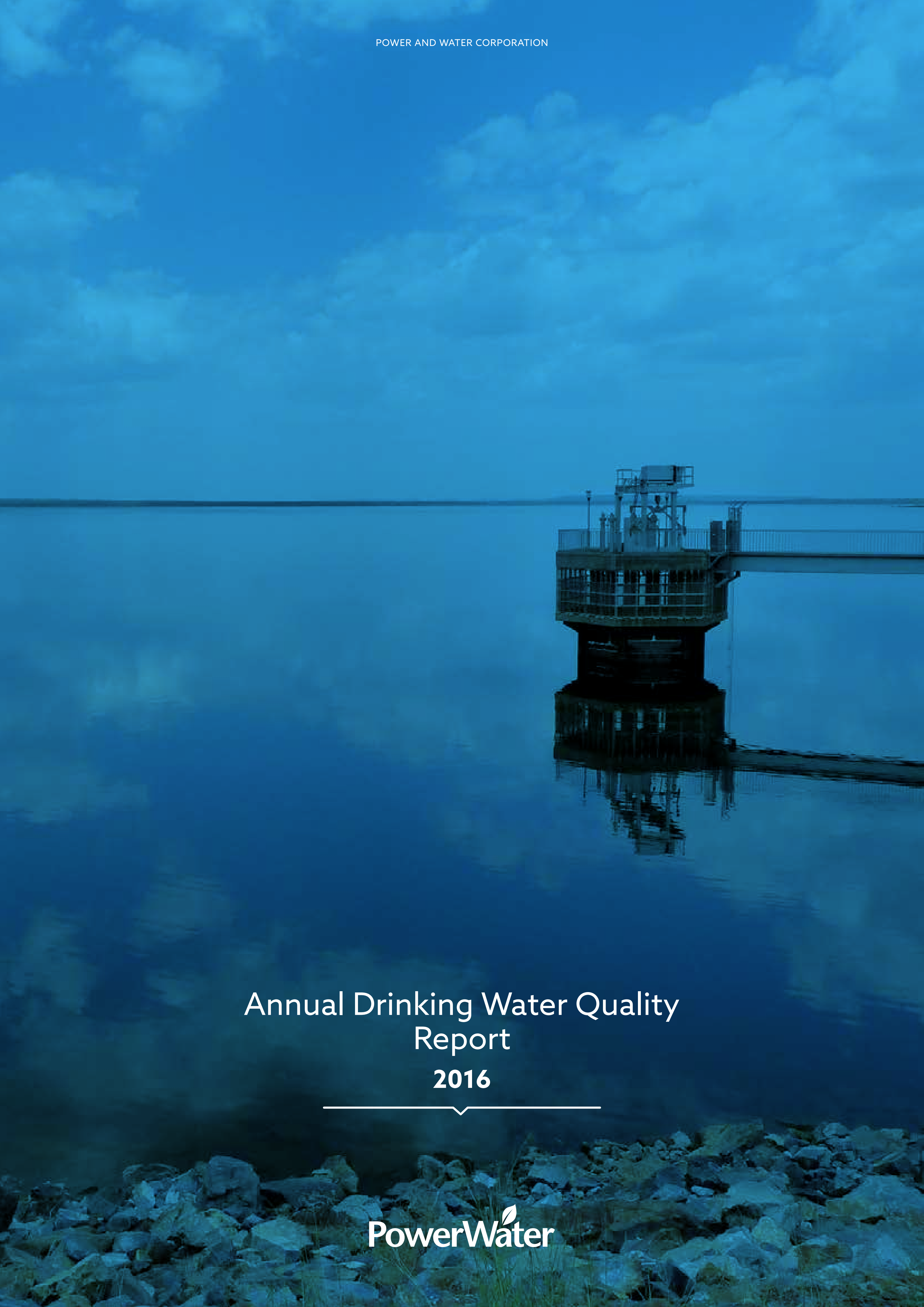
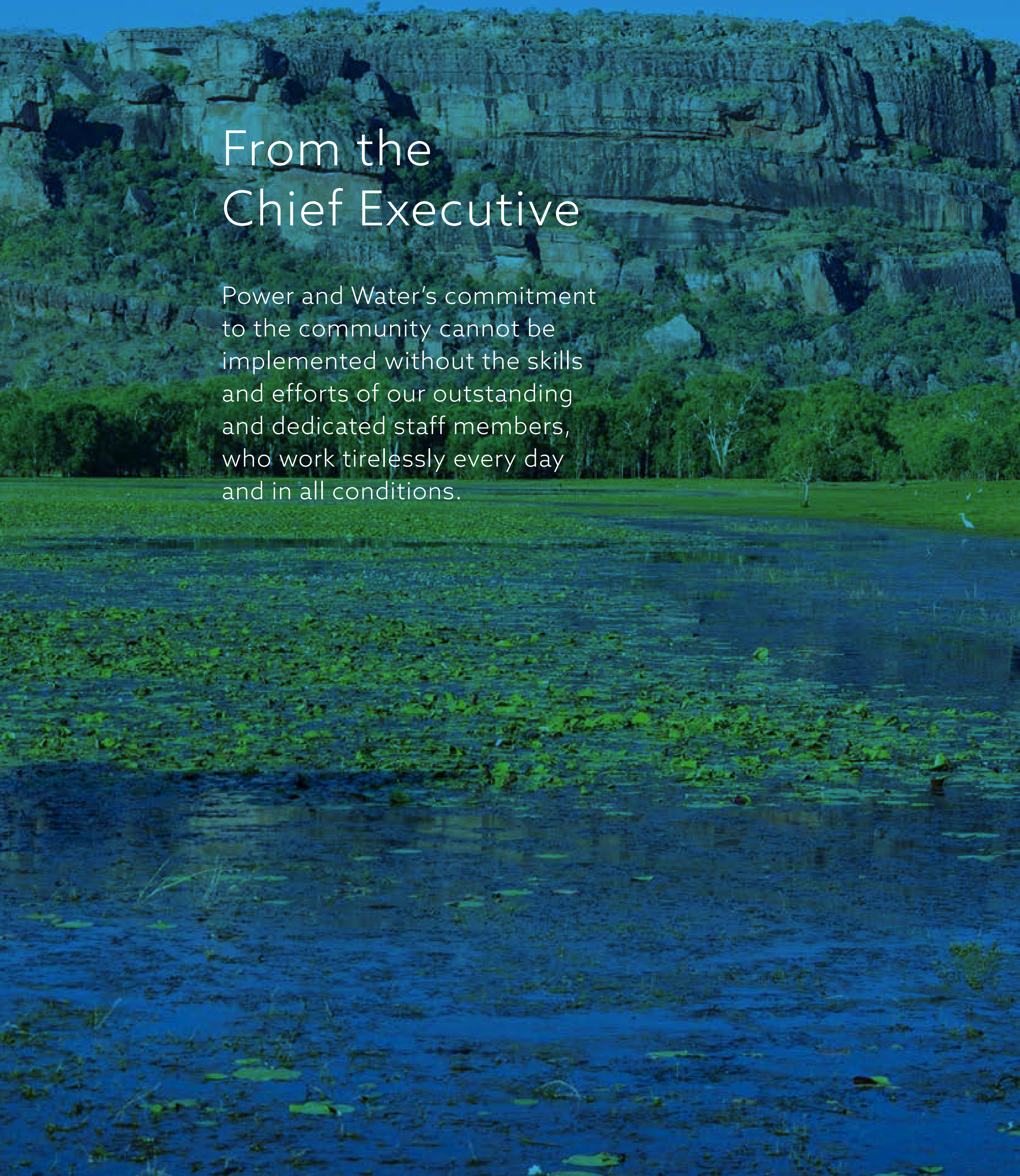


Annual Drinking Water Quality Report

2016

PowerWater

Contents



From the Chief Executive

Power and Water's commitment to the community cannot be implemented without the skills and efforts of our outstanding and dedicated staff members, who work tirelessly every day and in all conditions.

Power and Water Corporation is committed to the effective management of its drinking water supplies to provide safe drinking water to consumers.

The Drinking Water Quality Report 2016 provides a record of Power and Water's service delivery in this area. Power and Water operates under the framework of the Australian Drinking Water Guidelines, a preventative, risk management approach, which encompasses all the steps in water production – from catchment to consumer.

Power and Water strives for continuous improvement in all operational areas, and actively explores new ways to provide better water services to its customers. This includes investing in infrastructure to ensure that high quality water is accessible across the Northern Territory.

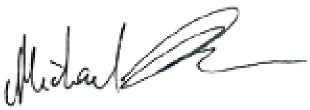
Power and Water continues to look to the future and is focused on ensuring Darwin's water supply system has the capacity to meet the demands of a rapidly growing population.

Power and Water's commitment to the community cannot be implemented without the skills and effort of our outstanding and dedicated staff members, who work tirelessly every day and in all conditions. All managers, employees and contractors involved in the supply of drinking water are responsible for understanding and working towards implementing the drinking water quality management system. We will continue to build the capability of this diverse workforce.

We will also continue to review and report on our progress delivering quality drinking water to our customers using our extensive water quality monitoring program, using the best monitoring methods and drawing on customer feedback to track our performance. We will continue to strive to improve and deliver on our customers' increasing expectations for the services we provide.

Power and Water continues to work closely with the Department of Health under a memorandum of understanding that defines the roles, responsibilities and obligations to achieve best practice drinking water quality management throughout the Northern Territory.

Our focus is on meeting increased demand for quality water across the Northern Territory in line with population growth, new development and the establishment of major infrastructure as residential communities and commercial precincts continue to expand.



Michael Thomson
Chief Executive

Drinking Water Quality Report Water Services 2012–16

This Drinking Water Quality Report provides a record of water quality management activity and water quality performance at Power and Water urban centres over four financial years, 1 July 2012 to 30 June 2016. The report delivers drinking water quality information to the wider public of the Northern Territory, the Department of Health and other interested stakeholders.

In this report drinking water quality management activities are described in two sections.

Section A explains the preventative, water quality management work undertaken over this period. Providing background about the Australian Drinking Water Guidelines (ADWG) 2011 and how this guidance was used to manage drinking water quality.

Section B provides information about the drinking water quality supplied to consumers. The water quality statistics are located in various tables as Appendices.

Section A: Framework for Drinking Water Quality Management

Australian Drinking Water Guidelines (ADWG)

The ADWG are the primary reference on drinking water quality in Australia. They are designed to provide an authoritative reference on what defines safe, good quality drinking water as well as how it can be achieved and assured. The ADWG are published by the National Health and Medical Research Council (NHMRC) in collaboration with the Natural Resource Management Ministerial Council (NRMMC).

The ADWG are developed based on the best available scientific evidence regarding both the health and the aesthetic aspects of drinking water quality. They are the adopted standards and provide a common benchmark for assessing the acceptability of drinking water supplied to consumers across Australia. The guidelines apply to any water intended for drinking irrespective of the source or where it is consumed, with the exception of bottled and packaged water, which is covered under the national Food Standards Code.

The ADWG describe a preventative, risk management approach that encompasses all steps in water production - from catchment to consumer. Version 3 of the ADWG was released in October 2011 and contains the Framework for Management of Drinking Water Quality, which defines this preventative, integrated approach.

The framework outlines four general areas for ensuring the provision of good quality drinking water. These include:

1. Organisational commitment to drinking water quality management
2. System analysis and management
3. Supporting requirements
4. Review processes for continual improvement.

Across these four areas, the framework outlines 12 elements considered good practice for the integrated management of drinking water supplies. Together, these elements comprise a proactive approach for ensuring safe and reliable drinking water to the community.

The ADWG undergo rolling revisions to ensure they represent the latest scientific evidence on good quality drinking water. All assessments made in this report are made against version 3.2, updated February 2016.

01 Commitment to drinking water quality management

Power and Water demonstrates an ongoing commitment to the effective management of its drinking water supplies and the provision of good quality, safe drinking water to consumers throughout the Northern Territory.

This commitment to consumers is clearly outlined in publicly available documents – *Power and Water's Customer Contract, Drinking Water Quality Policy* and the *Memorandum of Understanding between the Department of Health (DoH) and the Power and Water Corporation for Drinking Water* (MoU).

Our customer contract

Legally binding under the *Water Supply and Sewerage Services Act 2000* (NT), our customer contract outlines the rights and obligations of both Power and Water and its customers. During this reporting period the customer contract was reviewed following the structural separation of Power and Water Corporation, Territory Generation and Jacana Energy from 1 July 2014.

In this contract, Power and Water agrees to provide customers with a good quality, safe and reliable water supply appropriate to the environment in which the community is located and in accordance with parameters set by the ADWG.

A copy of the customer contract is readily available at any Power and Water office or at **www.powerwater.com.au**

Power and Water's Drinking Water Quality Policy

In 2014 Power and Water reviewed its *Drinking Water Quality Policy*. This policy outlines Power and Water's commitment to the effective management of its drinking water supplies and to provide good quality drinking water to its consumers.

With this policy, Power and Water commits to implement and preventatively maintain a drinking water quality management system consistent with the ADWG, to effectively manage risks to drinking water quality and to ensure that managers, employees and contractors involved in the supply of drinking water are responsible for understanding and working towards implementing the drinking water quality management system.

Building effective partnerships

Power and Water has a primary responsibility for providing customers safe drinking water through the *Water Supply and Sewerage Services Act 2000* (NT), in line with the licence conditions under the *Water Act 1992* (NT) and sound commercial practices. It co-ordinates and co-operates with a number of other government agencies to ensure that the highest standard of water quality is achieved and maintained.

Northern Territory Government

The Department of Environment and Natural Resources (DENR) is leading the development of an effective regulatory framework for water. Power and Water is working with DENR and various departments to progress a strategic plan for water in the Northern Territory. In 2014 the Northern Territory Government committed to a holistic approach for water resource management in line with the National Water Initiative (NWI) and began developing a strategic water plan for the next 50 years.

In 2015 the Northern Territory Government released a discussion paper *Our Water Future Discussion Paper: A Conversation with Territorians*. Public meetings were held across the Northern Territory during May and June to obtain community feedback on the proposed strategic plan for water. The public comments and submissions provided valuable feedback on the management of water in the Northern Territory.

The proposals and recommendations from individuals, advocacy organisations, industry and government are being used to guide the development of the *Our Water Future Strategic Plan*. Power and Water remains committed to working with DENR on this approach to managing water in the Northern Territory.

DENR also has an important role in protecting water quality through providing a regulatory role over the control of pollution of the Northern Territory's water resources.

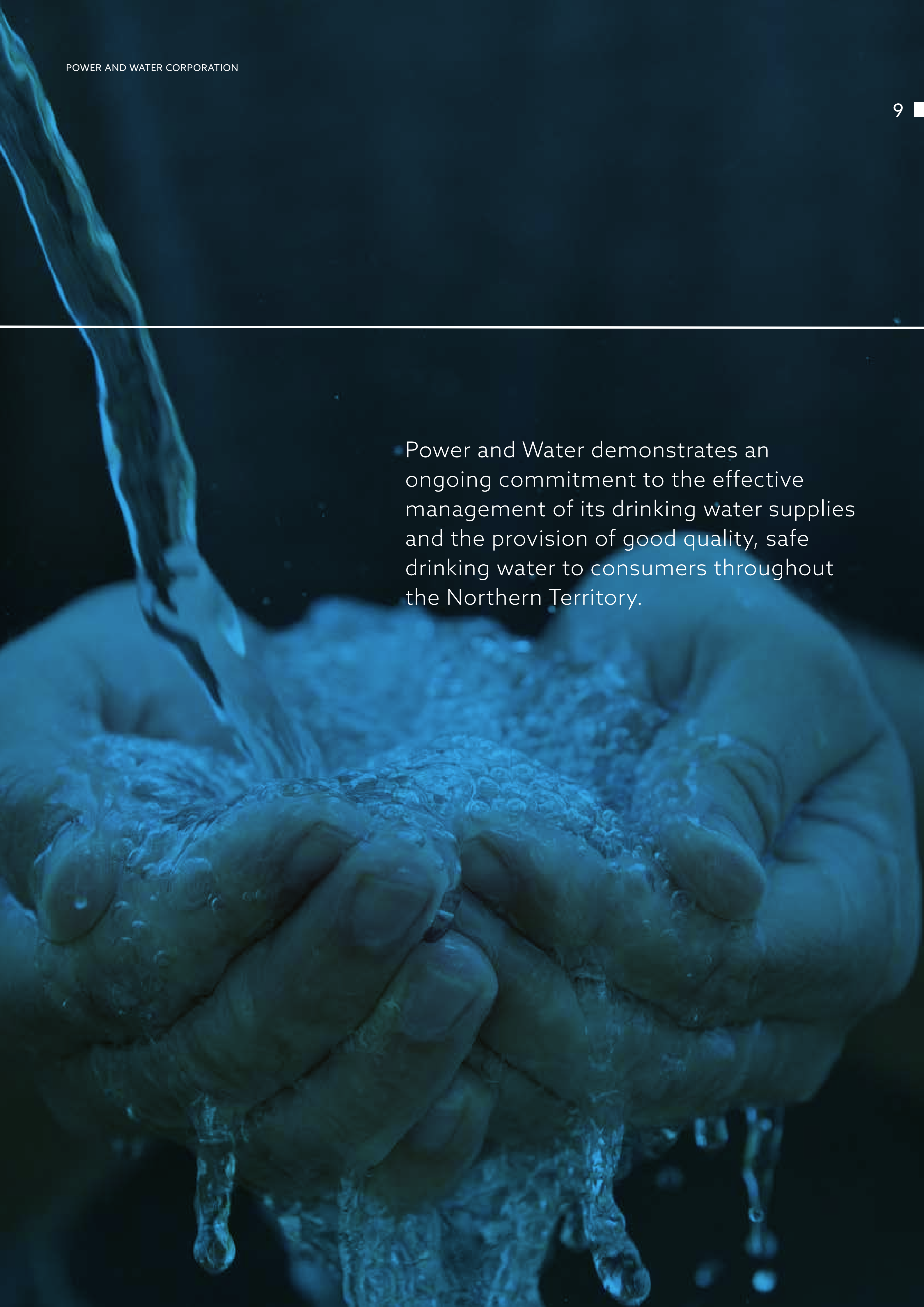
The Department of Infrastructure, Planning and Logistics (DIPL) has a major role in protecting water quality through appropriate land use planning.

The Department of Primary Industry and Resources (DPIR) undertakes independent analyses of water samples in its laboratories in Darwin and Alice Springs.

Department of Health

The DoH has important responsibilities in protecting public health under the Public and Environmental Health Act 2011 (NT). Power and Water's public health partnership with the DoH is documented in the MoU between the two organisations. The MoU defines the roles, responsibilities and obligations as we work together to achieve best practice drinking water quality management.

On the 30 June 2015 the MoU was extended to support a renewal and improvement process. A working group compromising officers from the DoH and Power and Water was formed and is progressing the redrafting of an improved MoU.



Power and Water demonstrates an ongoing commitment to the effective management of its drinking water supplies and the provision of good quality, safe drinking water to consumers throughout the Northern Territory.

02 Assessment of the drinking water supply system

Identification and management of risk is fundamental to our management approach. It aligns with the philosophy of the Australian Drinking Water Guidelines (ADWG) and the principles of good corporate governance.

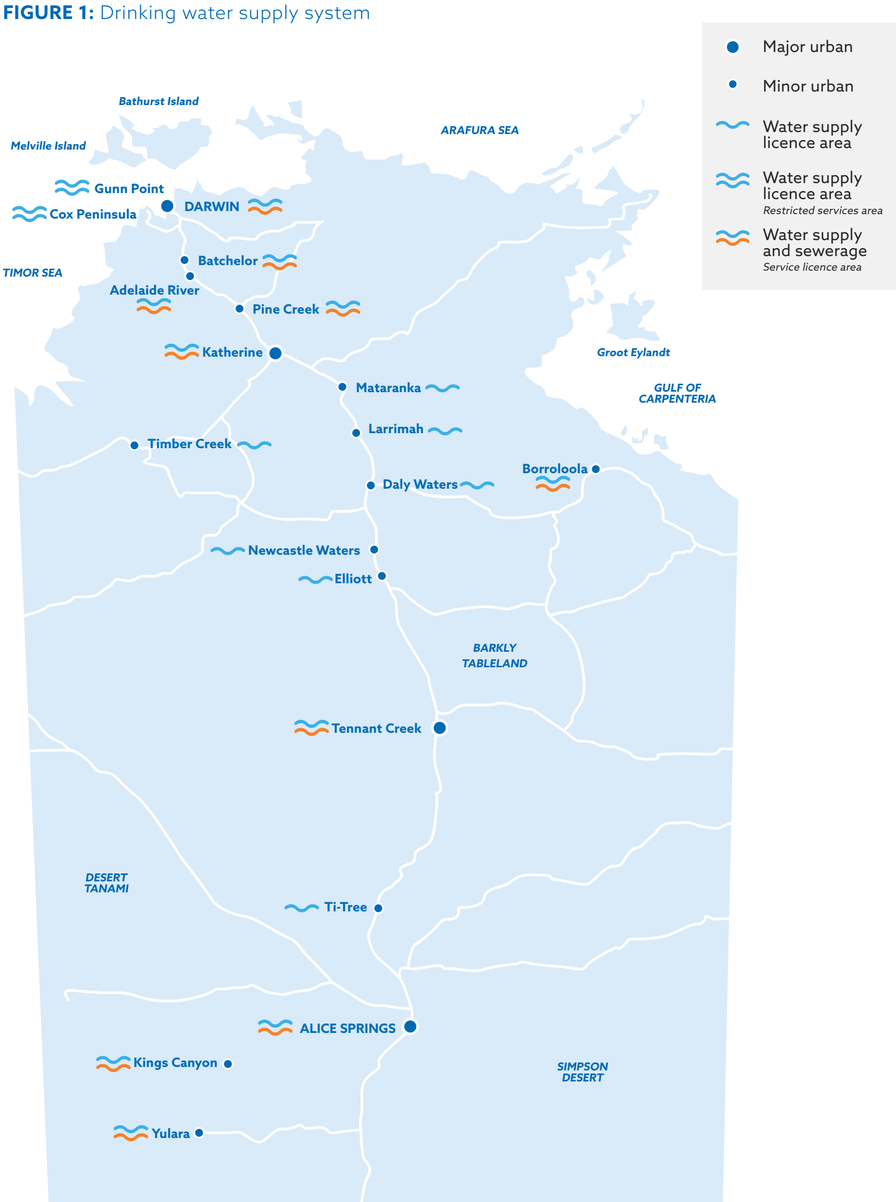
Individual urban centres that had comprehensive drinking water quality risk assessments completed in this reporting period include Adelaide River, Darwin, Pine Creek and Tennant Creek. These urban centres have had water sources expanded or capability within treatment facilities increased. Various other urban centres had assessments that focused on distinct parts in the catchment to consumer supply chain.

Power and Water's approach to assessing and evaluating the potential risks to drinking water quality has evolved in this reporting period. Changes were required to align with good practice and the rising service level expectations of the community. A range of improvements to risk management are currently being planned following the management review described in Section 12.

Across the Northern Territory, Power and Water supplies water to five major urban centres and 14 minor urban centres. As the five major urban centres have larger and more complex infrastructures, Power and Water provides technical services to maintain supplies to these centres, which then function as technical and administrative hubs, extending services to minor urban centres, as illustrated in Figure 1.

It should be noted that while the Mabunji Aboriginal Resource Centre

FIGURE 1: Drinking water supply system



Copperfield Reservoir

TABLE 1: Summary of drinking water sources in major and minor urban centres

Centre[1]	Source
Adelaide River	Ground water
Alice Springs	Ground water (Roe Creek Borefield)
Batchelor	Ground water
Borroloola[2]	Ground water
Cox Peninsula	Ground water
Daly Waters	Ground water
Darwin	Surface water (Darwin River Reservoir) + ground water (10%)
Elliott	Ground water
Gunn Point	Ground water
Katherine	Surface water (Katherine River) + ground water (20%)
Kings Canyon	Ground water
Larrimah	Ground water
Mataranka	Ground water
Newcastle Waters	Ground water
Pine Creek	Surface water (Copperfield Reservoir) + ground water (90%)
Tennant Creek	Ground water (Kelly Well, Kelly Well West and Cabbage Gum Borefields)
Timber Creek	Ground water
Ti Tree	Ground water
Yulara	Ground water

[1] With local names where in common use.
[2] The water source for the Borroloola town camp Garawa is groundwater and is separate from the Borroloola source

is the custodian of the Garawa water supply infrastructure, it is still included in this report. This is because Power and Water continues to assist the Mabunji Aboriginal Resource Centre by monitoring the quality of Garawa drinking water as part of the Borroloola water quality monitoring program.

Water sources

Power and Water currently manages three surface water sources. Darwin River Reservoir is the major source of drinking water supply to Darwin. Katherine's drinking water is mostly from a surface water supply drawn from the Katherine River at Donkey Camp weir.

The town of Pine Creek can rely on the surface water from Copperfield Reservoir if required.

All major and minor urban centres serviced by Power and Water are either in part or completely reliant upon groundwater for their drinking water supply. Local subsurface aquifers, at a range of depths and in a variety of geological environments, are used.

Some drinking water sources are better protected than others, such as those with 'closed' catchments like Darwin River Reservoir. However even the protected water sources are still vulnerable to a broad range of potential hazards and require active management to maintain water quality.

Darwin water quality risk assessment

In 2014, Power and Water engaged Hunter H2O to undertake a comprehensive water quality risk assessment of Darwin's water supply region. Three separate risk assessments and reports were undertaken for the borefields, Darwin River Reservoir and the drinking water distribution network. A combined assessment was finalised in February 2016, which summarises the findings to provide a single set of recommendations for further action. These recommendations are being applied by Power and Water and include:

- reviewing and increasing the water quality monitoring program
- determining a better understanding of current levels of disinfection

- reviewing and implementing further pipeline and tank maintenance and cleaning programs
- reviewing current online analysers and chemical dosing control systems.

Enhancing Darwin's water supply

Power and Water is implementing strategies for adapting to increased demand on Darwin's drinking water. The Darwin Region Water Supply Strategy details Power and Water's approach to managing the balance between demand for water and supply capability to 2030. Water quality plays a significant role in determining the supply capability now and beyond.

Through the reporting period, implementation of the strategy has resulted in:

- upgraded supply capability (Howard East Borefield project)
- upgraded understanding of the Darwin River Reservoir supply capability
- a demand management program (Living Water Smart)
- planning and design for water source augmentation in the short term (Manton River Reservoir return to service)
- planning to support the assessment of a range of medium term water source options, against financial, engineering, social and environmental objectives.

Howard East and McMinns Borefields

McMinns and Howard East Borefields are important water sources for Darwin. Approximately 10-15 per cent of Darwin's water supply is ground water extracted at these borefields.

In 2014, Power and Water successfully lodged an application for an extraction licence to bring four existing bores in the Howard East Borefield into service. The bores have been equipped and commissioning is underway to bring them into service for the Darwin drinking water supply.

Darwin River Reservoir capability

Darwin River Reservoir supplies approximately 85-90 per cent of Darwin's drinking water. To maintain the best quality water in the reservoir, no development or uncontrolled public access is permitted within the catchment. As the Darwin water supply does not have filtration facilities, water quality hazards in the source can directly impact the supply. A variable tropical climate, fluctuating rainfall, evaporation levels and periodic inundation continued to influence the water quality capability through this reporting period.

Through this reporting period, the understanding of the hazards in the Darwin River Reservoir improved as a consequence of monitoring completed under the limnological contract with Tropical Water Solutions (TWS).

In 2014, intense monitoring following rainfall increased the understanding of the water quality capability during these events.

The significant water quality changes observed following the raising of the spillway in 2010 continued through to 2016. The elevated risk of algal blooms demanded ongoing and responsive management until 2016.

Living Water Smart

Water conservation plays a critical part to the ongoing sustainability of the Darwin region's water supply. Power and Water has been working hard in this space and plans to keep up the effort. See more at: www.livingwatersmart.com.au

Manton River Reservoir

To satisfy the growing demand for drinking water in the Darwin region, Manton River Reservoir may need to be returned to service. This reservoir is not currently used as an operational source of water due to infrastructure constraints and water quality hazards. Investigations to improve and stabilise Manton River Reservoir's water quality by in reservoir treatment began in 2007-08 and continued throughout 2014-16. In reservoir treatment and stabilisation will minimise the potential for algal blooms and iron-manganese mobilisation providing constant quality feedwater to a water treatment plant. This will provide cost savings through appropriate scaling of the water treatment plant.

03 Preventative measures for drinking water quality management

There are unique challenges involved in ensuring the delivery of good quality drinking water across the Northern Territory. Power and Water adopts a systematic, preventative and multiple barrier approach to control the potential risks to drinking water quality.

A multiple barrier approach

The Australian Drinking Water Guidelines (ADWG) outline how to protect drinking water. They recommend 'catchment to consumer' management of water quality, using a preventative risk based and multiple barrier approach. A similar approach is recommended by the World Health Organisation.

The multiple barrier approach is universally recognised as the foundation for ensuring safe drinking water. Specific water treatment methods can prevent disease from being transmitted to the community. However, treating water after it leaves reservoirs and storages is not the only way to maintain water quality.

Power and Water has adopted the multiple barrier approach to protect drinking water supplies. The strength of multiple barriers is that a failure of one barrier may be compensated for by the remaining barriers, minimising the likelihood of contaminants passing through the entire treatment system. The placement of barriers in a conventional multiple barrier system is shown in Figure 2 below.

The catchment to consumer framework applies across the entire drinking water supply system – from the water source to consumers' tap. It ensures a holistic assessment of water quality risks and solutions to ensure the reliable delivery of safe drinking water to consumers.

A diagram outlining a conventional multiple barrier system is shown in Figure 2.

A table showing the multiple barriers in place across major and minor urban centre water supply systems in the Northern Territory is shown in Table 2.

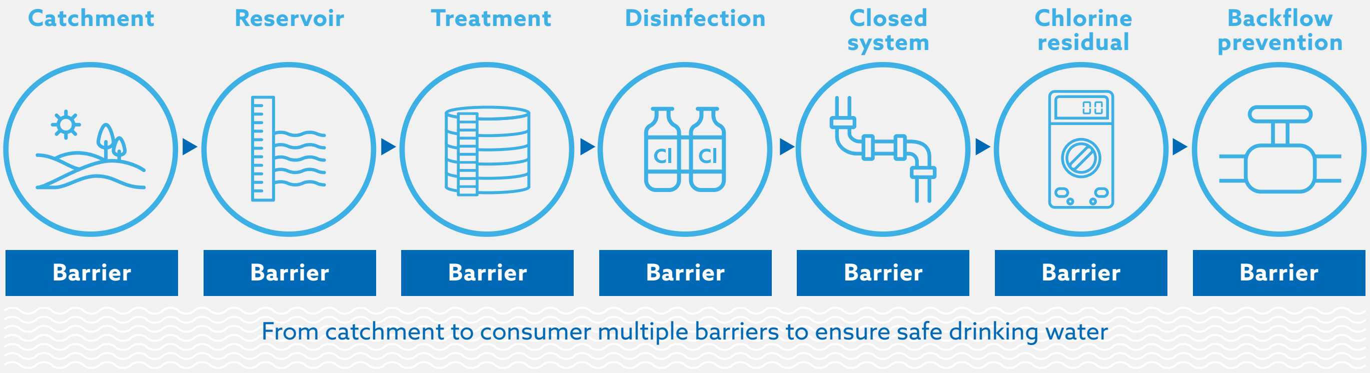
Protecting the source

For Power and Water, the first and most important focus for protection is the catchment itself. It is the primary asset of any water supply and implementing effective measures to protect it has flow-on effects that can result in a lower cost, safer drinking water supply.

In 2013, Power and Water finalised its *Catchment and Water Source Protection Strategy*, which outlines an integrated, comprehensive framework for protecting the Northern Territory's water assets. This strategy outlines the 12 key principles that guide management and clearly articulates the actions that will be taken to uphold these principles. Catchment management priorities are identified at a number of water sources.

Implementation of the strategy since 2013 has resulted in the development of water source protection plans for the individual water sources identified. These plans define our approach to the

FIGURE 2: A multiple barrier system



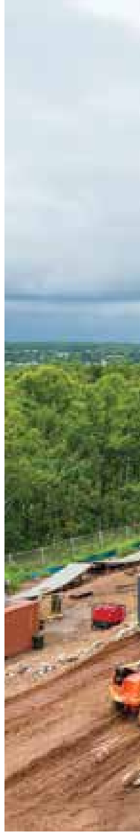
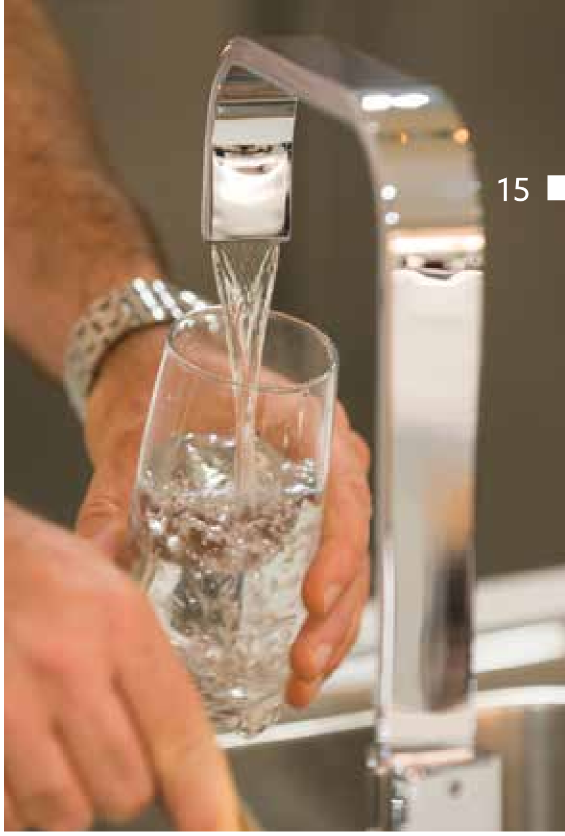


TABLE 2: Water quality barriers in major and minor urban centres

Centres	Catchment protection	Detention in reservoirs and aquifers	Bore head protection zone	Bore head integrity	Coagulation, filtration or membrane filtration	Disinfection	Storage tank integrity and cleaning	Maintenance of positive pressure in reticulation	Back-flow prevention in reticulation	Disinfection residual to customer's meter
Adelaide River		•	•	•	•	•	•	•	•	•
Alice Springs	•	•	•	•		•	•	•	•	•
Batchelor		•	•	•		•	•	•	•	•
Borroloola		•	•	•		•	•	•	•	•
Cox Peninsula	•	•	•	•		•	•	N/A	N/A	•
Daly Waters	•	•	•	•		•	•	•	•	•
Darwin - ground water	•	•	•	•		•	•	•	•	•
Darwin - surface water	•	•	N/A	N/A		•	•	•	•	•
Elliott		•	•	•		•	•	•	•	•
Gunn Point		•	•	•		•	•	•	•	•
Katherine - ground water		•	•	•		•	•	•	•	•
Katherine - surface water			N/A	N/A	•	•	•	•	•	•
Kings Canyon	•	•	•	•		•	•	•	•	•
Larrimah	•	•	•	•		•	•	•	•	•
Mataranka		•	•	•		•	•	•	•	•
Newcastle Waters	•	•	•	•		•	•	•	•	•
Pine Creek - ground water		•	•	•		•	•	•	•	•
Pine Creek - surface water			N/A	N/A		•	•	•	•	•
Tennant Creek		•	•	•		•	•	•	•	•
Timber Creek		•	•	•		•	•	•	•	•
Ti Tree	•	•	•	•		•	•	•	•	•
Yulara	•	•	•	•	•	•	•	•	•	•



protection and sustainable management of these water sources. Individual plans set specific objectives for each of the water sources and the management actions required for meeting those objectives.

Water supply treatment

Microbiological water quality is of highest priority at Power and Water. We continue to work at maintaining a number of effective barriers against disease causing organisms. In conjunction with other barriers to protect the water source, chlorination is a vital defence against microbiological contamination. Continuous chlorination is the preferred method to disinfect drinking water and without it there exists an elevated and unnecessary level of risk to public health.

Power and Water pro-actively guards against risks presented by *Naegleria fowleri*. We have set a minimum free chlorine residual of 0.5 mg/L to be maintained in all supplies at all times. The effectiveness of this control is assessed by monitoring the free chlorine residual and recording and acting on incidents where the free chlorine residual falls below 0.5 mg/L.

Maintaining a minimum free chlorine residual of 0.5 mg/L has the inevitable consequence that the free chlorine level will frequently exceed the aesthetic guideline value of 0.6 mg/L. Free chlorine is therefore excluded as an aesthetic parameter in microbiological risk assessments.

During this reporting period, Power and Water has expanded its treatment systems:

Tennant Creek continuous chlorination

Continuous chlorination provides an efficient, reliable and cost effective way of providing safe drinking water and is used across Australia and the world. Prior to the installation of continuous chlorination, Tennant Creek's water supply was hand dosed with chlorine in reaction to events. It was the only town in the Northern Territory without continuous chlorination and experienced a succession of drinking water quality contamination issues.

Power and Water partnered with the Department of Health (DoH) to install continuous chlorination for the Tennant Creek community. The continuous chlorination plant is located at the Cabbage Gum Pump Station, 15 km south of Tennant Creek, and was opened in April 2015. As a result, Tennant Creek's water supply is no longer unacceptably vulnerable to microbial contamination.

Continuous chlorination creates better quality drinking water for the Tennant Creek community, in line with other major Australian towns and centres.

Adelaide River water treatment plant

Prior to June 2015, drinking water in the Adelaide River town typically contained elevated iron and manganese concentrations. While this water supply was safe to drink and met the health values in the ADWG, the mineral concentrations caused drinking water that was discoloured, had an unpleasant taste and the potential to stain laundry.

Construction work commenced on a new water treatment plant for Adelaide River in September 2014 and the new water treatment plant was operational by September 2015. The plant is located in the existing Power and Water compound and will service the surrounding population of around 300 residents, supplying up to 1.1 ML/day of improved drinking water, in peak demand.

The upgrade to the water treatment plant included the introduction of an Australian-first biological filtration system to provide for the removal of iron and manganese. This provides a more reliable, sustainable and cost effective method of treating bore water than the traditional process.

04 Operational procedures and process control

Power and Water maintains operational procedures and monitoring to ensure the reliable supply of quality drinking water across the Northern Territory.
To consistently achieve a reliable water supply with good quality water, it is essential to have effective control over the processes and activities.

The configuration of the infrastructure at each urban centre determines the exact process control methods required. Figure 3 represents the infrastructure configuration common in most minor urban centres. Raw water is pumped from the source (typically one or more bores) along a rising main to a ground level water storage tank. From the ground level water storage tank, raw water is treated with chlorine and pumped to an elevated tank. Drinking water is distributed to customers via the reticulation network and the elevated tank maintains adequate pressure in the reticulation network.

Water supply process control

Power and Water uses industrial control systems (ICS) such as the Supervisory Control and Data Acquisition (SCADA) system for process control. This computer controlled supervisory system is used to monitor and control industrial processes that exist in the physical world. SCADA systems are different from other ICS systems as they are large scale processes that can include multiple sites and large distances.

Power and Water's SCADA system monitors control points in water supplies using a range of online monitoring systems in each centre. Apart from monitoring the status and performance of infrastructure, this system provides continuous monitoring for specific water quality parameters such as chlorine, fluoride, conductivity, turbidity and pH levels. Infield sampling or measurements, such as temperature and chlorine residuals help to identify performance issues and provide direction for corrective actions.

Operational procedures

To maintain process control, appropriate procedures were managed by Power and Water through the reporting period. In 2013, Power and Water voluntarily discontinued its quality ISO 9001:2000 certification, as part of an organisation wide review and rationalisation process. Through this period of change Power and Water remained committed to a program of quality management for documented procedures and continues to liaise with and inform the Department of Health (DoH) of any potential impacts to the drinking water quality management system.

Appropriately established procedures and water quality information are made readily available to all employees via Power and Water's intranet site, Aquanet. In 2014 the Aquanet site was redeveloped to maintain the visibility of the information and procedures. The Aquanet site continued to be improved in 2015, acting as the central point to link key water quality tools, procedures and data.

Corrective actions

In this reporting period Power and Water strengthened corrective and preventative procedures. In particular corrective actions linked to operational monitoring were formalised.

Algal response procedure

The *Management of Algal Blooms* procedure was finalised in 2014. The document describes a standard approach to the management of cyanobacteria or nuisance algae. The alert levels interpret the monitoring results and describe the appropriate response to take, including notification. The document also contains site specific information to help with managing the response.

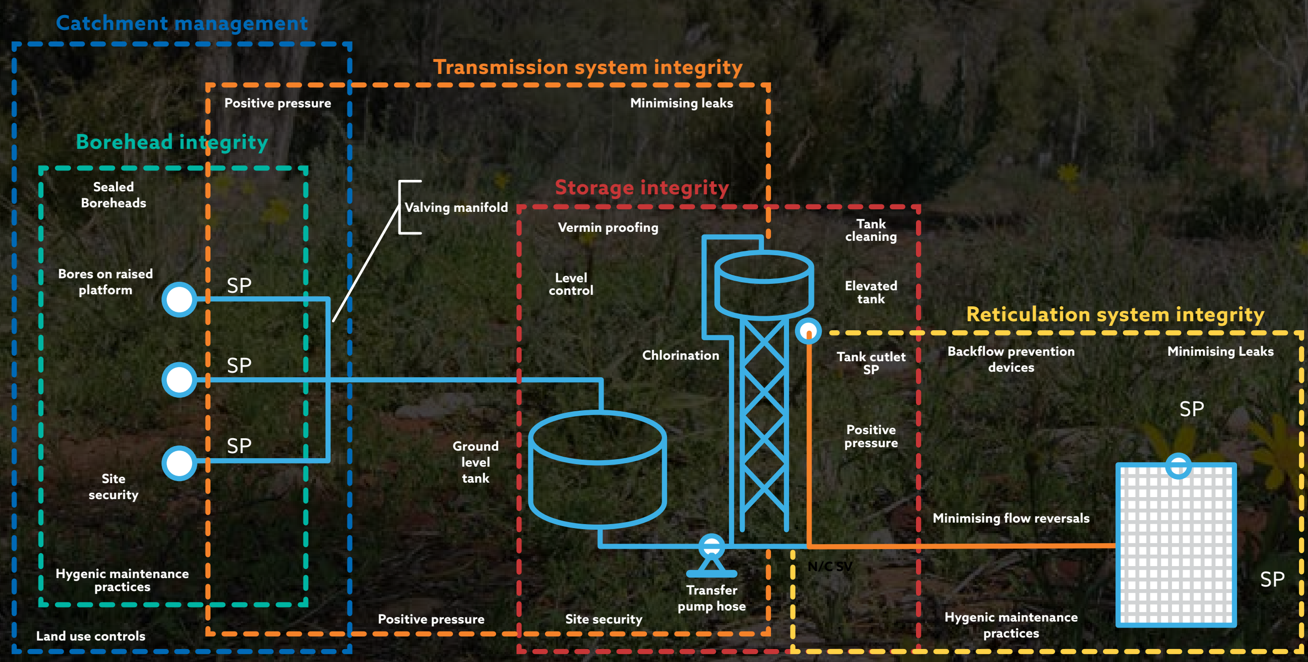
Materials and chemicals

Materials used by Power and Water that contact potable water must normally comply with AS/NZS 4020:2005, *Testing of products for use in contact with drinking water* or other relevant standards.

Suppliers of chemicals used by Power and Water for water treatment are required to provide an analysis report of the chemical to be supplied. Chemicals must comply with the relevant ANSI/AWWA standard and the management system at the site of manufacture of the chemical must be certified to ISO 9001.

In the reporting period DoH and Power and Water formalised the schedules listing materials, products and chemicals, to ensure they are the only ones used by operational personnel. This followed an audit, that identified products and materials, eg greases, jointing compounds etc. that may be in contact with drinking water which falls outside the scope of AS/NZS 4020:2005 or other relevant standards. This audit also identified chemicals used for cleaning of water treatment plant equipment and for weed control in catchments.

FIGURE 3: Typical minor urban centre water supply configuration



SP - sample point

05 Verification of drinking water quality

Verification of drinking water quality provides an assessment of the overall performance of the system and communicates the quality of drinking water being supplied to consumers. Power and Water verifies its drinking water quality through the monitoring of drinking water quality and the assessment of consumer satisfaction.

Water quality monitoring

Power and Water managed the water quality monitoring programs for all major and minor urban water supplies in this reporting period. In accordance with the principal commitments contained in the MoU between Power and Water and Department of Health (DoH), these monitoring programs were reviewed annually and carried out with close consultation between each party.

The extensive water quality monitoring programs have specific targeted objectives. Between 2012 and 2016, our drinking water monitoring programs stipulate the collection of 20,965 operational and verification samples. In all, 19,161 samples, or 91 per cent were able to be collected over this period. The collected data, from monitoring was used for both operational and verification objectives.

Operational monitoring

Operational monitoring provides information for long term data evaluations, detailed studies and investigations that increase the understanding of the drinking water supplies. The data is also used, if necessary, as a trigger for immediate short-term corrective action.

The operational data collected in this reporting period is not used here for assessing conformance with the Australian Drinking Water Guidelines (ADWG) or compliance with the agreed levels of service.

Verification (compliance) monitoring

Verification monitoring is the final check that the barriers and preventative measures implemented to protect public health are working effectively. Verification data is used for assessing conformance with the ADWG, compliance with agreed levels of service and as a trigger for short-term corrective action.

Section B of this report provides a wide ranging assessment of the verification data collected for the drinking water quality supplied to consumers.

Water quality indicators

It is neither necessary nor feasible for all potential contaminants to be monitored in a water quality monitoring program. The key indicator parameters used to determine the water quality for the reporting period are described in the following sections. Section B of this report provides the assessment while the data is located in various tables in the Appendices.

Microbiological parameters

Waterborne disease-causing organisms (pathogens) pose a serious risk to human health. The risk from pathogens in water supplies can vary significantly within a short period of time therefore frequent microbiological monitoring is required to assess the potential for their presence.

The primary source of pathogens is faecal material either directly from animals or from sewage. Pathogens are difficult to detect and the analytical procedures are complex, protracted and require a specific test for each pathogen. The time taken for these analyses makes it impractical to directly test for pathogens, therefore indicator organisms are used to determine if contamination with faecal material has occurred.

Power and Water monitored the following indicator organisms:

- *Escherichia coli (or E. coli)* indicates faecal contamination from warm-blooded animals, including humans and hence, the potential for the presence of disease-causing micro-organisms
- total coliforms indicate the range of bacteria found in many soil and aquatic environments and can provide a measure of the effectiveness of a water treatment system, and the cleanliness of the drinking water supply more generally.

The ADWG performance requirements stipulate that no *E. coli* should be detected in drinking water. Recognising the uncertainty attached to *E. coli* results, the guidelines also include the requirement that rigorous corrective action be undertaken and documented in response to an *E. coli* detection, to prevent recurrences of potential faecal contamination.

As well as these two indicators, Power and Water continued to monitor for the presence of *N. fowleri*, a free-living ameboflagellate found in soil and aquatic environments. This pathogen causes a

rapid and usually fatal infection, primary amoebic meningoencephalitis (PAM), acquired when contaminated water is forced into the nasal passages.

N. fowleri is not associated with faecal contamination and therefore the indicator organisms described above are not suitable indicators for it. Separate and extensive monitoring of this pathogen has occurred in all major and minor centres since 2006-07, after the organism was detected in the Darwin water supply in 2005.

The ADWG recommend an action level of two *N. fowleri* organisms per litre (or one per 500mL) in the treated water system and controlling *N. fowleri* by maintaining a minimum free chlorine level of 0.5 mg/L. Power and Water aims to maintain this level of chlorination in all distribution systems. Results of *N. fowleri* monitoring between 2012 and 2016 are presented in Section B.

Finally, Power and Water also monitors reticulated water for the presence of the pathogen *Burkholderia pseudomallei*. This bacterium is the agent responsible for the disease melioidosis. Infections usually occur when skin cuts and abrasions come into contact with contaminated soil or muddy water, or by the inhalation of airborne dust or contaminated water droplets. Infection may also occur after drinking water containing the bacteria, however this is very rare. Power and Water's drinking water monitoring program includes *B. pseudomallei* as an investigative and research activity. Power and Water works closely with Menzies School of Health Research (MSHR) to identify water supplies likely to be at risk of colonisation by *B. pseudomallei*.

Targeted monitoring for this pathogen continues to focus on the at risk supplies. The results of monitoring for this pathogen can be found in Section B.

Chemical parameters (Health)

The safe levels of chemicals in drinking water are specified in the ADWG and are based on assumptions including water consumption and potential exposure to chemicals from other sources. Power and Water monitored numerous chemical parameters to ensure that water supplied to customers is safe to drink.

The potential risk to human health increases as the levels of these chemicals increase. Monitoring by Power and Water ensures any risk to human health is identified and quickly minimised.

The results for health related chemical parameters are presented in Tables A3 and A4 in the Appendices.

Chemical and physical parameters (Aesthetic)

Aesthetic parameters are the chemical and physical characteristics of water quality that pose no threat to human health, however can affect drinking water appearance, taste, feel and odour. This includes total dissolved solids (TDS), hardness (calcium and magnesium carbonates and sulfates), colour, pH and a few common metals.

The aesthetic quality will affect the acceptance of drinking water by the consumer and is usually the first change in water quality observed. Results for the annual assessment of Aesthetic parameters are shown in Tables A3 and A4 in the Appendices.

Radionuclides

Low levels of radioactivity are occasionally detected in drinking water supplies in the Northern Territory. The radionuclides responsible for this radioactivity are natural and a characteristic of the local hydrogeology.

The 2011 ADWG outline the corrective action responses recommended when guideline limits are exceeded:

- If the total annual dose is less than 0.5 mSv, Power and Water will continue monitoring in accordance with 2004 ADWG.
- If the total annual dose lies between 0.5 and 1.0 mSv, results are reported to the relevant health authority - Department of Health (DoH). Collectively Power and Water and DoH determine the frequency of ongoing sampling (primary response level).
- If the total annual dose exceeds 1.0 mSv intervention is required. In this instance, Power and Water and DoH would assess the results and examine options to reduce the levels of exposure (secondary response level).

Details of the radiological assessment are reported in Section B. Results are shown Tables A3 and A4 in the Appendices.

Organic chemicals

While it is neither necessary nor feasible for all potential organic chemical contaminants to be monitored in Power and Water's water quality monitoring program, the program remains responsive to emerging potential risks as they become known. For example, the result of preliminary testing for per- and polyfluoroalkyl substances (PFAS), chemicals associated with historical usage of firefighting foams, is currently being undertaken by the Department of Defence. Power and Water will expand its program to include these chemicals as risks are identified.

Other organic chemicals of interest include:

• *Trihalomethanes*

Chlorine introduced into a water supply as a disinfectant reacts with naturally occurring organic matter such as decaying leaves and other vegetation to produce by-products of disinfection, primarily trihalomethanes (THMs).

The concentration of THMs is typically proportional to the amount of organic material in the water. Surface water supplies have higher levels of naturally occurring organic matter than ground water supplies and hence higher THM levels after disinfection.

All major and minor urban centres were monitored for THMs in 2012-16 as part of the drinking water monitoring programs. Results can be found in Tables A3 and A4 in the Appendices.

• *Pesticides*

Pesticides (insecticides and herbicides) are sometimes used in our catchments to control insects and weeds and DoH requires testing of these when there is the potential for water supply contamination. The 2011 ADWG lists more than one hundred new pesticides that have the potential to find their way into drinking water sources.

Our pesticide monitoring program focuses on 46 commonly used pesticides including organochlorine, organophosphate and triazine pesticides, insecticides and acidic herbicides.

Although monitored for several years, pesticides in the Northern Territory water supplies are rarely detected despite limited use in some areas. Pesticide monitoring of drinking water supplies is restricted to Darwin and Katherine supplies.

Disinfection performance

The most commonly used disinfectant, chlorine, is used to destroy disease-causing organisms in water. Only chlorine based disinfectants leave a beneficial residual level that remains in treated water helping to protect it during distribution and storage. Chlorine can only be efficacious when its concentration is maintained at an effective level. This requires frequent measurement of the concentration and correction when the concentration is found to be inadequate.

Chlorine decay

In order to achieve adequate disinfection the concentrations of both free chlorine and total chlorine must be measured. In a well performing water supply the concentrations of total chlorine and free chlorine are nearly equal.
A difference between these residuals indicates material in the system is reacting with the free chlorine reducing its concentration. The decline in the free chlorine concentration, through deactivation and/or combination, is referred to as chlorine decay. With the decay in free chlorine there is a corresponding increase in the difference between the free chlorine and total chlorine concentrations. The greater the chlorine decay the poorer the quality/performance of the system.

Free chlorine total chlorine ratio (FC/TC)

The free chlorine - total chlorine ratio is a measure of chlorine demand and chlorine decay and is a useful indication of the cleanliness of a distribution system. In a well operated and maintained system the free chlorine to total chlorine ratio is 0.90 or greater. The critical limit is 0.8 (WIOA).

During the 2012-16 monitoring periods, Power and Water began monitoring disinfection performance with the intention to provide an assessment report to its Water Operations business unit.

Customer satisfaction

Monitoring of consumer comments and complaints provides valuable information on potential problems that may not have been identified by performance monitoring. The ADWG recommends that water suppliers evaluate customer complaints.

Power and Water has successfully introduced IBM's Maximo Asset Management IT system in this reporting period. This has streamlined customer service processes and enables the systematic recording of customer complaints. Call scripts constructed by Power and Water's Water Quality team ensure correct categorisation of calls received from customers. This process simplifies the evaluation and collation of data in preparation for submission to the National Performance Report (NPR).

The results of specific water quality complaints made by Power and Water customers between 2011 and 2016 can be found in Section B. This includes a summary of drinking water quality complaints by type (eg clarity/dirtiness/particles, alleged illness, taste and other) for the Darwin water supply between 2015 and 2016.

06 Management of incidents and emergencies

The protection of public health and best service to our customers relies on Power and Water's ability to respond appropriately and systematically to incidents that compromise water quality. To this end, Power and Water adheres to a number of protocols that enable the most effective response and the rapid dissemination of information when water quality failures and incidents occur.

The *Protocol for the Notification by Power and Water Corporation of Drinking Water Quality and Supply Reportable Incidents and Events to the Department of Health* was established between Power and Water and Department of Health (DoH) and updated in December 2013. It sets out a series of actions that must be followed to ensure information of adverse changes in water quality is promptly conveyed to the DoH.

This information includes analytical results where the measured value of a parameter exceeds an aesthetic or health Australian Drinking Water Guidelines (ADWG) guideline value or set trigger value. Additional information includes known details of the circumstances of the drinking water quality incident or event and actions being taken to rectify the situation.

The agreement between Power and Water and the Department of Primary Industry Resources (DPIR) microbiological laboratories, the *Protocol for the Notification by Laboratory Service Providers of E. coli and Coliform Detections in Potable Waters*, was reviewed and updated three times in this reporting period. Version 1.5 is the current approved document.

This protocol sets out the procedures whereby laboratory service providers notify Power and Water and the DoH when *E. coli* and coliforms are detected in raw (untreated) and drinking water. The protocol outlines trigger levels, organisational accountabilities and notification methods.

The protocol covering the notification of out of range fluoride results at specific sites in the corporation s drinking water supplies was reviewed and updated three times. Version 1.3 is the current approved document.

07 Employee awareness and training

The knowledge, skills, motivation and commitment of employees and contractors ultimately determine Power and Water's ability to operate a water supply system successfully. Power and Water is focused on building a professional, capable, accountable and diverse workforce.

Power and Water's training techniques during this reporting period include formal training courses accredited by a national training body, in house training, on the job experience, mentor programs, workshops, demonstrations, seminars, courses and conferences.

Industry training

Power and Water is committed to gaining industry training to either Certificate III or IV for all Water Operators. Certificates III and IV in Water Operations provide training for operators in the water industry and the opportunity for specialisations in water treatment, wastewater treatment, water supply distribution (network), trade waste, catchment operations, irrigation, dam safety, dam operations and source protection, river groundwater diversions and licensing, and construction and maintenance. Trade technical workers continue to work towards the completion of Certificate III and Certificate IV in Water Operations.

On-line inductions

Water Services' on-line induction process was updated in this reporting period to ensure current site and safety information remains current.

The induction process contains consistent, site specific and up to date information. The system ensures personnel and contractors are inducted to a level that meets Power and Water's legislative requirements and industry best practice.

Training, seminars and workshops

Internal Trainer Network

Power and Water's Internal Trainer Network initiative was implemented in May 2015. The Internal Trainer Network recognises the skills and knowledge of the corporation's employees through the delivery of non accredited, Power and Water specific training. This framework reduces the cost of training delivery, empowers employees to own processes and procedures and recognises their skills. Employees have a better understanding of the safety management system, materials equipment and operating environment while trainers develop improved presentation skills.

To facilitate knowledge sharing and collaborative service improvement, Power and Water also participates with SA Water (South Australia) and Water Corporation (Western Australia) in the water quality network.

Ensuring safe drinking water

In February 2015, Power and Water employees attended a one-day workshop led by Steve Hrudey, an international expert on responses to drinking water quality incidents and author of *Ensuring Safe Drinking Water – Learning from Frontline Experience with Contamination*, published in 2014 by the American Water Works Association.

Monitoring and managing chlorine residuals

In February 2015, Power and Water staff participated in a training workshop as part of the Water Quality Research Australia Limited (WaterRA) project #1064 *Develop Evidence based Approaches to Monitor and Manage Chlorine and Chloramine Residuals*. This workshop shared and applied the learnings from the project.

Water in the bush

Power and Water employees continue to participate in professional and industry events such as the annual Water in the Bush conference. This event brings together Northern Australia water professionals, the community and industry to share knowledge on issues affecting water. The 2015 event included a workshop about the implementation of a health based target (HBT), which was attended by Power and Water and the Department of Health (DoH).

Staff engagement

The result of our staff engagement survey in 2015 showed that Power and Water maintained an overall engagement score of 71 per cent. Actions identified in the survey to continue and improve engagement were progressively achieved. Particular focus was placed on improving recognition and reward of staff at Power and Water.

08 Research and development

Research and development activities help to ensure continual improvement and the ongoing capability to meet drinking water quality requirements.

WaterRA projects

Power and Water is an industry member of Water Quality Research Australia Limited (WaterRA), a not for profit organisation that undertakes collaborative research on water quality issues of national importance. WaterRA brings together key water research groups and industry members across Australia.

The primary aim of WaterRA is to implement a structured program of collaborative and relevant research and to ensure that knowledge gained from this research is transferred to industry.

As an active member of WaterRA, Power and Water participates and contributes funding to numerous research projects. This includes the following projects completed between 2013 and 2016:

> Project Number 1047
Application of Capacitive Deionisation in Inland Brackish Water Desalination

For inland communities in Australia, the only reliable water resource is groundwater and limited surface river water and much of which contains salt that is higher than the acceptable drinking water guideline value. It is necessary to use a desalination process to remove the salt and produce drinking water (< 500 mg/L salinity).

This project sought to apply the capacitive deionisation (CDI) technology to real applications for inland drinking water supply and direct agriculture use by desalting brackish ground water. The trial used multiple locations across Australia including Western Australia, South Australia and the Northern Territory. The project conducted on site trials and investigated the full operational performance of the technologies.

> Project Number 1064
Develop Evidence based Approaches to Monitor and Manage Chlorine and Chloramine Disinfection Residuals

The aim of this project was to provide water quality managers with the best available information and tools to assist them in achieving practical and improved disinfection system outcomes that best meet their customers' requirements. This project drew together information from literature, including previous research and recent operational trials from the industry. A disinfection management guidance manual was produced, along with a literature review and a suite of factsheets. The project team also developed a training package for utilities.

> Project Number 1077
Decentralised Treatment Solutions for Regional and Remote Water Supplies

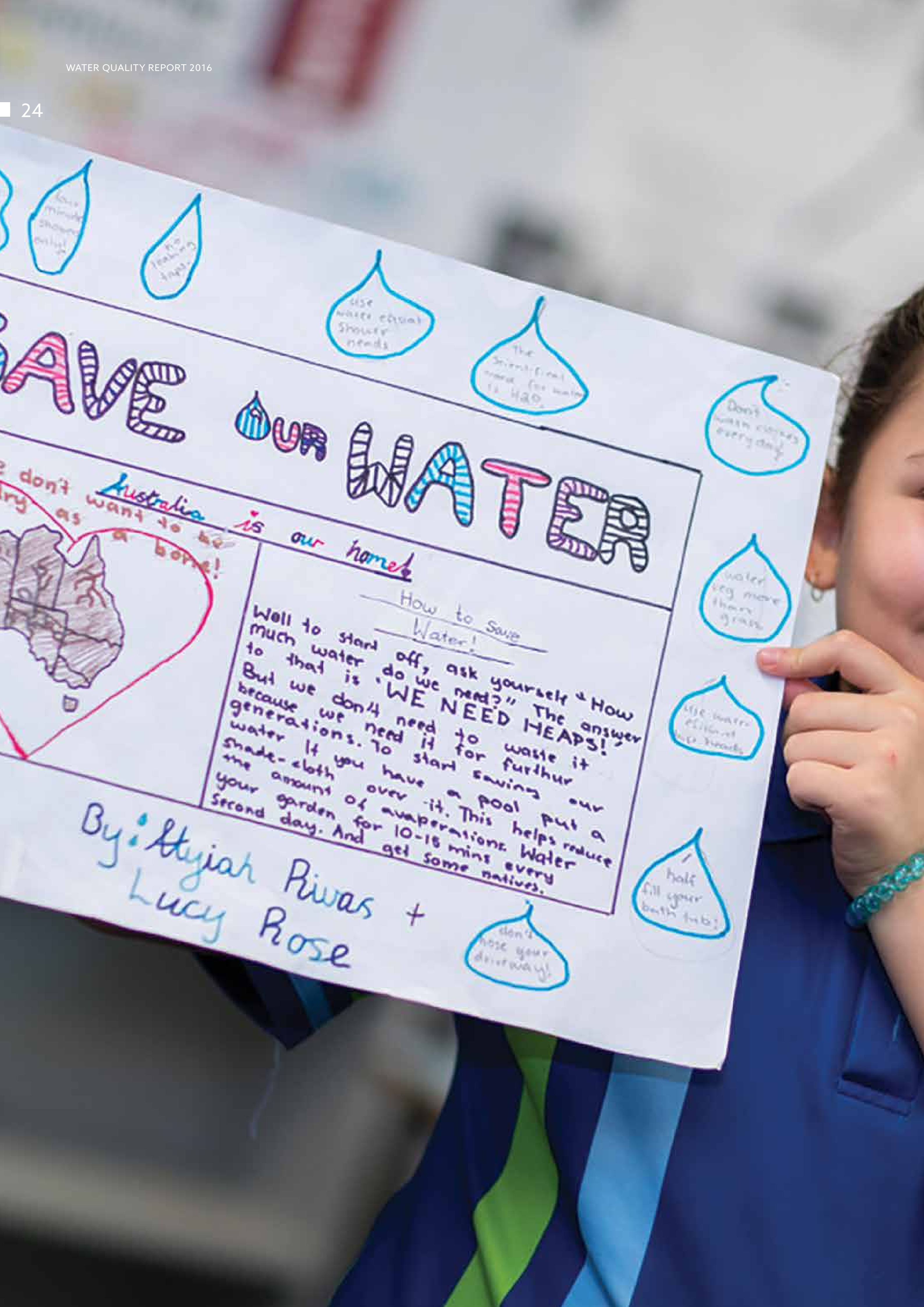
Case studies from GWMWater, TasWater, Coliban Water, Power and Water and Yarra Valley Water were used to develop a portfolio of information on decentralised treatment solutions.

The review assessed key variables such as source water quality, available technology, operability, maintainability, cost, health risks for non compliance, performance and reliability – and summarised the findings for easy comparison.

Manton River Reservoir monitoring

Although Manton River Reservoir is currently only used for recreational purposes, the growing demand for water in the Darwin region may result in this reservoir being returned to service as a future drinking water supply. For this reason, Power and Water has continued to work to understand its water quality and investigated options for stabilising Manton River Reservoir's water quality by in reservoir treatment.

Increasing the understanding of the reservoir's water quality informs the management of this potential source. In 2014, a report was completed presenting an overview of the water quality monitoring by Tropical Water Solutions (TWS). The assessment clearly illustrates the potential hazards if using this source and the ongoing connection with climatic conditions.


AVE OUR WATER
Australia is our home!
How to Save Water!
Well to start off, ask yourself "How much water do we need?" The answer to that is "WE NEED HEAPS!" But we don't need to waste it because we need it for further generations. To start saving our water if you have a pool put a shade-cloth over it. This helps reduce the amount of evaporations. Water your garden for 10-15 mins every second day. And get some natives.
By: Alyiah Riwas + Lucy Rose
half fill your bath tub!
don't hose your driveway!
Don't wash clothes every day

09 Community involvement and awareness

The Northern Territory has a unique, vibrant and diverse community. Connecting with this community is vitally important as part of effectively managing water supplies and delivering quality drinking water. Communication and engagement on issues affecting drinking water quality continues to be a key priority for Power and Water.

Engaging with our community

Communication

Power and Water works proactively to maintain effective two way communication with its consumers. This allows Power and Water to keep the community informed on issues associated with the provision of safe drinking water and helps consumers to keep us informed about any issues with water quality, damage to water supply or sewerage infrastructure and suspicious activity or unauthorised access to Power and Water's facilities.

Customers are kept informed of current and predicted water quality issues through placement of newspaper advertisements, our website and via social media.

Education and awareness

Power and Water maintains a comprehensive website and publishes pamphlets and fact sheets to promote better understanding of the Northern Territory's various water quality issues.

Water quality specialists are also available to visit schools and conduct interactive presentations on water science and other water related subjects.

Making a contribution

Power and Water is committed to making a meaningful contribution to the Northern Territory community. We support community events and promote awareness of water quality. Examples in recent years include:

- sponsoring the Water in the Bush conference hosted by the Northern Territory branch of Australian Water Association (AWA)
- recognising and rewarding examples of exceptional environmental stewardship as part of Power and Water's Melaleuca Awards
- presenting at major regional events including the Tropical Garden Spectacular and Sustainable Living Festival in Darwin
- supporting cultural and local community events such as the desertSMART EcoFair and the Desert Harmony Festival.

Continuous improvement

There are always opportunities to improve relationships with our consumers. Power and Water works towards this by considering actions to improve our phone and online customer service, build our presence on social media platforms and apply the results of our customer survey to build a greater understanding of the needs and expectations of our consumers.

Water smart programs

Commenced in 2013, *Living Water Smart* is a five year program focused on reducing water consumption across the Darwin region by 10 GL, or what constitutes a quarter of Darwin's annual water consumption. The program has a number of benefits, including a reduction in expenditure on major infrastructure, savings for customers and the long term benefits achieved through sustainable living.

The *Alice Water Smart* program successfully implemented a number of concurrent projects to preserve Alice Springs' finite groundwater source and secure the long term sustainability of the town.

10 Documentation and reporting

Documentation provides a basis for effective communication within the organisation as well as with the community and various stakeholders. The Australian Drinking Water Guidelines (ADWG) recommends that a system of regular reporting, both internal and external, is important to ensure that the relevant people receive the information needed to make informed decisions about the management or regulation of drinking water quality.

Power and Water's systems and processes are electronically managed in an Integrated Management System (IMS). Core components of the IMS are used for managing information and reporting. Aquanet is the interface used to access the many water components of Power and Water's IMS including documentation.

In 2012, Power and Water successfully completed projects within the Asset Management Capability program to replace outdated and inflexible IMS components. Facilities Information System (FIS) and the Work Information Management System (WIMS) were integrated into IBM's Maximo Asset Management. Maximo enabled the systematic recording of asset information and contributed to streamlining Power and Water's reporting processes.

Further extensive changes to the IMS occurred following the structural separation of Power and Water Corporation to form three separate corporations including Territory Generation and Jacana Energy from 1 July 2014. These substantial changes involved a commitment to separate systems and processes while finding efficiencies. This focus raised opportunities to advance drinking water quality documentation and reporting.

In 2014 the Aquanet site was redeveloped to make key water quality documentation and information visible. The Aquanet site continued to be developed in 2015, acting as the central point to link key water quality documents and data. The established documentation and water quality information are made readily available to all employees via Power and Water's Aquanet intranet site.

Data generated from the drinking water quality monitoring is maintained and accessed using a purpose specific Oracle database. The database underwent important upgrades several times in this reporting period to maintain connectivity with the changes in the IMS.

Operational data from the online monitoring SCADA is made reportable through a data historian application. This process information system (PI System) records, displays and reports the real time status of water supply infrastructure and water quality. Power and Water has progressively rolled out additional access to the PI system within Water Services.

Reporting

By producing an annual drinking water quality report, Power and Water provides an objective account of the quality of Northern Territory drinking water supplied in major and minor urban centres to customers, regulatory bodies and stakeholders. It also reports on its progress and achievements through other channels.

Power and Water continues to make comprehensive and quality information available to the public via its website or on request. This includes technical information, guides about water conservation and media releases.

Information provided to the National Water Commission also forms part of the NPR and provides the Northern Territory and the public a reliable and transparent source of information on urban water utilities.

Power and Water's annual report is tabled in the Northern Territory Legislative Assembly as a reporting mechanism for Power and Water's Shareholding Minister and Northern Territory Parliament. It also provides information for others, including the wider public, who have an interest in the provision of water, sewerage and electricity services in the Northern Territory.

Maintaining safe drinking water also requires strong reporting relationships between Power and Water and the Department of Health (DoH). Power and Water works closely with this department to resolve any water quality health related issues as they arise. This relationship is formalised in an MoU. Clear protocols are in place to ensure any deviations from the ADWG are reported promptly to DoH by Power and Water.

11 Evaluation and audit

The Australian Drinking Water Guidelines (ADWG) recommends that a long term evaluation should look at the overall system performance and identify any worrying trends within the data or problems within the water supply. The overall water supply performance refers to all components of the water supply such as source, storage, disinfection, reticulation and other elements. The review should include operational data like field results and any online data such as chlorine residuals, chlorine dose, pH, flows or tank levels.

Throughout this reporting period, Power and Water was on a path of major change, that involved an extensive commitment to re-evaluate business unit practices and functions for improved efficiencies. This focus on efficiency provided opportunities to advance drinking water quality practices and data evaluation.

Long term evaluation

A long term appraisal of water quality monitoring practices occurred in 2013, identifying opportunities to improve data evaluation. The drinking water quality monitoring program was reviewed in 2013 to include changes introduced with Version 3 of ADWG. In accordance with the principal commitments contained in the MoU between Power and Water and the Department of Health (DoH), these improvements were agreed and progressed.

In 2014 a raw water data, long term evaluation, was performed and used to prioritise preventative maintenance. The evaluation informed maintenance plans of wellhead infrastructure at numerous urban centres like Batchelor, Newcastle Waters and Darwin.

Darwin River Reservoir monitoring

Darwin River Reservoir is the major source of Darwin's water supply. The ongoing evaluation of the reservoir's water quality informs the management of this important water source.

In 2016, an evaluation report was completed presenting an overview of four years of water quality monitoring by Tropical Water Solutions (TWS). The assessment clearly illustrates the ongoing connection with climatic conditions, the impact of first rainfall events and the impact of the raised spillway.

Power and Water supports ongoing limnological assessments of Darwin River Reservoir and is considering the potential use of a 3D hydrodynamic model to guide water quality management by predicting transport processes, bacterial load and water discolouration with wet season turbulence.

Health based target trial

In late 2014, Power and Water participated in a trial co-ordinated by the Water Services Association of Australia (WSAA) about the introduction of a health based target for microbial water quality into the ADWG. This trial required Power and Water to perform several long term assessments of operational data such as raw water quality and online chlorine residuals. Water safety assessments were performed, using the WSAA *Manual for the Application of Health Based Treatment Targets*.

The trial assessed the Darwin supply system and informed maintenance of infrastructure. In 2015 the Darwin River chlorination system maintenance resulted in improvement to the supplies water quality performance.

Water quality health check

In February 2015, a commitment to implement a 'health check' of Power and Water's drinking water quality management system was made and a strategic action item included in the *2015-16 Water Services Business Unit Plan*.

The objective of the health check is to evaluate the drinking water quality management system and make recommendations. The first phase of the health check was undertaken by Water Futures Pty Ltd. in December 2015. The report summarising the findings of the first phase of the health check was finalised in April 2016. Recommendations for the next phase of the process are currently under review by senior management.

12 Review and continual improvement

Senior executive support, commitment and ongoing involvement are essential to the continual improvement of the organisation's activities relating to drinking water quality.

Power and Water continued to demonstrate commitment to the on-going review and continuous improvement of its services in this reporting period. On 13 December 2013, the Northern Territory Government announced the structural separation of Power and Water effective from 1 July 2014.

This substantial change involved an extensive commitment from the senior executive to build and implement a reshaped organisation. The process involved re-evaluating business unit practices, functions and a forensic assessment of asset management practices that gave a renewed vision for an efficient future. This period of restructure was challenging and we have strived to meet these challenges while continuing to deliver drinking water quality.

Water Services undertook a process of functional realignment in 2015 with the water quality function being a key driver. The water quality function was divided into the two key functions of strategy and operation. The new structures provide a foundation from which Power and Water will grow and develop into the future.

Support and involvement

LIVECHATelt is an intranet based forum that connects the Executive Leadership Team (ELT) with staff in 'real time'. It is designed to encourage the open sharing of knowledge and ideas, as well as provide staff with an opportunity to directly ask the ELT questions. Discussion of water quality improvement was the most popular topic on this forum in the 2015 conversation threads.

Senior executive water quality management system review

Senior executive initiated a review of the drinking water quality management system following the reshaping of Power and Water. The review of the application of the drinking water quality management system occurred in May 2016. The assessment was made according to the 12 elements of the Australian Drinking Water Guidelines (ADWG) along with the recommendation for continuous improvement. A range of improvements to governance, risk management and training are planned.

Relative risk assessment model

The model used to compare drinking water quality risks. The relative risk assessment model was reviewed and updated in 2013. This model of assessment was used until 2015 to approximately assess and compare drinking water risks from each water supply. The model became obsolete in 2015 as long term data evaluations, detailed studies and investigations increased the understanding of the drinking water supplies.

Section B: Drinking Water Quality and Performance

FIGURE 4: Percentage of samples taken in major urban centres in which no *E.coli* were detected monitoring program periods 2011-16

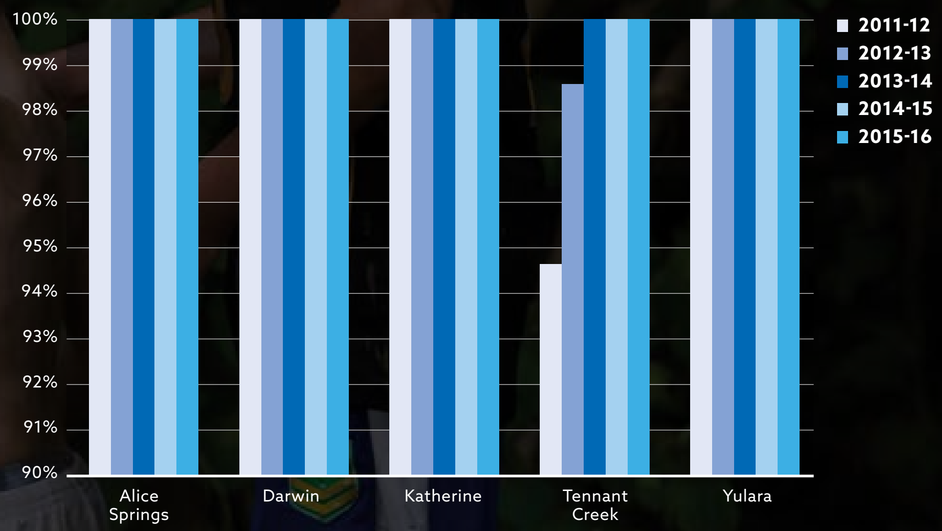
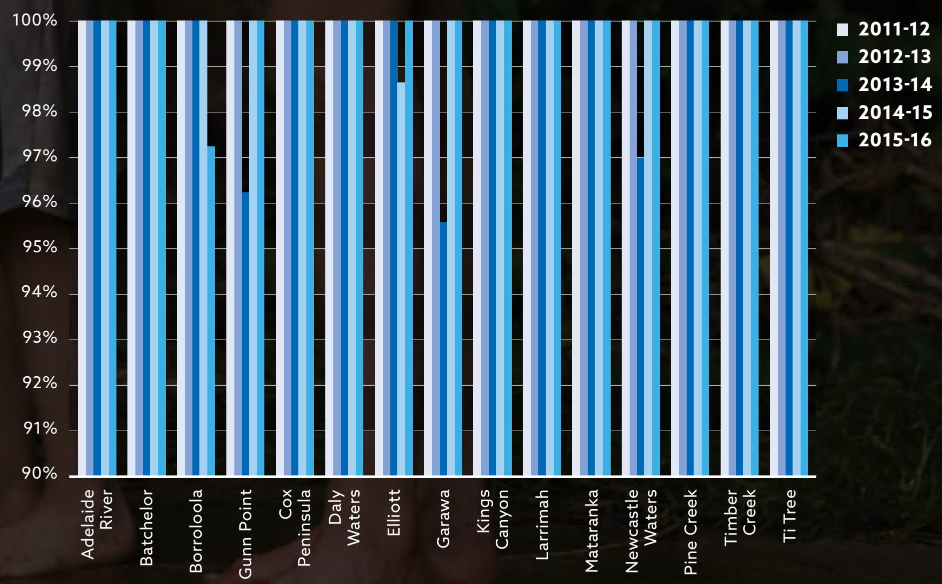


FIGURE 5: Percentage of samples taken in minor urban centres in which no *E.coli* were detected for monitoring program periods 2011-16



Microbiological results

Bacteria

Monitoring objective

Bacterial indicators are used for verifying the effectiveness of treatment and to assess the system microbiological cleanliness for the year. Monitoring for indicator bacteria provides a useful communication tool to verify that the preventative barriers to protect public health are working effectively.

Monitoring program

Power and Water s drinking water monitoring programs require that samples, representative of the quality of water supplied to consumers, be collected and analysed for *E. coli* at a minimum frequency. The results from this monitoring are used to demonstrate compliance and are reported as verification of the microbiological quality.

Operational monitoring for bacteria provides the detailed information needed to maintain a treatment process within defined parameters (process control). This information is not reported here.

The drinking water monitoring programs required a total of 10,741 samples to be collected for bacteriological verification assessment from 20 centres across the Northern Territory over the reporting period. A total of 10,956 samples were taken. The sample collection performance for individual urban centres for the recent period 2015-16 is presented in Tables A1 and A2 in the Appendices.

Limitations of monitoring

Microbiological verification monitoring is not intended to provide an absolute measure of safety because of the inherent sampling and analysis limitations. Samples only ever represent a small percentage of the total water consumed. Analytical methods take substantial time to produce a result, which means the water is already consumed before a result is received.

Compliance performance

Our performance can be regarded as satisfactory if over the preceding 12 months:

- at least the minimum numbers of programmed samples have been tested for *E. coli*
- samples tested are representative of the quality of water supplied to consumers
- no *E. coli* are detected in 100 per cent of samples as per the Australian Drinking Water Guidelines (ADWG) (this excludes repeat or special purpose samples).

With one exception, the 100 per cent *E. coli* free target was achieved in all major urban centres in the Northern Territory. The exception was Tennant Creek, which recorded *E. coli* detections in October 2014 prior to the installation of a continuous chlorination system. Since commissioning of the continuous chlorination system in April 2015 no *E.coli* were detected at this centre.

The majority of minor urban centres also achieved the 100 per cent *E. coli* free targets. A summary of the eight incidents that occurred during the monitoring period can be found in Table 6. A graph showing the percentage of samples taken in major urban centres between 2011-2016 in which no *E. coli* were detected can be found in Figure 4. A similar graph for the minor urban centres is found in Figure 5.

Naegleria fowleri

The detection of *N. fowleri* in the Darwin distribution system in 2005 prompted Power and Water to undertake extensive monitoring of water supplies and to implement procedures to control this amoeba.

An effective chlorine residual maintained throughout the distribution system provides protection against contamination and limits the regrowth of *N. fowleri*. Free chlorine at 0.5 mg/L or higher will control *N. fowleri*, provided the disinfectant persists at that concentration throughout the water supply system. Power and Water now requires all water supplies to maintain a minimum free chlorine residual not less than 0.5 mg/L throughout the entire supply.

Through the reporting period Power and Water conducted the *N. fowleri* monitoring program collecting 1465 routine samples from across the Northern Territory. Investigation sampling of tank sediments continued during tank cleaning.

All distribution systems and sources monitored during the 2012-16 were free of *N. fowleri*, with the exception of Gunn Point and Tennant Creek distribution systems.

The results from the 2012-16 *N. fowleri* monitoring program can be found in Table 3.

While *N. fowleri* is the amoeba of primary concern, the detection of any thermophilic amoeba is considered significant because it indicates that conditions in the water supply may be conducive for the growth of *N. fowleri*. If this occurs, further investigation or remedial action maybe warranted.

Naegleria species (spp) other than *N. fowleri* were detected in the Darwin, Gunn Point and Tennant Creek distribution systems and Darwin's groundwater. *Naegleria* spp. was not detected in surface waters.

Investigations during sediment removal from Darwin distribution storage tanks through the period 2012-16 found *N. fowleri* present in the sediment of seven tanks. This finding supports the long term strategy to control *N. fowleri* growth in tanks by increasing the frequency of tank cleaning and minimising sediment accumulation.

Several detections of *N. fowleri* in the distribution system at Manton Dam Park tap sampling site over the past few years have required Power and Water to increase the free chlorine residual at this site. This has been achieved in part by:

- the installation of an automatic irrigation system at Manton Dam Park, which routinely draws water through the pipeline and prevents the accumulation of chlorine depleted water
- changing the booster pump feeding the mains that supplies the park to a higher capacity pump
- the installation of a secondary chlorination facility.

In addition, a significant increase in the number of consumers connected to this main has increased water turnover and reduced the retention time of water in it. These factors together have improved the quality of water supplied to the area in the vicinity of the Manton Dam Park tap sampling site. During the 2012-16 reporting period no Naegleria spp. were detected at Manton Dam Park tap sampling site.

Burkholderia pseudomallei

B. pseudomallei is the agent responsible for meliodosis and despite being ubiquitous in the tropics, the understanding in a drinking water context is limited. Appropriate chlorination controls this pathogen with recent research helping to identify water supplies at risk of contamination.

The detection of *B. Pseudomallei* in private Darwin rural supplies in 2010 prompted Power and Water to undertake monitoring of public water supplies to help define the risk.

Power and Water's drinking water monitoring programs have included *B. pseudomallei* as an investigative and research activity. Power and Water works closely with Menzies School of Health Research (MSHR) to identify water supplies at risk.

Between 2013 and 2016 *B. pseudomallei* was detected in untreated water from the Katherine, the Darwin River Reservoir, McMinns borefields and the Adelaide River. Katherine *B. pseudomallei* detections are from unchlorinated parts of the water treatment plant. The positive detections in Darwin were from samples of raw water collected prior to the disinfection process. The Adelaide River positive detection was from a sample of the sediment in a tank that was offline for cleaning.

TABLE 3: Thermophyllic Amoeba detections 2012-16

		Acanthamoeba group III(/L)	Amoebae - Total (/L)	Amoebae - Total (solids) g dry weight	*Hartmannella* (/L)	*Naegleria* - Total (/L)	*Naegleria* - Total (solids) g dry weight	*Naegleria fowleri* (/L)	*Naegleria lovaniensis* (/L)	*Willaertia magna* (/L)
Centre routine monitoring	**Samples collected**	**Positive samples**								
Alice Springs distribution totals	36	0	0	0	0	0	0	0	0	0
Darwin distribution totals	822	2	99	0	90	13	0	0	13	0
Darwin source bores and reservoir totals	107	2	13	0	4	5	0	0	5	0
Gunn Point distribution totals	106	0	20	0	9	16	0	1	15	1
Gunn Point Bore	1	0	1	0	0	1	0	0	1	0
Katherine distribution totals	112	0	3	0	3	0	0	0	0	0
Tennant Creek distribution totals	221	2	10	0	1	9	0	1	9	0
Yulara distribution	17	0	0	0	0	0	0	0	0	0
Yulara source bore totals	7	0	1	0	0	1	0	0	1	0
Total samples	**1429**									

		Acanthamoeba group III(/L)	Amoebae - Total (/L)	Amoebae - Total (solids) g dry weight	*Hartmannella* (/L)	*Naegleria* - Total (/L)	*Naegleria* - Total (solids) g dry weight	*Naegleria fowleri* (/L)	*Naegleria lovaniensis* (/L)	*Willaertia magna* (/L)
Centre investigational monitoring	**Samples collected**	**Positive samples**								
Adelaide River totals	2	0	1	1	1	0	1	0	1	0
Alice Springs storage tanks sediments	1	0	0	0	0	0	0	0	0	0
Darwin storage tank sediment	32	15	5	21	19	2	6	7	2	13
Darwin hydrant flushing	1	0	1	0	1	0	0	0	0	0
Total samples	**36**									

Chemical and physical results

The results of monitoring 43 different chemical and physical water quality parameters are presented in this report as statistical values. Health related parameters are reported as a 95th percentile where statistically adequate data is available. If data is limited, values are reported as the maximum value. As specified by the Australian Drinking Water Guidelines (ADWG), aesthetic and other parameters are reported as a mean or average.

Table A3 and A4 in the Appendices show the results of the health, aesthetic and Other parameters for each major and minor urban centre respectively. Table B1, also in the Appendices, shows a five year trend of exceedances for selected water quality parameters.

Radiological results

All water supplies are examined to gain an initial measure of gross alpha and gross beta activity concentrations.

The ADWG recommend that further radiological measurements be undertaken to determine the total annual radiation dose if the gross activities are higher than 0.5 Bq/L and that the total annual radiation dose must not exceed 1 mSv/year.

To precisely calculate the annual radiological dose (ARD), all radioactive species in the water supply must be identified and their activity concentrations determined. Generally, radium-226 (an alpha emitter) and radium-228 (a beta emitter) are the major radionuclides contributing to the gross alpha and beta values. When radium-226 and radium-228 do not account for all gross alpha and beta values, other radionuclides present must be identified and their levels determined.

The likely worst case leading to the highest exposure is where the gross alpha and gross beta activities are due entirely to radium-226 and radium-228. If the analysis fails to include all radionuclides, the total annual radiation dose is calculated by treating the gross alpha value as if it were due entirely to radium-226 and the K40 corrected gross beta value as if it were due entirely to radium-228. As described previously, this treatment of the assessment calculates the maximum possible exposure. This approach derives its validity from the knowledge that radium-226 and radium-228 are the most consequential radionuclides present in water and on a concentration based comparison, contribute more to the annual dosage than any other radionuclide. The annual radiation dose calculated by this method is a conservative solution and produces a total annual radiation dose estimate in excess of the true value. An estimation of the total annual radiation dose cannot be made without values for gross alpha and gross beta activities.

To comply with the ADWG, the radiological data used in the calculation of the total annual radiation dose must be no more than two years outside the reporting period for ground water supplies and no more than five years for surface water.

Annual assessment

When a water supply passes both the gross alpha and potassium-40 corrected gross beta screening assessment or the estimated annual dose is below 0.5 mSv/year, sampling can be less frequent – every two years for groundwater supplies and every five years for surface water supplies. All water supplies included in this report draw some water from ground water sources.

Annual assessments conducted for the monitoring years 2012-13 to 2015-16 are presented in this report.

As shown in Table 4, the majority of water supplies complied with the ADWG screening level, with radioactivity levels below 0.5 Bq/L during reporting periods. All water supplies passed an annual guideline limit of 1.0 mSv/year in 2013-14. However, the Kings Canyon water supply exceeded the guideline value in other reporting periods.

The Kings Canyon's water supply has higher levels of radionuclides than other Northern Territory water supplies and as a result is intensely monitored. For example, 241 samples were collected from the Kings Canyon supply between 2014 and 2016. Fourteen of these samples exceeded the 1.0 mSv/year limit with the highest value, 2.08 mSv/year, recorded at the ground level tank outlet (same sample location for all the recorded highest levels). Kings Canyon's ARD for 2015-16 is 1.07 mSv/year (95th percentile).

The ARD is calculated only for supplies that had one or more samples failing the screening level. Results for the radiological assessment of all supplies for 2015-16 are shown in Appendices Table A3 and A4.

Uncertainty in radiological assessment

No measurement is exact. When a quantity is measured, the outcome depends on the measuring system, the measurement procedure, the skill of the operator, the environment and other effects. Uncertainty is the quantitative estimation of error present in data. All measurements contain some uncertainty generated through systematic error and/or random error.

The expression of the value of the result of a measurement is incomplete without a statement of its evaluated uncertainty. This characterises the range in which the true value is estimated to lie with a given level of confidence.

Total uncertainty for radiological measurements is quoted at the 2 sigma (95 per cent) confidence interval but may

TABLE 4: Summary of annual radiological assessments

Reporting year		2012-13	2013-14	2014-15	2015-16
Total number of centres sampled		18	19	20	20
Number of centres comply with 2011 ADWG screening level	Major	4	4	3	3
	Minor	8	9	11	12
Number of centres exceed the annual guideline value (1.0 mSv/year)	Major	None	None	None	None
	Minor	1*	None	1*	1*

not be symmetrical around the measured value. Radiological measurements are therefore reported with an upper and lower uncertainty. The Annual Radiological Dose (ARD) calculated for Kings Canyon using the upper and lower uncertainties indicates the true value is within the range 0.91-1.24 mSv/year in 2015-16.

Organic chemicals

Trihalamethanes

The baseline data set for Trihalomethanes (THMs) in Power and Water urban centre supplies was initially determined in 2002-03. Values ranged from less than 0.004 mg/L in Alice Springs to less than 0.08 mg/L in Darwin. These concentrations were well below the 2011 ADWG level of 0.25 mg/L. During the 2015-16 monitoring period, all water supplies were assessed for THMs. The concentration of THMs for these water supplies ranged from <0.004 to 0.083 mg/L.

Long term THM levels (2011-2016) are shown in Table A3 and A4 in the Appendices. THMs in all water supplies remain at levels similar to those measured in previous years and appear to be stable. The low levels of THMs measured in Northern Territory water supplies is due to the low level of total organic carbons (TOC), the precursors of THMs, in these waters. The highest levels of THMs are in Darwin, Katherine and Pine Creek supplies, all of which use surface water.

Pesticides

The pesticide monitoring program focuses on 46 commonly used pesticides, including organochlorine, organophosphate and triazine pesticides, insecticides and acidic herbicides. Monitoring is generally undertaken on water supplies where local pesticide use suggests a water supply may be at risk. Good management of surface water sources and bores reduces the risk of drinking water becoming contaminated with pesticides. Bores are required to be constructed to standards that ensure bore head integrity and prevent surface water (potentially containing pesticides) from entering the bore. Surface waters (reservoirs and rivers) are managed to strictly control pesticide use in their catchments.

From 2011 until July 2016, only one sample tested for pesticides has returned a result above the level of detection of the test method. The measured value, 0.0015 mg/L for Dicamba at Darwin is still well below the 2011 ADWG limit of 0.1 mg/L.

Occasionally weed problems in reservoirs and catchments can only be managed effectively through the use of herbicides. Dicamba (Banvel, 3, 6-dichloro-2-methoxybenzoic acid) is a moderate to low toxicity herbicide used to control weeds and mimosa in the catchment of Darwin River Reservoir. Dicamba is moderately persistent in soil and breaks down to very simple substances such as carbon dioxide and water. The reported half life of Dicamba in soil ranges from one to six weeks. This herbicide is applied two to three times a year as part of the mimosa control program.

Although monitored for several years, pesticides have rarely been detected in the Northern Territory water supplies despite limited use in some areas. In consideration of these results, pesticide monitoring during 2011-16 was restricted to Darwin and Katherine water supplies. These supplies are considered potentially vulnerable to pesticide contamination due to agricultural activities close to production bores and surface water sources.

Customer satisfaction

Water quality customer complaints

Complaints from consumers concerning the quality of their drinking water supply mostly focus on the aesthetic aspects of the water – its appearance, its taste and its odour. Like other Australian drinking water providers, Power and Water records all water quality complaints made by its customers and reports them to the National Water Commission.

As discussed in Element 5, Power and Water's Maximo system streamlines Power and Water's customer service processes and enables the systematic recording of customer complaints and simplifies the collation of data.

Number of complaints

Table 5 shows the total number of water quality specific complaints made by customers between 2011 and 2016. In addition to this, Power and Water's Facebook Page also received two water quality complaints about discoloured water during 2015-16.

During 2015-16, there were no water quality complaints reported from Adelaide River. In Alice Springs, there was a reduction of approximately 75 per cent in water quality complaints in the 2012-16 reporting period, compared to previous the reporting period 2011-12.

A month by month breakdown of Darwin water quality complaints is shown in Figure 6 and reflects a discernible pattern between complaints in water quality and seasonality. The highest numbers of complaints were received in May 2016, at the start of dry season. This can be attributed to increased water demand in the dry season and the increased flow rates in the distribution system. During the dry season, as water demand rises and flow rates are increased, the settled iron and manganese in the water distribution system are mobilised by the higher velocity water and become the cause of high number of water quality complaints.

As with many water supply reservoirs, Darwin River Reservoir is subject to stratification. Stratification is the development of distinct layers of water of different temperature or density at various depths in a water body and the subsequent restriction of mixing between these layers. Stratification develops when the upper layers of the reservoir are heated by solar radiation faster than the heat can disperse into the lower depths of the reservoir. The generated difference in the surface and bottom water densities limit circulation between these layers and can lead to these layers having significantly different aesthetic qualities.

Atmospheric oxygen is absorbed by water at the interface between air and water. Algal photosynthesis near the surface also supplies oxygen to the water. Oxygen at the bottom of a reservoir is consumed by the decomposition of organic material. As water circulation is restricted due to stratification, oxygen consumed in the lower layers is not replenished from the surface resulting in further oxygen depletion at the bottom of the reservoir. The decomposition of organic material under anaerobic conditions lowers the pH and encourages production of hydrogen sulphide. This process reduces iron and manganese in the sediments to soluble forms.

Once the reservoir has stratified, a large amount of energy is required to disrupt the layered structure and mix the reservoir again. Destratification occurs with a decrease in surface temperature, in flow and wind induced mixing processes that cause the layers to mix and bring low quality anoxic water from the bottom of the reservoir to the surface, where it is drawn into the supply. Soluble iron and manganese entering the distribution system can be oxidised and will precipitate out of solution creating discoloured water. This pattern corresponds with the comparatively high number of complaints received in the wet season shown in Figure 6.

Power and Water strives to minimise the frequency and the magnitude of the impact of these seasonal variations. In major centres where customers frequently report discoloured water, mains are flushed before the anticipated increased demands associated with seasonal changes. If a customer reports discoloured water, the mains supplying the customer's residence is also flushed. In addition, water quality is monitored at a number of locations in the Darwin water supply to gauge the extent of discoloured water and determine when routine flushing is required.

Types of complaints

Water quality issues reported are classified into four categories. These are clarity/dirtiness/particles, taste/odour/smell, alleged illness and other. The graph showing the

TABLE 5: Water quality complaints

Region	Properties (2015-16)	2011-12	2012-13	2013-14	2014-15	2015-16
Adelaide River	97[A]	3	1	1	8	0
Alice Springs	12468	24	6	4	4	5
Darwin	59116	336	155	173	235	246
Katherine	2692[A]	4	3	3	2	6
Tennant Creek	1265[A]	1	0	0	0	0
Total	**71584**	**368**	**165**	**181**	**249**	**257**
Complaints per 1000 properties (all NT)		5.14	2.30	2.53	3.48	3.59

[A] Properties based on number of meters proportions of each type of complaint received for the Darwin water supply in 2015-16 is shown in Figure 7.

The largest proportion of Darwin's customer complaints (89 per cent) related to discoloured water, milky water, dirty water and floating particles. Milkiness or cloudiness is most commonly due to the repressurising of water mains. This causes trapped air to become dissolved into the water and minute air bubbles form in the water when the tap is turned on, creating a milky appearance that clears if the water is left to stand. Other causes of cloudy water are tap aerators and hot water systems.

Customers also complain about odour, taste and high chlorine levels. These often relate to varying chlorine levels due to changing water demand. The chlorine residual in the reticulation network is regularly monitored and adjusted as required. Online water quality monitoring units are installed in most centres to improve monitoring across the entire network.

Other taste and odour complaints can result from water that contains compounds produced by certain types of algae, cyanobacteria (blue green algae), bacteria and sometimes protozoa. Other organic compounds that are produced as by products when water is disinfected with chlorine can cause objectionable tastes and odours.

Occasionally, harmless white algae are encountered in the Darwin water supply. These algae grow naturally in Darwin River Reservoir and their original green colour is lost during the disinfection process.

As a response to the detection of *N. fowleri* in some Northern Territory water supplies, free chlorine residuals are now maintained at a minimum of 0.5 mg/L. This level of chlorine can be objectionable to some customers.

If there is doubt as to the cause of a water quality problem, an investigation is carried out and when necessary, water samples are taken and analysed.

FIGURE 6: Monthly drinking water quality complaints received for Darwin 2015-16

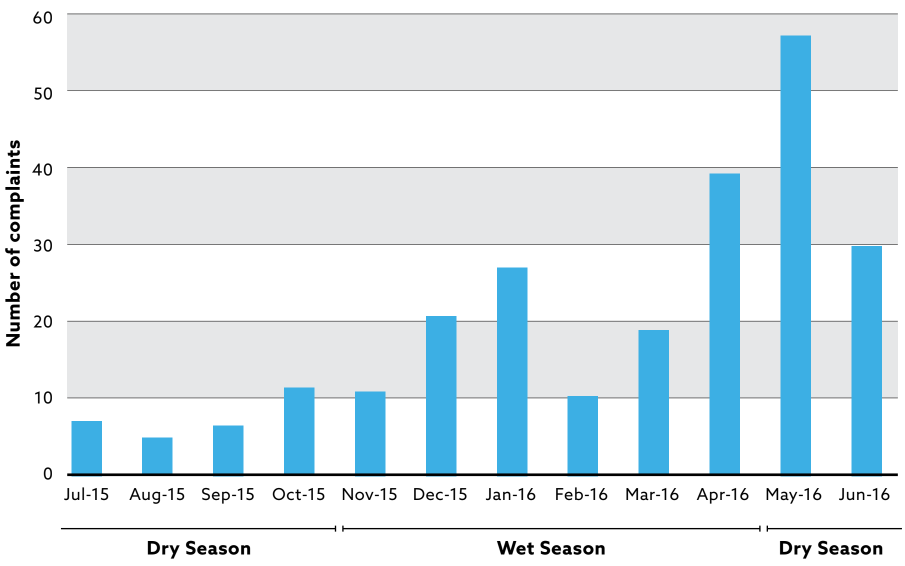
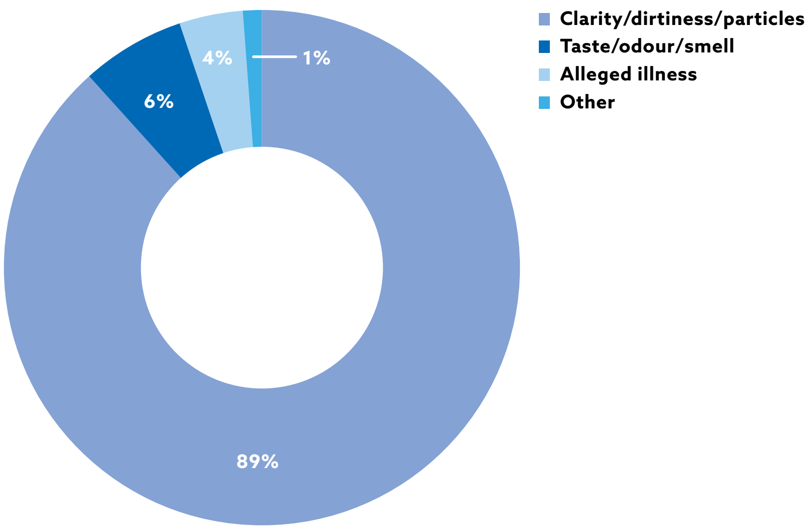


FIGURE 7: Customer complaints for Darwin 2015-16 by complaint type




Foreshore
single use
bottles you buy

Recorded emergencies/incidents

From 2012 to 2016 incidents that occurred were:

- a 'boil water' alert at Elliott
- eight *E. coli* detections from drinking water distribution samples at various urban centres
- a major water supply disruption at Larrimah
- disinfection disruptions at various urban centres drinking water supplies.

All incidents had remedial actions undertaken as a priority and were investigated to prevent reoccurrences.

E. coli detections

During the reporting period a total of eight incidents of *E. coli* were recorded from verification water samples, see Table 6. In all incidents remedial actions were given priority and the DoH was notified to help determine the most effective corrective actions. Investigations were conducted to determine the likely causes and identified preventative corrective actions.

In Tennant Creek the recorded *E. coli* detections were prior to the installation of a continuous chlorination system. Since October 2014 and the investment in a continuous chlorination system, no *E. coli* has been detected in verification samples collected from this centre's water supply.

The Gunn Point incident was likely due to low level faecal contamination from small animals, while inadequate chlorination due to a chlorination system disruption is likely to have contributed to identification of *E.coli* in samples from the Garawa and Newcastle Waters water supplies. Access by frogs or lizards was likely a contributing factor to the detection in Elliott on 18 August 2014 and was corrected by increasing the chlorine dosing, flushing the overflow pipework and sealing it with a one-way valve. The *E.coli* detection at Borroloola on 13 January 2016 was due to error during the sample collection.

The Elliott water supply had a series of *E. coli* detections in July 2014 that triggered a boil water alert. *E. coli* was detected from a sample taken from the distribution tank on 16 July 2014. When samples taken on 18 and 20 July 2014 found *E. coli* still present, a boil water alert was issued by the DoH. Power and Water took the tank offline, increased disinfection, flushed and resampled. Samples taken on 22 July 2014 were found to be clear. The boil water alert was lifted the following day.

Investigation found that a newly commissioned tank and a power failure in the days prior contributed to the contamination. The commissioning of a new tank allowed the entry of vermin and the power fault prevented adequate disinfection.

Water supply disruption

In October 2015, a major disruption to the Larrimah water supply occurred in the early morning due to a water transfer pump fault. The supervisory control and data inquisition (SCADA) system was not working at this centre and early warning of the incident did not occur. The disruption to the water supply was fixed by midmorning. Investigation of the incident resulted in improvements to the SCADA system at Larrimah.

Disinfection disruption

Inadequate or over chlorination can occur as a result of power interruptions, equipment failure and system faults. During 2012 to 2016 incidents of disrupted disinfection occurred in Darwin, Timber Creek, Borroloola, Alice Springs, Ti Tree and Batchelor. Power and Water takes these incidents seriously and remedial actions were undertaken with priority. The incidents were investigated and improvements to control chlorination have occurred to address these incidents.

TABLE 6: *E.coli* incidents during the drinking water quality monitoring program period 2012-16

Year	Supply	Samples with *E.coli* detections	Collection date	Number of *E.coli* detected in sample (MPN/10mL)
2012-13	Tennant Creek	2	26 November 2012	2 and 2
	Tennant Creek	1	14 January 2013	1
2013-14	Gunn Point	1	24 September 2013	1
	Garawa	1	14 August 2013	9
	Newcastle Waters	1	3 February 2014	4
2014-15	Elliott	1	16 July 2014	4
	Elliott	1	18 August 2014	1
2015-16	Borroloola	1	13 January 2016	1

Appendices

TABLE A1: Bacteriological monitoring in major centres 2015-16

Centre	Parameter (MP N/100mL)	Target level	Total No. samples required	Total No. samples collected	Total exceedances (No.)	Samples passing reporting level (1%)
Alice Springs	*E. coli*	No *E. coli* in 100% samples	174	**171**	0	100
	Total Coliforms	<10 in 95% of samples	174	**171**	0	100
Darwin	*E. coli*	No *E. coli* in 100% samples	573	**566**	0	100
	Total Coliforms	<10 in 95% of samples	573	**566**	0	100
Katherine	*E. coli*	No *E. coli* in 100% samples	179	179	0	100
	Total Coliforms	<10 in 95% of samples	179	179	0	100
Tennant Creek	*E. coli*	No *E. coli* in 100% samples	208	208	0	100
	Total Coliforms	<10 in 95% of samples	208	208	0	100
Yulara	*E. coli*	No *E. coli* in 100% samples	104	104	0	100
	Total Coliforms	<10 in 95% of samples	104	104	0	100

*Number in bold letter indicate samples collected less than required in the monitoring program

TABLE A2: Bacteriological monitoring in minor centres 2015-16

Centre	Parameter (MP N/100mL)	Target level	Total No. samples required	Total No. samples collected	Total exceedances (No.)	Samples passing reporting level (1%)
Adelaide River	*E. coli*	No E. coli in 100% samples	104	104	0	100
	Total Coliforms	<10 in 95% of samples	104	104	0	100
Batchelor	*E. coli*	No E. coli in 100% samples	104	104	0	100
	Total Coliforms	<10 in 95% of samples	104	104	0	100
Borroloola	*E. coli*	No E. coli in 100% samples	36	36	1	97.2
	Total Coliforms	<10 in 95% of samples	36	36	0	100
Gunn Point	*E. coli*	No E. coli in 100% samples	26	26	0	100
	Total Coliforms	<10 in 95% of samples	26	26	0	100
Cox Peninsula	*E. coli*	No E. coli in 100% samples	53	53	0	100
	Total Coliforms	<10 in 95% of samples	53	53	0	100
Daly Waters	*E. coli*	No E. coli in 100% samples	36	36	0	100
	Total Coliforms	<10 in 95% of samples	36	36	0	100
Elliott	*E. coli*	No E. coli in 100% samples	156	**147**	0	100
	Total Coliforms	<10 in 95% of samples	156	**147**	0	100
Garawa	*E. coli*	No E. coli in 100% samples	24	24	0	100
	Total Coliforms	<10 in 95% of samples	24	24	0	100
Kings Canyon	*E. coli*	No E. coli in 100% samples	104	156	0	100
	Total Coliforms	<10 in 95% of samples	104	156	0	100
Larrimah	*E. coli*	No E. coli in 100% samples	36	36	0	100
	Total Coliforms	<10 in 95% of samples	36	36	0	100
Mataranka	*E. coli*	No E. coli in 100% samples	48	**47**	0	100
	Total Coliforms	<10 in 95% of samples	48	**47**	1	97.9
Newcastle Waters	*E. coli*	No E. coli in 100% samples	36	**34**	0	100
	Total Coliforms	<10 in 95% of samples	36	**34**	0	100
Pine Creek	*E. coli*	No E. coli in 100% samples	156	**153**	0	100
	Total Coliforms	<10 in 95% of samples	156	**153**	0	100
Timber Creek	*E. coli*	No E. coli in 100% samples	36	36	0	100
	Total Coliforms	<10 in 95% of samples	36	36	0	100
Ti Tree	*E. coli*	No E. coli in 100% samples	36	36	0	100
	Total Coliforms	<10 in 95% of samples	36	36	0	100

*Number in bold letter indicate samples collected less than required in the monitoring program

TABLE A3: Health, aesthetic and other parameters in major centres 2015-16

Parameter/centre	Guideline value	Units	Alice Springs	Darwin	Katherine	Tennant Creek	Yulara
Health parameters – 95th percentile or maximum values							
Antimony	0.003	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	0.01	mg/L	<0.0005	<0.0005	<0.0005	0.0020	<0.0005
Barium	2	mg/L	0.10	<0.05	<0.05	0.10	<0.05
Beryllium	0.06	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	4	mg/L	0.16	<0.02	<0.02	0.56	0.82
Cadmium	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chlorine (Total)	5	mg/L	1.37	2.46	1.31	1.25	0.99
Chromium	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	2	mg/L	0.18	0.09	0.09	0.07	0.15
Fluoride	1.5	mg/L	0.5	0.9	0.8	1.5	0.3
Iodide	0.5	mg/L	0.07	0.01	<0.01	0.20	0.04
Lead	0.01	mg/L	0.002	0.002	<0.001	<0.001	0.003
Manganese	0.5	mg/L	0.029	0.063	<0.005	<0.005	<0.005
Mercury	0.001	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	0.02	mg/L	<0.002	<0.002	<0.002	<0.002	0.002
Nitrate	50	mg/L	9	2	2	44	42
Radiological	1	mSv/yr	0.34	PASS	PASS	0.36	PASS
Selenium	0.01	mg/L	0.002	<0.001	<0.001	0.003	<0.001
Silver		mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	500	mg/L	68	1	10	54	64
THMs	0.25	mg/L	0.004	0.079	0.063	0.024	0.009
Uranium *	0.017	mg/L	<0.017	<0.017	<0.017	<0.017	<0.017
Aesthetic parameters – mean values							
Aluminium	0.2	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride	250	mg/L	72	9	5	115	81
Chlorine (free)	0.6	mg/L	**0.87**	**1.22**	**0.97**	**0.89**	**0.74**
Copper	1	mg/L	0.05	0.02	0.02	0.01	0.04
Hardness	200	mg/L (as CaCO3)	209	38	105	190	37
Iron	0.3	mg/L	<0.05	0.07	<0.05	<0.05	<0.05
Manganese	0.1	mg/L	0.005	0.032	<0.005	<0.005	<0.005
pH	6.5-8.5	pH unit	7.6	7.5	7.7	7.8	7.5
Silica	80	mg/L	17	12	17	**88**	14
Sodium	180	mg/L	81	3	5	122	65
Sulfate	250	mg/L	54	0	4	45	14
TDS **	800	mg/L	444	55	124	653	241
Zinc	3	mg/L	0.02	0.01	<0.01	0.01	0.03
Other parameters – mean values							
Alkalinity		mg/L (as CaCO3)	237	32	103	274	<20
Bromide		mg/L	0.18	0.02	0.02	0.62	0.22
Calcium		mg/L	46	8	25	30	9
Electrical conductivity		µS/cm	804	89	231	1063	422
Magnesium		mg/L	23	4	10	28	3
Potassium		mg/L	5.9	0.7	0.8	30.2	7.6
Tin		mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE A4: Health, aesthetic and other parameters in minor centres 2015-16

Parameter/centre	Guideline value	Units	Adelaide River	Batchelor	Borroloola	Cox Peninsula	Daly Waters
Health parameters – 95th percentile or maximum values							
Antimony	0.003	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	0.01	mg/L	0.0035	<0.0005	<0.0005	<0.0005	<0.0005
Barium	2	mg/L	<0.05	<0.05	<0.05	<0.05	0.06
Beryllium	0.06	mg/L	<0.001	<0.001	<0.001	0.001	<0.001
Boron	4	mg/L	0.02	0.02	0.05	0.02	0.46
Cadmium	0.002	mg/L	<0.0002	<0.0002	<0.0002	0.0004	<0.0002
Chlorine (Total)	5	mg/L	1.37	1.56	1.54	1.51	1.25
Chromium	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	2	mg/L	0.07	0.05	0.14	0.18	0.21
Fluoride	1.5	mg/L	0.4	0.2	<0.1	0.2	0.4
Iodide	0.5	mg/L	<0.01	<0.01	0.01	<0.01	0.14
Lead	0.01	mg/L	0.006	0.001	0.003	0.004	0.002
Manganese	0.5	mg/L	0.244	0.010	0.158	<0.005	0.097
Mercury	0.001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	0.02	mg/L	<0.002	<0.002	0.002	0.002	0.006
Nitrate	50	mg/L	<1	3	1	2	11
Radiological	1	mSv/yr	PASS	PASS	0.46	PASS	PASS
Selenium	0.01	mg/L	<0.001	<0.001	<0.001	<0.001	0.003
Silver	0.1	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	500	mg/L	4	1	2	18	211
THMs	0.25	mg/L	0.017	<0.004	0.004	0.011	0.034
Uranium *	0.017	mg/L	<0.017	<0.017	<0.017	<0.017	<0.017
Aesthetic parameters – mean values							
Aluminium	0.2	mg/L	<0.02	<0.02	0.02	<0.02	<0.02
Chloride	250	mg/L	26	7	11	9	**264**
Chlorine (free)	0.6	mg/L	**0.90**	**0.84**	**1.06**	**1.07**	**0.89**
Copper	1	mg/L	0.02	0.02	0.03	0.05	0.05
Hardness	200	mg/L (as CaCO3)	109	**214**	54	11	**518**
Iron	0.3	mg/L	0.29	<0.05	0.07	<0.05	0.09
Manganese	0.1	mg/L	0.081	<0.005	0.038	<0.005	0.016
pH	6.5-8.5	pH unit	7.8	7.5	6.9	6.8	7.2
Silica	80	mg/L	46	34	14	23	35
Sodium	180	mg/L	33	6	7	7	170
Sulfate	250	mg/L	2	1	1	2	146
TDS **	800	mg/L	221	238	82	45	**1093**
Zinc	3	mg/L	0.01	0.01	0.02	0.04	0.01
Other parameters – mean values							
Alkalinity		mg/L (as CaCO3)	141	220	49	<20	419
Bromide		mg/L	0.06	0.01	0.02	0.01	0.87
Calcium		mg/L	18	31	20	3	123
Electrical conductivity		µS/cm	363	426	133	51	1858
Magnesium		mg/L	16	33	1	0	51
Potassium		mg/L	1.2	0.4	1.2	1.0	19.7
Tin		mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE A4 (Contd.): Health, aesthetic and other parameters in minor centres 2015-16

Parameter/centre	Guideline value	Units	Elliott	Garawa	Gunn Point	Kings Canyon	Larrimah
Health parameters – 95th percentile or maximum values							
Antimony	0.003	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	0.01	mg/L	<0.0005	<0.0005	0.0010	0.0015	<0.0005
Barium	2	mg/L	0.20	<0.05	0.15	<0.05	0.05
Beryllium	0.06	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	4	mg/L	0.34	0.04	0.02	0.34	0.26
Cadmium	0.002	mg/L	<0.0002	<0.0002	0.0006	<0.0002	<0.0002
Chlorine (Total)	5	mg/L	1.69	1.44	4.37	1.09	1.19
Chromium	0.05	mg/L	<0.005	<0.005	<0.005	0.010	<0.005
Copper	2	mg/L	0.13	0.18	0.02	0.06	0.13
Fluoride	1.5	mg/L	0.9	<0.1	0.6	0.6	0.2
Iodide	0.5	mg/L	0.07	<0.01	<0.01	0.24	0.09
Lead	0.01	mg/L	0.001	**0.014**	0.003	0.002	<0.001
Manganese	0.5	mg/L	0.010	0.030	0.013	0.005	<0.005
Mercury	0.001	mg/L	<0.0001	<0.0001	<0.0001	0.0004	0.0001
Molybdenum	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	0.02	mg/L	0.002	0.002	0.006	0.006	<0.002
Nitrate	50	mg/L	17	<1	<1	5	5
Radiological	1	mSv/yr	PASS	0.32	PASS	**1.07**	PASS
Selenium	0.01	mg/L	0.002	<0.001	<0.001	0.003	0.004
Silver	0.1	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	500	mg/L	82	2	3	195	196
THMs	0.25	mg/L	0.005	<0.004	0.019	0.006	0.007
Uranium *	0.017	mg/L	<0.017	<0.017	<0.017	<0.017	<0.017
Aesthetic parameters – mean values							
Aluminium	0.2	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride	250	mg/L	144	15	12	253	198
Chlorine (free)	0.6	mg/L	**1.15**	**1.07**	**1.38**	**0.75**	**0.92**
Copper	1	mg/L	0.02	0.06	0.01	0.02	0.03
Hardness	200	mg/L (as CaCO3)	**422**	18	91	**374**	**490**
Iron	0.3	mg/L	<0.05	0.05	<0.05	0.07	<0.05
Manganese	0.1	mg/L	<0.005	0.005	0.005	<0.005	<0.005
pH	6.5-8.5	pH unit	7.9	6.0	8.3	7.0	7.5
Silica	80	mg/L	51	14	10	22	43
Sodium	180	mg/L	83	11	10	121	129
Sulfate	250	mg/L	44	1	2	174	118
TDS **	800	mg/L	722	50	120	799	**937**
Zinc	3	mg/L	<0.01	0.02	0.31	0.02	0.02
Other parameters – mean values							
Alkalinity		mg/L (as CaCO3)	382	<20	97	136	432
Bromide		mg/L	0.40	0.02	0.01	0.77	0.53
Calcium		mg/L	96	5	17	76	109
Electrical conductivity		µS/cm	1243	73	226	1420	1586
Magnesium		mg/L	44	1	12	45	53
Potassium		mg/L	21.6	1.3	1.3	24.4	12.4
Tin		mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE A4 (Contd.): Health, aesthetic and other parameters in minor centres 2015-16

Parameter/centre	Guideline value	Units	Mataranka	Newcastle Waters	Pine Creek	Ti Tree	Timber Creek
Health parameters – 95th percentile or maximum values							
Antimony	0.003	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	0.01	mg/L	<0.0005	0.0005	0.0055	0.0010	0.0010
Barium	2	mg/L	0.10	0.25	<0.05	0.10	1.74
Beryllium	0.06	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	4	mg/L	0.26	0.30	<0.02	0.38	0.13
Cadmium	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chlorine (Total)	5	mg/L	1.08	1.47	1.52	1.15	1.27
Chromium	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	2	mg/L	0.19	0.04	0.11	0.30	0.04
Fluoride	1.5	mg/L	0.3	0.9	0.6	0.9	1.5
Iodide	0.5	mg/L	0.06	0.06	0.02	0.14	0.02
Lead	0.01	mg/L	0.002	<0.001	0.002	<0.001	0.002
Manganese	0.5	mg/L	0.015	<0.005	0.134	<0.005	<0.005
Mercury	0.001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	0.02	mg/L	<0.002	<0.002	<0.002	<0.002	0.004
Nitrate	50	mg/L	3	10	2	**61**	1
Radiological	1	mSv/yr	PASS	PASS	PASS	PASS	PASS
Selenium	0.01	mg/L	0.004	<0.001	<0.001	0.002	<0.001
Silver	0.1	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	500	mg/L	105	47	85	43	7
THMs	0.25	mg/L	0.007	<0.004	0.035	0.008	0.007
Uranium *	0.017	mg/L	<0.017	<0.017	<0.017	<0.017	<0.017
Aesthetic parameters – mean values							
Aluminium	0.2	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride	250	mg/L	106	47	10	68	34
Chlorine (free)	0.6	mg/L	**0.82**	**0.98**	**1.04**	**0.83**	**0.76**
Copper	1	mg/L	0.03	0.01	0.05	0.06	0.02
Hardness	200	mg/L (as CaCO3)	**401**	**318**	104	**212**	**408**
Iron	0.3	mg/L	<0.05	<0.05	0.09	<0.05	<0.05
Manganese	0.1	mg/L	<0.005	<0.005	0.031	<0.005	<0.005
pH	6.5-8.5	pH unit	7.4	7.8	6.9	8.0	7.1
Silica	80	mg/L	36	59	40	**94**	22
Sodium	180	mg/L	78	54	29	68	22
Sulfate	250	mg/L	67	22	13	35	3
TDS **	800	mg/L	687	526	195	520	471
Zinc	3	mg/L	0.01	0.01	0.01	0.01	0.01
Other parameters – mean values							
Alkalinity		mg/L (as CaCO3)	408	382	133	213	437
Bromide		mg/L	0.22	0.15	0.03	0.25	0.10
Calcium		mg/L	93	72	16	49	63
Electrical conductivity		µS/cm	1175	884	322	793	880
Magnesium		mg/L	41	34	15	22	61
Potassium		mg/L	12.0	29.2	1.3	18.8	6.4
Tin		mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

LEGEND: Table A3 and A4

Radiological	Results are reported as 'Pass' if screening levels of gross alpha and gross beta (K corrected) are less than 0.5 Bq/L. Water supplies passing the screening level do not require an annual dosage assessment. Where assessment is required, data used is not more than two years older than the starting date of the reporting period for bores and five years for surface water. Annual dosage is reported as 95th percentile for large data sets and maximum value for small data sets. Data covers the period 2011-16.
Health parameters	Assessments are reported as the 95th percentile for large data sets (30 or more samples) and maximum value for small data sets. Data covers the period 2011-16. Exceedances are shown **bold**.
Aesthetic parameters	Assessments are reported as the mean. Data covers the period 2011-16. Exceedances are shown **bold**.
Other parameters	Assessments are reported as the mean. Data covers the period 2011-16. Exceedances are shown **bold**. No guideline value applicable
<	All values reported preceded with "<" indicate the value is below the level of detection of the analytical method.
*	As the Uranium concentrations are very low, reported as < guideline value
**	TDS guideline value set by DoH.

TABLE B1: Five-year trend of exceedances

Parameters	Health parameters								Aesthetic parameters						
	Arsenic	Barium	Fluoride	Iodide	Lead	Nitrate	Radiological	Selenium	Chloride	Hardness	Iron	Manganese	pH	Sodium	TDS
Centre/ADWG 2011 (mg/L)	**0.010**	**2.00**	**1.5**	**0.50**	**0.010**	**50**	**1.00**	**0.010**	**250**	**200**	**0.30**	**0.100**	**6.5-8.5**	**180**	**800**
Adelaide River 11-12											**0.64**	**0.122**			
Adelaide River 12-13											**0.46**	0.092			
Adelaide River 13-14											**0.45**	0.079			
Adelaide River 14-15											**0.33**	0.083			
Adelaide River 15-16											<0.05	0.048			
Alice Springs 11-12										**208**					
Alice Springs 12-13										197					
Alice Springs 13-14										**213**					
Alice Springs 14-15										**201**					
Alice Springs 15-16										**229**					
Batchelor 11-12										**200**					
Batchelor 12-13										**252**					
Batchelor 13-14										186					
Batchelor 14-15										**215**					
Batchelor 15-16										**225**					
Borroloola 11-12													**6.4**		
Borroloola 12-13													**6.4**		
Borroloola 13-14													7.3		
Borroloola 14-15													7.5		
Borroloola 15-16													7.2		
Cox Peninsula 11-16															
Daly Waters 11-12									**347**	**517**				**213**	**1297**
Daly Waters 12-13									**297**	**501**				**211**	**1300**
Daly Waters 13-14									222	**505**				133	**953**
Daly Waters 14-15									**255**	**516**				164	**1018**
Daly Waters 15-16									**275**	**562**				167	**1075**
Darwin 11-16															
Elliott 11-12										**407**					
Elliott 12-13										**404**					
Elliott 13-14										**403**					
Elliott 14-15										**440**					
Elliott 15-16										**440**					
Garawa 11-12					0.001								**5.8**		
Garawa 12-13					0.010								**6.0**		
Garawa 13-14					0.005								**6.0**		
Garawa 14-15					0.007								**6.0**		
Garawa 15-16					**0.014**								**5.8**		
Gunn Point 11-16															
Katherine 11-16															

* Exceedances are in bold text

TABLE B1 (Contd.): Five-year trend of exceedances

Parameters	Health parameters								Aesthetic parameters						
	Arsenic	Barium	Fluoride	Iodide	Lead	Nitrate	Radiological	Selenium	Chloride	Hardness	Iron	Manganese	pH	Sodium	TDS
Centre/ADWG 2011 (mg/L)	**0.010**	**2.00**	**1.5**	**0.50**	**0.010**	**50**	**1.00**	**0.010**	**250**	**200**	**0.30**	**0.100**	**6.5-8.5**	**180**	**800**
Kings Canyon 11-12							**1.04**		**265**	**371**					**816**
Kings Canyon 12-13							**1.00**		**253**	**374**					**825**
Kings Canyon 13-14							0.95		229	**370**					769
Kings Canyon 14-15							**1.05**		238	**359**					763
Kings Canyon 15-16							**1.07**		**263**	**381**					794
Larrimah 11-12										**482**					**883**
Larrimah 12-13										**483**					**949**
Larrimah 13-14										**504**					**940**
Larrimah 14-15										**465**					**944**
Larrimah 15-16										**548**					**972**
Mataranka 11-12										**462**					**865**
Mataranka 12-13										**428**					**856**
Mataranka 13-14										**451**					**814**
Mataranka 14-15										**317**					391
Mataranka 15-16										**352**					406
Newcastle Waters 11-12										**303**					
Newcastle Waters 12-13										**300**					
Newcastle Waters 13-14										**320**					
Newcastle Waters 14-15										**315**					
Newcastle Waters 15-16										**334**					
Pine Creek 11-16															
Tennant Creek 11-12			**1.6**							175					
Tennant Creek 12-13			**1.5**							182					
Tennant Creek 13-14			1.4							**210**					
Tennant Creek 14-15			**1.5**							187					
Tennant Creek 15-16			**1.5**							**200**					
Ti Tree 11-12						**58**				**201**					
Ti Tree 12-13						**56**				**205**					
Ti Tree 13-14						**60**				**209**					
Ti Tree 14-15						**62**				**222**					
Ti Tree 15-16						**61**				**223**					
Timber Creek 11-12			1.4							**398**					
Timber Creek 12-13			1.3							**387**					
Timber Creek 13-14			1.3							**389**					
Timber Creek 14-15			1.3							**395**					
Timber Creek 15-16			**1.6**							**454**					
Yulara 11-16															

* Exceedances are in bold text

Glossary of acronyms and initialisms

ADI	Acceptable daily intake
ADWG	Australian Drinking Water Guidelines 2011
ANSI	American National Standards Institute
ARD	Annual Radiological Dose
AS/NZS	Australian/New Zealand Standards
AWA	Australian Water Association
AWWA	American Water Works Association
CDI	Capacitive deionisation
CRC	Cooperative Research Centre
DENR	Department of Environment and Natural Resources
DIPL	Department of Infrastructure, Planning and Logistics
DoH	Department of Health
DPIR	Department of Primary Industry and Resources
DRR	Darwin River Reservoir
EC	Electrical conductivity
ESO	Essential Service Operator
FC/TC	Free chlorine/Total chlorine ratio
FIS	Facilities Information System
IBM	International Business Machines
ICS	Industrial control system
IMS	Information Management System
ISO	International Organisation for Standardisation
MoU	Memorandum of understanding
MSHR	Menzies School of Health Research
N/A	Not applicable
NF	Naegleria fowleri
NHMRC	National Health and Medical Research Council
NPR	National Performance Report
NRMMC	National Resources Management Council
NT	Northern Territory
NTG	Northern Territory Government
PAM	Primary amoebic meningoencephalitis
PCR	Polymerase chain reaction
PI System	Process information system for the management of real time data and events
PWC	Power and Water Corporation
SA	South Australia
SAI Global	Standards Australia International (Global)
SCADA	Supervisory control and data acquisition
SU	Sustainability Unit
TDS	Total dissolved solids
THMs	Trihalomethanes
TOC	Total organic carbons
TRIM	Power and Water's electronic document management system
TWS	Tropical Water Solutions
UV	Ultraviolet
WIMS	Work Information Management System
WIOA	Water Industry Operators Association
WQFA	Water Quality Front End Application
WQIMO	Water Quality Information Management Officer
WaterRA	Water Quality Research Australia
WTP	Water treatment plant

Units of measurement

Bq/L	Becquerel per litre
µg/L	micrograms per litre
mg/L	milligrams per litre
MPN/100mL	Most probable number per 100 millilitre
mSv/yr	millisieverts per year
ML	megalitres
µS/cm	microsiemens per centimetre

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