

Appendix 1 Template for cooling tower system risk management plan

Components and format of a risk management plan

Generally, a risk management plan (RMP) should have a number of basic components, including:

- site and contact details
- assessment of each of the critical risks
- summary of the overall risk classification
- details of the system (collected during the risk assessment process)
- attachments or references to other documents, such as operational plans and shut-down procedures.

There is no prescribed format for an RMP. This template is provided as a guide, but other formats may be used.

About the template

The template is designed to be completed:

- by operators of cooling tower system, or landowners who have cooling tower systems on their land
- after reading this guide
- after completing a thorough risk assessment, as outlined in this guide.

This process will meet the requirements of the *Public Health and Wellbeing Act 2008* for development of an RMP.

An RMP must be developed for every cooling tower system on the site. It must be made available to an authorised officer of the Department of Health and Human Services on request.

Implementation of the operational program outlined in the RMP would also meet the requirements of the *Public Health and Wellbeing Regulations 2009*.

An electronic version of the template (in Word) is also available,¹⁵ and can be modified for development of an RMP.

Disclaimer

This document is intended only as a general guide to the development of risk management plans for cooling tower systems. No warranty as to the completeness of the information is given. The Department of Health and Human Services and its employees disclaim all liability and responsibility for any direct or indirect loss or damage that may be suffered through reliance on any information contained in, or omitted from, this document. No person should act solely on the basis of the information contained in the document without obtaining appropriate professional advice about obligations in specific circumstances.

Site and key contact details¹⁶

Record	Details
Site location (<i>property address</i>)	
Number of cooling towers in system	
Cooling tower system number ¹⁷	
Registration period ¹⁸	
Tower location reference (<i>if one exists</i>)	
Site owner's name and contact details (<i>Include company name, and contact person's business and after-hours telephone numbers</i>)	
Cooling tower system owner's name and contact details (<i>Include company name, and contact person's business and after-hours telephone numbers</i>)	
Person responsible for day-to-day operation of the cooling tower system (<i>Include company name, and contact person's business and after-hours telephone numbers</i>) ¹⁹	
Water treatment provider's name and contact details (<i>Include company name, and contact person's business and after-hours telephone numbers</i>)	
Water sampling or laboratory contractor name and contact details (<i>Include company name, and contact person's business and after-hours telephone numbers</i>)	
Department of Health and Human Services <i>Legionella</i> Team	1800 248 898

¹⁶ The *Public Health and Wellbeing Act 2008* requires the department to be notified in writing within 30 days of any change in ownership, address or any other contact details by the owner of the land (or their agent) on which the cooling tower system is located.

¹⁷ This is marked on the Certificate of Registration supplied by the department.

¹⁸ The department registers cooling tower systems for 1, 2 or 3 years. The registration period is included on the certificate of registration.

¹⁹ This person has the authority to approve the disinfection of the system on request of the department. It is not the water treatment service provider.

Critical risks

Stagnant water

Risk control strategy for stagnant water	Assessment of the cooling tower system	Operational or tower system improvement response ²⁰
Install a timer connected to a recirculating pump set to operate at least once a day to circulate the water	Is the system (or part of the system) idle for more than a month? <input type="checkbox"/> Yes <input type="checkbox"/> No	
	Where the system (or part of the system) is idle for more than a month, is a recirculating pump with a timer fitted to automatically circulate the water at regular intervals, to prevent it becoming stagnant? <input type="checkbox"/> Yes <input type="checkbox"/> No ²¹	
Remove or activate any 'dead legs'	Are there dead legs in the system? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Other ²²		
Risk classification for stagnant water ²³		<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D

20 Indicate the operational program or improvements you will put in place as a result of this assessment.

21 If you do not have a recirculating pump and timer installed, you can address the risk by installing such a pump. You should state the date that the pump will be installed. If you do not propose to install such a pump, you should describe how you will address the risk in the response column.

22 Use this row to describe other risks and response strategies that relate to these risks.

23 Refer to Table 3 in Section 7.2.2 of this guide to find the scenario that matches your system, to evaluate the risk from your system associated with stagnant water.

Nutrient growth

Risk control strategy for nutrient growth	Assessment of the cooling tower system	Operational or tower system improvement response ²⁴
Identify sources of environmental contamination and, where possible, reduce the amount of contamination	Are there factors in and around the site that may lead to environmental contamination and an increase in the level of nutrients in the water of the cooling tower system? <input type="checkbox"/> Yes <input type="checkbox"/> No	
	If 'Yes', can you reduce the levels of contamination? <input type="checkbox"/> Yes ²⁵ <input type="checkbox"/> No ²⁶	
Control corrosion	Do you have a corrosion control program? <input type="checkbox"/> Yes <input type="checkbox"/> No ²⁷	
Increase the frequency of cleaning	How frequently is the tower cleaned? ²⁸	
Protect the basin and 'top deck' of the tower from sunlight	Are any of the wetted surfaces exposed to sunlight? <input type="checkbox"/> Yes ²⁹ <input type="checkbox"/> No	
Reduce the water temperature, where possible	Can the water temperature of the tower be reduced? <input type="checkbox"/> Yes ³⁰ <input type="checkbox"/> No ³¹	
Other ³²		
Risk classification for nutrient growth ³³ <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		

24 Indicate the operational program or improvements you will put in place as a result of this assessment.

25 Describe the strategies in the response column.

26 Describe how you will address the risk in the response column.

27 The Public Health and Wellbeing Regulations 2009 require treatment of the cooling tower system water with chemicals or other agents to minimise corrosion.

28 The Public Health and Wellbeing Regulations 2009 require disinfection, cleaning and re-disinfection before initial start-up or any shut-down period of more than 1 month, and at intervals not exceeding 6 months.

29 Describe how you will address the risk in the response column.

30 Describe how and when you will reduce the temperature in the response column.

31 Describe how you will address the risk in the response column.

32 Use this row to describe other risks and response strategies that relate to these risks.

33 Refer to Table 3 in Section 7.2.2 of this guide to find the scenario that matches your system, to evaluate the risk from your system associated with nutrient growth.

Poor water quality

Risk control strategy for poor water quality	Assessment of the cooling tower system	Operational or tower system improvement response ³⁴
Ensure comprehensive water treatment program	Do you use two or more biocides in some form of rotation? <input type="checkbox"/> Yes <input type="checkbox"/> No ³⁵	
	Is the system continuously treated with a biocides? <input type="checkbox"/> Yes <input type="checkbox"/> No ³⁶	
	Do you use a biocides that is compatible with the other chemicals in use (including chlorine) during the disinfection, cleaning and re-disinfection process? <input type="checkbox"/> Yes <input type="checkbox"/> No ³⁷	
	Do you treat the water with anticorrosion chemicals? <input type="checkbox"/> Yes <input type="checkbox"/> No ³⁸	
	Have you developed performance indicators that are frequently measured to confirm that the water chemistry is under control? <input type="checkbox"/> Yes ³⁹ <input type="checkbox"/> No ⁴⁰	
Test for HCC	How frequently do you test for HCC?	
Test for <i>Legionella</i>	How frequently do you test for <i>Legionella</i> ? ⁴¹	
Manage HCC	What HCC do you allow before you take remedial action? <input type="checkbox"/> 200,000 CFU/mL <input type="checkbox"/> Less than 200,000 CFU/mL ⁴²	
Respond to high HCC results	How do you respond to a high HCC test result? <input type="checkbox"/> We follow Figure A1 ⁴³ <input type="checkbox"/> We follow Figure A2 ⁴⁴ <input type="checkbox"/> We follow our own response plan ⁴⁵	

34 Indicate the operational program or improvements you will put in place as a result of this assessment.

35 Use of two biocides is recommended, to minimise the risks of bacteria becoming resistant to the biocide.

36 The Public Health and Wellbeing Regulations 2009 require that the system is continuously treated with a biocides.

37 The Public Health and Wellbeing Regulations 2009 require the use of a chlorine-compatible biocides as part of the disinfection, cleaning and re-disinfection process, which is required (as a minimum) before initial startup or any shut-down period of more than 1 month, and at intervals not exceeding 6 months.

38 The Public Health and Wellbeing Regulations 2009 require treatment of the cooling tower system water with chemicals or other agents to minimise corrosion.

39 Describe these in the response column.

40 Monitoring of performance indicators can increase your confidence that the system is under control and can provide early warning when it is not. Describe how you will address the risk in the response column.

41 The Department of Health and Human Services recommends that every cooling tower system be tested regularly for *Legionella*, as per Section 8.4 of this guide. The Public Health and Wellbeing Regulations 2009 require a minimum of quarterly testing for *Legionella*.

42 If you use a lower number than 200,000 CFU/mL, provide the number in the response column.

Risk control strategy for poor water quality	Assessment of the cooling tower system	Operational or tower system improvement response ³⁴
Respond to the detection of <i>Legionella</i>	How do you respond to <i>Legionella</i> being detected in a sample? ⁴⁶ <input type="checkbox"/> We follow Figure A3 ⁴⁷ <input type="checkbox"/> We follow another plan that still meets the requirements of the Regulations ⁴⁸	
Respond to the detection of <i>Legionella</i> on two or more occasions within a 12-month period	How do you respond to <i>Legionella</i> being detected in a sample on two or more occasions during a 12-month period ⁴⁹ ? <input type="checkbox"/> The RMP is reviewed, in addition to the required actions (refer to Figure A3) <input type="checkbox"/> Other (provide details)	
Label the cooling tower system	Is the cooling tower and cooling tower system labelled with the CTS number? <input type="checkbox"/> Yes ⁵⁰ <input type="checkbox"/> No ⁵¹	
Ensure appropriate bleed-off rates to prevent a build-up of solids	Is an automated bleed-off device installed? ⁵² <input type="checkbox"/> Yes <input type="checkbox"/> No ⁵³	
Install automated biocide dosing device	Do you have an automated biocide dosing device? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁵⁴	
Install automated dosing devices for all chemicals and agents	Do you have automated dosing devices for all chemicals and agents? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁵⁵	
Select an appropriate point for chemical dosing	Does the chemical dosing occur well away from the sampling point for bacterial tests? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁵⁶	
Provide a dedicated water sampling point	Are water samples always taken from the same point? <input type="checkbox"/> Yes <input type="checkbox"/> No	
	If 'Yes', is that point clearly labelled with the CTS number? ⁵⁷ <input type="checkbox"/> Yes <input type="checkbox"/> No	
	Has a sampling tap been fitted? <input type="checkbox"/> Yes <input type="checkbox"/> No	

46 The Public Health and Wellbeing Regulations 2009 require that action is taken following the detection of *Legionella*.

47 This refers to Figure A3 in Appendix 4, which summarises aspects of the requirements of the Public Health and Wellbeing Regulations 2009.

48 Detail the process that you will follow in the response column.

49 Section 92(2) of the Public Health and Wellbeing Act 2008 requires the owner of the land to take all reasonable steps to ensure that the RMP is reviewed, and if necessary updated, if *Legionella* is detected in the cooling tower system on two or more occasions in any period of 12 months.

50 Describe where the label appears on the system in the response column. The department recommends that you use a system where a tower is labelled with the CTS number (e.g. '1234') followed by a slash and then a number or other identifying mark to describe the tower (e.g. '1234/1' would designate Tower 1 of system 1234).

51 Describe in the response column how you will deal with the risk of confusion about which tower or system is being referred to in service reports or laboratory test results (among other things).

52 Best practice is the use of conductivity-controlled meters fitted with lock-out devices to prevent excessive loss of chemicals during the bleed-off process.

53 Describe how you will address the risk of poor water quality in the response column.

54 Best practice is the use of electronic, programmable, automated dosing units. Describe how you will address the risks of biocide failure in the response column.

55 Best practice is the use of electronic, programmable, automated dosing units. Describe how you will address the risks of inadequate chemical dosing in the response column.

56 You should modify your sampling program to ensure that you are getting representative results.

57 This number is printed on your Certificate of Registration.

Risk control strategy for poor water quality	Assessment of the cooling tower system	Operational or tower system improvement response ³⁴
Install a side-stream filter if environment is dirty	Is the environment around the tower dirty? <input type="checkbox"/> Yes <input type="checkbox"/> No	
	If 'Yes', do you have a side-stream filter? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁵⁸	
Other ⁵⁹		

CFU = colony forming unit; CTS = cooling tower system; HCC = heterotrophic colony count

Risk classification for poor water quality ⁶⁰	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
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58 Describe how you will address the risk in the response column.

59 Use this row to describe other risks and response strategies that relate to these risks.

60 Refer to Table 3 in Section 7.2.2 of this guide to find the scenario that matches your system, to evaluate the risk from your system associated with poor water quality.

Deficiencies in the cooling tower system

Risk control strategy for deficiencies in the cooling tower system	Assessment of the cooling tower system	Operational or tower system improvement response ⁶¹
Review the system design against AS/NZS 3666	Has a review been conducted? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁶²	
	Can any improvements be made to the system design to reduce risks? <input type="checkbox"/> Yes ⁶³ <input type="checkbox"/> No ⁶⁴	
Review current performance of system	Has a review been conducted? <input type="checkbox"/> Yes ⁶⁵ <input type="checkbox"/> No ⁶⁶	
Develop operating and maintenance manuals	Have operating and maintenance manuals been developed? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁶⁷	
Review the useful life of the system and plan to replace it at an appropriate time	When was the tower built?	
	Do you have a program to replace it? <input type="checkbox"/> Yes ⁶⁸ <input type="checkbox"/> No ⁶⁹	
Install a modern, high-efficiency drift eliminator	Is a modern, high-efficiency drift eliminator fitted to every tower in the system? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁷⁰	
	Are the drift eliminators in good condition? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁷¹	
	Have the drift eliminators been certified by the manufacturer as meeting AS/NZS 3666? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁷²	
Use suitable materials for external components	Have you reviewed the condition of the tower structure? <input type="checkbox"/> Yes ⁷³ <input type="checkbox"/> No ⁷⁴	

61 Indicate the operational program or improvements you will put in place as a result of this assessment.

62 Describe how you will address the risk in the response column.

63 Describe the improvements in the response column.

64 Describe how you will address the risk in the response column.

65 Describe the improvements in the response column.

66 Without a review, it is impossible to complete a proper risk assessment. Describe how you will address the risks without the review in the response column.

67 Describe how you will address the risks in the response column.

68 Describe when you plan to replace the system in the response column.

69 Describe how you will address the risks in the response column.

70 Describe how you will address the risk of excessive drift leaving the towers in the response column (e.g. by installing a drift eliminator that complies with AS/NZS 3666).

71 Describe how you will address the risk of excessive drift leaving the towers in the response column (e.g. by installing a drift eliminator that complies with AS/NZS 3666).

72 Describe how you will address the risk of excessive drift leaving the towers in the response column (e.g. by installing a drift eliminator that complies with AS/NZS 3666).

73 Describe the improvements in the response column.

74 Describe how you will address the risk in the response column.

Risk control strategy for deficiencies in the cooling tower system	Assessment of the cooling tower system	Operational or tower system improvement response ⁶¹
Use suitable materials for internal components	Have you reviewed the materials and condition of the internal components of the tower system? <input type="checkbox"/> Yes ⁷⁵ <input type="checkbox"/> No ⁷⁶	
Other ⁷⁷		
Risk classification for deficiencies in the cooling tower system ⁷⁸ <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		

75 Describe the improvements in the response column.

76 Describe how you will address the risk in the response column.

77 Use this row to describe other risks and response strategies that relate to these risks.

78 Refer to Table 3 in Section 7.2.2 of this guide to find the scenario that matches your system, to evaluate the risk from your system associated with deficiencies in the cooling tower system.

Location and access

Risk control strategy for location and access	Assessment of the cooling tower system	Operational or tower system improvement response ⁷⁹
Understand the extent of potential exposure to the cooling tower	Is the cooling tower system located in an acute health or aged residential care facility? <input type="checkbox"/> Yes ⁸⁰ <input type="checkbox"/> No	
	If 'No', is the cooling tower system located within 500 m of an acute health or aged residential care facility? <input type="checkbox"/> Yes ⁸¹ <input type="checkbox"/> No	
Minimise access to tower and surrounds	How many people have access to the tower and its surrounds? ⁸² <input type="checkbox"/> Very high numbers ⁸³ <input type="checkbox"/> High numbers ⁸⁴ <input type="checkbox"/> Moderate numbers ⁸⁵ <input type="checkbox"/> Low numbers ⁸⁶	
	Are warning signs ⁸⁷ displayed around the tower? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁸⁸	
	Is the area around the cooling tower system used as a gathering place for staff and visitors, particularly smokers? <input type="checkbox"/> Yes ⁸⁹ <input type="checkbox"/> No	
	Is access to the tower restricted? <input type="checkbox"/> Yes <input type="checkbox"/> No ⁹⁰	
Relocate the tower to a more remote site or less contaminated environment (where possible)	Have you reviewed whether it is possible to relocate the tower to a safer location? <input type="checkbox"/> Yes ⁹¹ <input type="checkbox"/> No ⁹²	

79 Indicate the operational program you will put in place as a result of this assessment.

80 Classify as risk category A and respond with the highest standards of maintenance and surveillance.

81 Classify as risk category B (at the minimum) and respond with high standards of maintenance and surveillance.

82 Consider the surroundings within 500 m of the cooling tower

83 Refer to Figure 10 of this guide.

84 Refer to Figure 10 of this guide.

85 Refer to Figure 10 of this guide.

86 Refer to Figure 10 of this guide.

87 For example, 'Authorised persons only'.

88 Describe in the response column how you will address the risks without such signs.

89 Describe in the response column how you will address the risk of smokers being in close proximity to the cooling tower.

90 Describe in the response column how you will address the risks until access to the tower has been restricted.

91 Describe outcomes of the review in the response column.

92 Describe in the response column how you will address the risk of location and access without such a review.

Risk control strategy for location and access	Assessment of the cooling tower system	Operational or tower system improvement response ⁷⁹
Ensure that there is a safe and stable area for maintenance workers to access the cooling tower system	Have you reviewed the working environment for maintenance workers? ⁹³ <input type="checkbox"/> Yes ⁹⁴ <input type="checkbox"/> No ⁹⁵	
Other ⁹⁶		
Risk classification for location and access ⁹⁷		<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D

Risk assessment summary

Critical risk	Risk classification ⁹⁸
Stagnant water	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D
Nutrient growth	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D
Poor water quality	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D
Deficiencies in the cooling tower system	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D
Location and access	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D
Are there any other considerations that may affect the overall risk assessment of the cooling tower system?	
Overall cooling tower system risk classification category	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D

93 This is a key area in terms of meeting your responsibilities under the Occupational Health and Safety Act.

94 Describe in the response column the outcomes of the review (e.g. any actions to be taken).

95 Describe in the response column how you will address the risks without such a review.

96 Use this row to describe other risks and response strategies that relate to these risks.

97 Refer to Table 3 in Section 7.2.2 of this guide to find the scenario that matches your system, to evaluate the risk from your system associated with location and access.

98 Tick the appropriate box based on your responses to the questions in Table 3 in Section 7.2.2 of this guide.

Attachments⁹⁹

Operational program

Recommended operational programs based on risk classification

Program A	Program B	Program C	Program D
Weekly inspection	Monthly inspection (2 weeks after service)	Monthly inspection (2 weeks after service)	Monthly service
Fortnightly service	Monthly service	Monthly service	
HCC and <i>Legionella</i> tested at a minimum of once each month	HCC and <i>Legionella</i> tested monthly	HCC tested monthly <i>Legionella</i> tested every 2 months	HCC tested monthly <i>Legionella</i> tested every 3 months
Six monthly cleaning, or more frequently where environmental contamination (e.g. dust, soil, building works) is a problem			

HCC = heterotrophic colony count

Element	Response
Describe your maintenance program	<input type="checkbox"/> Department of Health and Human Services program A
	<input type="checkbox"/> Department of Health and Human Services program B
	<input type="checkbox"/> Department of Health and Human Services program C
	<input type="checkbox"/> Department of Health and Human Services program D
	<input type="checkbox"/> Self-developed
	<input type="checkbox"/> Developed by consultant
If self-developed or developed by consultant, complete remainder of table	
Service frequency	<input type="checkbox"/> Weekly
	<input type="checkbox"/> Fortnightly
	<input type="checkbox"/> Monthly
HCC testing frequency	<input type="checkbox"/> Monthly <input type="checkbox"/> Every week(s)
<i>Legionella</i> testing frequency	<input type="checkbox"/> Every 3 months <input type="checkbox"/> Every weeks/months
Tower cleaning frequency	<input type="checkbox"/> Every 6 months <input type="checkbox"/> Every months
Inspection frequency	<input type="checkbox"/> Every weeks/months

99 Other information that can be appended to the RMP includes site plan, photographs, schematics of water flows, cooling tower makes and models, and basic system parameters (e.g. system volume, system heat rejection capacity, system operating temperature).

Monitoring and review

Element	Response
Date that the RMP is due for review	
Name and title of person responsible for the review	
Date that the RMP was reviewed	
Are all site and key contact details accurate? Has the Department of Health and Human Services been notified of any changes?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is the cooling tower system currently registered with the Department of Health and Human Services?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Does the RMP require amendment?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Was the review conducted as a result of a triggering event? ¹⁰⁰	
If the RMP requires amendment, dates that the amendments were due and completed	Due
	Completed

100 Under section 92(2) of the Public Health and Wellbeing Act 2008, the owner of the land must take all reasonable steps to ensure that the RMP is reviewed and, if necessary, updated, if:

- *Legionella* is detected in the cooling tower system on two or more occasions in any period of 12 months; or
- the owner of the land is given written advice by the Secretary of the Department of Health and Human Services that a case of Legionnaires' disease is associated with the cooling tower system; or
- the owner of the land receives a report from the Secretary, any person engaged by the owner of the land or the owner of the cooling tower system that control measures used for the cooling tower system are inadequate or require improvement; or
- there is a significant change in
- any of the environmental conditions under which the cooling tower system operates; or
- the operation of the cooling tower system; or
- the owner of the land receives an audit certificate that states that the RMP does not address the prescribed risks.

Communication

Element	Details			
	Category	Name and title	Telephone	Comment
List parties (names and contact details) who will be informed in the event of a positive <i>Legionella</i> test	Staff			
	Occupational health staff or contractors			
	Unions			
	Building owner			
	Other building occupiers			
	Medical officer			
	Staff counsellors			
	Department of Health and Human Services <i>Legionella</i> Team		1800 248 898 or email legionella@health.vic.gov.au	
	Media liaison officer			
	Company spokesperson			
	Chief executive			
	Other (specify)			

Endorsement of risk management plan

Name and position of person responsible for risk management plan	
Signature	Date

Appendix 2 Responsibilities of stakeholders

Stakeholder	Responsibility
Landowner	<ul style="list-style-type: none"> • Register all cooling tower systems on the land • Take all practicable steps to ensure that an RMP is developed for all cooling tower systems • Take all practicable steps to ensure that the RMPs reviewed annually • Take all practicable steps to ensure that the RMP is audited annually for all cooling tower systems • Ensure that reasonable steps are being taken to minimise the risks
System owner	<ul style="list-style-type: none"> • Allocate sufficient resources to manage the risks of <i>Legionella</i> • Ensure that the Public Health and Wellbeing Regulations 2009 are complied with
System manager	<ul style="list-style-type: none"> • Ensure that the Public Health and Wellbeing Regulations 2009 are complied with • Manage contracts that relate to the system • Ensure that any reports from contractors requiring action are actioned promptly • Report to senior management any requirements for capital expenditure • Ensure that reasonable steps are taken to minimise the risks
Property manager	<ul style="list-style-type: none"> • Manage contracts that relate to the system • Ensure that any reports from contractors requiring action are actioned promptly • Report to the client any requirements for capital expenditure, and any significant public health or safety issues
Property maintenance contractor	<ul style="list-style-type: none"> • Manage contracts that relate to the system • Ensure that any reports from contractors requiring action are actioned promptly • Report to the client any requirements for capital expenditure, and any significant public health or safety issues
Mechanical services maintenance contractor	<ul style="list-style-type: none"> • Manage contracts that relate to the system • Ensure that any reports from contractors requiring action are actioned promptly • Report to the client any requirements for capital expenditure, and any significant public health or safety issues
Water treatment provider	<ul style="list-style-type: none"> • Comply with the Public Health and Wellbeing Regulations 2009 • Provide advice to clients on water treatment issues • Treat water to minimise risks of <i>Legionella</i> growth
RMP consultant	<ul style="list-style-type: none"> • Perform a comprehensive risk assessment that identifies risks to the client and recommends corrective actions to minimise these risks • Ensure that the draft RMP meets legal requirements for client acceptance
Cooling tower supplier	<ul style="list-style-type: none"> • Confirm that tower meets AS/NZS 3666
Cooling tower system designer	<ul style="list-style-type: none"> • Ensure that the system meets AS/NZS 3666, and reduces risks of 'dead legs' and <i>Legionella</i> growth in general

RMP = risk management plan

Appendix 3 Decommissioning a cooling tower system

Where an existing cooling tower system is no longer required, the following actions should be taken:

- Drain the cooling tower system to the sewer, in accordance with any advice from the local water authority.
- Remove chemical dosing tanks.
- Disconnect the power supply to the system.
- Disconnect the water supply to the system.
- Remove the tower and preferably the other components of the system. Where this is not practical, place a sign on the tower indicating that the system must not be reactivated.

The Department of Health and Human Services must be notified within 30 days that a cooling tower system has been decommissioned. This can be done using a form that is available on the department's website (www.health.vic.gov.au/legionella).

Appendix 4 Model operational program

Scope of work

The maintenance program includes:

- treatment of the cooling tower system for control of corrosion, scale formation and fouling, and to minimise microbiological growth (ensuring that it remains at safe levels)
- testing of the water for heterotrophic colony count (HCC) (also called total bacteria or total plate count)
- testing of the water for *Legionella*
- monitoring of the cooling tower system structure itself to ensure that the cooling tower equipment is operating effectively, and that the cooling tower system is safe and free from hazards.

Chemical program

The chemical program must incorporate use of:

- a corrosion and scale inhibitor
- at least one biocide (preferably two, used in rotation)
- a biodispersant to help remove any biofilm in the system.

Bacterial testing

Bacterial testing is required as follows.

Heterotrophic colony count

- Sampling for HCC in accordance with AS/NZS 3666.3 for sample collection, and AS 2031 for selection of containers and preservation of water samples for microbiological testing.
- Analysis of water samples for HCC in accordance with AS 4276.3 by a laboratory accredited by the National Association of Testing Authorities.
- Analysis commenced within 24 hours of the sample being taken.¹⁰¹

Legionella

- Sampling for *Legionella* in accordance with AS/NZS 3666.3 for sample collection, and AS 2031 for selection of containers and preservation of water samples for microbiological testing.
- Transport of the samples to the laboratory as soon as possible.
- Testing for *Legionella* by a laboratory in accordance with AS/NZS 3896 (*Waters – Examination for Legionella spp. including Legionella pneumophila*) by a laboratory accredited by the National Association of Testing Authorities.

¹⁰¹ In some remote areas, it is not always possible to achieve this objective, but analysis must still take place in the shortest practicable time. Contact should be made with the testing laboratory to determine the best transport option.

Reporting

Reporting of all results must include:

- for any results that exceed the limits set by legislation or this contract (whichever is more stringent), immediate notification by fax or email,¹⁰² and a follow-up telephone call to confirm receipt
- emailing of a copy of all results¹⁰³
- availability to discuss results, either by telephone or on-site, as appropriate.

Poor results

The Public Health and Wellbeing Regulations 2009¹⁰⁴ specify the following with regard to HCC:

1. Within 24 hours of receiving a report from a laboratory that any sample of water taken from the cooling tower system has a heterotrophic colony count exceeding 200,000 colony forming units per millilitre, the responsible person must ensure that the following procedure is implemented:
 - a. the water of the system must be manually treated with additional quantities of biocide or with an alternative biocide; and
 - b. the water treatment program, tower operation and maintenance program of the system must be reviewed; and
 - c. any faults must be corrected; and
 - d. any changes necessary to prevent a re-occurrence of those faults must be implemented.
5. Between 2 and 7 days after the water has been treated under subregulation (1), the responsible person must ensure that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count.
6. Within 24 hours of receiving a report from a laboratory that a sample taken in accordance with subregulation (2) has a heterotrophic colony count exceeding 200,000 colony forming units per millilitre, the responsible person must ensure that the water of the cooling tower system is disinfected.
7. Between 2 and 7 days after the water has been disinfected under subregulation (3), the responsible person must ensure that a further sample of the recirculating water of the cooling tower system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count.
8. If, after following the procedure in subregulations (1), (2), (3) and (4), the heterotrophic colony count still exceeds 200,000 colony forming units per millilitre, the responsible person must:
 - a. ensure that the steps in subregulations (3) and (4) are repeated until the heterotrophic colony count does not exceed 200,000 colony forming units per millilitre in 2 consecutive water samples taken approximately one week apart; or
 - b. close the cooling tower system until the problem has been remedied.

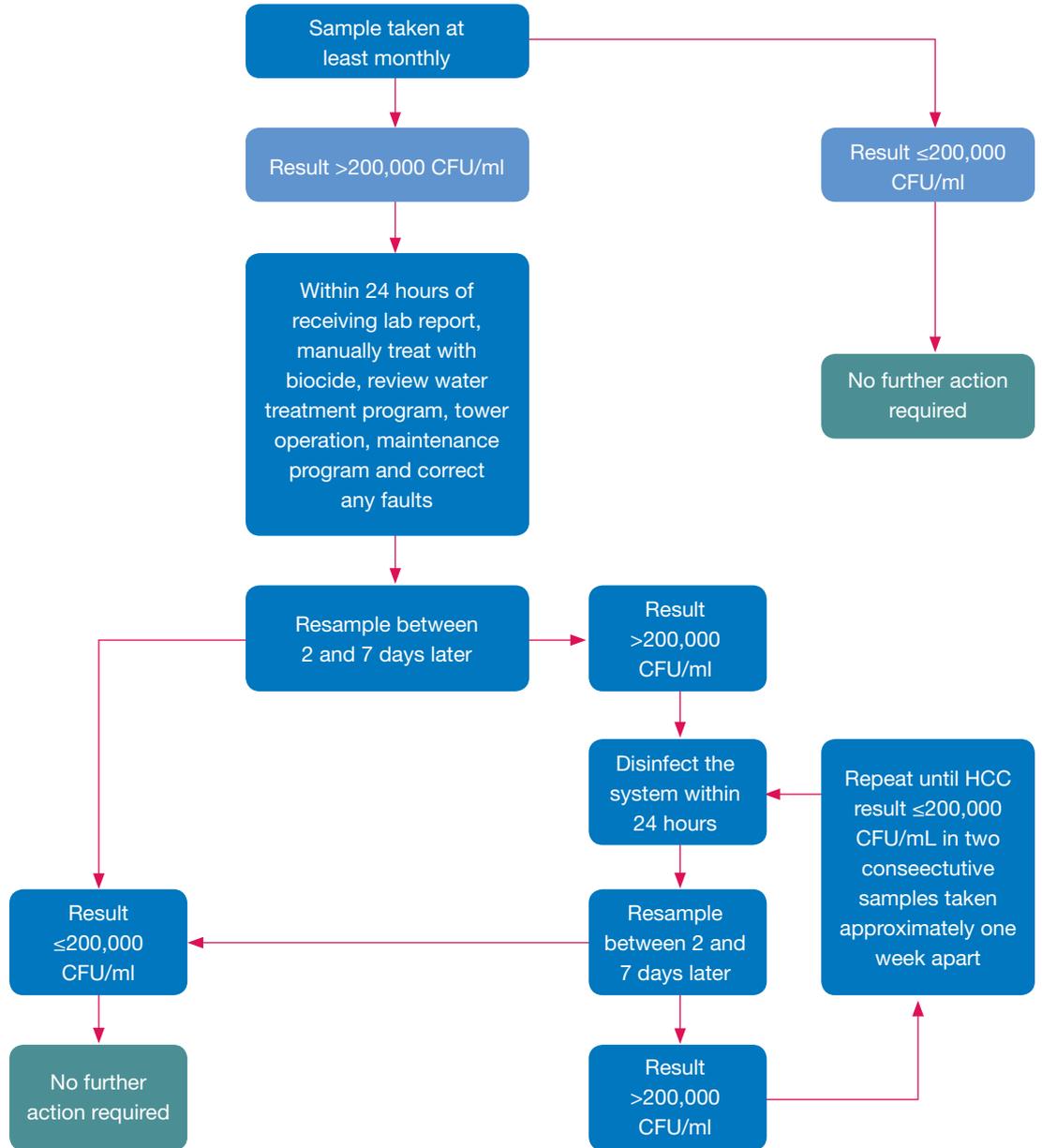
These Regulations are summarised in Figure A1.

¹⁰² Where the sampling and maintenance have been outsourced to one company that then subcontracts to another company for microbiological analysis, it is important that you obtain a copy of the testing laboratory's results rather than a report from the maintenance contractor.

¹⁰³ Where available

¹⁰⁴ Regulation 57

Figure A1: Standard HCC sampling and response

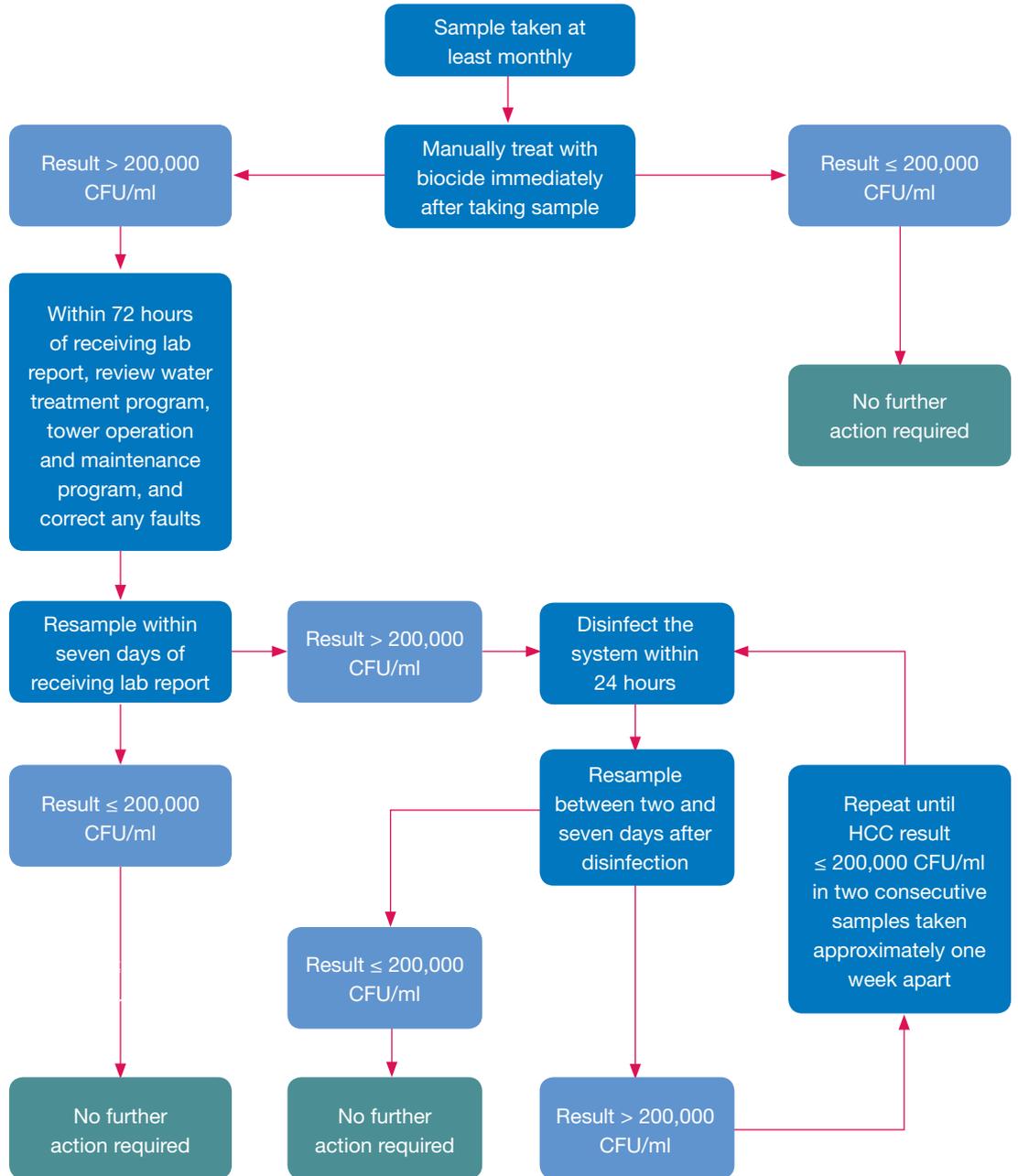


The Regulations further state:

1. The responsible person is not required to comply with subregulations (1) to (5) if:
 - a. during the period between the sample being taken for the purpose of regulation 56(2) and the receipt of a report from a laboratory indicating that the cooling tower system has a heterotrophic colony count exceeding 200,000 colony forming units per millilitre, the system was manually treated with additional quantities of biocide or an alternative biocide; and
 - b. within 72 hours of receiving the report that any sample of water taken from the cooling tower system has a heterotrophic colony count exceeding 200,000 colony forming units per millilitre, the responsible person—
 - reviews the water treatment program, tower, operation and maintenance program; and
 - corrects any faults and makes changes necessary to prevent a re-occurrence of those faults; and
 - c. within 7 days of receiving the report in subregulation (6)(b), the responsible person ensures that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count;
 - d. within 24 hours of receiving a report that a sample taken in accordance with subregulation (6)(c) has a heterotrophic colony count exceeding 200,000 colony forming units per millilitre, the responsible person –
 - ensures the water in the cooling tower system is disinfected; and
 - between 2 and 7 days after the water has been disinfected in accordance with paragraph (i), ensures that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count;
 - e. after following the procedure in subregulation (6)(d) the heterotrophic colony count continues to exceed 200,000 colony forming units per millilitre, the responsible person –
 - ensures the steps in subregulation (6)(d) are repeated until the heterotrophic colony count does not exceed 200,000 colony forming units per millilitre in 2 consecutive water samples taken approximately one week apart; or
 - closes the cooling tower system until the problem has been remedied.

These Regulations are summarised in Figure A2.

Figure A2: Alternative HCC sampling and response



The Public Health and Wellbeing Regulations 2009¹⁰⁵ specify the following with regard to *Legionella*:

1. Within 24 hours of receiving a report that *Legionella* has been detected in a water sample taken from a cooling tower system, the responsible person must ensure that the following procedure is implemented :
 - a. the cooling tower system must be disinfected; and
 - b. the water treatment program, tower operation and maintenance programs of the system must be reviewed; and
 - c. any faults must be corrected and any changes necessary to prevent a re-occurrence of those faults must be implemented.
4. Between 2 and 7 days after the disinfection required by subregulation (1)(a) has been completed, the responsible person must ensure that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for *Legionella*.
5. Within 24 hours of receiving a report that *Legionella* has been detected in a sample taken in accordance with subregulation (2), the responsible person must ensure that the water of the cooling tower system is disinfected, cleaned and re-disinfected.¹⁰⁶
6. Between 2 and 7 days after the disinfection required by subregulation (3) has been completed, the responsible person must ensure that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for *Legionella*.
7. If, after following the procedure in subregulations (1), (2), (3) and (4), *Legionella* is still detected, the responsible person must:
 - a. ensure that the steps in subregulations (3) and (4) are repeated until *Legionella* is not detected in 2 consecutive water samples taken approximately one week apart; or
 - b. close the cooling tower system until the problem has been remedied.

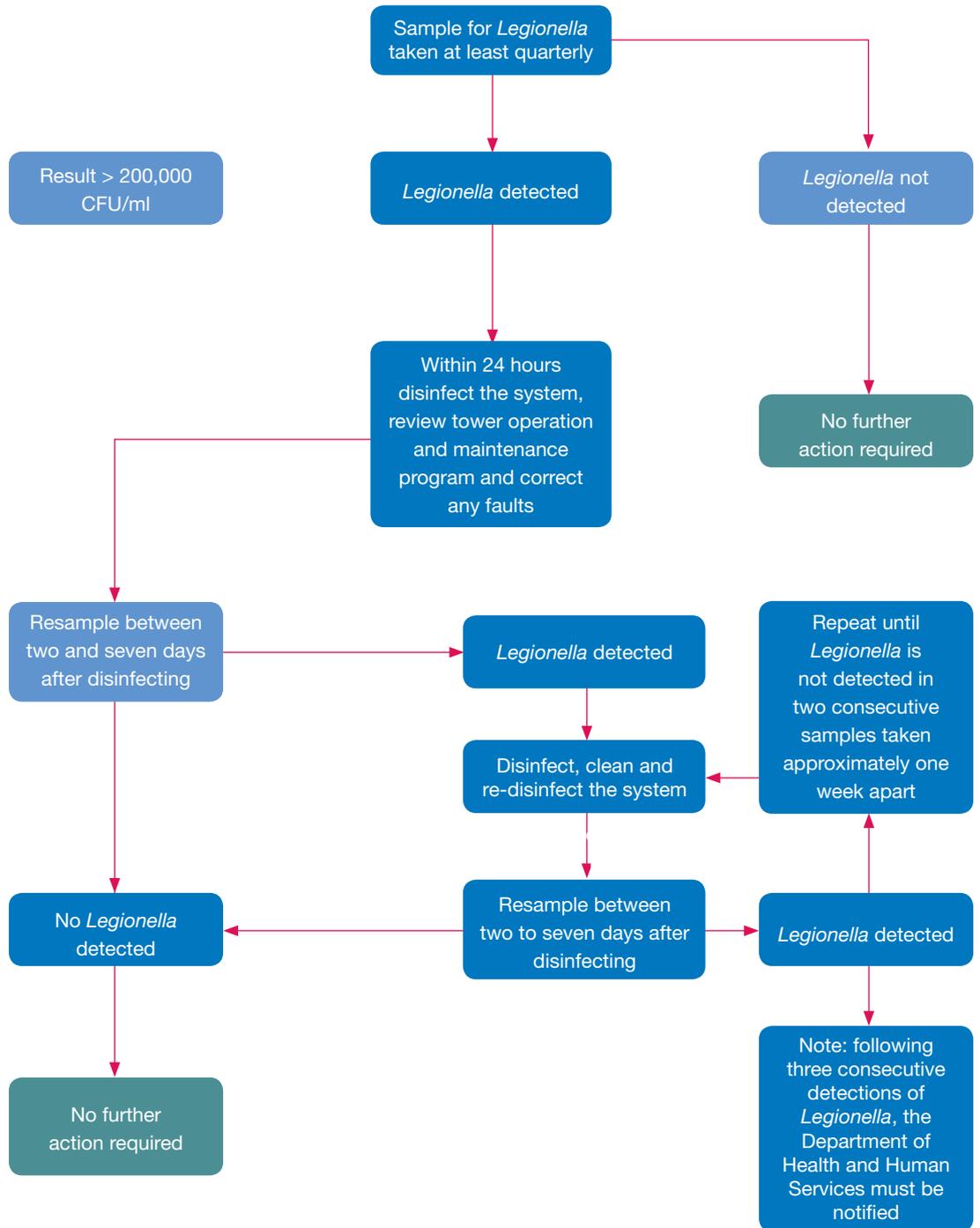
These Regulations are summarised in Figure A3.

1. If, while following the procedure in this regulation *Legionella* is detected in 3 consecutive water samples taken from the same system, the responsible person must notify the Secretary of the detection of the presence of that organism:
 - a. immediately by telephone; and
 - b. by notice in writing within 3 days.

105 Regulation 58

106 A chlorine-compatible biocidal dispersant must be added to the recirculating water, and the system must then be disinfected by dosing the water with a chlorine-based biocide, equivalent to 10 mg/L of free chlorine for at least 1 hour, while maintaining a pH of between 7.0 and 7.6. A bromine-based compound may be used equivalent to at least 20 mg/L of free bromine for at least 1 hour, while maintaining the pH of the water between 7.0 and 8.5.

Figure A3: *Legionella* sampling and response



Service frequency

The service frequency shall be as specified in the operational plan.

The service shall ensure that:

- water quality is checked
- chemical dosing tanks are refilled
- empty tanks are removed from the site
- dosing and control equipment is checked, and is operating correctly; if problems are observed, remedial action will be taken to fix the problem
- the wetted components will be inspected, and the general integrity of the system (including cleanliness) will be checked; action will be taken to remedy any problems.¹⁰⁷

In addition to the service frequency, the corrosion coupons (metal test plates) will be checked every 3 months for signs of corrosion. The corrosion coupons must be of the same types of metal as those used in the cooling tower system, and are to be immersed in the system water and checked as above.¹⁰⁸

All samples of water to be taken for bacterial testing (HCC and/or *Legionella*) must be taken before any addition of chemicals.

Tower cleaning

Tower cleaning shall be in accordance with the operational program.¹⁰⁹

The tower cleaning process should be as follows:

3. Thoroughly clean the internal shell, fill and tower sump by brushing and/or hosing all surfaces.
4. Remove all debris.
5. Thoroughly clean internally and externally all water filters, strainers, separators, water nozzles and fittings associated with the water distribution system.

Service report

A service report must be completed at the time of each visit, detailing all test results, observations and actions taken, including repairs, maintenance and testing work. The information to be provided as a minimum following each visit is shown in Appendix 6.

A copy of the service report¹¹⁰ is to be provided to the responsible person, and any points of significance are to be discussed with the contract manager.

¹⁰⁷ Insert other requirements

¹⁰⁸ You may need to seek independent specialist advice about the risk of corrosion in your system and the best ways to control and monitor it.

¹⁰⁹ Insert desired cleaning frequency (e.g. 6-monthly).

¹¹⁰ The Public Health and Wellbeing Regulations require the responsible person for the cooling tower system to keep records of all microbiological test results, as well as maintenance and corrective activities undertaken in relation to the system during the preceding 12 months. These records must be produced for inspection at the request of authorised officers from the Department of Health and Human Services. Electronic record keeping is becoming more popular, and the department considers this to meet the requirement of the Regulations, provided that these records can be produced on request.

Appendix 5 Routine inspection of a cooling tower system

A routine inspection by a competent person as described in this guide should include checks of:

- power supply
- connection and integrity of chemical dosing lines
- water clarity
- levels of dosing chemicals within tanks
- performance indicators, such as chemical parameters
- obvious visible corrosion
- obvious physical defects or damage
- pump operation.

Appendix 6 Model service report

At a minimum, the written service report should include the following components:

- Date of service or inspection.
- Identification of the cooling tower system.
- Identification of particular towers.
- Name of the person and organisation conducting the inspection or service.
- Type, make and model of the cooling tower(s).
- Water storage volumes for dosing calculations.
- Details of the inspection – for example, what was the purpose and scope?
- Details of any actions, such as:
 - any chemicals added and their volumes
 - whether the bleed-off rate was checked
 - whether the tower(s) were cleaned
 - whether the cooling tower water was tested for chemical levels, and the results for key parameters such as pH
 - whether the cooling tower water was tested for bacteria – What tests were requested? What is the name of the laboratory? What were the results?

It is advisable for the desired or target range for each parameter to be listed as part of the result, and a statement (with comments, if required) provided of whether the test result was within the range.

Appendix 7 Key elements of a model service contract

Disclaimer

This document describes only the key elements that should be considered in a contract for treatment and servicing of a cooling tower system to manage the risk of *Legionella* infection. The precise terms and conditions of the contract – including its duration and price, and the conditions under which it may be terminated – will need to be determined by the contracting parties themselves. The document is not intended to replace the need for contracting parties to obtain their own specialist commercial or legal advice.

Introduction

This specification deals with best-practice management of corrosion and microbiological control for *(insert name of company)*.

The service required will include the supply of chemicals and services for treatment of the cooling tower at *(insert address of site)*. This includes full cleaning of the tower, including disinfection.

The attached plan shows the cooling tower systems covered by the contract and the piping layout for the system.

Scope of work

The contractor shall supply all necessary chemicals and provide all necessary technical services to:

- maintain the cooling tower in accordance with the attached maintenance schedule
- ensure that our staff, contractors and the public are not affected by water treatment maintenance or the operation of the cooling tower
- meet all occupational health and safety obligations
- note and report any mechanical faults associated with the cooling tower to the contract manager.

Quarterly meetings

The contractor shall attend a meeting each quarter with the contract manager to:

- review compliance with Australian Standards AS/NZS 3666, AS 2031, AS 4276.3.1 and AS/NZS 3896, and legislation (including the Public Health and Wellbeing Regulations 2009)
- discuss the performance of the cooling tower and the contractor, including any works program that may be required.

Indicators

The contractor shall ensure that:

- the heterotrophic colony count complies with the Public Health and Wellbeing Regulations 2009 in at least 95% of tests over a 12-month period, and that *Legionella* is not detected in any samples
- corrosion is at low levels – no visible signs of corrosion should be present¹¹¹
- chemical control is maintained in accordance with an agreement to be reached before the commencement of the contract. The ranges in the table below are provided for guidance.

¹¹¹ You may need to seek engineering advice about an acceptable rate of corrosion for your business operation.

Indicative water quality target ranges	
Bacteria	
<i>Legionella</i>	Not detected (<10 CFU/mL)
Heterotrophic colony count	Less than 200,000 CFU/mL
Solids	
Total dissolved solids	Less than 1,000 mg/L
Conductivity	Less than 1,500 µS/cm
Suspended solids	Less than 150 mg/L
Calcium hardness	Less than 180 mg/L
pH	
pH (for bromine-based compounds)	7–8.5
pH (for chlorine-based compounds)	7–7.6
Total alkalinity	80–300 mg/L
Other additives	
Biodispersant	Follow the manufacturer's specifications
Corrosion inhibitor	Follow the manufacturer's specifications

CFU = colony forming units

Where the results of testing do not meet the requirements of the Public Health and Wellbeing Regulations 2009, the contractor must immediately notify the contract manager.

Occupational health and safety

The contractor is responsible for the safety of its employees while on-site, in all matters over which the contractor has control. All equipment brought on site by the contractor or its employees must fulfil the requirements of occupational health and safety legislation.

Quality assurance

The contractor shall have a formal quality assurance system in place and provide evidence that the quality assurance system has been audited each year.

Insurance

The contractor shall have both professional indemnity and public risk insurance in place for the supply of services for the term of this contract. The contractor shall provide an annual confirmation of the continued existence of the policies.¹¹²

¹¹² The level of insurance should address the worst-case scenario where the cooling tower is demonstrated to have been the source of an outbreak of Legionnaires' disease.

Appendix 8 Model procedure following *Legionella* being detected in a cooling tower system

Background

The Public Health and Wellbeing Regulations 2009 require cooling tower systems to be continuously and effectively treated with one or more biocides to effectively control the growth of microorganisms, including *Legionella*.

Cooling tower systems should also be continuously treated with chemicals and other agents to minimise scale formation, corrosion and fouling, and with a biodispersant.

{...responsible person...} is responsible for the operation of the cooling tower system within **{...company name...}**. If he/she is unavailable, **{...emergency contact...}** is to be contacted.

{...water treatment provider...} is employed to undertake the maintenance, cleaning and bacterial testing of the cooling tower system.

If *Legionella* is detected, **{...water treatment provider...}** will telephone or email **{...responsible person...}** with the initial results, and then send a written report with the results of heterotrophic colony count (HCC) and *Legionella* tests by email.

Phone numbers:

Responsible person:

Emergency contact:

Water treatment provider:

Legionella detection

If *Legionella* is detected in a sample of water taken from the cooling tower system at **{site address}**, the following actions will be taken:

- {...responsible person...}** will contact the water treatment provider to arrange for the disinfection¹¹³ of the cooling tower system, and review¹¹⁴ the water treatment program, tower operation and maintenance program of the system. The water treatment provider will correct any faults identified within 24 hours of the *Legionella* notification.
{...responsible person...} will advise people in the manner described and listed in the table below, and continue to communicate with these stakeholders as the *Legionella* detection is addressed.
- {...responsible person...}** will arrange for **{...water treatment provider/other...}** to take a sample of water from the cooling tower system and submit it to the laboratory for *Legionella* testing between 2 and 7 days after the disinfection.

¹¹³ Disinfection of a cooling tower system is achieved by dosing the water of the system with:

- a chlorine-based compound, equivalent to at least 10 mg/L of free chlorine for at least 1 hour, while maintaining the pH of the water between 7.0 and 7.6; or
- a bromine-based compound, equivalent to at least 20 mg/L of free bromine for at least 1 hour, while maintaining the pH of the water between 7.0 and 8.5.

¹¹⁴ This review must be documented. It will usually involve the water treatment company and staff with expertise in the process.

If *Legionella* is detected in a second consecutive sample of water:

3. **{...responsible person...}** will arrange for the water treatment provider to clean the cooling tower system. This means that the cooling tower system will be disinfected, cleaned and re-disinfected.
4. **{...responsible person...}** will arrange for **{...water treatment provider/other...}** to take a sample of water from the cooling tower system and submit it to the laboratory for *Legionella* testing between 2 and 7 days after the clean.

If *Legionella* is detected after following the steps above:

5. **{...responsible person...}** will repeat steps 3 and 4 until *Legionella* is not detected in two samples taken approximately 1 week apart, or close the cooling tower system until the problem has been corrected.

If *Legionella* is detected in three consecutive water samples:

6. **{...responsible person...}** will notify the Department of Health and Human Services *Legionella* Team by calling 1800 248 898 immediately and by emailing Legionella@health.vic.gov.au within 3 days of receiving notification of the detection.

If **{responsible person}** is unavailable, **{emergency contact}** is to undertake the role of the responsible person.

Positive *Legionella* test notification list

Category	Name and position	Telephone	Responsibility for notification
Staff			To be advised by ... ¹¹⁵
Elected health and safety representatives			To be advised by
Occupational health staff/contractors			To be advised by
Unions			To be advised by
Building owner			To be advised by
Other building occupiers			To be advised by
Medical officer			To be advised by
Staff counsellors			To be advised by
Service contractors			
Neighbours of the site			
Customers			
Department of Health and Human Services, Legionell Team		1800 248 898	To be advised by
Local council	Environmental health officer		To be advised by
Media liaison officer			To be advised by
Company spokesperson			To be advised by
Chief executive			To be advised by

¹¹⁵ Once the decision to notify has been made, consideration must be given to the method of notification. This will work best where staff (in particular) have some understanding of the procedures for the cooling tower and the significance of test results, well in advance of notification of the adverse result.

Appendix 9 Model procedure for decontaminating a cooling tower system

Background

Decontamination may be required in cooling tower systems linked to a case or cases of Legionnaires' disease, as described in the Public Health and Wellbeing Regulations 2009.

Procedure

The following process is considered by the Department of Health and Human Services to meet the intent of the Regulations. Other processes can be used, provided that they meet the requirements of the Regulations.

1. Follow all relevant occupational health and safety procedures, including the use of personal protective equipment.
2. Cease any chemical treatment. Isolate any electrical equipment except the water treatment pump.
3. Add a low-foaming, chlorine-compatible biocide to the recirculating water.
4. Disinfect the system by dosing the water with either:
 - a chlorine-based compound, equivalent to at least 10 mg/L of free chlorine for at least 1 hour, while maintaining the pH of the water between 7.0 and 7.6, or
 - a bromine-based compound, equivalent to at least 20 mg/L of free bromine for at least 1 hour, while maintaining the pH of the water between 7.0 and 8.5.Add the disinfectant slowly, over 5–10 minutes, to a turbulent zone of the tower basin to promote its rapid dispersion. Use an anti-foaming agent if excessive foaming occurs.
5. Switch off equipment and drain cooling tower to waste in a manner approved by the local water authority. The entire cooling water system should be drained.¹¹⁶ Use of a wet vacuum cleaner can make it easier to remove waste material from the basin floor.
6. Refill with clean water and switch on the recirculating pump.
7. Repeat step 4, but maintain the specified concentrations for 3 hours. Then switch off the recirculating pump. Drain the cooling tower system to waste in a manner approved by the local water authority.
8. Inspect the drift eliminators, and clean, repair or replace them, as necessary. If the eliminators are moved, ensure that they are correctly installed on replacement. Suitable precautions should be taken to minimise the release of aerosols during cleaning operations.
9. Thoroughly clean the internal shell, fill and tower sump by brushing and gently hosing all surfaces. Remove all debris. Avoid damage to the tower and accessories during this operation.
10. Thoroughly internally clean all water filters, strainers, separators, water nozzles and fittings associated with the water distribution system.
11. Reassemble all components and hose with clean water.
12. Repeat step 4, but maintain the specified concentrations for 3 hours. Then switch off the recirculating pump. Drain the cooling tower system to waste in a manner approved by the local water authority.
13. Refill with clean water and switch on the recirculating pump.

¹¹⁶ Where this is not practicable, a very high bleed-off rate should be used during step 4. This will help to remove suspended particulate matter from the system and partially replace cooling water with clean make-up water.

14. Repeat step 4 if the water is not visually clear. Clean the water filters and strainers, and repeat step 13. Repeat this sequence until the water quality is satisfactory.
15. Immediately reinstate comprehensive effective water treatment, including use of biocide(s) and anticorrosives, and scale control.
16. Record all actions in the maintenance logbook.

Abbreviations

CFU	colony forming units
CTS number	cooling tower system number
the department	the Victorian Department of Health and Human Services
HCC	heterotrophic colony count
RMP	risk management plan

Glossary

Acute health or aged residential care facility

A place where acute health care is provided (such as a hospital) or aged residential care facilities (such as nursing homes or hostels).

Automated dosing device

A device that automatically discharges a measured amount of chemical to the water inside a cooling tower system.

Biocide

A physical or chemical agent capable of killing microorganisms, including *Legionella* bacteria.

Biodispersant

A chemical added to the water inside a cooling tower system, to penetrate and break down any biofilm that may be present on the wetted surfaces.

Biofilm

A surface layer of microorganisms. It is usually combined with particulate matter, scale and products of corrosion.

CFU/mL

Colony forming units per millilitre. The unit of measure of bacterial levels in a sample.

Cleaned

Cleaning if a cooling tower system involves the following steps:

1. Thoroughly clean the internal shell, fill and tower sump by brushing and/or hosing all surfaces.
2. Remove all debris.
3. Thoroughly clean internally and externally all water filters, strainers, separators, water nozzles and fittings associated with the water distribution system.

Cooling tower

A device for lowering:

- the temperature of recirculated water, by bringing the water into contact with fan-forced or fan-induced atmospheric air; or
- the temperature of water, a refrigerant or other fluid in a pipe or other container, by bringing recirculated water and fan-forced or fan-induced atmospheric air into contact with the pipe or container.

An evaporative air cooler or evaporative air-conditioner is not a cooling tower.

Cooling tower fill

A structure at the top of a cooling tower that is designed to create an extensive wetted surface area through which air passes.

Cooling tower system

A system comprising:

- a cooling tower or a number of interconnected cooling towers that use the same recirculating water
- any machinery that is used to operate the tower(s)
- any associated tanks, pipes, valves, pumps or controls.

Decontamination

A process used when a cooling tower system is suspected or implicated as a source of Legionnaires' disease. The decontamination process is usually determined in consultation with the Department of Health and Human Services *Legionella* Team. It involves a series of actions to disinfect, clean and re-disinfect the cooling tower system (see Appendix 9).

Disinfection

A process intended to kill or remove pathogenic microorganisms, including *Legionella*.

In the case of a cooling tower system, disinfection consists of dosing the water of a system with either:

- a chlorine-based compound, equivalent to at least 10 mg/L of free chlorine for at least 1 hour, while maintaining the pH of the water between 7.0 and 7.6; or
- a bromine-based compound, equivalent to at least 20 mg/L of free bromine for at least 1 hour, while maintaining the pH of the water between 7.0 and 8.5.

Heterotrophic colony count (HCC)

An estimate of the number of viable units of bacteria per millilitre of water made using the pour plate, spread plate or membrane filter test. Also known as total bacteria count, total plate count or viable bacteria count test.

Operational program

A documented program detailing the water treatment and physical maintenance of the cooling tower system, including details of service frequency.

Owner of land

Owner in relation to the land or Crown land within the meaning of the *Public Health and Wellbeing Act 2008*.

Responsible person

Person who owns, manages or controls the cooling tower system.

Service frequency

The frequency with which the cooling tower system is thoroughly checked by a competent person. It includes a check of the water quality, as well as physical components.

Slug dosing

The manual addition, in a single dose, of a much higher amount of chemical biocide than is normally applied, with the intention of rapidly raising the concentration of biocide in the water to a level expected to kill most if not all organisms in the water.

Bibliography

Australian Standards:

- AS/NZS 3666: *Air-handling and water systems of buildings – Microbial control*
- AS/NZS 3666.1:2011: *Air-handling and water systems of buildings – Microbial control – Design, installation and commissioning*
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- AS 4276.3.1:2007: *Water microbiology – Heterotrophic colony count methods – Pour plate method using yeast extract agar*
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- AS/NZS 1715:2009: *Selection, use and maintenance of respiratory protective equipment*
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- AS/NZS 1337.1:2010/Amdt 1: 2012: *Personal eye protection – Eye and face protectors for occupational applications*
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