POWER AND WATER CORPORATION

2009 DRINKING WATER QUALITY REPORT

MAJOR AND MINOR URBAN CENTRES

PowerWater

CONTENTS

FROM THE MANAGING DIRECTOR

Power and Water has an obvious lead role to play to ensure a safe and sustainable supply of good quality drinking water for Territorians.

From the desert to the tropics we manage water from sources as varied as underground aquifers more than 10,000 years old to above-ground reservoirs that overflow nearly every year in the tropical Wet Season.

Across these varied conditions and some 1.3 million square kilometres, Power and Water has an established program of monitoring at the sources and throughout its distribution systems.

This annual report provides details on our water quality management system and the results of our water quality monitoring for 2008-09.

However, our major centres continue to grow and change and this report also outlines our priorities for future investment and continual improvement.

Power and Water is working to raise the Darwin River Dam spillway and is evaluating Manton River Reservoir for reintroduction as a drinking water source. An integral part of these types of projects is the maintenance of water quality. The Manton project includes a comprehensive monitoring program that will ensure the provision of quality drinking water from this resource.

Multiple barriers against contamination provide the maximum protection for water supplies. In Elliott we have installed an ultra-violet disinfection unit as an additional barrier significantly increasing the security of this supply.

Sustainable water supply continues to be a priority for utilities across Australia and Power and Water faces the same issues. We continue to work with our communities to encourage responsible use of this precious resource.

Andrew Macrides
Managing Director

Power and Water Corporation

SECTION A: FRAMEWORK FOR DRINKING WATER QUALITY MANAGEMENT

The *Australian Drinking Water Guidelines* (the 2004 ADWG) were published by a joint committee of the National Health and Medical Research Council (NHMRC) and Natural Resource Management Ministerial Council (NRMMC) in 2004. Based on the best available scientific evidence, these national guidelines provide a framework for good management of drinking water supplies and an authoritative reference on what defines safe, good quality water, how it can be achieved and assured.

Power and Water is committed to providing safe drinking water by adopting and implementing the Framework for Management of Drinking Water Quality included as a key part of the 2004 ADWG.

There are 12 elements to the Framework, which is based on a proactive approach to ensuring the safety of drinking water by managing all steps in water supply from catchment to consumer. The 12 elements are outlined in this report.

1. COMMITMENT TO DRINKING WATER QUALITY MANAGEMENT

Power and Water is committed to being a trusted provider of safe, good quality drinking water. This is outlined in our Drinking Water Quality Policy and Customer Contract. A copy of the Customer Contract is available at any Power and Water office or at www.powerwater.com.au

SUMMARY OF POWER AND WATER'S DRINKING WATER QUALITY POLICY

We aim to provide you with a good quality, safe and reliable water supply. We will:

- Supply drinking water, appropriate to the environment in which the community is located, in accordance with parameters set by the 2004 ADWG.
- Monitor the quality of drinking water in line with the Drinking Water Operational and Verification Monitoring Program and report the results to the Chief Health Officer, Department of Health and Families (DHF).
- Develop contingency and response plans to deal with incidents that may adversely affect drinking water quality.
- Implement any arrangements notified by the Chief Health Officer in an emergency, to ensure the safety of supply.
- Respond promptly to any problem identified.
- Consult with the community where health-related physical, chemical or radiological parameters exceed the Guideline value.

While Power and Water has primary responsibility for providing safe drinking water through the *Water Supply and Sewerage Services Act*, a number of government agencies are also involved.

DHF has a key role in applying the 2004 ADWG and monitoring compliance with them in the interest of public health.

The Department of Natural Resources, Environment, The Arts and Sport (NRETAS) also has a role in protecting water quality, including the regulation and management of water resources and the regulation of pollution control.

The Department of Resources (DoR) undertakes independent analyses of water samples through its laboratories in Darwin and Alice Springs.

The Department of Construction and Infrastructure (DCI) has a major role in protecting water quality through land use planning.

These agencies coordinate and cooperate to ensure highest standard of water quality is achieved and maintained.

BELOW ▸ WATER FLOW RECORDING. DARWIN RIVER RESERVOIR PUMP STATION

2. ASSESSMENT OF THE DRINKING WATER SUPPLY SYSTEM

Power and Water supplies water to five major centres and 13 minor centres illustrated in Figure 1 below.

FIGURE 1: POWER AND WATER CORPORATION WATER SUPPLY SERVICE AREAS

Major centres have larger and usually more complex infrastructures. Power and Water provides the technical services to maintain these supplies. With these resources in place, major centres are able to extend these services to minor centres functioning both as a technical and administrative hub.

WATER SOURCES

With the exception of Darwin, Katherine and Pine Creek, our centres rely solely on ground water, particularly in the arid centre. In some cases, the ground water is more than 10,000 years old. Table 1 shows existing water sources for major and minor centres of the Northern Territory.

Most of Darwin's water supply comes from Darwin River Reservoir. To ensure good quality water, no development or uncontrolled public access is allowed within the catchment. The reservoir is drawn down through the year, with the majority of use in the Dry Season (May to October) and recharged during the Wet Season (November to April). The balance of supply (at least 10 per cent) is ground water from the McMinns and Howard East borefields.

In 2007-08 Power and Water began investigations into the use of Manton River Reservoir as an additional permanent water supply for Darwin. This involved drawing down the reservoir and monitoring major potable water quality parameters, as well as studying the effects this use would have on the existing recreational uses of the reservoir. This investigation continued through 2008-09 and will continue in 2009-10.

TABLE 1: SUMMARY OF EXISTING DRINKING WATER SOURCES IN MAJOR AND MINOR CENTRES

Centre	Source*
Adelaide River	Ground water
Alice Springs	Ground water (Roe Creek borefield)
Batchelor	Ground water
Borroloola	Ground water
Daly Waters	Ground water
Darwin	Surface water (Darwin River Reservoir) + ground water (10%)
Elliott	Ground water
Katherine	Surface water (Katherine River) + ground water (30%)
Kings Canyon	Ground water
Larrimah	Ground water
Mataranka	Ground water
Newcastle Waters	Ground water
Pine Creek	Surface water (Copperfield Reservoir) + ground water (40%)
Tennant Creek	Ground water (Kelly Well, Kelly Well West and Cabbage Gum borefields)
Timber Creek	Ground water
Ti Tree	Ground water
Yulara	Ground water

*With local names where in common use.

Power and Water has developed a semi-quantitative risk assessment method to identify the water quality hazards that pose a risk to Territory water supplies and to provide a relative ranking of the risks. This assessment is based on water quality measurements of health and aesthetic parameters taken in all centres from 2004 to 2009. The assessment generates a score for each centre which enables them to be ranked according to the scale of the risks.

This information is used to allocate resources to improve water quality. The results are in **Section 12 – Review and continual improvement.**

3. PREVENTATIVE STRATEGIES FOR DRINKING WATER SUPPLY

Power and Water has adopted the multiple barrier principle to protect drinking water supplies. This requires the establishment of a number of barriers to minimise the potential for water supply contamination. This is one of the key elements of the Framework for Management of Drinking Water Quality.

Table 2 summarises the current barriers in place in the major and minor centres to ensure the supply of safe drinking water.

TABLE 2: WATER QUALITY BARRIERS IN MAJOR AND MINOR CENTRES

Centre	Catchment protection	Detention in reservoirs/ aquifers	Bore head integrity	Alternative sources of supply	Coagulation, filtration or membrane filtration	Disinfection	Storage tank integrity and cleaning	Maintenance of positive pressure in reticulation	Back-flow prevention in reticulation	Disinfection residual at customer's tap
Adelaide River										
Alice Springs										
Batchelor										
Borroloola										
Cox Peninsula								N/A	N/A	
Daly Waters										
Darwin Ground water										
Darwin Surface Water			N/A							
Elliott										
Katherine Ground water										
Katherine Surface Water			N/A							
Kings Canyon										
Larrimah										
Mataranka										
Newcastle Waters										
Pine Creek Ground water										
Pine Creek Surface Water			N/A							
Tennant Creek										
Timber Creek										
Ti Tree										
Yulara										

Notes: White indicates no barrier. Light blue indicates a partial barrier and dark blue indicates a full barrier. N/A – Not Applicable.

4. OPERATIONAL PROCEDURES AND PROCESS CONTROL

Power and Water has documented procedures to ensure the uninterrupted supply of quality drinking water across the Northern Territory. Operators have access to these procedures via Power and Water's intranet.

Operating procedures are routinely reviewed and amended in accordance with Power and Water's commitment to continual improvement and implementation of systems certified to comply with International Standards Organisation (ISO) standards, Environment (AS/NZS ISO 14001:2004), Quality (AS/NZS ISO 9001:2008) and Occupational Health and Safety (AS/NZS ISO 4801:2001).

Operational monitoring is included as a component of Power and Water's monitoring program and addresses chemical, physical and biological parameters relevant to water quality. Critical control points in each supply are monitored using a range of online monitoring systems in each centre. Apart from monitoring the status and performance of infrastructure these systems provide continuous monitoring for chlorine, fluoride, conductivity, turbidity and pH. In-field measurements, such as temperature and chlorine residuals help to identify performance issues and corrective actions.

Corrective actions and preventative actions cover all aspects of operation and include health, safety and quality. Corrective actions specific to a procedure usually form part of that procedure. Corrective actions can be linked to operational monitoring providing a formalised response to deviations from set point values at critical control points.

Materials used by Power and Water that contact potable water must comply with AS/NZS 4020:2005 - Testing of products for use in contact with drinking water.

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 site of manufacture of the chemical must be certified to ISO9001.

BELOW ▸ WET SEASON OVERLOW AT MANTON RIVER RESERVOIR

5. VERIFICATION OF DRINKING WATER QUALITY

WATER QUALITY MONITORING

Power and Water's Water Drinking Water Operational and Verification Program 2006-09 is used to verify the effectiveness of water quality management strategies. The program is based on the 2004 ADWG's recommendations but knowledge of specific water quality issues for a water supply may require an increase in monitoring frequency or monitoring of additional parameters.

Microbiological, physical, chemical and radiological samples are scheduled to be collected from the source, storage and distribution systems of all Territory water supplies.

Power and Water has designed and implemented a three-year monitoring program, which was approved by the DHCS (now DHF) for the period 2006 - 2009. The types of monitoring in the program include:

MICROBIOLOGICAL MONITORING

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 so frequent microbiological monitoring is used 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. 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 so indicator organisms are used to show whether contamination with faecal material may have occurred. The indicator organisms Power and Water monitors are:

- *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; and
- Total coliforms: a range of bacteria found in many soil and aquatic environments. Total coliforms provide a measure of the effectiveness of the treatment system and a general indication of the cleanliness of the drinking water supply.

The 2004 ADWG require that for assessment of microbiological performance:

- At least a minimum number of routine samples have been tested for *E. coli*; and
- At least 98 per cent of scheduled samples (as distinct from repeat or special purpose samples) contain no *E. coli*.

The number of routine samples collected for *E. coli* testing is defined in the 2004 ADWG and is based on the population served by each water supply.

Power and Water monitors for the presence of *Naegleria fowleri*. *N. fowleri* is a free-living ameboflagellate found in soil and aquatic environments. This amoeba causes primary amoebic meningoencephalitis (PAM), a very rapid and usually fatal infection acquired when water contaminated with *N. fowleri* enters the nasal passages.

Testing for *N. fowleri* is included separately in the monitoring program as the indicator organisms described above are not suitable indicators for the presence of *N. fowleri*.

Power and Water introduced an extensive monitoring program for *N. fowleri* in all major and minor centres in 2006-07 following the detection of this organism in South Australia and Western Australia. Monitoring was continued through 2007-08 and 2008-09 (Refer to section **B1 Drinking water quality and performance** for discussion of 2008-09 results).

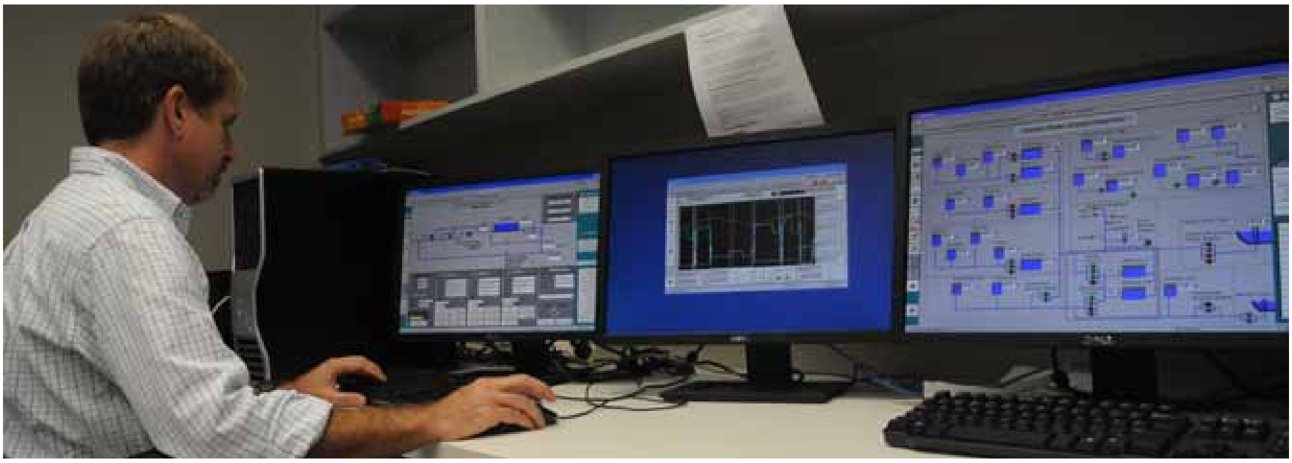
The 2004 ADWG recommend an action level of two *N. fowleri* organisms per litre in the treated water system. The 2004 ADWG recommend controlling *N. fowleri* by maintaining a minimum free chlorine level of 0.5 mg/L. Power and Water aims to do this in all distribution systems (except Tennant Creek, where continuous chlorination is not practiced).

During the 2008-09 monitoring period *N. fowleri* was not detected in any monitored water supply in the Northern Territory.

Power and Water monitors for the presence of *Burkholderia pseudomallei* in reticulated water. *B. pseudomallei* is the agent responsible for the disease melioidosis. This primarily tropical disease causes a potentially fatal human infection that generally manifests itself as a localised soft tissue infection, pneumonia, abscesses of the liver and spleen, or acute and often rapidly fatal septicaemia.

The monitoring program was developed in 2006-07 in consultation with the DHCS (now DHF), and focussed on the Tennant Creek water supply which is not chlorinated. Monitoring was continued during 2007-08 and 2008-09 (Refer to section **B1 Drinking water quality and performance** for discussion of 2008-09 results).

To date *B. pseudomallei* has not been detected in the Tennant Creek water supply.



ABOVE ▸ SYSTEM MONITORING AND CONTROL CENTRE

CHEMICAL AND PHYSICAL MONITORING (HEALTH PARAMETERS)

Power and Water monitors numerous chemical and physical parameters to ensure that water supplied to customers is safe to drink.

In general, the potential risk to human health increases as the levels of these chemical and physical parameters increase. Monitoring by Power and Water ensures any risk to human health is identified and quickly minimised. The safe levels of these chemicals in drinking water are specified in the 2004 ADWG, based on assumptions including water consumption and potential exposure to chemicals from other sources.

Radionuclides or radiation-emitting elements are sometimes found in drinking water supplies. In the Northern Territory these elements are natural and characteristic of the local hydrogeology. The 2004 ADWG define corrective action responses 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, discussions should be held with the relevant health authority (DHF) to determine the frequency of ongoing sampling (Primary response level);
- If the total annual dose exceeds 1.0 mSv intervention is required. Power and Water and DHF should assess the results and examine options to reduce the levels of exposure (Secondary response level).

Radionuclide monitoring was continued for a number of major and minor centres in 2008-09 as part of the three-year water monitoring program endorsed by DHF.

Disinfection by-products are formed when chlorine reacts with organic material in the water supply. Chlorine is the primary defence against disease-causing microbiological contaminants in public water systems. During the disinfection process chlorine reacts with naturally occurring organic matter such as decaying leaves and other vegetation to produce several by-products, mostly trihalomethanes (THMs).

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

Selected minor and major centres were monitored for THMs in 2008-09 as part of the agreed three-year water monitoring program.

Pesticides (insecticides and herbicides) are sometimes used in our catchments to control insects and weeds. DHF requires testing for pesticides where there is the potential for water supply contamination.

Results of the 2007-08 pesticide monitoring program showed pesticides were not detectable in any water supply, that is, the level of pesticides in all samples was below the level of detection.

In respect of these results, pesticide monitoring of drinking water supplies during 2008-09 was limited.

CHEMICAL AND PHYSICAL MONITORING (AESTHETIC PARAMETERS)

Numerous chemical and physical parameters are monitored by Power and Water in order to supply customers with aesthetically acceptable drinking water.

Aesthetic parameters are the chemical and physical characteristics of water quality which pose no threat to human health but 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 by the consumer.

6. INCIDENT AND EMERGENCY RESPONSE

Appropriate and systematic responses to incidents that can compromise water quality are essential to protect public health and provide best service to customers.

A response procedure, approved by the Chief Health Officer, DHF, exists for any microbiological exceedance of the agreed limit. Power and Water responses include re-sampling, mains flushing and manual disinfection of storage tanks with sodium hypochlorite. DHF is notified promptly of any substantial microbiological failure. The management of more serious incidents may trigger the use of Power and Water's Corporate Crisis and Recovery Manual.

7. EMPLOYEE AWARENESS AND TRAINING

Power and Water ensures that all employees are appropriately trained and aware of their responsibilities. Procedures and documentation are frequently reviewed and training requirements are identified and programmed into training schedules. Training is monitored to ensure staff knowledge and skills are current.

Planned developments for Water Services include the recruitment of a specialist training officer in late 2009.

8. COMMUNITY INVOLVEMENT AND AWARENESS

Power and Water seeks community involvement in and awareness of water quality issues. We would like the community to:

- Understand issues associated with their drinking water quality;
- Help Power and Water ensure the security and integrity of their supply by reporting:
  - problems with water quality;
  - damage to water supply or sewage infrastructure;
  - suspicious activity or unauthorised access to Power and Water's facilities.

Water quality specialists visit schools if requested and present classes on water science and other water-related subjects. Information on this, as well as our previous water quality reports, can be viewed at www.powerwater.com.au

Power and Water sponsors various community activities and technical events to promote awareness of water quality by:

- Sponsoring the Water in the Bush conference hosted by the Northern Territory branch of Australian Water Association (AWA);
- Providing grants as part of the annual Power and Water Melaleuca Awards;
- Staging various open days at their facilities, such as Darwin River Dam;
- Making presentations at major events including regional shows, the Tropical Garden Spectacular in Darwin and the Sustainability Festival in Alice Springs;
- Publishing pamphlets to promote better understanding of the Territory's various water issues.

9. RESEARCH AND DEVELOPMENT

Water Quality Research Australia Limited (WQRA) is a national research centre established to succeed the Cooperative Research Centre (CRC) for Water Quality and Treatment when the CRC ended on 30 June 2008. WQRA undertakes collaborative research of national application on drinking water quality, recycled water and relevant areas of wastewater management. The main focus of the research program is on urban water issues related to public health and acceptability aspects of water supply, water recycling and aspects of wastewater management. WQRA also has an education program, utilising the most successful elements of the CRC program.

Power and Water Managing Director Andrew Macrides is Power and Water's industry membership representative for WQRA.

Power and Water, as a member of WQRA, plays an active role in the Regional and Rural Water Supplies Program. This program aims to:

- Address key issues that impact on the provision of good quality drinking water to regional and rural communities in Australia;
- Identify research that will provide affordable and sustainable solutions to water supply problems;
- Help represent regional and rural water supply areas in setting industry policy, regulation and strategic directions.

Power and Water maintains direct involvement in a range of research projects to improve water quality throughout the Territory. Power and Water has also commissioned a number of internal and external reports on water quality issues during 2008-09. These are listed in table 3.

TABLE 3:CURRENT RESEARCH PROJECTS AND COMMISSIONED REPORTS

Title of commissioned report	Author	Status
Bathymetric Survey of Manton Dam	Dr Kevin Boland	Active
Water Quality in Manton Dam 2008-09	Dr Kevin Boland	Active
Scale Formation in Small and Remote Community Water Supplies	Adele Jones, Andrew S. Kinsela, Richard N. Collins and T. David Waite with Rino Trolio (WA Water Corp.) and Amy Dysart (Power and Water Corporation)	Active

10. DOCUMENTATION AND REPORTING

Power and Water's Integrated Management System (IMS) integrates all of Power and Water's systems and processes into one complete framework, enabling the organisation to work as a single unit with unified objectives.

Core components of the IMS are the maintenance of documentation and the dissemination of information through a formalised reporting system.

The majority of Power and Water's documentation is stored electronically.

Data generated from the drinking water quality monitoring program is maintained in a purpose-specific Oracle database.

Operational data from the online monitoring supervisory control and data acquisition system (SCADA) is made available to operators through a data historian application. This process information system (PI System) allows operators to record, analyse, and monitor the real-time status of water supply infrastructure and water quality.

Research and development data is maintained in the Corporation's electronic data management system (TRIM).

Technical and operational details of the water supply system including technical drawings and maps are contained in the Facilities Information System (FIS).

All of the above information is accessible through the Power and Water intranet.

Power and Water provides information to the public via its website. This includes technical information, guides to water conservation and media releases.

Power and Water reports to the Water Services Association of Australia (WSAA) the national body of the Australian urban water industry. The information provided by Power and Water forms part of the National Performance Report and affords the Territory and Australian public with a reliable and transparent source of information on urban water utilities.

This report, Power and Water's Annual Drinking Water Quality Report 2009, provides an objective account of the quality of Northern Territory potable water supply to consumers, regulatory bodies and stakeholders.

The intrinsic relationship between potable water and public health means Power and Water and DHF share common responsibilities and are required to work together to resolve water quality health-related issues. Protocols are in place to ensure any exceedence of the 2004 ADWG is reported promptly to DHF by Power and Water.

11. EVALUATION AND AUDIT

The evaluation and audit of Power and Water's water quality management system ensures successful management of water quality data and processes.

The preparation of the 2008-09 Annual Drinking Water Quality report is an important part of the review and evaluation process. Audits ensure that operational procedures and processes are in place so that accurate water quality data is collected and appropriate management systems are maintained.

In March 2008, just prior to the reporting period of this report, SAI Global conducted a series of surveillance audits on Power and Water. This included our water quality management system's drinking water monitoring and assessment processes.

The audit emphasised the following observations:

- ✓ Water monitoring program complies with the requirements of the 2004 ADWG and is conducted correctly;
- ✓ Responses to failures are effective;
- ✓ Recording of response actions is thorough;
- ✓ Responses are completed in a timely manner;
- ✓ Annual report adequately details 2004 ADWG non-compliances;
- ✓ Sampling procedures are detailed and unambiguous;
- ✓ Safety, environmental and quality aspects are all addressed.

12. REVIEW AND CONTINUAL IMPROVEMENT

Power and Water is committed to developing and improving its drinking water quality management system and the safety of drinking water supplies.

Power and Water has formed a Water Quality Network with SA Water (South Australia) and Water Corporation (Western Australia). The network provides a forum to share information, knowledge and discuss emerging issues. This allows us to benchmark our performance and identify other ways to improve drinking water quality. Although the network group meets only twice a year information exchange is continuous as required.

REVIEW OF DRINKING WATER QUALITY SYSTEM

This annual report has a significant role in the identification of water quality issues and helps to identify where operational and management system improvements are needed.

AQUALITY

Aquality is an internet-based tool that measures the implementation of the 2004 ADWG – Framework for the Management of Drinking Water. Scores are calculated for each of the 12 elements of the Framework as well as implementation of the whole Framework. *Aquality* allows water utilities to undertake the scoring process online and compare results with other Australian utilities.

In 2008-09, Power and Water continued to use *Aquality* to assess implementation of the Framework for elements 1 through 4.

MICROBIOLOGICAL RISK ASSESSMENT

Microbiological water quality is assigned the highest precedence and is assured by assessing the number and effectiveness of barriers that prevent the introduction of disease-causing organisms. Table 2 shows that Tennant Creek has the least number of protective barriers so is monitored more frequently to ensure system security.

In 2007-08 Power and Water investigated ultra-violet (UV) disinfection systems for the Tennant Creek supply and for the ground water supplies in Darwin and Katherine. Ultra-violet disinfection would provide a significant barrier against microbial contamination of the Tennant Creek water supply, however, unlike chlorination which provides disinfection deep into the reticulation, UV disinfection does not provide protection beyond the point of application.

During 2008-09 a review of microbiological data was completed and provided to DHF. This review identified regular deterioration of microbial quality of supplied water which required management by frequent, intermittent manual dosing of the contents of service storage tanks with sodium hypochlorite and flushing of the reticulation system. Continuous chlorination of the water supply is the most cost effective and technically appropriate disinfection barrier. Chlorination uses robust, reliable equipment that is capable of being maintained and operated by local personnel. During 2009-10 it is proposed that a final decision be made on proceeding with the adoption of a UV system. The significantly higher cost of constructing a UV system requires securing of additional funds. Detailed design of the final preferred solution is expected to commence in 2010-11.

A risk assessment of Katherine ground water was undertaken in 2007. The study concluded a barrier was required to provide protection against pathogens that may enter the aquifer through various pathways such as sinkholes and private bores located within the protection zone(s) of the bore heads. In December 2008 a UV system was recommended as chlorination may not deactivate chlorine resistant pathogens such as *Giardia* cysts, *Cryptosporidium* oocysts and some viruses. The UV system would also act as a second disinfection barrier against a range of chlorine sensitive pathogens. This is still being considered due to potential scaling problems limiting the effectiveness of the UV process.

LEFT ▸ UV DISINFECTION UNIT DURING INSTALLATION IN ELLIOTT 2008

ABOVE ▸ DARWIN RIVER RESERVOIR

In addition, the preferred location of the UV system would ideally disinfect surface water obtained from the Katherine River, however, difficulties have been encountered during preliminary design with the integration of a UV system within the existing water treatment plant. Priority has been placed upon completing refurbishment of the treatment plant's sand filters. This work is planned to be undertaken in early 2011.

A UV system was installed on bore M64 – part of the Darwin water supply – in May 2009. The borefield is in the rural area and the UV system provides an extra barrier against contamination from the animals and septic systems in the area.

A UV disinfection system was installed and commissioned in Elliott in November 2008 after concerns the bores were potentially susceptible to contamination by septic systems. The UV system was installed between the ground level storage tank and elevated tank to eliminate microorganisms not eradicated by chlorine. The water is further treated with sodium hypochlorite to provide residual disinfection throughout the Elliott reticulation system.

CHEMICAL, PHYSICAL AND RADIOLOGICAL RISK ASSESSMENT

A risk assessment procedure has been developed to prioritise improvements in chemical and physical water quality. It focuses on a scoring system for centres that exceed the 2004 ADWG values for one or more chemical, physical or radiological parameters.

To assess risk, Power and Water combines likelihood and consequences. The likelihood of a parameter resulting in a problem is assumed to be proportional to the ratio of the statistically-derived value to the 2004 ADWG value. That is, where a statistically-derived value exceeds a guideline value by double, the likelihood is given a value of two.

The consequence of any exceedance is given a weighting according to its effect on human health. Weightings were developed in conjunction with DHF (at that time the Department of Health and Community Services) and are as follows:

- Relatively significant health impact: 10;
- Relatively minor health impact: 5; and
- Relatively significant aesthetic impact: 3.

For example, under this system arsenic is given a weighting of 10 and salinity (TDS) is given a weighting of 3.

For each water supply the risk contributed by each parameter exceeding the 2004 ADWG is calculated. The values of each of these risks are then summed and a final risk value for that water supply obtained.

The risk calculation is based on the 95th percentile for chemical health parameters and average concentration for aesthetic values. Radiological values used in this assessment are the 95th percentile or where data is limited, the maximum potential annual radiation dose.

The total risk value for each water supply is compared to the total risk value of all other water supplies. The results are compiled to rank water supplies according to the scale of the risks from lowest to highest.

This provides a means for determining priorities for further action. Actions may include collection of additional water quality data, carrying out more detailed studies, or investigation into alternative sources of supply and water treatment options.

Table 4 shows Kings Canyon and Daly Waters have the highest risk scores. The primary water quality parameters of concern for Kings Canyon are iodide and lead, and in Daly Waters they are iodide and hardness. Nine of the 18 water supplies have slightly elevated levels of iodide.

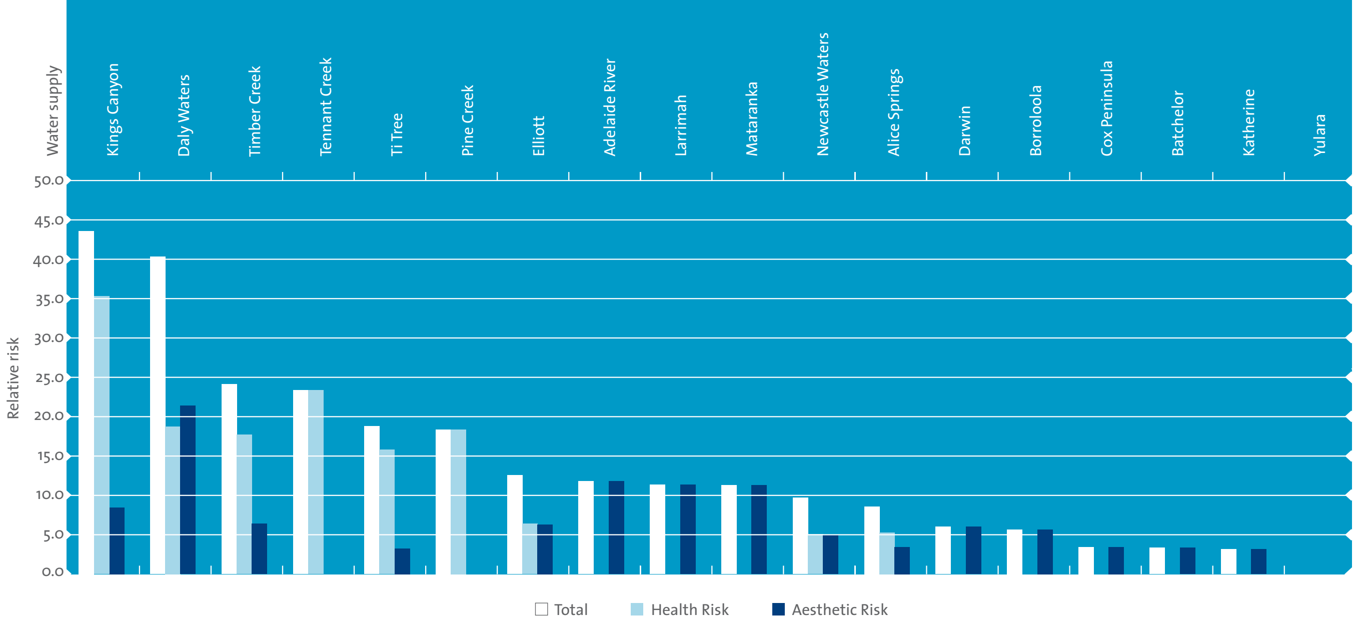
Figure 2 clarifies the contributions from health and aesthetic parameters for the total risk for each supply.

TABLE 4: RELATIVE RISK SCORING FOR ALL WATER SUPPLIES 2008-09

Rank	Centre	Relative Risk Score	Parameters Exceeding 2004 ADWG and DHF TDS Value 2008-09
1	**Kings Canyon**	43.7	Hardness, Iodide, Lead, Selenium, TDS
2	**Daly Waters**	40.3	Chloride, Hardness, Iodide, Selenium, Sodium, TDS
3	**Timber Creek**	24.2	Barium, Fluoride, Hardness
4	**Tennant Creek**	23.3	Fluoride, Iodide
5	**Ti Tree**	18.8	Hardness, Iodide, Nitrate
6	**Pine Creek**	18.3	Arsenic, Iodide, Chlorine (free)
7	**Larrimah**	17.5	Hardness, Iodide, TDS
8	**Elliott**	12.4	Hardness, Iodide, Chlorine (free)
9	**Adelaide River**	11.7	Iron, Manganese
10	**Mataranka**	11.2	Hardness, TDS
11	**Newcastle Waters**	9.7	Hardness, Iodide
12	**Alice Springs**	8.5	Hardness, Iodide
13	**Darwin**	6.0	Chlorine (free)
14	**Borroloola**	5.5	pH
15	**Cox Peninsula**	3.4	Chlorine (free)
16	**Batchelor**	3.2	Hardness
17	**Katherine**	3.0	Chlorine (free)
18	**Yulara**	0.0	None

FIGURE 2:

RELATIVE RISK SCORES SHOWING CONTRIBUTING PROPORTIONS FROM HEALTH AND AESTHETIC PARAMETERS



SECTION B: DRINKING WATER QUALITY AND PERFORMANCE

MICROBIOLOGICAL RESULTS SUMMARY

BACTERIA

As part of the verification monitoring program, 1191 scheduled drinking water samples were collected for bacteriological analysis across the Northern Territory in 2008-09. This number excludes resamples and operational samples.

The 2004 ADWG require that no *E. coli* be detected in 98 per cent of samples collected from each system. Figure 3 shows that for 2008-09, all major centres except Tennant Creek, an un-chlorinated water supply, achieved the 98% *E. coli* free target.

FIGURE 3:

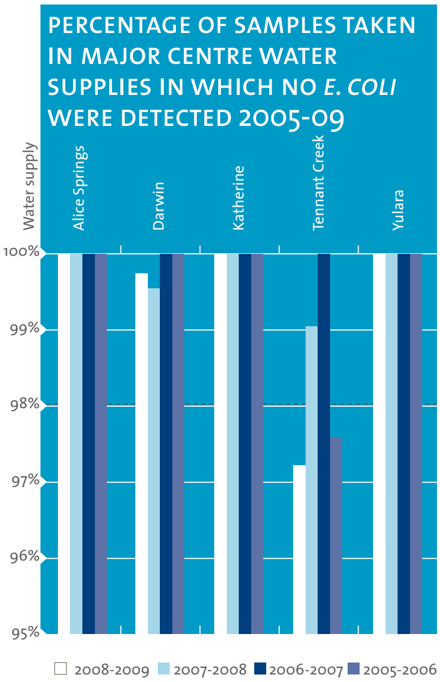
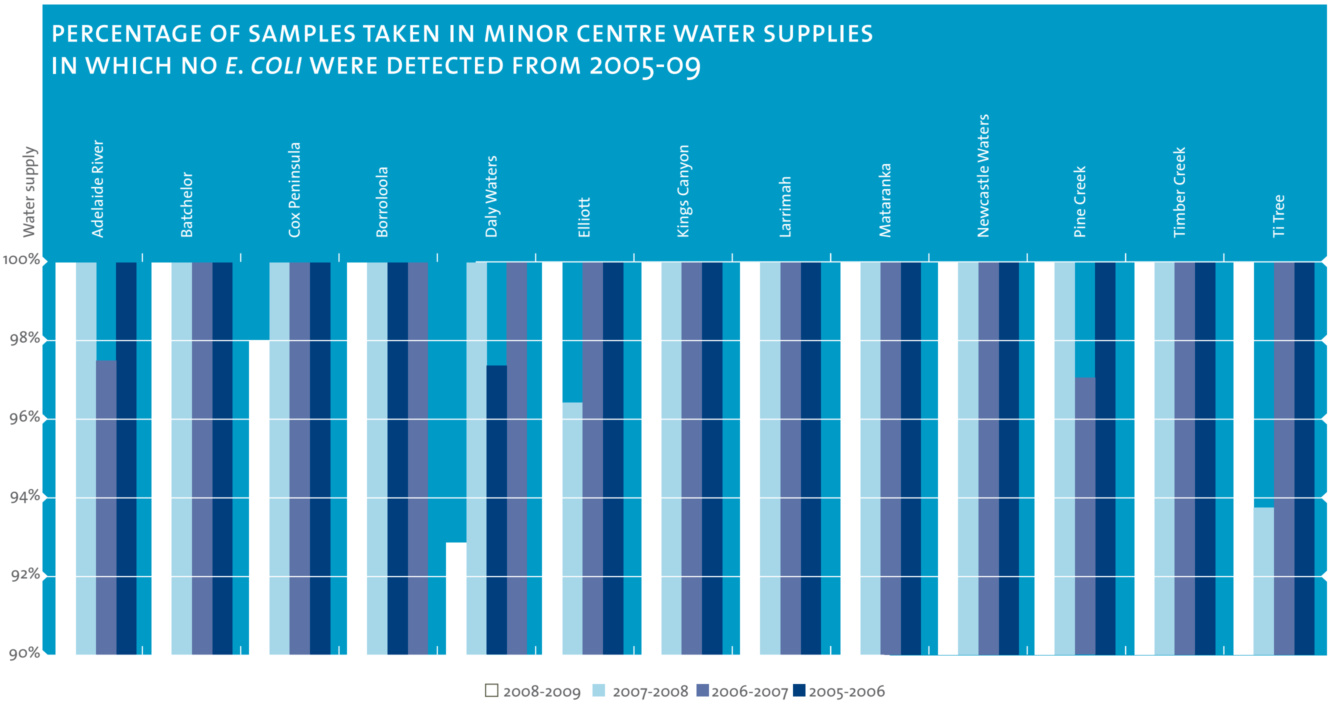


FIGURE 4 presents results for all the minor centres in the Northern Territory. Daly Waters failed to pass *E. coli* performance targets in 2008-09 with *E. coli* detected in two samples. *E. coli* was detected in one sample from Cox Peninsula but this supply passed the *E. coli* performance target with 98 percent of samples free of *E. coli*. All other minor centres achieved 100 per cent compliance in 2008-09, reflecting the upgraded chlorine dosing and monitoring facilities installed over the past four years, and improved system operation and maintenance.

FIGURE 4:



Full details of bacteriological results from the 2008-09 year are outlined in Appendix 1.

Naegleria fowleri

The *N. fowleri* monitoring program in major centres continued in 2008-09, with 416 samples collected. Analytical results in Table 5 show all water supply reticulation samples collected from major centres in 2008-09 contained no *N. fowleri* and the 2004 ADWG action level of two organisms per litre was not exceeded in this period.

Table 5 also lists all amoeba detections for 2008-09 and shows during the 12 month monitoring period all 80 reticulation samples collected from monitored minor centres were free of *N. fowleri*.

Although the action level directly focuses on *N. fowleri* the detection of any thermophylic amoeba is considered significant. The detection of thermophilic amoeba indicate that conditions in that water supply are conducive for the potential growth of *N. fowleri* and further investigation or remedial action may be warranted.

TABLE 5: THERMOPHYLIC AMOEBA DETECTIONS, MONITORED SUPPLIES 2008-09

Centre	Total samples 2008-09	Amoebae positive samples	Naegleria positive samples	*Naegleria lovaniensis* positive samples	*Naegleria fowleri* positive samples
Alice Springs	18	2	0	0	0
Boroloola	3	0	0	0	0
Cox Peninsula	50	3	0	0	0
Darwin	212	59	19	19	0
Katherine	26	0	0	0	0
Pine Creek	18	3	3	3	0
Tennant Ck	148	13	12	12	0
Timber Creek	3	0	0	0	0
Yulara	5	0	0	0	0

Burkholderia pseudomallei

Burkholderia pseudomallei was not detected in any of the five water samples from the Tennant Creek water supply system in 2008-09.

CHEMICAL AND PHYSICAL RESULTS SUMMARY

Health-related water quality parameters are reported as a 95th percentile. If data is limited, values are not reported as the 95th percentile but as the maximum value.

Aesthetic parameters are reported as an average as specified in the 2004 ADWG.

RADIONUCLIDES

Water supplies are screened to gain an initial measure of gross alpha and beta activity concentrations. The 2004 ADWG recommend further analyses and annual radiation dose determination if levels are higher than 0.5 Bq/L.

To comply with 2004 ADWG radiological data from ground water supplies used in annual reporting must be from no more than two years outside the reporting period and for surface water no more than five years.

To calculate the precise radiation dose, all radioactive species in the water supply must be identified and their values determined. Generally radium 226 and 228 are the major radionuclides contributing to the gross alpha and beta values. When radium 226 and 228 do not account for all gross alpha and beta values other radionuclides present must be identified and their levels determined.

When the analysis failed to include these radionulides the annual radiation dose is calculated by treating the gross alpha value as if it is due entirely to radium 226 and the K40 corrected gross beta value as if it is due entirely to radium 228.

This is a valid approach as 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.

This method of annual radiation dose calculation is a conservative solution and produces an annual radiation dose estimate in excess of the true value.

Water from nine minor centres and one major centre complies with the 2004 ADWG screening level, with radioactivity levels below 0.5 Bq/L.

Samples collected from Borroloola, Pine Creek and Yulara were analysed for the specific radionuclides radium 226 and radium 228 only. As gross alpha and beta concentrations are not available annual dose determinations could not be made.

Mataranka and Tennant Creek supplies are included in Power and Water's radiological monitoring program but were not sampled in this period due to a scheduling error.

Samples collected from Batchelor, Daly Waters, Darwin, Katherine, Ti Tree and Yulara water supplies were not all analysed for all required parameters. Some samples were analysed for gross alpha and beta only and some were analysed for radium only. Therefore not all data from these supplies could be used to determine compliance and annual dose.

The Darwin water supply is sourced from bores and the Darwin River Reservoir.

Although levels are traditionally negligible, Darwin water supply reticulation and Darwin River Reservoir were not assessed within the time frame required for this report. Radionuclide data valid for the reporting period is only available for the bores. It is therefore not possible to provide an annual radiation dose value for the Darwin water supply.

Alice Springs bores were assessed for radioactivity levels in June 2008. Nine of the 14 bores supplying Alice Springs were below the gross alpha and gross beta activity concentration screening value of 0.5 Bq/L. Five bores exceeded 0.5 Bq/L for gross alpha but all were below 0.5 Bq/L for K-40 corrected gross beta.

Although Alice Springs supply was correctly monitored and samples collected some radiological parameters needed for the determination of annual dose were not measured during analysis.

In the absence of these parameters the annual radiation dose is calculated as described earlier assuming all gross alpha radioactivity is radium 226 and all gross beta is radium 228. When this calculation is applied to data from all bores the potential maximum radiation dose is 0.38 mSv/year and below the 2004 ADWG value of 1.0 mSv/year.

Kings Canyon water supply has higher levels of radionuclides than other Northern Territory water supplies. In July 2007, Queensland Health Scientific Services completed a report on the radiological properties of the water used for domestic and industrial purposes and subsequent wastewater treatment.

This study determined the combined total average dose per annum to be 0.69 mSv/yr. The 95th percentile required for assessment would therefore be greater than 0.69 mSv/yr and so would exceed the guideline level for intervention (0.5 mSv/yr). It is not possible to determine from this data if the total annual dose guideline value (1.0 mSv/yr) has been exceeded.

In response to this study, monitoring of the Kings Canyon water supply was increased from monthly to fortnightly during 2007-08 and remained at this frequency during 2008-09. The annual radiation dose can be estimated from the potential maximums calculated for each monitoring point within the supply. Using this approach, the potential maximum annual radiation dose (95th percentile) is 0.89 mSv/year.

Radiological monitoring and data assessment procedures put in place during the writing of this report will enable dose calculation reporting in the 2009-10 report for water supplies where activity screening concentrations are exceeded.

TRIHALOMETHANES

The 2004 ADWG set a health guideline value of 0.25 mg/L for trihalomethanes (THMs). THMs in Power and Water supplies were initially measured for reference 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 acceptable 2004 ADWG level.

Samples in 2008-09 showed THMs ranged from less than 0.004 mg/L for 13 water supplies to 0.150 mg/L in Darwin. These levels remain below the 2004 ADWG guideline value and appear to be relatively stable. The low levels measured and the low potential for the formation of THMs in NT water supplies is supported by the low level of THM precursors, total organic carbons (TOC), in these waters.

HERBICIDES AND PESTICIDES

The 2004 ADWG health values for pesticides are very conservative and include a range of safety factors. The values are derived from the acceptable daily intake (ADI) and set at about 10 per cent of the ADI for an adult weight of 70 kg for a daily water consumption of two litres.

Although guideline values have been provided for a large number of pesticides, most are unlikely to be present in Australian drinking water supplies. Monitoring is undertaken for those pesticides that have been detected in the source water, or where local usage suggests that they might be detected.

Dicamba (Banvel, 3,6-dichloro-2-methoxybenzoic acid) is a moderate to low toxicity herbicide used to control weeds and mimosa in the Darwin River Reservoir catchment. Dicamba is moderately persistent in soil and breaks down to very simple substances such as carbon dioxide and water. Its reported half-life in soil ranges from one to six weeks. This herbicide is applied two - three times a year as part of the mimosa control program. Usually pesticide monitoring is executed in conjunction with weed management programs to ensure pesticide levels remain within 2004 ADWG values, but this was not achieved during the 2008-09 period.

Dicamba is also used in the Manton River Reservoir catchment and monitoring of this reservoir showed Dicamba levels to be below the level of detection.

As pesticides were not detected in any of the 18 water supplies during 2007-08 only the Darwin water supply was monitored during 2008-09.

The pesticide analysis program focuses on 43 commonly used pesticides including organochlorine, organophosphate and triazine pesticides, insecticides and acidic herbicides. In 2008-09, water samples were collected from the Darwin bores and reticulation on four occasions and analysed for the presence of pesticides.

Reticulation samples submitted to the laboratory were not tested for Dicamba or any other acidic herbicide. At this time the monitoring program referenced pesticides in general terms. Therefore the analytical request contained insufficient detail to ensure all pesticides were included in the analysis.

Full details of the health and aesthetic parameters for each major and minor centre are outlined in Appendix 1.

CUSTOMER SATISFACTION

WATER QUALITY CUSTOMER COMPLAINTS

Appearance, taste and odour are monitored as they are generally the characteristics by which customers judge water quality.

Power and Water records all water quality complaints made by customers.

Power and Water reports the number of customer complaints to the Water Services Association of Australia (WSAA) for publication, as do other Australian water utilities.

Table 6 shows the total number of complaints and the number of complaints per 1,000 customer properties.

TABLE 6: WATER QUALITY COMPLAINTS 2004-09

		TOTAL NUMBER OF COMPLAINTS				
Location	Properties	2004-05	2005-06	2006-07	2007-08	2008-09
Darwin	50731[1]	121	112	147	371	355
Adelaide River	109[2]	DNA	0	0	2	1
Alice Springs	11661[1]	3	8	5	1	4
Katherine	2031[2]	6	7	2	DNA	DNA
Total	**62392**	**130**	**127**	**154**	**374**	**360**
Complaints per 1000 properties (all NT)		3.22	2.13	2.44	6.13	5.77

DNA Data not available
[1] Based on WSAA reporting guidelines
[2] Properties based on number of electrical meters

The pattern of complaints about Darwin water supply is largely governed by changes in water quality and demand associated with the seasons. As with many water supply reservoirs, Darwin River Reservoir is subject to stratification. This is due to the sun heating the upper layers of the reservoir so that distinct layers or strata of water of different temperature are formed. The water at a lower depth is colder and of lower aesthetic quality due to complex chemical processes in the water. This is not normally a problem as water to supply Darwin is drawn from the warmer, more aesthetically acceptable water near the surface.

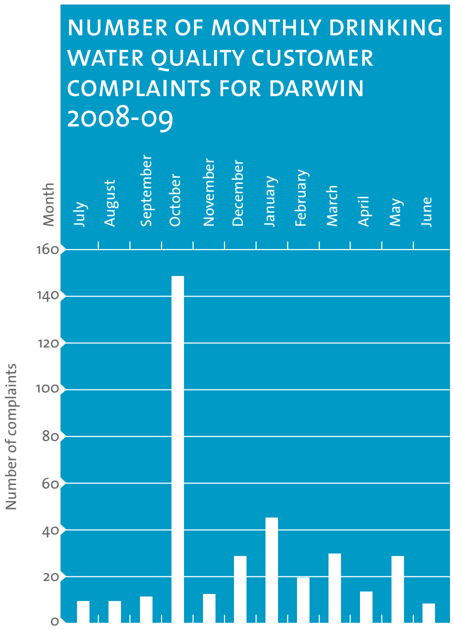
Stratification can be disrupted by strong winds, cloudy days, or seasonal changes. As a result of this disruption, water of lower aesthetic quality from the lower part of the reservoir may come to the surface and be drawn into the supply system. Once in the supply system, this lower quality water can precipitate out iron and manganese compounds that appear unsightly and cause immediate complaints. During the Wet Season, as water demand drops, these compounds may settle out in the distribution system since flows are low. However, at the beginning of the next Dry Season, as flows in the distribution system increase, they are stirred up and become the cause of further customer complaints. The levels of iron and manganese in the drinking water do not constitute a health risk due to the relatively short duration of the discoloured water events.

The frequency of drinking water complaints for the Darwin water supply during the 2008-09 period is shown in Figure 5.

Power and Water works to minimise the frequency and the magnitude of these events, primarily through a mains flushing program in major centres where customers frequently report discoloured water. Mains are flushed before anticipated increased demands associated with seasonal changes. When a customer reports discoloured water, Power and Water flushes the mains supplying the customer's residence.

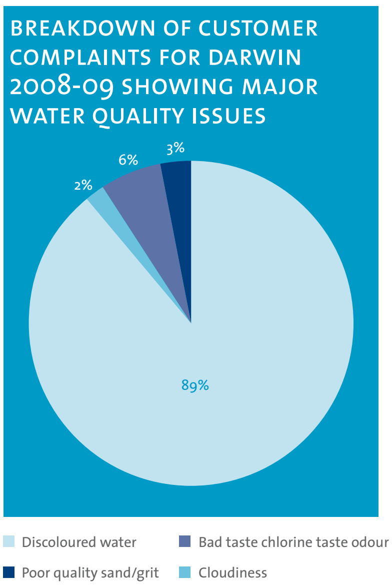
Water quality is also observed at a number of locations in the Darwin water supply to gauge the extent of discoloured water and determine whether routine flushing is required.

FIGURE 5:



Customers have also complained about cloudy water, floating particles, odour, taste and high chlorine levels. High chlorine levels manifest themselves as chloronous taste and odour complaints. Firure 6 shows a breakdown of customer complaints for 2008-09.

FIGURE 6:



Taste and odour complaints 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 have been installed in most major and minor centres to improve monitoring across the entire network.

Objectionable tastes and odours can result from compounds produced by certain types of algae, cyanobacteria (blue-green algae), bacteria and sometimes protozoa.

A number of organic compounds causing tastes and odours can be produced as by-products when water is disinfected with chlorine.

Sometimes a customer will report cloudy or milky water. This is generally due to the presence of dissolved air in the water. Milkiness or cloudiness in water most commonly occurs after water mains repairs. Repressurising of water mains causes trapped air to be dissolved. When a tap is turned on minute air bubbles are released causing the water to appear milky. When left to stand, this cloudy water will clear rapidly. Other causes of cloudy water are tap aerators and hot water systems.

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

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.

RECORDED EMERGENCIES / INCIDENTS

No water quality emergencies were recorded in 2008-09. Significant investment in the upgrading of facilities and securing of systems continues reducing risks and the potential for contamination or failure.

In the 2008-09 year there were five incidents in which *E. coli* was detected in water supplies:

- Cox Peninsula - one sample 8/04/2009;
- Daly Waters - two samples 13/01/2009 (single incident);
- Darwin - one sample 29/12/2008; and
- Tennant Creek - one sample 11/11/2008 and two samples 5/05/2009 (two incidents).

Response to these incidents included manual chlorination of tanks, flushing of mains and re-sampling of the water supply as agreed with DHF. Following remedial action water supplies were tested and all results were negative for *E. coli*.

APPENDICES

APPENDIX 1: WATER QUALITY RESULTS TABLES

TABLE A1: BACTERIOLOGICAL MONITORING IN MAJOR CENTRES 2008-09

Parameter/Centre	Target level	Total no. of samples required	Total no. of samples collected*	Total no. of exceedances	Samples passing reporting level (%)
Alice Springs					
E. coli (mpn/100 mL)	<1 in 98% samples	104	106	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	104	106	0	100.0
Darwin					
E. coli (mpn/100 mL)	<1 in 98% samples	364	385	1	99.7
Total coliforms (mpn/100 mL)	<10 in 95% samples	364	385	4	99.0
Katherine					
E. coli (mpn/100 mL)	<1 in 98% samples	104	83	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	104	83	0	100.0
Tennant Creek					
E. coli (mpn/100 mL)	<1 in 98% samples	104	108	3	97.2
Total coliforms (mpn/100 mL)	<10 in 95% samples	104	108	19	82.4
Yulara					
E. coli (mpn/100 mL)	<1 in 98% samples	52	53	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	52	53	0	100.0

*Centres with samples below the required number fell short due to laboratory closure and logistical error.

TABLE A2: BACTERIOLOGICAL MONITORING IN MINOR CENTRES 2008-09

Parameter/Centre	Target level	Total no. of samples required	Total no. of samples collected*	Total no. of exceedances	Samples passing reporting level (%)
Adelaide River					
E. coli (mpn/100 mL)	<1 in 98% samples	24	24	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	24	0	100.0
Batchelor					
E. coli (mpn/100 mL)	<1 in 98% samples	52	36	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	52	36	0	100.0
Borroloola					
E. coli (mpn/100 mL)	<1 in 98% samples	24	15	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	15	0	100.0
Cox Peninsula					
E. coli (mpn/100 mL)	<1 in 98% samples	52	49	1	98.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	52	49	0	100.0

TABLE A2: BACTERIOLOGICAL MONITORING IN MINOR CENTRES 2008-09

Parameter/Centre	Target level	Total no. of samples required	Total no. of samples collected*	Total no. of exceedances	Samples passing reporting level (%)
Daly Waters					
E. coli (mpn/100 mL)	<1 in 98% samples	24	28	2	92.9
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	28	2	92.9
Elliott					
E. coli (mpn/100 mL)	<1 in 98% samples	24	53	1	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	53	2	96.2
Kings Canyon					
E. coli (mpn/100 mL)	<1 in 98% samples	52	95	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	52	95	0	100.0
Larrimah					
E. coli (mpn/100 mL)	<1 in 98% samples	24	24	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	24	0	100.0
Mataranka					
E. coli (mpn/100 mL)	<1 in 98% samples	24	24	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	24	0	100.0
Newcastle Waters					
E. coli (mpn/100 mL)	<1 in 98% samples	24	22	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	22	0	100.0
Pine Creek					
E. coli (mpn/100 mL)	<1 in 98% samples	24	24	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	24	0	100.0
Timber Creek					
E. coli (mpn/100 mL)	<1 in 98% samples	24	13	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	13	0	100.0
Ti Tree					
E. coli (mpn/100 mL)	<1 in 98% samples	24	43	0	100.0
Total coliforms (mpn/100 mL)	<10 in 95% samples	24	43	0	100.0

*Centres with samples below the required number fell short due to laboratory closure and logistical error.

TABLE A3: HEALTH, AESTHETIC AND OTHER PARAMETERS IN MAJOR CENTRES 2008-09

Parameter / Centre	Guideline Value[3]	Units	Alice Springs	Darwin	Katherine	Tennant Creek	Yulara
HEALTH PARAMETERS - 95th PERCENTILE VALUES[1]							
Antimony	0.003	mg/L	<0.0002	<0.0002	0.0005	<0.0002	<0.0002
Arsenic	0.007	mg/L	<0.0005	<0.0005	<0.0005	0.0029	<0.0005
Barium	0.7	mg/L	0.10	<0.05	<0.05	<0.05	<0.05
Boron	4	mg/L	0.13	<0.02	<0.02	0.52	0.70
Cadmium	0.002	mg/L	<0.0002	<0.0002	<0.0002	0.0009	0.0011
Chlorine (free)	5	mg/L	DNA	1.91	0.85	N/A	0.57
Chromium	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	2	mg/L	0.15	0.12	0.11	0.06	0.14
Fluoride	1.5	mg/L	0.5	0.8	0.5	**1.6**	0.1
Iodide	0.1	mg/L	**0.10**	0.02	<0.01	**0.36**	0.06
Lead	0.01	mg/L	0.003	0.002	<0.001	<0.001	<0.001
Manganese	0.5	mg/L	<0.005	0.065	<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	0.007	<0.002	<0.002	<0.002	0.004
Nitrate	50	mg/L	8	3	1	37	41
Radiological[4]	1.0	mSv/yr	0.37[M]	DNA	DNA	DNA	DNA
Selenium	0.01	mg/L	<0.002	<0.001	<0.001	0.006	<0.001
Silver	0.1	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	500	mg/L	59	12	10	74	332
THMs[5]	0.25	mg/L	<0.004	0.150	0.055	<0.004	0.014
Uranium	0.02	mg/L	0.00904	0.00005	0.00020	0.00872	0.00008
AESTHETIC PARAMETERS - MEAN VALUES[2]							
Aluminium	0.2	mg/L	<0.02	<0.02	0.04	<0.02	<0.02
Chloride	250	mg/L	72	5	6	93	54
Chlorine (free)	0.6	mg/L	DNA	**1.21**	**0.60**	N/A	0.41
Copper	1	mg/L	0.05	0.04	0.03	0.02	0.06
Hardness	200	mg/L $CaCO_3$	**220**	42	147	176	34
Iron	0.3	mg/L	0.05	0.12	0.09	0.07	0.05
Manganese	0.1	mg/L	<0.005	0.029	<0.005	<0.005	<0.005
pH	6.5 - 8.5	pH units	8.1	7.5	7.8	7.8	7.4
Sodium	180	mg/L	76	3	5	117	45
Sulfate	250	mg/L	52	3	4	50	72
TDS[3]	800	mg/L	452	58	165	616	185
Zinc	3	mg/L	0.02	0.02	0.01	0.01	0.04

TABLE A3: HEALTH, AESTHETIC AND OTHER PARAMETERS IN MAJOR CENTRES 2008-09

Parameter / Centre	Guideline Value[3]	Units	Alice Springs	Darwin	Katherine	Tennant Creek	Yulara
OTHER PARAMETERS - MEAN VALUES[2]							
Alkalinity	*	mg/L	249	38	142	278	17
Beryllium	*	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Bromide	*	mg/L	0.35	0.02	0.02	0.74	0.32
Calcium	*	mg/L	48	8	34	26	8
Electrical conductivity	*	µS/cm	805	97	282	960	311
Magnesium	*	mg/L	24	5	15	26	3
Potassium	*	mg/L	6.0	0.5	0.8	30.6	4.9
Silica	*	mg/L	17	10	14	49	7
Tin	*	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

APPENDIX 1: WATER QUALITY RESULTS TABLES

TABLE A3: HEALTH, AESTHETIC AND OTHER PARAMETERS IN MAJOR CENTRES 2008–09

Parameter / Centre	Guideline Value[3]	Units	Adelaide River	Batchelor	Borroloola	Cox Peninsula	Daly Waters	Elliott	Kings Canyon	Larrimah	Mataranka	Newcastle Waters	Pine Creek	Ti Tree	Timber Creek
HEALTH PARAMETERS - 95th PERCENTILE VALUES[1]															
Antimony	0.003	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	0.007	mg/L	0.0020	<0.0005	<0.0005	<0.0005	0.0018	<0.0005	0.0049	0.0011	<0.0005	<0.0005	**0.0082**	0.0014	0.0010
Barium	0.7	mg/L	<0.05	<0.05	<0.05	<0.05	0.09	0.15	<0.05	<0.05	<0.05	0.25	<0.05	0.10	**1.76**
Boron	4	mg/L	<0.02	<0.02	<0.02	<0.02	0.41	0.31	0.35	0.21	0.24	0.26	<0.02	0.33	0.12
Cadmium	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chlorine (free)	5	mg/L	0.39	0.51	0.68	1.37	0.95	2.33	0.49	0.54	0.86	0.84	1.06	DNA	0.80
Chromium	0.05	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	2	mg/L	0.03	0.05	0.62	0.06	0.02	0.02	0.44	0.01	0.05	0.02	0.02	0.08	0.05
Fluoride	1.5	mg/L	0.5	0.2	0.1	DNA	0.5	0.9	0.5	0.3	0.4	0.9	0.7	0.9	**1.6**
Iodide	0.1	mg/L	<0.01	<0.01	0.02	<0.01	**0.27**	**0.13**	**0.41**	**0.13**	0.09	**0.10**	**0.10**	**0.18**	0.03
Lead	0.01	mg/L	<0.001	<0.001	0.005	0.002	0.003	<0.001	**0.010**	<0.001	<0.001	<0.001	0.001	0.001	0.003
Manganese	0.5	mg/L	0.233	<0.005	0.016	<0.005	0.228	<0.005	0.011	<0.005	0.011	<0.005	0.087	<0.005	0.229
Mercury	0.001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0004	<0.0001	<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	<0.005	<0.005	<0.005	<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	0.005	0.012	0.004	0.005	<0.002	<0.002	<0.002	0.012
Nitrate	50	mg/L	1	1	1	DNA	12	41	5	5	3	10	1	**67**	1
Radiological[4]	1.0	mSv/yr	Pass	Pass	DNA	Pass	Pass	Pass	0.89[P]	Pass	DNA	0.37[M]	Pass	Pass	Pass
Selenium	0.01	mg/L	<0.001	<0.001	<0.001	<0.001	**0.010**	0.003	**0.010**	0.005	<0.001	<0.001	<0.001	0.003	<0.001
Silver	0.1	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfate	500	mg/L	DNA	DNA	5	DNA	216	400	180	126	133	269	97	143	6
THMs[5]	0.25	mg/L	<0.004	<0.004	<0.004	<0.004	0.009	<0.004	<0.004	<0.004	<0.004	<0.004	0.021	<0.004	<0.004
Uranium	0.02	mg/L	0.00003	0.00047	0.00022	0.00002	0.00756	0.00603	0.00262	0.00284	0.00342	0.00501	0.00018	0.00953	0.00218

TABLE A3: HEALTH, AESTHETIC AND OTHER PARAMETERS IN MAJOR CENTRES 2008–09

Parameter / Centre	Guideline Value[3]	Units	Adelaide River	Batchelor	Borroloola	Cox Peninsula	Daly Waters	Elliott	Kings Canyon	Larrimah	Mataranka	Newcastle Waters	Pine Creek	Ti Tree	Timber Creek
AESTHETIC PARAMETERS - MEAN VALUES[2]															
Aluminium	0.2	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride	250	mg/L	22	6	10	DNA	**346**	151	248	188	182	51	12	64	29
Chlorine (free)	0.6	mg/L	0.17	0.26	0.49	**0.68**	0.49	**1.12**	0.24	0.34	0.51	0.50	**0.68**	DNA	0.34
Copper	1	mg/L	0.02	0.02	0.13	0.03	<0.01	<0.01	0.09	<0.01	0.03	<0.01	0.02	0.02	0.02
Hardness	200	mg/L $CaCO_3$	112	**214**	22	DNA	**580**	**412**	**360**	**522**	**515**	**320**	118	**208**	**428**
Iron	0.3	mg/L	**0.80**	0.06	0.08	0.03	0.22	0.13	0.20	0.14	0.19	0.07	0.13	0.06	0.09
Manganese	0.1	mg/L	**0.121**	<0.005	0.008	<0.005	0.055	<0.005	0.006	<0.005	0.007	<0.005	0.051	<0.005	0.030
pH	6.5 - 8.5	pH units	7.0	7.6	**6.5**	DNA	7.5	7.9	7.0	7.6	7.7	7.8	7.3	8.0	7.4
Sodium	180	mg/L	25	4	6	DNA	**215**	95	115	120	137	57	29	66	21
Sulfate	250	mg/L	1	3	1	DNA	199	183	178	113	129	44	20	48	5
TDS[3]	800	mg/L	195	209	55	DNA	**1337**	794	**821**	**900**	**920**	555	219	520	462
Zinc	3	mg/L	0.05	0.05	0.33	0.04	<0.01	0.01	0.07	0.03	0.04	0.02	0.01	0.04	0.03
OTHER PARAMETERS - MEAN VALUES[2]															
Alkalinity	*	mg/L	129	204	40	DNA	434	370	127	431	475	381	151	216	450
Beryllium	*	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromide	*	mg/L	0.03	0.01	0.02	0.01	2.09	0.79	1.38	1.05	0.88	0.17	0.06	0.46	0.13
Calcium	*	mg/L	16	26	7	DNA	128	90	71	120	116	72	20	47	64
Electrical conductivity	*	µS/cm	313	378	81	DNA	2116	1283	1371	1449	1577	892	348	755	861
Magnesium	*	mg/L	17	36	1	DNA	63	45	44	54	54	34	17	22	65
Potassium	*	mg/L	1.2	0.4	1.1	DNA	26.0	22.6	23.9	12.3	18.3	28.9	1.6	19.1	6.7
Silica	*	mg/L	13	16	11	DNA	29	48	17	34	31	50	34	81	19
Tin	*	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

LEGEND (TABLE A3 & A4)

Values at or exceeding the guideline value are shown in bold.

All values reported preceded with "<" indicate the value is below the level of detection of the analytical method.

Supplies for which there is insufficient data, incomplete data or where the only data available is outdated are reported as data not available (DNA).

[1] 95th percentile of all Health related values where data is available from 2004-09. Free Chlorine values are reported as the 95th percentile for 2008-09 period. If data is limited radiological values are not reported as the 95th percentile but as the maximum value.

[M] - Maximum value. [P] - 95th percentile.

[2] Mean of aesthetic and other values where data is available from 2004-09.

[3] 2004 ADWG value for health and aesthetic parameters. TDS value set by DHCS.

[4] Supplies in which the gross alpha and gross beta values are below the screening level of 0.5 Bq/L automatically comply with the 2004 ADWG. Further analysis to identify specific radionuclides and the calculation of an annual dosage are not required. These supplies are reported as PASS.

[5] Trihalomethanes (THMs) are reported as the maximum value of the data available from 2004-09.

N/A	Not applicable	*	No guideline value applicable
mSv/year	millisieverts per year	μS/cm	microsiemens per centimetre
mg/L	milligrams per litre	DNA	Data not available

GLOSSARY OF ACRONYMS

ADI	Acceptable daily intake
ADWG	Australian Drinking Water Guidelines (2004) Referred to in this report as "2004 ADWG ".
ANSI	American National Standards Institute
AWA	Australian Water Association
AWWA	American Water Works Association
CRC	Cooperative Research Centre
DCI	Department of Construction and Infrastructure (from 4 December 2009)
DHCS	Department of Health and Community Services (until 1 July 2008)
DHF	Department of Health and Families (from 1 July 2008)
DNA	Data not available
DNRETA	Department of Natural Resources, Environment and The Arts (until 18 August 2008)
DNRETAS	Department of Natural Resources, Environment, The Arts and Sport (from 18 August 2008)
DoR	Department of Resources (from 4 December 2009)
DPI	Department of Planning and Infrastructure (until 4 December 2009)
DPIFM	Department of Primary Industry, Fisheries and Mines (until 4 December 2009)
FIS	Facilities Information System
GIS	Geographical information systems
IMS	Integrated management system
N/A	Not applicable
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NT	Northern Territory
PAM	Primary amoebic meningoencephalitis
PI System	Process information system for the management of real-time data and events
SAI Global	Standards Australia International (Global)
SCADA	Supervisory control and data acquisition
TDS	Total dissolved solids
THMs	Trihalomethanes
TOC	Total organic carbon
TRIM	Power and Water's electronic document management system
UV	Ultra-violet
WQRA	Water Quality Research Australia
WSAA	Water Services Association of Australia

UNITS OF MEASUREMENT

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

STANDARDS

AS/NZS ISO 14001:2004
Environmental management systems – Requirements with guidance for use

The objective of this Standard is to specify requirements for an environmental management system (EMS) to enable an organization to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organization subscribes, and information about significant environmental aspects.

AS/NZS ISO 9001:2008
Quality management systems – Requirements

This Standard promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements. For an organization to function effectively, it has to determine and manage numerous linked activities. An activity or set of activities using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process. Often the output from one process directly forms the input to the next.

AS/NZS 4801:2001
Occupational health and safety management systems – Specification with guidance for use

The objective of this Standard is to set auditable criteria for an occupational health and safety management system. The Standard is a specification that aims to encompass the best elements of such systems already widely used in Australia and New Zealand.

AS/NZS 4020:2005
Testing of products for use in contact with drinking water

This Standard specifies requirements for the suitability of products for use in contact with drinking water, with regard to their effect on the quality of water. These products include all items such as pipes, fittings, components, and materials used in coating, protection, lining, jointing, sealing and lubrication applications in the water supply and plumbing industry. Chemicals and media used directly for treating raw water to provide a suitable drinking water supply (e.g. lime, coagulants, activated carbon, ion-exchange resins) are not covered by this Standard.

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Head Office 2nd Level, Mitchell Centre, 55 Mitchell Street, Darwin NT 0800, GPO Box 1921, Darwin NT 0801

Customer service centres

Darwin Shop 28, Ground Floor, Mitchell Centre, 55 Mitchell Street, Darwin

Palmerston Shop 21, Palmerston Shopping Centre, 10 Temple Terrace, Palmerston

Katherine Ground Floor, Government Centre, 5 First Street, Katherine

Tennant Creek Ground Floor, Government Centre, Peko Road, Tennant Creek

Alice Springs Shop 8, Alice Plaza, 36 Todd Mall, Alice Springs