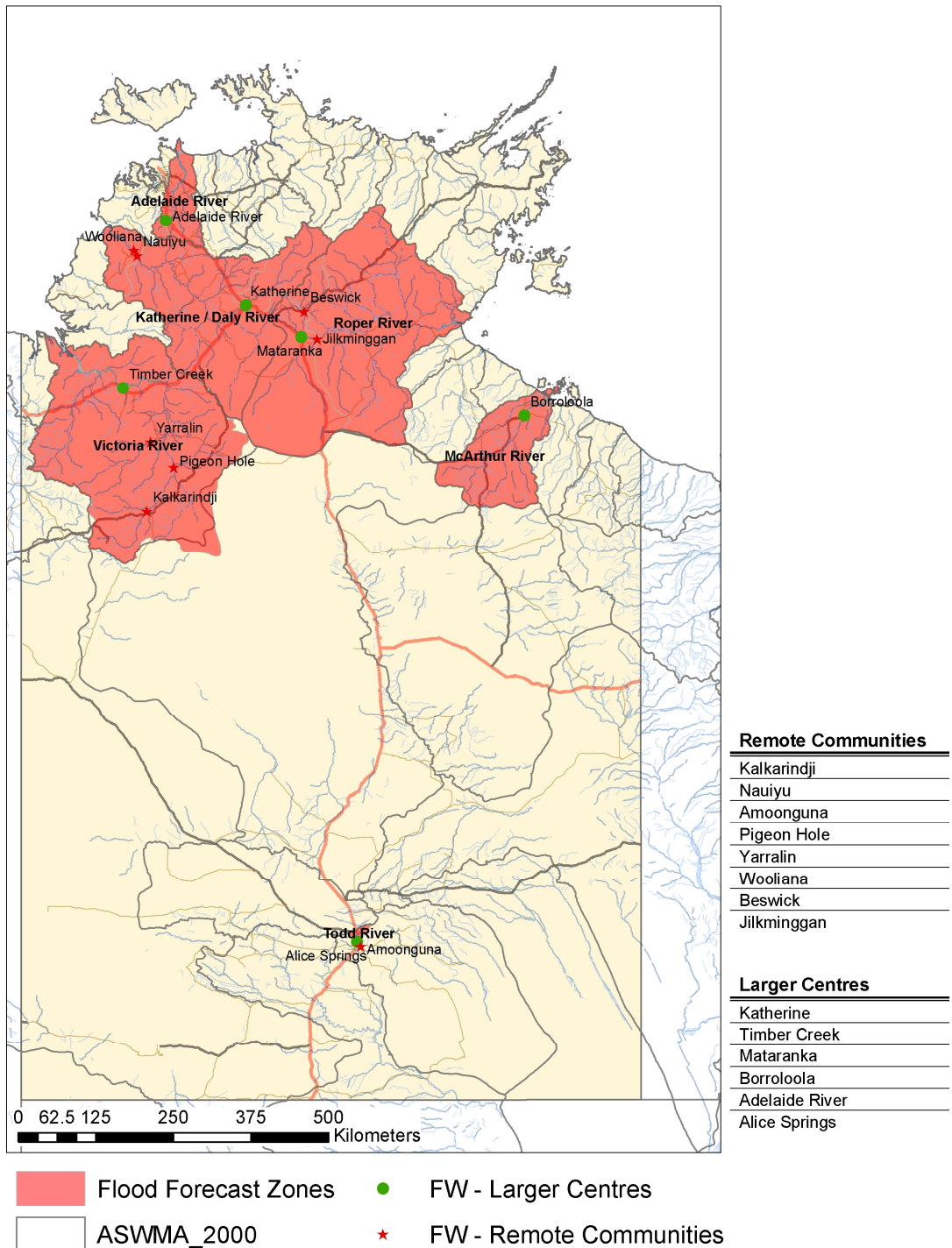
Floodplain management activities entail largely water assessments to provide advice for community, regional and infrastructure planning. Spatially, assessments are undertaken right across the territory.

#### **Flood Forecasting and Warning**

Flood forecasting and warning is a program undertaken by the lead water agency collaboratively with the Bureau.

The program currently provides the service to more than 25 communities across seven catchments (SWMA). The warning service is classified as either direct or in-direct based on whether the warning is generated from a modeled forecast or from river stage monitoring.

# NT Flood Forecasting



#### **1.A.4 Water Resource Priorities and Priority Regions**

Water resource priorities are defined by the distribution of management activities and functions across the NT. This is illustrated in the figure below that has been constructed as an overlay of function and management activity focus regions.

The NT identifies five priority regions:

1. Daly/Roper - SWMA 814 & 903
2. Darwin Region - SWMA 815, 817, 818
3. Central NT - Ti-Tree, Western Davenport & Tennant Creek
4. Alice Springs
5. Other - priority activities in the remainder of the NT including:
  - a. Victoria River
  - b. McArthur River
  - c. Gove
  - d. Groote Eylandt
  - e. Tiwi Islands

The first version of the NT SWIMP will address the requirements of the first four identified priority regions in detail. Subsequent SWIMP's are expected to address the remainder of the NT.



## **1.A.5 Region by Region**

### **1.A.5.1 The Daly/Roper Region**

The Daly/Roper region is an area of growing pressures on water resources with increasing levels of development and political interest. This is reflected in the high level of focus and effort from the lead water agency

The area occupied by this basin is approximately 160,000 square kilometres. There are four significant groundwater systems within it and establishing comprehensive knowledge and understanding across all these systems is a multi generational undertaking. There are also many less significant systems which will not be considered for monitoring due to their development potential as stock and domestic water supply sources only.

### ***Water Resource Activities and Functions***

#### **Water Control District**

The entire Daly/Roper Region defined by Surface Water Management Areas (SWMA's) 814 and 903 has been declared a single water control district to enable a greater level of control and management in these developing areas.

#### **Water Allocation Planning**

This region is subject to an intense water allocation planning work program that will see piecewise planning of regional water resource entities partly falling under an overarching basin plan for the Daly Region (SWMA 814). The current planning schedule for the Daly/Roper region is:

<b>WAP</b>	<b>Target declaration date</b>
Katherine Tindal	Early 2009
Mataranka Tindal	Late 2010
Oolloo aquifer	Late 2010
Overarching Daly Basin (SWMA 814)	2013 (TRaCK funding is currently out to 2012)

### **Planning Objectives**

The broad planning objectives for the region are to ensure environmental and cultural sustainability whilst providing sustainability and water security to consumptive users. An endemic feature of this region is the provision of baseflow from groundwater to major river systems including the Katherine, Daly and Roper rivers and is a priority focus for planning design.

Table 1.A.5.1-1 Water Allocation Plans for Daly/Roper Region

<b>WAP</b>	<b>Drivers and Priority</b>
Katherine Tindal	High level of competitive uses for public benefit and environmental requirements (E.g. GDE's and cultural sites of significance). Is a major centre for horticulture /agriculture industries and development in the NT. Extensive development existing with concerns regarding current and future levels of consumptive water use. Extensive areas of irrigable land in the region.
Mataranka Tindal	Significant GDE's and culturally significant sites including the springs in the vicinity of Mataranka. Increasing interest in irrigated horticultural development. Community water supplies sourced from the Roper river which is groundwater fed for 4 to 6 months each year.
Ooloo aquifer	Significant GDEs and cultural sites including the iconic Daly River. Identified for agricultural development due to large areas of irrigable land. High level of demand for water resources to establish irrigation projects.
Jinduckin Aquifer	Confining geological water bearing aquifer between the Tindal and Ooloo aquifers in the Daly basin with a need for better information regarding GDE's and cultural flow requirements.
Overarching Daly Basin	Need to tie together discreet aquifer WAPs including rules and guidelines for surface water use in the Daly Catchment.

Water allocation planning has been completed for the Tindal aquifer in the Katherine region. New plans are being developed for the Ooloo aquifer in the Daly Basin and the Tindal aquifer in the Mataranka region.

## Water Supply

Katherine is the third largest urban centre in the NT with a population of approximately 10,000 people with a consumption of around 3000 ML per year.

Power and Water Corporation's Remote Operation team also provide water supply to a number remote communities including Eva Valley, Minyerri and Ngukurr.

## Mining

Until recently, there were two mines operating in the region before the closure of Pine Creek Gold operating under waste discharge licences. Mount Todd gold mine is now the only significant monitored mining operation remaining in the region.

## Flood Monitoring Services

Flood monitoring and warning services are provided to the main regional centres of Katherine and Mataranka as well to remote communities including Wooliana, Nauiyu on the Daly River and Beswick and Jilkminggan on the Roper River.

## Information Requirements

The broad range of water management issues in the region are reflected the diversity of information requirements identified and include:

- Catchment characteristics and response to flood events.
- Contributions of spring flows and spring flow water quality to baseflow in the Daly and Roper Rivers.
- Indicators and trigger levels for significant cultural and environmental ecosystems and groundwater dependant ecosystems.
- Aquifer performance (behavior and response) as determined by monitored groundwater levels measured against extraction from the aquifer.

The highest priority information requirements for the Daly/Roper Region pertain to the following management activities:

	Mgt Priority
1. Flood Forecasting	1
2. The Katherine Tindall Water Allocation Plan	2
3. The Mataranka Tindall Water Allocation Plan	3

The following tables are subsets highlighting key areas of interest for the Daly/Roper region differentiated by management activity. See Appendix 1.A.1 for the complete Daly Region PIR listing.

## Flood Forecasting

Table 1.A.5.1-2 Priority Information Requirements for the Daly/Roper Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
FF-9	River conditions - cross sections, primary and secondary levee levels.	1	183
FF-8	Flood categories and classifications	1	183
FF-10	Qualitative forecasts - Indirect Predictions	1	183
FF-7	Modelled outputs - Direct Predictions: Katherine Upstream	1	183
FF-11	Temporal patterns and spatial distribution of rainfall	1	183
FF-6	Modelled outputs - Direct Predictions: Daly	1	183
FF-30	Modelled outputs - Direct Predictions: Lower Roper	2	169
FF-32	Catchments' Characteristics	3	154
FF-33	Spatial variation of soil moisture	3	154
FF-1	Modelled outputs - multiple peaks	4	140

### Katherine Tindall Water Allocation Plan

The highest priority information requirements for this management activity pertain to identifying water availability for consumptive use (info priority 1) followed by environmental health and water quality (info priority 2).

Table 1.A.5.1-3 Priority Information Requirements for the Katherine Tindall Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
KTWAP-4	Model output (cumecs) for Katherine River at 1 November, to make announced allocations for each water accounting year.	1	155
KTWAP-3	Recharge Modelling	1	155
KTWAP-2	Surfacewater and groundwater water quality response to extraction	1	155
KTWAP-1	Total discharge into Katherine River within WAP area	1	155
KTWAP-7	Katherine River Water Quality trigger values	2	141
KTWAP-8	Climate change	2	141
KTWAP-6	GW Dependant Ecosystem health indicators	2	141
KTWAP-5	GW Dependant Ecosystem identification and site locations	2	141
KTWAP-14	Confirmation of assumption that cultural flow requirements are the same as environmental flow requirements.	2	141
KTWAP-13	Relationship between groundwater levels and springflow	2	141
KTWAP-11	Waste discharge data - quantity and quality	2	141
KTWAP-10	Estimated non-licensed extraction	2	141
KTWAP-9	Water use requirements for stock and domestic use	2	141

### Mataranka Tindall Water Allocation Plan

The highest priority information requirements for this management activity pertain to identifying water availability for environmental health and water quality (info priority 1).

Table 1.A.5.1-4 Water Allocation Plans for Mataranka Tindall Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
MTWAP-1	Environmental Water Requirements and locations for identified GDEs	1	127
MTWAP-2	Surface water and groundwater water quality response to extraction	1	127

### 1.A.5.2. Darwin Region

The Darwin region holds the NT's largest urban centres, Darwin and Palmerston, highly developed and relatively intense irrigated horticulture and agriculture, and well established peri-urban landscape in the Darwin surrounds. Consequently, this region has the highest demands on water resources and imposes a significant challenge to water resource management.

#### ***Water Resource Activities and Functions***

##### **Darwin Harbour Catchment**

Darwin Harbour is a large estuary that experiences substantial tidal variation. The water quality of Darwin Harbour varies with tide, season and location. Over each tidal cycle, and between neap and spring tides, the water clarity can change dramatically. This is most notable in the upper reaches of the estuary where water carrying sediment flows out of mangrove-lined tidal creeks. River inflows affect the salinity of the Harbour and for lengthy periods of time during the wet season the upper reaches can be affected by large plumes of freshwater and the pollutants they carry. The estuary is a complex system. Understanding how the system works is important in determining monitoring requirements, management interventions and measuring their effectiveness.

Darwin Harbour estuary is subject to point source discharges (licensed wastewater input from sewage treatment plants), and diffuse source discharges (non-point, such as stormwater from a catchment). These discharges are typically high in sediment and nutrients and can result in degraded water quality, particularly in parts of the Harbour that are poorly flushed. Although the estuarine waterways of the region are generally in good shape, several areas subject to point sources and urban influence show signs of localised impact, and poor water quality.

##### **Water Control District**

A water control district has been declared for the Darwin Harbour Catchment (SWMA 815). The current planning program is aiming to extend this district to include the Adelaide River and Mary River catchments (SWMA 817 and 818) due to rising horticulture and agriculture development interests.

##### **Water Allocation Planning**

This region is subject to an intense water allocation planning work program that will see piecewise planning of regional water resource entities partly falling under an overarching basin plan for SWMA 815. The current planning schedule for the Darwin region is:

WAP	Target declaration date
-----	-------------------------

Howard East	Late 2012
Berry Springs	2011
Wildman siltstone	2013
Acacia Ridge (Moccatto Road)	2013
Marrakai	2014
Over Arching Darwin Rural	2014
Adelaide River	2015
Batchelor	2015

## Planning Objectives

The broad planning objectives for the Darwin region is to secure water supply for Darwin and Palmerston, protect and provide for significant regional water dependant ecosystems (rainforests and springs) and to provide continued support to irrigation enterprises in the region.

Table: Water Allocation Plans to be developed

WAP	Drivers and Priority
Howard East	High level of competitive uses for public benefit and environmental requirements (E.g. GDE's and cultural sites of significance). Is a major centre for horticulture /agriculture industries and development in the NT. Extensive development existing with concerns regarding current and future levels of consumptive water use. Extensive peri urban development primarily based on private ground water supplies for stock and domestic purposes. Single alternative water supply for Darwin and Palmerston.
Berry Springs	High level of competitive uses for public benefit and environmental requirements (E.g. GDE's and cultural sites of significance). Is a major centre for horticulture /agriculture industries and development in the NT. Extensive development existing with concerns regarding current and future levels of consumptive water use. One of only two high yielding aquifers in the vicinity of Darwin and therefore very attractive for irrigated agricultural developments.
Wildman siltstone	Extensive peri urban development primarily based on private ground water supplies for stock and domestic purposes.
Acacia Ridge (Moccatto Road)	Extensive development existing with concerns regarding current and future levels of consumptive water use.
Marrakai	Currently developing as an irrigated agriculture region.
Over Arching Darwin Rural	Needed to tie together discreet aquifer WAPs
Adelaide River	Potential site for a new water supply dam for Darwin and Palmerston. Some irrigation development in the downstream reaches.

Batchelor	High level of competitive uses for public benefit and environmental requirements (E.g. GDE's and cultural sites of significance). Is a major centre for mining industries and agricultural development in the NT. Extensive development existing with concerns regarding current and future levels of consumptive water use.
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## Water Supply

Water supply for Darwin and Palmerston is provided primarily from Darwin River Dam which is augmented with groundwater from various bore fields in high yielding aquifers within the Darwin region. A second neighbouring supply dam, primarily used for recreation, is Manton Dam.

## Mining

There exists a significant number of mining operations in this region currently monitored by the Department of Resources (DoR), including:

- Moline
- Frances Creek
- Unions Reef
- Cosmo-Howley
- Brocks Creek
- Goodall
- Quest 29
- Rustlers Roost
- Tom's Gully
- Woodcutters
- Brown's Oxide

Some of these mines have in fact collapsed due to the economic downturn and many have wound down production to a bare minimum.

## Flood Monitoring Services

Direct flood warning services are provided to the Township of Adelaide River in the upstream of the catchment while indirect warnings are provided to downstream communities at the Arnhem Highway Bridge and Marrakai Crossing.

Adelaide River Township lies with a flash flooding zone where that section of the Adelaide is fed by two tributaries known as East and West Branch. A six metre rise at East/West Branch could mean a 16-20 metre rise at the Stuart Highway Bridge in Town with a delay of less than 8 hours.

## Information Requirements

The highest priority information requirements for the Darwin Region pertain to the following management activities:

## Mgt Priority

- |  |   |
|--|---|
| 1. Flood Forecasting                   | 1 |
| 2. Floodplain Management               | 3 |
| 3. Berry Springs Water Allocation Plan | 3 |

Management Priority 2 relates to the Darwin Harbour and Catchments.

At the time of publication the Water Quality Protection Plan and other Darwin Harbour management activity requirements were still in development. Subsequently, a listing of PIR is not included in this release of the NT SWIMP. It should be noted that Darwin Harbour and associated management activities are considered high priority (minimum Mgt Priority 2) for the region and will be addressed in the next release of this Plan.

## Flood Forecasting

PIR Key	Priority Information Requirement	Info Priority	PIR Score
FF-13	Flood categories and classifications	1	183
FF-14	River conditions - cross sections, primary and secondary levee levels.	1	183
FF-15	Qualitative forecasts - Indirect forecasts	1	183
FF-16	Temporal patterns and spatial distribution of rainfall	1	183
FF-12	Modelled outputs - Direct Predictions: Upper Adelaide River	1	183
FF-34	Catchments' Characteristics	3	154
FF-35	Spatial variation of soil moisture	3	154
FF-2	Modelled outputs - multiple peaks	4	140

## Floodplain Management

PIR Key	Priority Information Requirement	Info Priority	PIR Score
FPM-5	Floodplain Flow gauging during major floods	1	127
FPM-17	Flood categories and classifications	2	113
FPM-20	Temporal patterns and spatial distribution of rainfall	2	113
FPM-18	River conditions - cross sections, primary and secondary levee levels.	2	113
FPM-16	Peak flood heights, corresponding time and flood extent marks due to riverine flooding and coastal area inundation.	2	113
FPM-19	Digital Elevation Model of the floodplain and coastal areas.	2	113
FPM-21	Event hydrographs at selected locations	2	113

## Berry Springs Water Allocation Plan



The highest priority information requirements for this management activity pertain to identifying water availability for environmental health and water quality (info priority 1) followed by cultural flow considerations (info priority 2).

Table 1.A.5.2-1 Priority Information Requirements for Berry Springs

<b>PIR Key</b>	<b>Priority Information Requirement</b>	<b>Info Priority</b>	<b>PIR Score</b>
BSWAP-3	Recognition of Native Title and development on SIR	1	127
BSWAP-2	Surface water and groundwater water quality response to extraction	1	127
BSWAP-1	Environmental Water Requirements and locations for identified GDEs.	1	127
BSWAP-9	Confirmation of assumption that cultural flow requirements are the same as environmental flow requirements.	2	113
BSWAP-4	Finalisation of model	2	113
BSWAP-5	Climate change	2	113
BSWAP-6	Water use requirements for stock and domestic use	2	113
BSWAP-7	Water Quality trigger values	2	113
BSWAP-8	Relationship between groundwater levels and springflow	2	113

### **1.A.5.3. Central NT – Ti Tree, Western Davenport & Tennant Creek**

Central NT is an arid region with a relatively high level of competition for groundwater resources with little recharge. This region also supports significant horticultural enterprise; table grapes grown in this area from water sourced from bores constitute one Central Australia's largest horticultural commodities.

#### ***Water Resource Activities and Functions***

##### **Water Control District**

Water control districts have been declared for three regions for groundwater management purposes and they are:

- Ti Tree
- Western Davenport
- Tennant Creek

Each of these areas abut one another making a relatively large area in central Northern Territory under a higher level of management of water resources.

##### **Water Allocation Planning**

A water allocation plan spanning the entire Ti Tree water control district was declared in 2002. This plan was developed to address growing competition for water resources with the development of major irrigation ventures for horticulture, i.e. table grapes.

Water allocation plans are also scheduled for development for Western Davenport and Tennant Creek with target dates of 2010 and 2014 respectively.

##### **Planning Objectives**

Planning objectives for this region are primarily to protect and manage the highly critical groundwater systems.

Table 1.A.5.3-1 Water Allocation Plans for Central NT Region

WAP	Drivers and Priority
Ti Tree	<p>Almost all water supplies – for town and community use, irrigated agriculture, and pastoral homestead and stock needs – are drawn from groundwater. Most of these supplies rely on aquifers in the Ti-Tree Basin. Land overlying the Ti-Tree Basin is generally suitable for irrigated horticulture; extensive areas of sandplain with well-drained soils present few constraints for crop growth. Pastoral production and horticulture are major economic activities in the Strategy region.</p> <p>It is likely that water use from the Ti Tree Basin will continue to expand, causing increased competition between consumptive users of water i.e. agriculture, industry and public water supply, with potential impacts on non-consumptive water use for environment and cultural values. This area has extremely limited recharge meaning that water resources will have intergenerational sustainability only.</p>
Western Davenport	Identified for irrigation development. Limited water supplies and extremely limited recharge meaning that water resources will have intergenerational sustainability only.
Tennant Creek	Very limited supplies for public water supply. Limited recharge.

## Mining

A single mine exists just to the north of the Tennant Creek water control district, the Warrego Tails Project (copper mining).

## Information Requirements

The highest priority information requirements for Central NT pertain to the following management activities:

	Mgt Priority
1. Ti Tree Water Allocation Plan	1
2. Western Davenport Water Allocation Plan	5
3. Tennant Creek	5

The following tables are subsets of the Information Requirements highlighting key areas of interest for the Ti Tree, Western Davenport and Tennant Creek regions. These are differentiated by management activity. See Appendix 1.A.1 for the complete PIR listing.

### Ti Tree Water Allocation Plan

The highest priority information requirements for this management activity relate to identifying water availability for consumptive use (info priority 1) followed by future demands on water availability (info priority 2).

Table 1.A.5.3-1 Priority Information Requirements for the Ti Tree Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
TTWAR-1	Identification of Surface and Groundwater assets within the Ti Tree Basin.	1	127
TTWRS-2	Review regional water balance	1	71
TTWRS-3	Monitor regional groundwater quality	1	71
TTWRS-1	Reassess sustainable yield	1	71
TTWRS-2	Review regional water balance	1	71
TTWAR-7	Assessment of the water assets within the Ti Tree Basin and the changes in water assets for any given financial year. The first year being 2008/09.	2	113
TTWAR-6	Assessment of existing demands on water resources and identification of future changes due to environment and growth in demand by current and future users of water resources within the Ti Tree Basin.	2	113

### Western Davenport Water Allocation Plan (Proposed)

The highest priority of information requirements for this management activity relate to identifying water availability for consumptive use (info priority 1) followed by environmental health and water quality (info priority 2).

Table 1.A.5.3-2 Priority Information Requirements for the Western Davenport Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
WDWAP-1	Prepare formal water balance for District	1	71
WDWAP-2	Determine aquifer recharge and recharge areas	1	71
WDWAP-3	Determine sustainable yields of regional aquifers	1	71
WDWAP-5	Monitor regional rainfall and streamflow	1	71
WDWAP-6	Assess the role of surface water ecosystems in aquifer recharge and discharge	1	71
WDWAP-13	Monitor health of key water dependent environmental sites	2	57
WDWAP-15	Determine cultural water requirements for surface and groundwater resources in each management zone	2	57
WDWAP-16	Monitor health of key culturally significant water dependent sites that are vulnerable to change from water extraction	2	57

### Tennant Creek Water Allocation Plan (Proposed)

The highest priority of information requirements for this management activity relate to identifying water availability for consumptive use. At the time of publication limited research and reporting has been carried out for this region. It should be noted that the Tennant Creek Water Allocation Plan are considered a high priority (priority info 1) and will be addressed in a subsequent release of the Plan. Therefore baseline information is being collected within the arid zone (info priority 2) followed by information assessment and modelling (info priority 3).

Table 1.A.5.3-3 Priority Information Requirements for the Tennant Creek Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
SWIAP-6	Continuous river/creek heights, flows and rainfalls in the Catchment of interest	2	85
SWIAP-15	Temporal patterns and spatial distribution of rainfall	3	70
SWIAP-12	Flood categories and classifications	3	70
SWIAP-14	Catchments' Characteristics	3	70
SWIAP-13	River/Creek conditions - cross sections, primary and secondary levee levels, bed level at specified locations.	3	70

#### 1.A.5.4. Alice Springs

Alice Springs is the second largest populated city in the NT located in the centre of Australia on the Todd River.

### ***Water Resource Activities and Functions***

#### **Water Control District**

The Alice Springs water control district covers an area of 8 200 km<sup>2</sup>. This WCD encompasses the catchments of the Todd River and a portion of the groundwater aquifers in the northern part of the Amadeus Basin in the immediate vicinity of the township of Alice Springs. The remaining portion of the WCD to the south incorporates a number of other aquifers including the Mereenie, Pacoota Sandstones, and the Shannon and Goyder formations.

Almost all of the water supplies in the WCD are drawn from groundwater, either from alluvial sediments or from rock aquifers in the northern part of the Amadeus Basin, with the exception of some surface water retention in small dams for stock use.

In addition to support the area's unique environment and areas of traditional significance, the water resources of the Alice Springs region support all major economic activities of Alice Springs including residential development, tertiary industries (including tourism and regional support functions), defence, pastoral production and horticulture.

#### **Water Allocation Planning**

The Alice Springs Water Resource Strategy (ASWRS) is a water allocation plan for surface water and groundwater from the Alluvial Aquifers and the Amadeus Basin Aquifers. A copy of the ASWRS can be sourced from the Department of Natural Resources, Environment, The Arts and Sport website at <http://www.nt.gov.au/nreta/water/aswrs/index.html>.

#### **Planning Objectives**

Planning objectives for this region are primarily to protect and manage the highly critical groundwater systems.

Table 1.A.5.4-1 Water Allocation Plan for Alice Springs region

WAP	Drivers and Priority
Alice Springs Water Resource Strategy	Almost all of the water supplies in the Strategy region are drawn from groundwater, either from alluvial sediments or from rock aquifers in the northern part of the Amadeus Basin, with the exception of some surface water retention in small dams for stock use.

## Flood Monitoring Services

Direct flood warning services are provided to the Alice Springs Township and indirect warning is provided to communities downstream of Alice Springs such as Amoonguna. Whilst the network is maintained from staff in Darwin, the warning service is operated by a local team due to the flashy nature of the catchment. Further backup support is provided from Darwin.

## Information Requirements

The following tables are subsets of the Information Requirements highlighting key areas of interest for the Alice Springs region. These are differentiated by management activity. See Appendix 1.A.1 for the complete PIR listing.

### Flood Forecasting

Table 1.A.5.4-2 Priority Information Requirements for Flood Forecasting in the Alice Springs Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
FF-17	Modelled outputs - Direct Predictions: Upper Todd River	1	183
FF-18	Flood categories and classifications	1	183
FF-19	River conditions - cross sections, primary and secondary levee levels.	1	183
FF-20	Qualitative forecasts - Indirect forecasts	1	183
FF-21	Temporal patterns and spatial distribution of rainfall	1	183
FF-36	Catchments' Characteristics	3	154
FF-37	Spatial variation of soil moisture	3	154
FF-3	Modelled outputs - multiple peaks	4	140
FF-3	Modelled outputs - multiple peaks	4	140
FPM-7	Floodplain Flow gauging during major floods	1	127
FPM-6	Peak flood heights, corresponding time and flood extent marks	1	127

### Alice Springs Water Resource Strategy

The highest priority information requirements for this management activity relate to identifying water availability for consumptive use (info priority 1) followed by cultural and environmental flow considerations (info priority 2).

Table 1.A.5.4-3 Priority Information Requirements for the Alice Springs Region

PIR Key	Priority Information Requirement	Info Priority	PIR Score
ASWAP-5	Review regional monitoring program and report monitoring data and findings of water resource investigations to regional stakeholders regularly	1	155
ASWAP-1	Prepare conceptual hydrogeological model for the District	1	155
ASWAP-4	Monitor regional groundwater quality	1	155
ASWAP-10	Monitor regional rainfall and streamflow	2	141
ASWAP-11	Determine cultural water requirements for surface and groundwater resources in each policy zone	2	141
ASWAP-12	Monitor health of key culturally significant water dependent sites that are vulnerable to change from water extraction	2	141
ASWAP-10	Monitor regional rainfall and streamflow	2	141

### 1.A.5.5. Other – Priority activities outside management zones

#### Remote Community Water Supply

Power and Water Corporation, Remote Operations Branch have identified 28 priority remote communities that lie outside the priority water management zones listed above. They are:

Gunbalanya	Warruwi
Yuelamu	Angurugu
Yuendumu	Galiwinku
Gapuwiyak	Engawala
Maningrida	Atitjere
Milikapiti	Hermannsburg
Kalkarindji	Imanpa
Lajamanu	Kintore
Amanbidji	Yarralin
Nguiu	Milingimbi
Nganmarriyanga	Milyakburra
Wutungurra	Numbulwar
Peppimenarti	Ramingining
Wadeye	Umbakumba

These communities are distributed across the NT and source water from a variety of aquifers.



## **1.B Information Inventory**

Appendix 1.B lists all relevant priority information products (PIPs) identified at the time of release of this plan divided into the priority regions of the NT. Note that in some cases a PIP may be relevant to multiple regions and will appear multiple times. Included in the detail is a description of the product and a broad discussion of the monitoring and data requirements. As per the scoring system described in the introduction of this plan, the scores for each product are also provided.

Note: Appendix 1.B is also recognized as appendix 2.A as it is the PIPs that define the NT monitoring and data requirements according to the philosophy of this Plan.

### **Inventory Summary**

There are 61 information products recorded in WIMS at the time of release of this Plan to which 58 have received scores and hence are regarded as PIPs. The majority of these products are baseline and water management specific resource assessments to facilitate water resource planning and, licensing and regulation of the NT Water Act. Floodplain mapping and flood modeling also make up a considerable portion of the PIPs.

## **1.C Information Gap Analysis and Priority Assessment**

Gaps identified in this section are based on themes listed in the introduction to this plan. The main theme covered in this section is 'Knowledge, Understanding and Programs'.

Priority Information Requirements not currently addressed are indicated in Appendix 1.A.2.

As part of a review of the 2010 SWIMP, a report on whether there has been closure of identified gaps has been compiled and is attached at Appendix 3. This report highlights that while gaps identified through the Bureau of Meteorology's Modernisation and Extension Program have been addressed to some extent there has been little progress on the closure of the gaps identified in the 2010 SWIMP. This is primarily due to the fact that the 2010 SWIMP was only completed in June 2010.

Whilst work is progressing on developing a full gap analysis and a data monitoring program through the NT's new Water Information Management (WIMS) System, this is still in progress.

### **1.C.1 NT Wide Gaps**

#### **Knowledge, Understanding and Programs**

As part of the development of this monitoring plan, a prioritisation framework has been developed to better inform the gap analysis process and provide consistency and repeatability to each analysis. This has been developed into a database called the Water Information Management System (WIMS).

This system currently includes all water resource projects in the NT. Each project has been given a weighted priority based upon knowledge and experience of staff in the department. Information requirements for each project were then listed by the project managers and senior water resource staff, once again each information requirement has been given a weighted priority. For each information requirement a list of monitoring data requirements has been established; these monitoring data requirements have also been given a weighted priority.

This system has been built using an Access database but it is intended to migrate this to an oracle based system over the next six to twelve months to maximize the potential of the data and information. The system allows for a strategic and pragmatic approach to the identification of monitoring requirements associated with each of the projects or activities being undertaken by the Water Resources Branch. The system also allows for a range of perspectives to be applied. The analysis can be undertaken from a project information and data requirements perspective, from an overall information requirements perspective and finally from a site or data requirements perspective. It is envisaged that this will initially be used to undertake an overall review of the monitoring network in the NT. It is expected that this would result in a rationalization of the network to align work load with resources and to account for the plethora of new sites being established as new programs, such as water allocation plans, are delivered. Given the static or decreasing nature of resources there is a strong requirement to commence closure of low priority sites.

It is intended to undertake an initial analyses of each component of the framework, redesign the monitoring network accordingly and reapply the framework to assess any outstanding gaps. This is expected to be an iterative process which will be undertaken on a regular basis. The process will also be undertaken at the commencement of any new project to allow strategic planning to be undertaken and resource requirements to be more clearly understood and documented.

## **1.C.2 Region by Region**

### **1.C.2.1. Daly/Roper**

#### **Knowledge, Understanding and Programs**

The key gaps in knowledge across this region may be attributed to issues of recharge quantification, dependency and needs of groundwater dependent ecosystems and the karstic nature and very high permeability in the two major aquifer systems which pose difficulties in predicting and discerning groundwater movement and response.

#### **GAP DRKUP1 – Location of Significant Springs**

##### **Gap**

Significant river spring locations are not known or have not been mapped.

##### **Cause**

Recent and future plans under the WAP Schedule identify springs as key indicators of aquifer performance and health.

##### **Impact**

Appropriate monitoring network design is not possible without knowledge of the locations of significant spring locations. Monitoring significant spring flows and associated water quality is required to accurately determine contributions to baseflow and relative contributions to water quality on ground water discharge during low flow events/periods.

##### **Risk**

Risk assessment will be carried out in subsequent SWIMPs

#### **GAP DRKUP2 – Recharge Quantification**

##### **Gap**

The key gaps in knowledge across this region may be attributed to issues of recharge quantification, dependency and needs of groundwater dependent ecosystems and the karstic nature and very high permeability in the two major aquifer systems which pose difficulties in predicting and discerning groundwater movement and response.

Risk assessment will be carried out in subsequent SWIMPs.

#### **GAP DRKUP3 – Katherine-Tindal WAP Monitoring Program**

##### **Gap**

Appendix 2 of the Katherine Tindal WAP sites the requirement of a hydrographic and water quality monitoring program.

##### **Cause**

Katherine-Tindal WAP Implementation Strategy

##### **Impact**

Insufficient and inappropriate data to undertake evaluation of the Katherine-Tindal WAP

**Risk**

Risk assessment will be carried out in subsequent SWIMPs

### 1.C.3. Darwin Region

Tabled below are the known gaps for the Darwin Region. No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

Table 1.C.2.1 Darwin PIR's not addressed

<b>Mgt Activity</b>	<b>Priority Information Requirement</b>	<b>Score</b>
BSWAP	Recognition of Native Title and development on SIR	127
BSWAP	Water use requirements for stock and domestic use	113
BSWAP	Confirmation of assumption that cultural flow requirements are the same as environmental flow requirements.	113
FPM	Catchments' Characteristics	98
FPM	Spatial variation of soil moisture	98
HEWAP	Proposed rezoning	85
HEWAP	Surface and groundwater quality response to extraction	85
HEWAP	Determination of cultural flow requirements	85
HEWAP	Density and location of existing and proposed effluent disposal systems	85
HEWAP	Crop water use model	85
HEWAP	Estimate current rural domestic use (sourced from groundwater bores)	85
HEWAP	Consideration of strategic reserve to support Indigenous economic development opportunities (SIR)	85
AHWAP	Identify and prioritise sites of recreational and aesthetic importance	71
WHWAP	Identify and prioritise sites of recreational and aesthetic importance	71
WHWAP	Future rural residential development scenarios	71
WHWAP	GDE locations and Environmental Water Requirements (EWRs)	71
WHWAP	Localised impacts of extraction from production bores or high density of stock and domestic bores	71
WHWAP	Property development plans (PDPs)	71
WHWAP	Sites of Indigenous cultural importance	71
AHWAP	Property development plans (PDPs)	71
WHWAP	Sources of salinity	71
AHWAP	Sites of Indigenous cultural importance	71
AHWAP	Future rural residential development scenarios	71
AHWAP	Crop water use model	57
AHWAP	Consideration of strategic reserve to support Indigenous economic development opportunities (SIR)	57
WHWAP	Determination of cultural flow requirements	57
AHWAP	Determination of cultural flow requirements	57
WHWAP	Surface and groundwater quality response to extraction	57
AHWAP	Density and location of existing and proposed effluent disposal systems	57
WHWAP	Density and location of existing and proposed effluent disposal systems	57
WHWAP	Consideration of strategic reserve to support Indigenous economic development opportunities (SIR)	57
WHWAP	Crop water use model	57
WHWAP	Estimate current rural domestic use (sourced from groundwater bores)	57
WHWAP	Aquifer characterisation	28

### 1.C.3. Central NT - Ti-Tree, Western Davenport & Tennant Creek

#### Knowledge, Understanding and Programs

##### **GAP CNTKUP1 – Groundwater Chemistry monitoring program**

###### **Gap**

Action 4 of the Ti Tree WAP requires the implementation a monitoring program to investigate changes in groundwater chemistry.

###### **Cause**

Ti Tree WAP

###### **Impact**

Inability to detect saline encroachment of groundwaters in main horticultural area.

###### **Risk**

Reduced effectiveness of Ti Tree WAP to manage extraction and groundwater quality.

##### **GAP CNTKUP2 – Groundwater Dependant Ecosystem Health hydrographic monitoring program**

###### **Gap**

Action 6 of the Ti Tree WAP requires the implementation a monitoring program for indicators of environmental and cultural place health.

###### **Cause**

Ti Tree WAP and undefined aquatic health indicators

###### **Impact**

Inability to detect GDE and cultural place health deterioration as a result of extraction.

###### **Risk**

Reduced effectiveness of Ti Tree WAP to manage and maintain GDE and cultural place health.

### 1.C.4. Alice Springs

#### Knowledge, Understanding and Programs

##### **GAP ASKUP1 – Water Quality monitoring program**

### **Gap**

Action 6 of the Alice Springs Water Resource Strategy requires the implementation a water quality monitoring program.

### **Cause**

Alice Springs Water Resource Strategy and quantitative values for environmental water requirements.

### **Impact**

Insufficient data to undertake evaluation of the Alice Springs Water Resource Strategy.

### **Risk**

Reduced effectiveness of Alice Springs Water Resource Strategy to manage and maintain regional GDEs and cultural places.

## **1.C.5. Other - priority activities in the remainder of the NT**

### **Knowledge, Understanding and Programs**

#### **Gap OKUP1 – Remote Community Water Resources Monitoring**

### **Gap**

Groundwater level monitoring (Standing Water Levels) in remote aquifers withdrawn by the NTG in 1995, leading to the current situation of a growing 13 year-gap in aquifer information.

### **Cause**

NTG policy changes and NT Water Resources restructure in 1995 saw the break up and redistribution of water provision and water management/assessment services.

### **Impact**

13 year gap in monitoring data and information resulting in limited information regarding aquifer/system performance and health.

### **Risk**

One third of water sources may be at risk of over-extraction and little information is available to determine their risk level



## 1.D NT Water Information Priorities

This document, and more importantly the associated IT system, will enable the Agency to undertake gap analyses on a regular, repeatable and objective manner. One of the primary issues currently faced by water resource managers in the NT is the management of resources required to undertake a comprehensive data collection network, which delivers directly to the development of the information required to undertake the resource management programs.

This system allows for all aspects of the process to be objectively analysed, including programs, information and data requirements. By scoring and weighting each of these components pragmatic decisions regarding the most appropriate and achievable monitoring network design can be undertaken. It is intended that the initial review will be undertaken prior to the publication of the Plan, allowing for the development of an overarching strategic plan relating to information requirements and the associated data monitoring and collection in the NT.

As stated above, it is intended to introduce regular information and data requirement reviews both on the commencement of new programs and or, on at least an annual basis in line with business planning. These reviews are intended to ensure that the monitoring network remains up to date and its design best serves the prioritised information requirements for each program. This system is also expected to allow for the expansion and or reduction in the monitoring network, information requirements and programs, as new resources are identified and or existing resources lost, necessitating a downsizing of the monitoring effort.

Gaps identified as part of this new system will be assessed using the prioritisation standards developed as part of the Plan. If it is agreed that a particular gap has a high priority, and there are no available resources to expand the monitoring effort, the system will allow the agency to make much better informed decisions about where monitoring can be reduced in other lower priority programs or information requirements.

### 1.D.1 Multi Regional Tasks

No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

### 1.D.2 Region by Region

#### 1.D.2.1 Daly/Roper

Table 2.D.2.1 Daly/Roper Water Data and Monitoring Priorities

Action/Task	Region(s)	Commence	End
Develop and implement monitoring programs for the Katherine-Tindal WAP	Daly/Roper, Katherine-Tindal		
<b>Undertaken by</b>	NRETAS, Water Assessment		

<b>Description</b>	These programs will be developed in accordance with Appendix 2 of the Katherine-Tindal WAP implementation strategy.
<b>Status</b>	Quarterly groundwater level monitoring program currently conducted Continuous flow monitored in spring section of the Katherine River. Dry season flow monitoring of 'Katherine Hot Springs'.
<b>Outcome(s)</b>	Improvement in frequency of groundwater level monitoring sought through continuous logging systems. Knowledge gaps of recharge distribution and magnitude exist - strategic water level monitoring sites delivering continuous data therefore required to affirm concepts of processes occurring and behavioural response of resource. Data gaps exist in river geometry, location of specific spring sites and magnitude of flow emanating from those springs.
<b>GAP</b>	DRKUP3

### 1.D.2.2 Darwin Region

No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

### 1.D.2.3 Central NT - Ti-Tree, Western Davenport & Tennant Creek

Table 2.D.3 Central NT Water Data and Monitoring Priorities

Action/Task	Region(s)	Commence	End
Develop and implement a Groundwater chemistry monitoring program for the Ti Tree WAP	Central NT, Ti Tree		
<b>Undertaken by</b>	NRETAS, Water Assessment		
<b>Description</b>	This program is to be developed in accordance with Action 4 of the Ti Tree WAP: <i>Develop and implement a monitoring program to investigate changes in groundwater chemistry at key sites.</i>		
<b>Status</b>	Biannual water level monitoring program currently conducted with infrequent sampling of production bores in main borefield area.		
<b>Outcome(s)</b>	Issue of saline encroachment of groundwaters into main horticultural area due to extraction. Current sampling regime using production bores detects salinity after encroachment has already occurred – improvement in monitoring frequency and salinity trends required in area remote from borefield (ie. nearer source) sought. Strategic water level and salinity loggers required.		
<b>GAP</b>	CNTKUP1		

Action/Task	Region(s)	Commence	End
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Develop and implement monitoring program(s) relevant to significant environmental and cultural place health indicators	Central NT, Ti Tree		
<b>Undertaken by</b>	NRETAS, Water Assessment		
<b>Description</b>	This program is to be developed in accordance with Action 6 of the Ti Tree WAP: <i>Develop and implement programs to monitor health of key environmental (groundwater dependent ecosystems) and cultural places that are vulnerable to change due to water extraction.</i>		
<b>Status</b>	Biannual water level monitoring program currently conducted only.		
<b>Outcome(s)</b>	Improvement in knowledge of resource behaviour and seasonal trends sought with increased frequency of data capture to deliver better representation. Water level loggers required.		
<b>GAP</b>	CNTKUP2		

#### 1.D.2.4 Alice Springs

Table 2.D.4 Alice Springs Water Data and Monitoring Priorities

<b>Action/Task</b>	<b>Region(s)</b>	<b>Commence</b>	<b>End</b>
Develop water quality monitoring for the Alice Springs Water Resource Strategy	Alice Springs		
<b>Undertaken by</b>	NRETAS, Water Assessment		
<b>Description</b>	This program is to be developed in accordance with Action 6 of the Alice Springs Water Resource Strategy: <i>Determine quantitative values for environmental water requirements sourced from surface and groundwater resources and prepare management rules for sustaining ecosystems in relevant management zones, including monitoring and regular program review.</i>		
<b>Status</b>	Water level monitoring program currently conducted only.		
<b>Outcome(s)</b>	Water level 'trigger' for critical areas with potential for salinisation and waterlogging (sustainability of riparian vegetation determined as GDEs to be managed by control of local water levels). Future improved data accuracy and mapping of trends sought. Strategic water level and salinity loggers required.		
<b>GAP</b>	ASKUP1		

### 1.D.2.5 Other - priority activities in the remainder of the NT

<b>Action/Task</b>		<b>Region(s)</b>	<b>Commence</b>	<b>End</b>
Re-instatement and modernisation of groundwater resource monitoring for remote community water supply		NT Wide	2008	
<b>Undertaken by</b>	Power and Water Corporation, Remote Operations			
<b>Description</b>	<p>3 year plan to increase the monitoring of groundwater bores across NT communities, and as such, operational resources are available to maintain the monitoring program into the future.</p> <p>Plan includes the implementation and modernisation of monitoring groundwater resource monitoring at priority remote communities.</p>			
<b>Status</b>	Equipment purchased, monitoring program designed			
<b>Outcome(s)</b>	<ul style="list-style-type: none"> <li>Improved capacity to manage resource – resource health, performance and response.</li> <li>Increased understanding of remote aquifer systems and hydrological processes.</li> </ul>			
<b>GAP</b>	OKUP1			

## Section 2 – Data and Monitoring

There are over 60 water resource assessments or water information production programs current in the NT undertaken by the three named NT persons in the Regulations. These programs to greater or lesser extent address the Priority Information Requirements identified in section 1 and have been provided scores on this basis. That is, a program is scored by summing the scores of each PIR it addresses.

At the time of this publication 48 programs have been scored and are listed on the following page. As illustrated in the table, program scores range from 99 to 6557. Although it should be noted that the top scoring programs, GW baseline monitoring North and South, are broad and wide range programs and are misleading in terms of program priority.

These programs define the requirements and hence priorities for water data and monitoring in the NT.

Similarly, site priorities are scored on the sum of the scores of programs that have requested data from those sites. To date approximately 1819 sites have been requested as current monitoring points. Of these sites more than 1500 sites have received scores based on the 48 scored programs in the table on the following page.

Table 2.1 Scored Water Resource Assessments

Agency	Program / Project	Score
NRETAS	Baseline GW Monitoring Northern Region	6557
NRETAS	Baseline GW Monitoring Southern Region	4395
NRETAS	Baseline SW Monitoring SWMA 814 Daly River Region	4119
NRETAS	Baseline SW Monitoring SWMA 903 Roper River	2680
NRETAS	Alice Springs Regional Assessment	2269
NRETAS	Baseline SW Monitoring SWMA 006 Todd River	2267
NRETAS	Katherine Tindall Limestone Assessment	2060
NRETAS	Flood Forecasting Daly River	1715
NRETAS	Flood Forecasting Upper Roper River	1715
NRETAS	Flood Forecasting Katherine River	1715
NRETAS	Baseline SW Monitoring SWMA 815 Darwin Region	1693
NRETAS	Sust. Dev. and Mgt of Water Resources in Northern Australia: A Model Approach (NWC)	1398
NRETAS	Flood Forecasting Adelaide River	1363
NRETAS	Flood Forecasting Todd River	1363
NRETAS	Flood Forecasting Victoria River	1320
NRETAS	Flood Forecasting McArthur River	1209
NRETAS	Major spring systems of the Ooloo Dolostone Daly River project (NWC)	1159
NRETAS	Ooloo Assessment	1159
NRETAS	Tiwi Islands Assessment	1132
NRETAS	Floodplain Mgt Assessments Alice Springs Town	833
NRETAS	Floodplain Mgt Assessments Alice Springs Rural	833
NRETAS	Floodplain Mgt Assessments Finke River Region	833
NRETAS	Catchment Event Monitoring	830
NRETAS	Floodplain Mgt Assessments Borrooloola	819
NRETAS	Mataranka Tindal Limestone Assessment	819
NRETAS	Floodplain Mgt Assessments Beswick Community	805
NRETAS	Floodplain Mgt Assessments Nauiyu	805
NRETAS	Floodplain Mgt Assessments Adelaide River Township	805
NRETAS	McMinns\Howard East Assessment	778
NRETAS	Western Davenport Assessment	753
NRETAS	Baseline SW Monitoring SWMA 811 Victoria River	745
NRETAS	Floodplain Mgt Assessments Katherine Town and Rural	733
NRETAS	Floodplain Mgt Assessments Timber Creek	733
NRETAS	Berry Springs Assessment	706
NRETAS	Ti Tree Assessment	682
NRETAS	Koolpinyah Dolomite Aquifer Characteristics Project (NWC)	679
NRETAS	Baseline SW Monitoring SWMA 907 McArthur River	465
NRETAS	Baseline SW Monitoring SWMA 817 Adelaide River	465
NRETAS	GAB Mound Springs project	367
NRETAS	Baseline SW Monitoring SWMA 005 Finke River	365
NRETAS	GAB Monitoring Network Implementation (Stage 2) through funding under the GABSI	240
NRETAS	Biophysical Modelling of Water Quality in a Darwin Rural Area Groundwater Dependent Ecosystem (NHT)	184
NRETAS	Wildman River Assessment	141
NRETAS	Marrakai Assessment	141
NRETAS	Hydrographic Contract Services: KTC	127
NRETAS	Hydrographic Contract Services: DCI	127
NRETAS	Hydrographic Contract Services: ERISS	127
NRETAS	Salt Water Intrusion NT Coastal Plain (GA)	99

## **2.A Priority Data and Monitoring Requirements**

### **2.A.1 Region by Region**

#### **2.A.1.1 The Daly/Roper Region**

The Daly Roper region receives the most attention in terms of assessment and study. There are currently 16 programs undertaken by the lead water agency alone in this region signifying the importance of the Daly Roper. Fittingly, the region also holds the top 29 priority sites in the NT of 252 sites requested for the region.

Other than the baseline monitoring programs the highest priority assessment programs are

1. The Katherine Tindall Limestone Assessment (KTLA); and
2. Flood Forecasting for the Katherine, Daly and Roper Rivers

Significantly, the monitoring requirements for these programs are in stark contrast with each other.

The KTLA is an assessment of the performance and responsiveness of the Tindall aquifer, dealing largely with spring discharge into the Katherine River. Monitoring requirements for this program are primarily for late dry season low flows of the Katherine River and groundwater monitoring.

Flood Forecasting, comparatively, deals only with the Katherine, Daly and Roper Rivers during flood events in the Top End wet season.

### **2.A.1.2 The Darwin Region**

There are 12 assessment programs currently in the Darwin Region, ranging from Flood Forecasting to Aquatic Health to GW assessment and modeling. Again, other than baseline monitoring the top 3 highest priority programs are:

1. Flood Forecasting for the Adelaide River;
2. Floodplain Management Assessment for the Adelaide River Township; and
3. The McMinns / Howard East Aquifer Assessment

Other significant programs that should be noted are the ongoing Darwin Harbour Aquatic Health assessment (still to be allocated a score) and the Berry Springs Aquifer Assessment (that will deliver to the development of the Berry Springs WAP, which carries a management priority of 3, whereas the Howard East WAP carries a management priority of 4).

331 sites have been requested for monitoring in the region of which only 69 are surface water sites and the remaining are bores. The top ranking site, however, is a surface water site but sits only 119<sup>th</sup> in the rankings across the NT.



### **2.A.1.3 Central NT – Ti Tree, Western Davenport & Tennant Creek**

There are only 3 assessments currently being undertaken in the Central NT and reflect the region's total dependence on groundwater resources. Similarly, the relatively low program value scores, with the noted exception of the baseline monitoring program, reflect the overall low management priority placed on the region largely due to its remoteness and sparse population and subsequent resource pressures.

307 sites have been requested for this region with the highest site ranked around 800<sup>th</sup>. Not surprisingly, only 8 sites monitor surfacewater and rainfall while the rest are bores. A significant majority of these sites lie within the Ti Tree WCD where a WAP has been in operation since 2002.

### **2.A.1.4 Alice Springs**

There are 8 assessment programs currently being undertaken in the Alice Springs in essence addressing only 2 issues faced in the region: water allocation and flood mitigation. Other than baseline monitoring, the 2 highest ranking programs are:

1. Alice Springs Regional Assessment
2. Flood Forecasting

585 sites have been requested for monitoring in this region, which in terms of priority is second to the Daly Roper region. The highest ranked site is 30<sup>th</sup> over the NT which is highest priority site outside the Daly Roper region.

Of the 585 sites only 20 are surfacewater or rainfall with the remainder being bores.

### **2.A.1.5 Other Areas of the NT**

Including:

- a. Victoria River
- b. McArthur River
- c. Gove
- d. Groote Eylandt
- e. Tiwi Islands

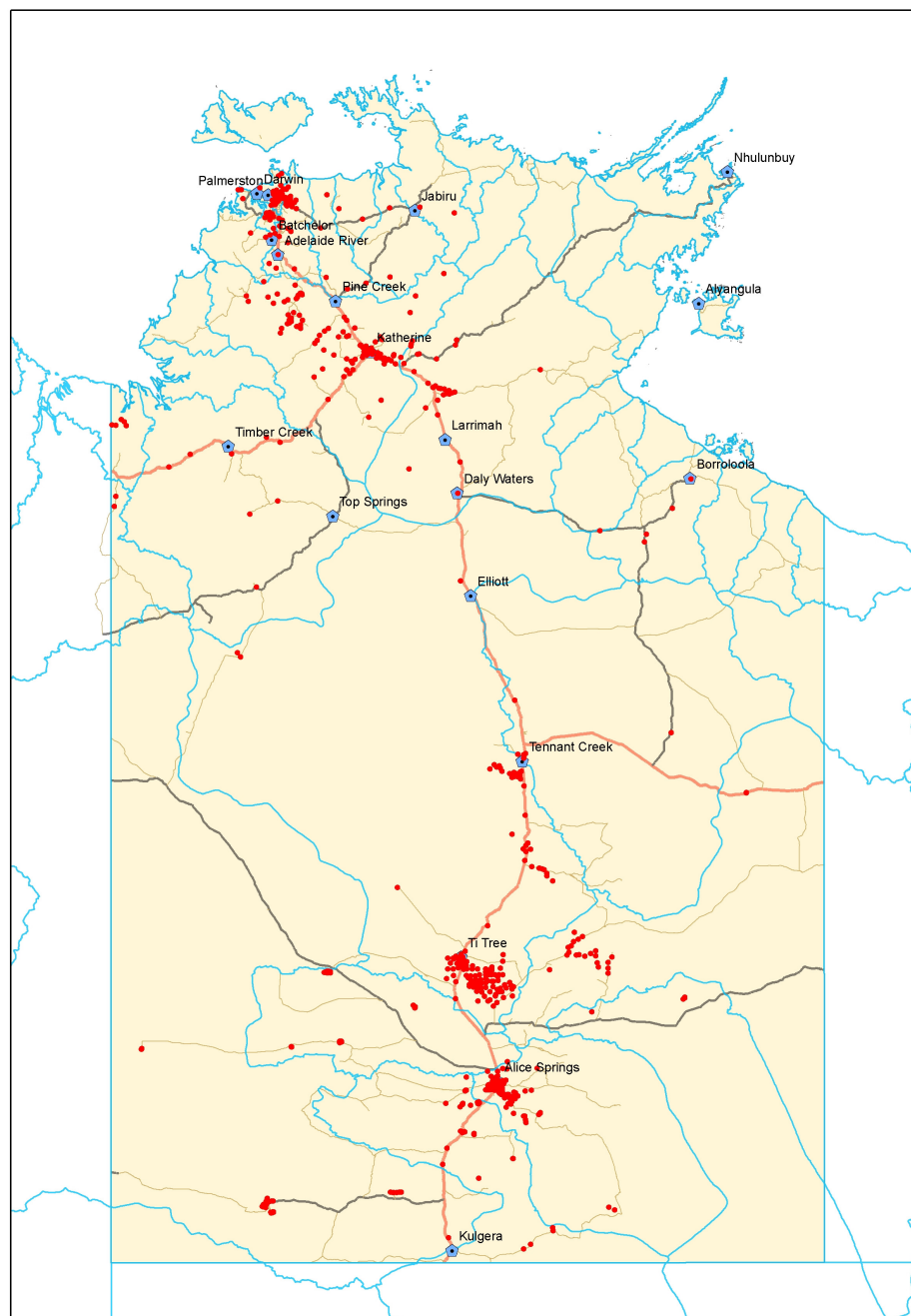
## **2.B Data and Monitoring Inventory**

The current and historic monitoring sites were captured in the BoM Water Monitoring Network 2009 project and is detailed in the attached Appendix 2.B

## 2.B.1 NRETAS

### Monitoring Sites

Illustrated below is the distribution of sites monitored by the lead water agency, NRETAS. There are over 900 sites listed as monitored by NRETAS of which 15% are surface water sites (including rainfall data only sites), leaving the 85% are groundwater water sites. This demonstrates the NTs heavy reliance on groundwater systems and is reflected by water management priorities as discussed in section 1 of this plan.



Appendix 2.B.1 provides a listing of sites and infrastructure currently monitored by NRETAS Hydrographic Services unit. This unit is responsible most of the NT's important and critical sites. This appendix is planned to grow as details of other monitoring groups are gathered.

### **NRETAS ICT Infrastructure**

#### Data Storage and Management

The corporate water database system in the NT is Hydstra, currently operating version 9.6.2 in a FoxPro environment with the following modules:

- Time Series
- Groundwater
- Water Quality
- Mapping

Version 10 is planned to be rolled out in the latter half of 2010 and a migration to MS SQLServer soon to follow.

Hydstra is located in Palmerston on a shared corporate server environment and managed by third party corporate services.

#### Telemetry and Communications

Telemetry services are facilitated by an iQuest HydroTel system that is managed and located separately from the primary water data store, Hydstra. Data is exported from HydroTel to be ingested into Hydstra by third party programs and scripts.

HydroTel is located in the Chan Centre, a secure data centre, in Darwin (City) on a dedicated server environment consisting of primary (Telemetry1) and backup (Telemetry2) servers (HP DL380). Communications is via a reverse proxy configuration enabling system to log IP communications and also FTP.

#### FTP and Data Provision

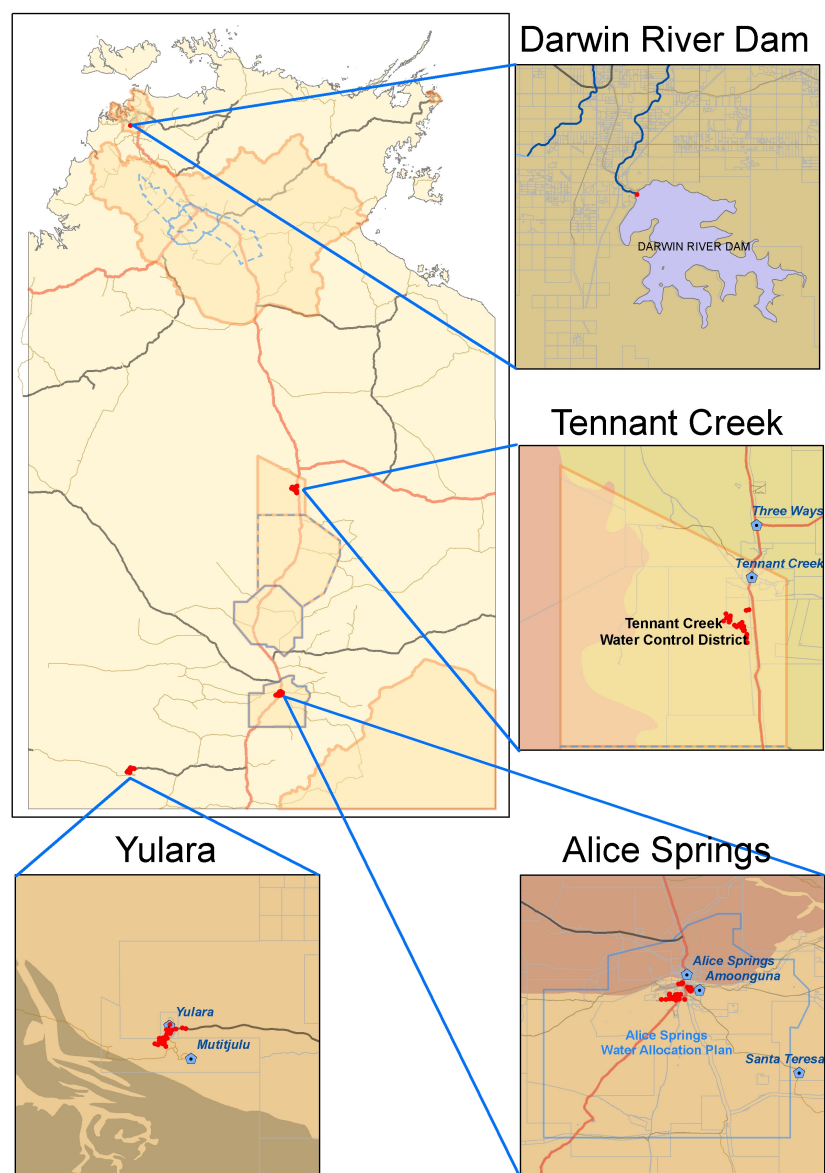
FTP and data provision is facilitated by Telemetry1 (and Telemetry2 in failover scenarios) server such data files are posted from Palmerston to Telemetry1 and then on-sent by on-board FTP services.

## 2.B.2 Power and Water Corp.

### Urban Water Supply

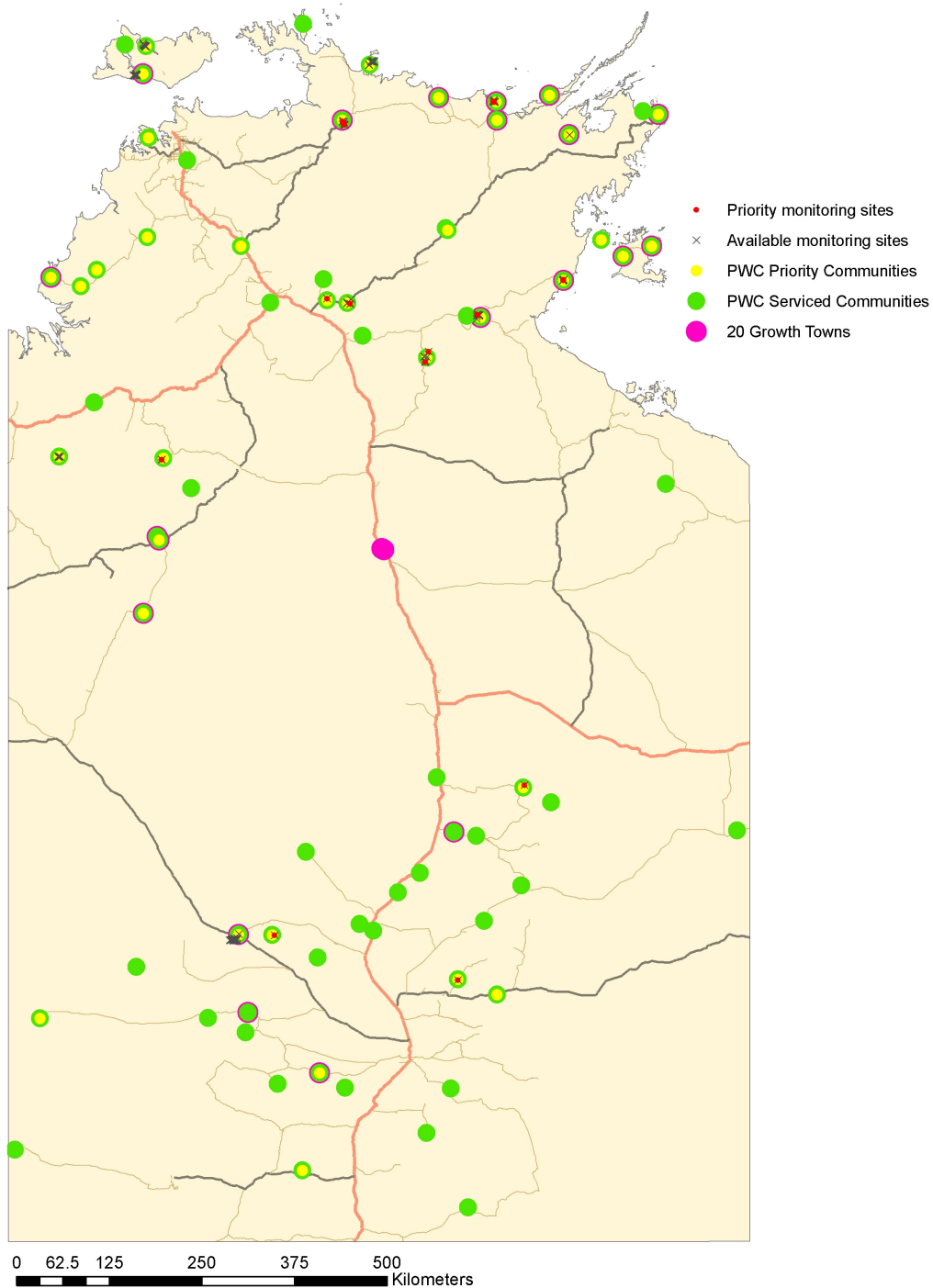
There are 4 primary centers whereby Power and Water Corp undertake monitoring for urban water supply and they are:

- Darwin River Dam – Darwin and Palmerston water supply
- Tennant Creek – Tennant Creek Township water supply
- Alice Springs – Alice Springs Township water supply
- Yulara – Yulara Resort water supply



## Remote Community Water Supply

Of 173 available monitoring sites for remotes community water resource monitoring, 30 have been identified at recommended or priority sites. The distribution of these sites is illustrated in the map below.



## **2.C Data and Monitoring Gap Analysis and Priority Assessment**

This gap analysis is considered preliminary with a substantial amount of analysis still to be completed and work remaining to link and integrate the newly developed WIMS to quantify the gaps. In the interim, the following are known gaps from corporate knowledge and understanding.

In the interim period, and as part of a review of the 2010 SWIMP, a report on whether there has been closure of identified gaps has been compiled and is attached at Appendix 3. This report highlights that while gaps identified through the Bureau of Meteorology's Modernisation and Extension Program have been addressed to some extent there has been little progress on the closure of the gaps identified in the 2010 SWIMP. This is primarily due to the fact that the 2010 SWIMP was only completed in June 2010.

Whilst work is progressing on developing a full gap analysis and a data monitoring program through the NT's new Water Information Management (WIMS) System, this is still in progress.

### **Coverage**

#### **GAP NTCO1 – Groundwater Monitoring Site Locations**

##### **Gap**

As an over-arching limitation of the groundwater monitoring network, the strategic location of many bores not considered optimal.

##### **Cause**

Considering that many monitoring bores are drilled with the intent of determining hydrogeological information or locating production bores, their placement might not necessarily be appropriate to monitor impacts on the various 'targets'. Indeed, the determination of what targets should be monitored is usually made with some understanding of the groundwater system behaviour. The finesse required may be developed iteratively with better and accumulated knowledge of the system.

#### **GAP NTCO2 – Water Quality Monitoring**

##### **Gap**

Limited water quality monitoring data or measurements outside the Darwin Harbour region.

##### **Cause**

To date water quality measurements in the NT have been project based and spatially constrained to Darwin Harbour and a few sites on the Daly River.

### **GAP NTCO3 – Remote Community Water Supply Monitoring**

#### **Gap**

13 year gap in aquifer information and monitoring for water supply sources for remote communities throughout the NT.

#### **Cause**

Northern Territory Government policy changes in the early 1990's led to a withdrawal of groundwater level monitoring (standing water levels) in many of these remote aquifers by the lead water agency by 1995, leading to the current situation of a growing

#### **Impact**

#### **Risk**

Ninety five percent of water supplies of the 72 remote indigenous communities under the provision of Power and Water Corporation are sourced from regional and local groundwater aquifers, however

### **Accuracy**

### **GAP NTAC1 – Monitoring Common Datum**

#### **Gap**

Currently very few gauging stations or groundwater monitoring bores in the Northern Territory are referenced to a common datum.

#### **Cause**

#### **Impact**

This significantly limits the ability of NRETAS or the Bureau of Meteorology (BoM) to model or reference data from one location to another. The current method of referencing sites is by the NT STRM which is based on 90m grid cells.

#### **Risk**

The primary risk is the reduced accuracy and reliability of model outputs dependant on this data such as the Katherine Tindal model used for water allocation in the Katherine Tindal Water Allocation Plan.

### **GAP NTAC2 – Groundwater Data Resolution**

#### **Gap**

Low temporal resolution of ground water monitoring data

#### **Cause**

In most cases, manual measurement of groundwater levels is undertaken from once to four times annually.

#### **Impact**



This minimalist resolution may or may not be considered appropriate depending on the application (eg. may be considered poor if required to quantify recharge in Top End systems but adequate for some arid zone systems).

## **Currency**

### **GAP NTCU1 – Groundwater Monitoring Currency**

#### **Gap**

Significant data gaps at many groundwater monitoring locations

#### **Cause**

Availability of manpower resources has largely dictated the currency of groundwater data available. In many cases across the NT, the need to focus on priority, usually management areas has been at the expense of abandoning other regional monitoring systems. In other cases, gaps in the data record have appeared where the monitoring regime has been reinstated.

#### **Impact**

The result is poor long term records with high levels of uncertainty between periods of monitoring.

### **GAP NTCU2 – Surface Water Monitoring Currency**

#### **Gap**

Data gaps at priority non-telemetered sites.

#### **Cause**

Aging equipment becoming less reliable with limited support for maintenance and repair.

#### **Impact**

Increasing equipment maintenance/repair costs are emerging as a significant impedance to network/site viability. Sites require increased attention.

#### **Risk**

Site closures, loss of data either temporarily or permanently.

## **Data**

### **GAP NTDA1 – Water Quality Data**

#### **Gap**

A significant quantity of water quality data and information exists outside corporate data storages such as NRETAS' instance of Hydstra. Much of this data has been collected on a project by project basis rather than as part off an on-going structured monitoring program.

**Cause**

For quite a period the Lead Agency did not have a water quality database. When the Hydstra water quality module was acquired it was not always used as designed, with many results being entered directly into MS Excel spreadsheets or reports.

**Impact**

This data held outside managed corporate data stores is limited in its accessibility and consequently of greatly reduced value.

**Risk**

There is a high risk that the data may be lost or become meaningless

**GAP NTDA2 – Hydrogeological Data**

**Gap**

A significant quantity of hydrogeological data and information exists outside corporate data storages such as NRETAS' instance of Hydstra. This data is recorded as part of standard bore drilling and construction reports.

**Cause**

Much of this data was recorded and managed before the acquisition of Hydstra which is now the corporate water data management product.

**Impact**

This data held outside managed corporate data stores is limited in its accessibility and consequently of greatly reduced value. This data is considered highly valuable in constructing accurate representation of hydrogeological features used for groundwater assessment and resource modelling.

## 2.D NT Water Data and Monitoring Priorities

This section details the Water and Data Monitoring Priorities. These priorities have been identified through the process of developing this Plan. However, a NT Water Data and Monitoring Strategy is still to be developed. This Strategy will tie into the an NT Water Information Strategy and will enable the NT to better manage water resource operations.

The following Water Data and Monitoring Priorities address priority gaps identified in SECTION C. Actions are grouped within priority regions (where applicable).

### 2.D.1 Multi Regional Tasks

Table 2.D.1 NT Wide Water Data and Monitoring Priorities

Action/Task		Region(s)	Commence	End
Hydrographic Gauging Station Network Upgrade		NT Wide	2007	
<b>Undertaken by</b>	NRETAS, Hydrographic Services			
<b>Description</b>	Hydrographic gauging network upgrade to high priority sites across the NT. Until recently, site refurbishment has largely been limited to flood warning sites. The upgrade program will see the refurbishment of all the NT's key gauging sites including the addition of telemetry at sites not previously telemetered.			
<b>Status</b>	Equipment received, rollout commenced			
<b>Outcome(s)</b>	<ul style="list-style-type: none"> <li>Improved accuracy and reliability with the refit of current sensor technology.</li> <li>Improved currency for newly telemetered sites.</li> <li>Improved maintenance/repair response and hence a reduction in data gaps.</li> </ul>			
<b>GAP</b>	NTCU2			

Action/Task		Region(s)	Commence	End
Groundwater Monitoring Network Upgrade		Darwin Daly/Roper Central NT Alice Springs	2008	2010
<b>Undertaken by</b>	NRETAS, Water Assessment			
<b>Description</b>	Project requires procurement and subsequent deployment of downhole groundwater data loggers. Logging systems include some 20 telemetered installations for seasonally restrictive and remote sites, and locations where loss of data is critical.			

<b>Status</b>	Loggers on order – delivery expected end of May, 2009. Deployment programmed to commence June 2009.
<b>Outcome(s)</b>	<ul style="list-style-type: none"> <li>Primarily required to indicate resource behaviour, response to recharge events, and to detect possible impacts. Sites will mainly aim to target regional scale information rather than localised effects or impacts</li> <li>Seasonal resource behaviour and specific events could be tracked, and with accuracy. This will be particularly important in the arid zone where recharge is via episodic events.</li> <li>Improvement in the quality of groundwater monitoring data acquired in terms of frequency of measurement and accuracy. Most sites only measured quarterly and frequency of data points usually only marginal for impact detection. Accuracy improved is determining timing and magnitude of specific features observed in the data trace.</li> <li>Savings in time and efficiency in data acquisition will be made, particularly for regional monitoring areas</li> <li>Data input to Hydstra database more efficient – especially for sites where telemetered systems used.</li> </ul>
<b>GAP</b>	NTAC2 NTCU1

## 2.D.2 Region by Region

### 2.D.2.1 Daly/Roper

No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

### 2.D.2.2 Darwin Region

No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

### 2.D.2.3 Central NT - Ti-Tree, Western Davenport & Tennant Creek

Action/Task	Region(s)	Commence	End
Review regional monitoring programs in Ti Tree	Central NT, Ti Tree		On-going
<b>Undertaken by</b>	NRETAS, Water Assessment		
<b>Description</b>	This review is in accordance with Action 3 of the Ti Tree WAP: <i>Review regional monitoring programs and recommend improvements to assist in determining sustainable yield (e.g. aquifer recharge, throughflow and change in storage).</i>		
<b>Status</b>	Biannual water level monitoring program currently conducted only.		
<b>Outcome(s)</b>	Improvements in knowledge of recharge and discharge processes required. Infrequent recharge occurs as this is believed to be event based. Little or		

	no data exists to serve analysis of water level response to large events. No infrastructure exists to be able to quantify runoff and flow to potential 'floodout' recharge areas.
<b>GAP</b>	

#### 2.D.2.4 Alice Springs

No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

#### 2.D.2.5 Other - priority activities in the remainder of the NT

No risk/impact. Assessment has been undertaken for the purpose of this Plan. These will be addressed in future releases of the Plan.

### 2.D.3 Data & Data Management

Table 2.D.3 Water Data and Date Management

<b>Action/Task</b>	<b>Region(s)</b>	<b>Commence</b>	<b>End</b>
Data Rescue for critical or high value water quality and hydro-geological data	Darwin Daly/Roper		On-going
<b>Undertaken by</b>	NRETAS, Aquatic Health		
<b>Description</b>	Design and implement processes for the preparation and ingestion of water quality data into the primary corporate water data store Hydstra. Data to be targeted is determined by those data relevant to high priority activities and gaps defined in section A and C.		
<b>Status</b>			
<b>Outcome(s)</b>	<ul style="list-style-type: none"> <li>Water quality data made available to a key management activities and assessment.</li> <li>Water quality data made available to a broader community.</li> <li>Risk of data loss ameliorated.</li> </ul>		
<b>GAP</b>	NTDA1		

<b>Action/Task</b>	<b>Region(s)</b>	<b>Commence</b>	<b>End</b>
Data Rescue for critical or high value hydro-geological data	Darwin Daly/Roper		On-going
<b>Undertaken by</b>	NRETAS, Water Assessment		
<b>Description</b>			
<b>Status</b>			
<b>Outcome(s)</b>			
<b>GAP</b>	NTDA2		