



**Cooling Towers,
Evaporative Condensers and
Warm Water Storage Systems
(Specialised Systems)**

Code of Practice 2005

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1. Introduction

- (1) This document provides a framework for the control of *Legionella* bacteria in building water systems in the Australian Capital Territory. The *Cooling Towers, Evaporative Condensers and Warm Water Storage Systems (Specialised Systems) Code of Practice 2005 (Code of Practice)* aims to minimise potential risks to public health from exposure to *Legionella* bacteria arising from building water systems and to provide guidance in maintaining these systems.
- (2) The **Code of Practice** has been developed in consultation with building owners, maintenance contractors, water treatment service providers and various interest groups in the ACT.

2. Scope

- (1) This **Code of Practice** sets out the minimum requirements for the operation and maintenance of **specialised systems** at premises in the Australian Capital Territory.
- (2) This **Code of Practice** is determined under section 133 of the *Public Health Act 1997* and is enforceable under section 20 of the **Act**.

3. Objective

- (1) The *Public Health Act 1997* and this **Code of Practice** are intended to minimise the potential risks to public health from exposure to *Legionella* bacteria by:
 - adopting standards for the design, location, commissioning, operation and maintenance of **specialised systems** at premises;
 - requiring regular maintenance, inspection and record keeping by trained or competent personnel to ensure that **specialised systems** at premises meet the standards; and
 - permitting **Public Health Officers** to check compliance, take samples for testing and the **Chief Health Officer** to require the closure of any **specialised systems** or require the evacuation of a premises where a suspected outbreak of Legionellosis has occurred.

4. Application

- (1) The *Public Health Act 1997* states that a person may apply to the Minister for a registration to carry on a registrable public health risk activity. The operation of a **specialised system** is declared to be a location-specific registrable public health risk activity. This activity may result in the transmission of disease to the community. Upon approval by a **Public Health Officer**, a **registration certificate** is issued for each **specialised system (cooling tower, evaporative condenser or warm water storage system)**.

- (2) Section 20 of the *Public Health Act 1997* also states that a person carrying on a public health risk activity shall not, without reasonable excuse, fail to comply with a **Code of Practice** in relation to that activity – penalties apply.
- (3) If a **registered person** fails to ensure that the **specialised system** is operated and maintained effectively then **ACT Health** may issue an improvement or prohibition notice under the *Public Health Act 1997*. Non-compliance with these notices attracts a penalty.
- (4) Meaning of a **specialised system** as stated in the *Public Health Act 1997*:

Specialised system means –

- (a) a water system within the meaning of the **AS/NZS 3666**, in which the temperature of the water at the point of outlet is not lower than 30⁰C and not higher than 55⁰C;
- (b) a mechanical ventilation system, including –
 - (i) an **air-handling system** within the meaning of the **AS/NZS 3666**;
and
 - (ii) an **evaporative condenser** within the meaning of the **AS/NZS 3666**; and
 - (iii) a **cooling tower** within the meaning of the **AS/NZS 3666**.
- (5) **Specialised system** for the purpose of this **Code of Practice** excludes the following:
 - (a) instantaneous hot water units or hot water storage units where the water is stored at a minimum of 60⁰C;
 - (b) a swimming, spa or hydrotherapy pool¹; and
 - (c) evaporative air conditioning equipment².

5. Definitions

For the purpose of this **Code of Practice**, the definitions below apply. Throughout the **Code of Practice**, terms or phrases that appear in **bold** identify those terms or phrases that have been defined.

Act - the *Public Health Act 1997*.

ACT Health – regulatory authority or the authority responsible for the *Public Health Act 1997* in the Australian Capital Territory.

¹ The requirements for swimming, spa and hydrotherapy pools are detailed in the *ACT Swimming and Spa Pools Code of Practice 1999* available from www.health.act.gov.au.

² Guidelines for the maintenance of evaporative air conditioning equipment can be found in the *ACT Guidelines for Evaporative Air Conditioning equipment* available from the Health Protection Service.

Air-handling system – a system for the purpose of directing air in a positive and controlled manner to and from specific enclosures by means of air-handling plant, ducts, plenums, air-distribution devices and control devices.

AS/NZS 3666 – the standard jointly published by Standards Australia and Standards New Zealand titled *AS/NZS 3666 – Air handling and water systems of buildings – Microbial control*, and includes Parts 1, 2 & 3 of that Standard.

Authorised Medical Officer – means the officer appointed under section 13 of the *Public Health Act 1997*.

Authorised Officer – means the **Chief Health Officer**, a **Public Health Officer**, or an **Authorised Medical Officer**.

cfu/mL – colony forming units per millilitre.

Chief Health Officer – means the officer appointed under section 7 of the *Public Health Act 1997*.

Code of Practice – the *Cooling Towers, Evaporative Condenser and Warm Water Storage Systems (Specialised Systems) Code of Practice 2005* determined under section 133 of the *Public Health Act 1997*.

Competent Person – A person who has had appropriate training or practical experience (or both) in the subject, sufficient to provide a safe and satisfactory performance.

Cooling Tower – a device for lowering the temperature of water by evaporative cooling in which atmospheric air is in contact with falling water, thereby exchanging heat. The term also includes those devices that incorporate a water-refrigerant or water-water heat exchanger.

DPD Test Kit – a kit for measuring free, combined and total chlorine residuals using the reagent DPD (N,N-diethyl-1,4-phenylene diamine or N,N-diethyl-p-phenylene diamine). Many test kits available from swimming pool suppliers measure only total chlorine and not free chlorine and consequently should not be used.

Evaporative Air Conditioning Equipment – a device that effects a reduction in the dry bulb temperature of air by evaporating water into the air.

Evaporative Condenser – a heat exchanger in which refrigerant is cooled by a combination of air movement and water spraying.

High Risk Event – an event that could reasonably be expected to significantly or adversely affect public health. E.g. a cooling tower has no biocide.

Licensed Plumber – must be licensed under the *Construction Occupations (Licensing) Act 2004* and work carried out by them must comply with *Water and Sewerage Act 2000 and Regulation 2001* and AS/NZS 3500:2003, Plumbing Standards.

mg/L – milligrams per litre.

pH - the term used to describe the hydrogen ion concentration in water, pH 7 is neutral.

Practising Engineer – an engineer registered with the National Engineering Registration Board (NPER) and registered to practice in the areas of mechanical and/or building services engineering.

Public Health Officer – means an officer appointed under section 12 of the *Public Health Act 1997*.

Public Health Risk Activity – The Minister may, in writing, declare an activity that may result in the transmission of disease, or that may otherwise adversely affect the health of individuals in the context of the wider health of the community, to be a public health risk activity. (Section 18 of the *Public Health Act 1997*.)

Registration – means registration to carry on the registered public health risk activity of operating a **specialised system** at a premises or location.

Registered Person – means a person registered under section 56G of the *Public Health Act 1997* to carry on a registered activity. The **registered person** may include his/her responsible representative. The **registered person** or representative is the person responsible for the maintenance and day to day running of the **specialised system** and would be the first point of contact in the event of a disease outbreak or emergency. The **registered person's** responsibilities are not absolved by contracting out the maintenance, cleaning and testing of the **specialised system**.

Registration Certificate – a certificate issued under section 56H of the *Public Health Act 1997*.

Significant Modification – a modification to a **specialised system** that directly affects the hazard potential of the equipment. For example, addition of drift eliminators to a **cooling tower** is a significant modification.

Specialised system – see section 4.

Standard – AS/NZS 3666.

Total Dissolved Solids or TDS – total dissolved salts or solids in a volume of water, usually expressed in **mg/L**.

Warm Water Storage System – a non-domestic water storage tank that maintains a water temperature of between 30⁰C and 60⁰C.

6. Adoption of AS/NZS 3666

- (1) This **Code of Practice** adopts **AS/NZS 3666**. A registered **specialised system** must be installed, operated and maintained in accordance with this **Standard**.

- (2) The edition of **AS/NZS 3666** to be used is the current, or latest version, of the **Standard**.
- (3) Where a section of **AS/NZS 3666** is inconsistent with a provision of this **Code of Practice**, the provision of this **Code of Practice** shall be taken to prevail to the extent of that inconsistency.
- (4) Compliance to **AS/NZS 3666** is required where the **Code of Practice** does not address an issue.

7. Notification to ACT Health

- (1) The registered person of a **specialised system** must notify **ACT Health** within 24 hours after receiving a result of greater than or equal to 1000 *Legionella* bacteria per millilitre, or after receiving a result of greater than or equal to 5,000,000 **cfu/mL** of heterotrophic microorganisms, or other **high risk event**.
- (2) Contact details for this notification are:
Environmental Health Unit
Health Protection Service
Phone: (02) 6205 1700 (bh)
After Hours: (02) 6269 0264
Facsimile: (02) 6205 1705

8. Occupational Health & Safety

8.1 Material Safety Data Sheets:

- (1) Material Safety Data Sheets must be kept for all chemicals in use on the premises and stored close and accessible to where the chemicals are located.
- (2) All chemical containers that are part of a chemical delivery system must be placed undercover within a bunded area or tray to prevent spills onto surrounding surfaces.

8.2 Ingress and Egress:

- (1) The **registered person** of a **specialised system** has a responsibility to provide safe ingress and egress for all persons employed to service systems on their premises. They must provide suitable ingress and egress; including working at heights requirements and entry into a confined space.

9. Records and Administrative

9.1 Manuals and Maintenance Records:

- (1) Operating and maintenance manuals must be provided and available on-site for all service provider personnel.

- (2) The maintenance service logbook must be kept current and available on the premises where the **specialised system** is located.
- (3) Maintenance service logbooks must contain the following information:
 - **registered person's** name and contact details;
 - name and contact details of the owner/manager of the building;
 - name and address of the building;
 - location details of the **specialised system**;
 - registration number of the **specialised system**;
 - name and contact details of the organisation undertaking the maintenance;
 - date of maintenance;
 - details of the maintenance and tests undertaken; and
 - assessment of the general condition of the **specialised system** (e.g. amount of rust present, if any or equipment wear and tear).
- (4) Maintenance service records containing the results of chemical testing of the **specialised system** must be kept and made available at the site for inspection upon request by an **authorised officer**.

9.2 Microbial Testing Records:

- (1) Microbial testing records include *Legionella* testing records and heterotrophic microorganism testing records.
- (2) Microbial testing records must be kept at a place agreed between the **registered person** and an **authorised officer** and be available for inspection upon request by an **authorised officer**.
- (3) All maintenance and microbial testing records must be kept for a minimum of seven years.

9.3 Notification of Changes:

- (1) The **registered person** must, within 14 days of any change in the information specified in the **registration certificate**, notify **ACT Health** in writing of that change.
- (2) The **registered person** must, within 30 days notify **ACT Health** in writing of the removal or permanent decommissioning of a **specialised system** and must return the **registration certificate** of the **specialised system** to **ACT Health**.

9.4 Modifications to Specialised Systems:

- (1) The **registered person** must, within one month of any significant modification to a **specialised system**, notify **ACT Health** in writing of that change.
- (2) The **registered person** must engage a **practising engineer** to undertake a risk assessment of a **specialised system** that has been significantly modified and

then submit this risk assessment to **ACT Health** within three months of the completion of the modification.

10. Additional Requirements For Specialised Systems

10.1 Cooling Towers:

- (1) **Cooling towers** also refer to evaporative condensers, which are similar heat rejection devices.
- (2) All **cooling towers** must comply with the following general requirements in addition to the requirements detailed in the **Standard** that are not addressed by this **Code**.
- (3) **Cooling towers** must operate in accordance with manufacturers specifications.
- (4) All **cooling towers** must be kept free of any extraneous matter, whether of plant, animal or inorganic origin, that may adversely affect the operation of the equipment or increase the risk to public health.
- (5) Servicing and maintenance of a **cooling tower** should only be carried out by an appropriately trained and **competent person**.

10.1.1 Drift Eliminators:

- (1) Drift eliminators are mandatory and are to be of an effective design and capable of achieving the required reduction of drift aerosols as per **AS/NZS 3666**.
- (2) The eliminator must cover the full exhaust air stream so there is no air by-pass.

10.1.2 Water Treatment:

- (1) **Cooling towers** must be provided with an automatically regulated water treatment system for managing corrosion, scaling, fouling and microbial growth through an effective water treatment program.
- (2) The water treatment regime adopted for a **cooling tower** must also account for the possible microbial resistance to a specific biocide or formulation of biocides. Alternate biocides must be used on a regular basis to reduce the likelihood of resistance. At least one biocide must be automatically dosed into the **cooling tower**.
- (3) All chemicals used must be compatible and the desirable pH range for their optimal effectiveness must be achieved.

10.1.3 Control of Total Dissolved Solids (TDS):

- (1) **Total Dissolved Solids or TDS** includes chemicals such as biocides and other inorganic and organic material. Water evaporation increases **TDS**, which

increases the potential for corrosion and scaling of equipment, heat exchangers and sensors. A small quantity of water should be bled and replaced with clean water to dilute the concentration of **TDS**. Bleed must be automatic and a lock-out device must be provided to prevent the bleed drain from operating while biocide is being added to the system. The bleed off water must be discharged to the sewer. A bleed lock-out is not required when oxidising biocides are being dosed using oxidation/reduction potential (ORP) control.

10.1.4 Stand-by or Back-up:

- (1) A **cooling tower** that is mainly on stand-by or used as a back-up system must be run at least one hour per week to circulate corrosion inhibitors and biocides.

10.1.5 Cleaning Schedule:

- (1) A **cooling tower** must be physically cleaned every three months unless another cleaning frequency or action is approved in writing by an **authorised officer**.
- (2) Where a **cooling tower** is able to be shut down and drained for cleaning, dosing with a biocides prior to dumping of the system's water and physical cleaning of the **cooling tower** is required.
- (3) Where a **cooling tower** cannot be shut down and its water dumped, it may be cleaned and disinfected in accordance with the requirements of Appendix B of **AS/NZS 3666.3**.
- (4) **Cooling towers** must be cleaned and disinfected before commissioning and before each start up after extended shutdown periods (e.g. shutdown is where systems are not run one hour per week to circulate corrosion inhibitors and biocides).

10.1.6 Shut Down:

- (1) **Cooling towers** must have a written shut down and start up procedure displayed on the **cooling tower** or on the equipment's switch panel. The written procedure must be protected from weathering.
- (2) **ACT Health** may advise that a shut down and emergency system decontamination in accordance with Paragraph C3 of Appendix C of **AS/NZS 3666.3** must be carried out on any **cooling tower** identified in the vicinity of an outbreak of Legionellosis. If a **cooling tower** cannot be shutdown for cleaning, system decontamination shall be carried out as directed or as required by an **authorised officer**.

10.1.7 Water Sampling:

- (1) Microbial water testing must be conducted:
 - after commissioning of a new **cooling tower**;
 - after the introduction of the water treatment program;

- when system start-up occurs;
 - when there is a change to the water treatment program to validate its acceptable performance; and
 - during on-going regular operating.
- (2) Sampling of water contained in a **cooling tower** must be undertaken monthly for the determination of *Legionella* bacteria and heterotrophic microorganism concentration.
 - (3) The water sampling point on each **cooling tower** must be clearly identified by a sign or label.
 - (4) Sampling points must wherever practicable be located on the return line to the **cooling tower**.
 - (5) Water samples must be taken as follows:
 - In containers as described in AS 2031.2 (*Selection of containers and preservation of water samples for chemical and microbiological analysis: Part 2 – Microbiological*); and
 - collected as described in AS/NZS 3666.3 (*Air-handling and water systems of buildings-Microbial Control: Part 3 – Performance-based maintenance of cooling water systems*); and
 - stored and transported as described in AS/NZS 3896 (*Waters-examination for Legionellae, including Legionella pneumophila*) for *Legionella* samples, or as described in AS 2031.2 for heterotrophic micro-organism samples.
 - (6) Testing of water samples for *Legionella* bacteria and heterotrophic micro-organisms must be performed at a National Association of Testing Authority (NATA) registered laboratory, in accordance with AS/NZS 3896 and AS/NZS 4276.3.2.

10.1.8 Results of Testing of Water Samples:

- (1) Limit of detection for water samples are 10 colony forming units per millilitre (**cfu/mL**).
- (2) Where a water sample shows a result of 10 or more *Legionella* **cfu/mL**, the **registered person** of the system must instigate the appropriate control strategy as detailed in Appendix A of this **Code of Practice**.
- (3) Where a water sample shows a result of greater than or equal to 100,000 **cfu/mL** or more of heterotrophic microorganisms, the **registered person** of the system must instigate the appropriate control strategy as detailed in Appendix B of this **Code of Practice**.

10.1.9 Certification:

- (1) For new **cooling towers**, the **registered person** must engage a **practising engineer** to certify that the **cooling tower** complies with this **Code of Practice**, referenced and relevant **Standards**. The **registered person** must submit a copy of the certification to **ACT Health** upon application for **registration** or upon request by an **authorised officer**.
- (2) Where a significant modification to a **cooling tower** takes place, the **registered person** must engage a **practising engineer** to certify that the **cooling tower** complies to this **Code of Practice** and referenced **Standards**. The **registered person** must submit a copy of the certification to **ACT Health** within two months of the modification or upon request by an **authorised officer**.

10.1.10 Risk Assessment:

- (1) The **registered person** must engage a **practising engineer** to undertake a risk assessment for **cooling towers** every five years or as directed by an **authorised officer**.
- (2) The **practising engineer** must review the current water treatment program prior to submitting this risk assessment to **ACT Health**.
- (3) The **registered person** of a newly installed **cooling tower** must supply a copy of the risk assessment upon application for **registration**.
- (4) The risk assessment must include:
 - make, model and serial number of each **cooling tower**;
 - identification of the sampling point from where all regular water sampling occurs;
 - an assessment of all risk factors detailed in Table 2.1 of AS/NZS 3666.3 for each **cooling tower**;
 - a statement of the performance criteria and operating control ranges for total alkalinity, chlorides, conductivity/**TDS**, pH and temperature on each **cooling tower**;
 - An outline of the chemical and physical parameters required for the effective operation of the selected biocide;
 - A statement of how the water sampling regime is linked to the monitoring program and effectiveness of the selected water treatment approach.
- (5) A copy of building plans (minimum scale of 1:50) with a site survey is also required showing the location of the **cooling tower**, air intakes and exhaust outlets. The site survey information should show details of pedestrian thoroughfares, other existing **cooling towers**, air intakes (including lift vents), exhaust outlets and natural ventilation openings of buildings adjacent to or facing the proposed new installation.

10.2 Warm Water Storage Systems:

- (1) Warm water storage systems must comply with the following requirements.

10.2.1 Water Treatment:

- (1) Warm water storage systems must have some form of physical or chemical process or a combination of both whereby the water is treated so that *Legionella* bacteria and heterotrophic microorganisms do not flourish in the storage system, e.g. heat, chlorination, ultra-violet devices and ozone.

10.2.2 Cleaning and Maintenance:

- (1) It is the **registered person's** responsibility to ensure that routine maintenance and servicing is undertaken on a **warm water storage system**.
- (2) Servicing and maintenance of a **warm water storage system** should only be carried out by an appropriately trained and **competent person**.
- (3) **Warm water storage systems** must be cleaned of sludge, sediment and scale every three months. Flushing of the pipe work associated with the **warm water storage system** must be carried out after servicing and upon commissioning of the equipment.
- (4) **Warm water storage systems** must be cleaned and disinfected as per Appendix C before commissioning and before each start up after lying idle for two or more weeks.

10.2.3 Water Sampling:

- (1) Water sampling of a **warm water storage system** must be undertaken at start up and then every month for six months to demonstrate that the disinfection process controls *Legionella* bacteria. Sampling must also be undertaken if the process of disinfection is modified or if a **authorised officer** directs that sampling is to be undertaken.
- (2) Testing of water samples for *Legionella* bacteria shall be performed at a National Association of Testing Authority (NATA) registered laboratory, in accordance with AS/NZS 3896.
- (3) A representative sample of the water in the **warm water storage system** should be taken at the point of outlet at various places throughout the building including outlets that are used infrequently, e.g. showers in large buildings.

10.2.4 Results of Testing of Water Samples:

- (1) Limit of detection for *Legionella* in water samples are 10 colony forming units per millilitre (**cfu/mL**).

- (2) Where a water sample from the **warm water storage system** shows a result of 10 or more *Legionella* cfu/mL, the **registered person** must instigate cleaning and a disinfection process as detailed in Appendix C of this **Code of Practice**.

10.2.5 Certification:

- (1) The **registered person** must engage a **licensed plumber** to certify that the **warm water storage system** complies to this **Code of Practice**, the **Standard** and AS/NZS 3500 where applicable. A copy of the certification shall be submitted to **ACT Health** upon application for **registration** or upon request by an **authorised officer**.
- (2) A **warm water storage system** must meet the requirements of AS/NZS 3500 and the Water and Sewerage Act 2000 and Regulation 2001. The storage system and pipe work must also be inspected by an ACT Planning and Land Authority plumbing inspector for issuing a Certificate of Compliance when the work is completed. A copy of this Certificate of Compliance shall be submitted with the application for registration to **ACT Health**.
- (3) Where a significant modification to a **warm water storage system** takes place, the **registered person** must engage a **licensed plumber** to certify that the **warm water storage system** complies to this **Code of Practice** the **Standard** and AS/NZS 3500 where applicable. A copy of the certification shall be submitted to **ACT Health** within two months of the modification or upon request by an **authorised officer**.

11. **Reference Documents:**

Standards Australia/Standards New Zealand:

AS/NZS 3666.1:2002 – *Air handling and water systems of buildings – Microbial control, Part 1: Design, installation and commissioning.*

AS/NZS 3666.2: 2002 – *Air handling and water systems of buildings – Microbial control, Part 2: Operation and Maintenance.*

AS/NZS 3666.3:2000 - *Air handling and water systems of buildings – Microbial control, Part 3: Performance-based maintenance of cooling water systems.*

AS/NZS 3896:1998 – *Waters - Examination for legionellae including Legionella pneumophila.*

AS/NZS 4276.3.2:2003 – *Water Microbiology – Method 3.2 - Heterotrophic colony count methods - plate count of water containing biocides.*

AS/NZS 2031:2001 - *Selection of containers and preservation of water samples for chemical and microbiological analysis: Part 2 – Microbiological.*

Further documents of interest include:

Standards Australia and Standards New Zealand HB 32:1995, *Control of microbial growth in air-handling and water systems of buildings.*

Broadbent C. 1996, *Guidance for the control of Legionella*, National Environmental Health Forum Monographs, Water Series No. 1, South Australian Health Commission.

Australian Institute of Refrigeration Air Conditioning and Heating, *Cooling Towers Selection & Application*, AIRAH Application Manual DA 17 - 1997.

Australian Institute of Refrigeration Air Conditioning and Heating, *Water Treatment*, AIRAH Application Manual DA 18 - 1998.

APPENDIX A
Control Strategies for the Presence of Legionellae

Legionellae Test Result (cfu/mL)	Required control strategy
Not detected, less than 10	(1) Maintain monthly monitoring. Maintain water treatment program.
Detected as between 10 and less than 1000	(2) Investigate problem. Review water treatment program. Take necessary remedial action including immediate on-line disinfection in accordance with Appendix B of AS/NZS 3666.3 and undertake control strategy (3)
	(3) Retest water within 3 to 7 days of plant operation after on-line disinfection: (a) If not detected, continue to retest water within 3 to 7 days until two consecutive samples, as appropriate, return readings of not detected and repeat control strategy (1) (b) If detected at less than 100 cfu/mL , repeat control strategy (2) (c) If detected at greater than or equal to 100 cfu/mL investigate problem and review water treatment program, immediately carry out on-line decontamination in accordance with Paragraph C2 of Appendix C of AS/NZS 3666.3 and repeat control strategy (3) (d) If detected at greater than or equal to 1000 cfu/mL , undertake control strategy (4)
Detected as greater than or equal to 1000	(4) Investigate problem. Review water treatment program. Take necessary remedial action including immediate on-line decontamination in accordance with Paragraph C2 Appendix C of AS/NZS 3666.3 and undertake control strategy (5) Notify ACT Health
	(5) Retest water within 3 to 7 days of plant operation after system decontamination (a) if not detected, continue to retest water within 3 to 7 days until two consecutive samples, as appropriate, return readings of not detected and repeat control strategy (1) (b) If detected at less than 100 cfu/mL , repeat control strategy(2) (c) If detected between greater than or equal to 100 and less than 1000 cfu/mL investigate problem and review water treatment program, immediately carry out on-line decontamination in accordance with Paragraph C2 of Appendix C of AS/NZS 3666.3 and repeat control strategy (5) (d) If detected at greater than or equal to 1000 cfu/mL investigate problem and review water treatment program, immediately carry out system decontamination in accordance with Paragraph C3 of Appendix C of AS/NZS 3666.3 and repeat control strategy (5).

APPENDIX B
Control Strategies for the Presence of Heterotrophic Microorganisms

Heterotrophic Microorganisms Test Result (cfu/mL)	Required control strategy
Detected as less than 100 000	(1) Maintain monthly monitoring. Maintain water treatment program.
Detected as between greater than or equal to 100 000 and less than 5 000 000	(2) Investigate problem. Review water treatment program. Take necessary remedial action including immediate on-line disinfection in accordance with Appendix B of AS/NZS 3666.3 and undertake control strategy (3)
	(3) Retest water within 3 to 7 days of plant operation after on-line disinfection: (a) If test result is less than 100 000 cfu/mL repeat control strategy (1) (b) If test result is greater than or equal to 100 000 cfu/mL but less than 5 000 000 cfu/mL undertake control strategy (2) (c) If test result is greater than or equal to 5 000 000 cfu/mL undertake control strategy (4)
Detected as greater than or equal to 5 000 000	(4) Investigate problem. Review water treatment program. Take necessary remedial action including immediate on-line disinfection in accordance with Appendix B of AS/NZS 3666.3 and undertake control strategy (5) Notify ACT Health.
	(5) Retest water with 3 to 7 days of plant operation after on-line disinfection a) If test result is less than 100 000 cfu/mL repeat control strategy (1) b) If test result is greater than or equal to 100 000 cfu/mL but less than 5 000 000 cfu/mL repeat control strategy (4) c) If test result is greater than or equal to 5 000 000 cfu/mL , investigate problem and review water treatment program, immediately carry out on-line decontamination in accordance with Paragraph C2 of Appendix C of AS/NZS 3666.3, and repeat control strategy (5)

APPENDIX C

Warm water storage system cleaning and disinfection

1. Cleaning

Warm water storage systems must be drained to remove sludge and sediment prior to the disinfection process.

2. Disinfection

Warm water storage systems must be disinfected by one of the following methods:

A. Heat Disinfection

- (i) Take reasonable precautions to ensure that the risk of scalding to building occupants is reduced during the heat disinfection process.
- (ii) Raise the temperature of the water in the **warm water storage system** to 70⁰C. Flush each outlet in turn for two minutes with water at a minimum temperature of 60⁰C.
- (iii) Record details in a maintenance log book.

B. Chlorine Disinfection

- (i) Isolate the heat source.
- (ii) Drain any sludge from the bottom of the **warm water storage system**.
- (iii) Ensure that an air break or back flow valve is incorporated between the water supply main and the **warm water storage system** to prevent contamination of water within ActewAGL's distribution system. (Refer to AS/NZS 3500 Part 1 Water Services, Section 4).
- (iv) Add chlorine to a residual of approximately 10 **mg/L** in the system as measured by a **DPD Test Kit** or similar test kit. Maintain the **pH** of the water between 7.0 and 7.6.
- (v) Ensure thorough mixing and circulation throughout the **warm water storage system** and any ring main.
- (vi) Flush each outlet in turn until there is a free chlorine level not less than 7 **mg/L** at one outlet, preferably the furthest point downstream of the **warm water storage system**. Check the free chlorine level with a **DPD Test Kit** or similar test kit.
- (vii) Allow the water to stand for one hour.
- (viii) Check that the free chlorine residual in the water is not less than 2 **mg/L** at the furthest outlet.
- (ix) Repeat the above procedure if the free chlorine residual is less than 2 **mg/L**.
- (x) Drain the **warm water storage system** if the free chlorine residual is 2 **mg/L** or greater and refill the **warm water storage system** with water and re-commission the system, flushing to remove any dislodged sludge.
- (xi) Record details in a maintenance log book.