WQPN 99, October 2007

Cooling tower wastewater management and disposal

Purpose

In Western Australia's hot climate, air conditioning systems are a desirable component of modern offices, group residential complexes, hospitals, shopping centres and commercial buildings. In air conditioning systems, cooling towers are often used to transfer heat via evaporation to the atmosphere. Most office cooling system operators add chemicals to cooling water to control corrosion and biological activity. Anti-corrosion chemicals include tolyltriazole, glycols, alcohols, and organic acids. Heavy metal-based corrosion inhibitors are now not widely used due to the risk of environmental harm if discharged. Biocides used to inhibit the growth of potentially harmful bacteria, algae and fungi include glutaraldehyde, hydantoins, isothiazolones, quaternary ammonium compounds and carbamates. Disinfection and draining of the entire water cooling system usually occurs at quarterly intervals. There is sometimes a small, continuous bleed-off of cooling water in areas where deposits of mineral scale form in the cooling system.

The wastewater from cooling systems is often discharged to stormwater drainage systems that flow into wetlands, rivers, estuaries and other water bodies. The discharge of cooling tower wastewater poses the following contamination risks:

- Sediment can cause turbidity problems in waterways and water bodies.
- Biocides and anti-corrosion chemicals can be toxic to humans and also to plants and animals in aquatic environments.
- Biocide and anti-corrosion chemical residues discharged to sewer may be toxic to the microbes used for sewage treatment.
- Heavy metals (additives or scoured from pipe-work) are toxic and can accumulate in aquatic organisms.

The Department of Water is responsible for managing and protecting the state's water resources. It is also a lead agency for water conservation and reuse. This note offers:

- The department's current views on cooling tower wastewater management.
- Guidance on acceptable practices used to protect the quality of Western Australian water resources.
- A basis for the development of a multi-agency code or guideline designed to balance the views of industry, government and the community, while sustaining a healthy environment.

This note provides a general guide on issues of environmental concern and offers potential solutions based on professional judgement and precedent.

The recommendations made do not override any statutory obligation or government policy statement. Alternative practical environmental solutions to suit local conditions may be proposed.

Regulatory agencies should not use this note's recommendations without a site-specific assessment of any project's environmental risks. Any conditions set should consider the values of the surrounding environment, the safeguards in place, and take a precautionary approach. The note shall not be used as this department's policy position on a specific matter, unless confirmed in writing.

Scope

This note applies to the management and discharge of cooling-tower wastewater from refrigerated or evaporative air-conditioning systems. It has particular relevance to office cooling-tower systems.

The note does not apply to single residential properties and de-centralised air-conditioning systems, but may offer some useful guidance on potential risks to water resources and good practice.

Advice and recommendations

Location

Within Public Drinking Water Source Areas (PDWSA)

Public drinking water source area (PDWSA) is the collective name given to any catchment area declared for the management and protection of a water source used for public drinking water supplies. PDWSA include *underground water pollution control areas*, *water reserves* and *catchment areas* proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *County Areas Water Supply Act 1947*. For details on these statutes and associated regulatory measures in PDWSA, see Appendix B.

Within PDWSA, three protective classifications of land areas are used (P1, 2 and 3) based on present land use and the vulnerability of the body of water. Each of these areas is managed in a different way to protect water resource quality. For more information on these areas, as well as *wellhead protection zones* and *prohibited (reservoir protection) zones*, see this department's water quality protection note *Protecting Public Drinking Water Source Areas*.

Information on the location of PDWSA is provided on the Department's web site at www.water.wa.gov.au, select *> maps, data and atlases > Geographic Data Atlas > environment > public drinking water source areas.*

1 Cooling towers are incompatible within P1 and P2 areas. Within P3 areas, cooling towers associated with commercial buildings, residential apartment blocks and community facilities are considered compatible with conditions. For more information see the department's water quality protection note *Land Use compatibility in Public Drinking Water Source Areas*.

Regulation

Under the *Health (Air-handling and Water Systems) Regulations 1994*, written approval of the local government authority is required to install or substantially modify an air-handling system, water system or cooling tower in a building.

2 The operation and maintenance of an air-handling system, water system or cooling tower should be in accordance with Australian Standard 3666 *Air handling and water systems of buildings*.

3 Any liquids discharged during the operation or maintenance of an air-handling system, water system or cooling tower should be discharged into a sewer or other waste system approved by the local government authority and any other relevant authority.

4 People who handle ozone-depleting or synthetic greenhouse-gas refrigerant, in bulk or in equipment, are required to be licensed under the *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995*, administered by the Australian Department of the Environment and Water Resources. Companies or people who acquire, possess or dispose of these substances are required to hold a refrigerant-trading authorisation. Refrigerant cannot be purchased without a valid authorisation. (For further information see Appendix A, Reference 14.)

System selection

5 Chemical-free and low chemical use cooling systems should be used (where practical) instead of standard evaporative and refrigerative systems, which could involve the release of significant quantities of treatment chemical residues.

6 Water saving, evaporative air conditioners, which minimise wastewater discharges from the system, should be utilised wherever practical.

Choosing chemical additives

Biocides

7 Carbamates and triazines are considered to have a moderate to low toxicity to aquatic fauna and flora. They should be used instead of hydantoins, isothiazolones and quaternary ammonium compounds, which have a higher toxicity rating.

Corrosion inhibitors

8 Borax and non-ionic surfactants are considered to have a low toxicity to aquatic flora and fauna. They should be used instead of tolytriazole and glycols, which have a higher toxicity rating.

Alternatives to chemical additives

9 Alternatives to chemical treatment include:

a Magneto hydrodynamics is system where a water stream is subjected to a change in magnetic field, which causes an acceleration of chemical reactions within the fluid. This is claimed to control scale, Legionella bacteria and corrosion.

b Ultraviolet (UV) disinfection uses ultraviolet irradiation is used to kill micro-organisms, including legionella bacteria. UV is only effective for disinfection of low turbidity waters.

c Ozone treatment involves ozone generated on-site being injected into a side stream of the cooling water. Ozone reacts with organic material, including micro-organisms within the cooling-tower water. The oxidative products formed as a result of this further react with other micro-organisms, biofilm and scale.

d Filtration systems (full stream and side stream) reduce suspended solids in cooling tower water. This helps to control legionella and corrosion, and reduces tower cleaning frequency.

e Other options are available in the marketplace, e.g. Calfa Bas. Users should proceed with caution until the efficacy of these treatments has been demonstrated via independent scientific studies and the appropriate safeguards put into place.

Operation

System maintenance

Cooling systems require regular maintenance to ensure their safe and efficient operation. Treatment for scale typically involves frequent blowdown of the water circuit, whereby water is removed to reduce mineral concentrations. Cleaning typically involves the discharge of large quantities of cooling-tower wastewater, which can have a significant impact on aquatic ecosystems and sensitive water sources.

10 Corrosion occurs more rapidly under acidic conditions. Effective pH control is required to reduce the effects of corrosion.

11 Corrosion inhibitors containing phosphates can increase the formation of scale through the build-up of calcium phosphate. Constant control of chemical use is required to obtain effective corrosion inhibition.

12 The use of chemical biocides in cooling systems can promote corrosion. In particular, compounds containing chlorine are highly corrosive to most metals, often resulting in the increased application of corrosion inhibitors. Alternative treatment should be used where practical.

13 Water-filtration systems increase the effectiveness of chemical treatment, which reduces chemical usage. Filtration also reduces the need for frequent tower cleaning and blowdown, and increases heat transfer efficiency.

14 A cooling-tower pool vacuum cleaner can be used to remove slime, algae, mud and other contaminates from cooling tower basins without the need to drain the system. This reduces the discharge of cooling tower wastewater and maximises water recycling within the system.

Potential for reusing treated grey water from other systems

15 Domestic wastewater from sinks, showers and washers, known as grey water, can be treated and reused within cooling-tower systems.

The recycled water should be free of bacteria, algae, nutrients or other contaminants that can have a detrimental effect, e.g. slime growth on the cooling-tower system.

Wastewater disposal

16 Cooling-tower wastewater should not be discharged into piped drainage systems, natural wetlands or waterways as any chemical residues present may harm aquatic ecosystems.

Reuse for landscape irrigation

17 Wastewater from some cooling systems can be treated and reused for irrigation, provided that there are no plant toxins. Some nutrients and trace elements found in the wastewater, such as phosphates, can be beneficial in agriculture and horticulture.

Discharge to sewer

18 Cooling-system wastewater containing chemical residues should be discharged to sewer. All discharges to sewer must be approved by the relevant water service provider. The Water Corporation requires *material safety data sheets* for all the chemicals used and laboratory analysis of the wastewater. Water service providers may require pre-treatment, e.g. filtration or flow rate controls, as a condition of acceptance. For further information, see Appendix A, Reference 13.

Discharge to soakage pits

19 The use of soakage pits may be necessary in localities that are not connected to reticulated sewerage systems. Effective pre-treatment of cooling system wastewater to remove chemical residues should occur prior to discharging to soakage pits. The quality of all releases to soakage pits should meet national guideline criteria to sustain local environmental values.

Owner responsibilities

20 It is the responsibility of the owner to ensure that cooling-system wastewater containing chemicals is discharged to sewer. Applications to discharge cooling-system wastewater including *material safety data sheets* for all of the chemicals to be used, should be made to the relevant water service provider. The water service provider may require pre-treatment, e.g. filtration or flow-rate controls, as a condition of acceptance.

21 Regular inspections and maintenance should be carried out in accordance with *AS 3666 Air Handling and Water Systems of Buildings*. It is recommended that all maintenance is carried out by a licensed air-conditioning technician.

22 Storage and handling of toxic chemicals should be in accordance with *AS 4452 The Storage and Handling of Toxic Substances* and this department's note *Toxic and Hazardous Substances: Storage and Use* (see Appendix A, Reference 7a).

Contingency planning

23 A contingency plan should be available on site to address emergency situations that could put local environment and water resources at risk (e.g. accidents, spills, vandalism, equipment breakdown).

24 Absorbent materials such as sand or inert absorbent litter (attapulgite) should be kept on site to assist in the immediate clean-up of spilt chemicals. Contaminated sand and litter should be placed into a suitable container for disposal at an approved location. For further information see this department's note *Contaminated Spills: Emergency Response* (see Appendix A, Reference 7a).

Environmental monitoring and reporting

25 Cooling-tower discharges to stormwater from chemical-free systems should be monitored e.g. for pH, chlorophyll a, turbidity and scoured metals to ensure that they will not harm the environment and water resources. Cooling-tower wastewater discharged to sewer should be monitored to ensure it complies with the acceptance criteria set by the water service provider.

26 If a significant spill occurs that may harm the environment, this should immediately be reported to the Department of Environment and Conservation's Pollution Response Team, phone 1300 784 782. If the spill is located within a Public Drinking Water Source Area, contact the Water Corporation, phone 1800 625 897.

More information

We welcome your views on this note. Feedback provided on this topic is held on this department's file No. **WT 0942**.

This note will be updated periodically as new information is received or industry/activity standards change. Updates are placed on the department's Internet site www.water.wa.gov.au, select water quality > publications > water quality protection notes.

To comment on this note or for more information, please contact this department's Water Source Protection Branch in Perth, phone (08) 6364 7600 (business hours), fax 6364 7601 or use *Contact us* at the department's Internet site, citing the note topic and version.

Where a conflict arises between the Department of Water's recommendations and any proposed activity that may affect a sensitive water resource, this note may be used to assist negotiations with stakeholders. The negotiated outcome should not result in a greater risk to water quality than if the department's recommended protection measures were used**.**

Department of Water
Government of Western Australia

www.water.wa.gov.au
Telephone: (08) 6364 7600
Facsimile: (08) 6364 6516
The Atrium
168 St Georges Terrace Perth
Western Australia 6000

Appendices

Appendix A – References and further reading

1 Australian Government – National Water Quality Management Strategy.

a *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* 2000.

b *Australian Guidelines for Water Quality Monitoring and Reporting,* 2000.

c see web page www.environment.gov.au/water/quality/nwqms/index.html.

d *Australian Drinking Water Guidelines,* 2004.

e see web page www.nhmrc.gov.au/publications/synopses/eh19syn.htm.

f *Policies and Principles,* 1994.

g *Implementation guidelines*, 1998.

see www.awa.asn.au, email bookshop@awa.asn.au, or request from a library service.

2 Standards Australia

a AS 3666 Air Handling and Water Systems of Buildings.

b AS 4452 The storage and handling of toxic substances 1997.

c AS 5667 Water Quality – Sampling.

see web page www.saiglobal.com/shop/script/search.asp.

3 Environmental Protection Authority (WA)

a Guidance statement no 3 *Industrial-residential buffer guidelines.*

b Draft guidance statement no. 33 *Environmental Guidance for Planning and Development*, June 2005.

see Internet site www.epa.wa.gov.au, select *Guidance statements.*

4 Department of Environment and Conservation (WA)

a Wetlands policy and guidelines

Position statement: Wetlands, WRC 2001.
see web page www.dec.wa.gov.au, select *Department of Environment > Water > Wetlands > Publications > Policy > Wetlands Position Statement.*

b Waste management

- *Guidelines for Acceptance of Solid Waste to Landfill,* 2001.
- *Landfill Waste Classification and Waste Definitions,* as amended.
- *Western Australian Waste Reduction and Recycling Policy,* 1997.

see web page www.dec.wa.gov.au select *Environment > land > waste management > publications > guidelines.*

c Contaminated sites

Refer to contaminated site guidance series
see web page www.dec.wa.gov.au, select *Department of Environment > land >* contaminated sites.

5 Department of the Environment and Water (Australia)
*Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 (amended 2006),*see relevant details on web page www.arctick.org/index.php

6 Department of Health (WA)
Safe use of household chemicals,
see web page www.population.health.wa.gov.au/Environmental/index.cfm, search *Household chemicals* or *Pesticide.*

7 Department of Water (WA)

a Water Quality Protection Notes:

- *Toxic and Hazardous Substances: Storage and use.*
- *Protecting Public Drinking Water Source Areas.*
- *Radiator repair and reconditioning*.
- *Contaminant spills – emergency response.*
  see web page www.water.wa.gov.au, select *water quality > publications > water quality protection notes.*

b Stormwater

Stormwater Management Manual for Western Australia,

see web page www.water.wa.gov.au**,** select *publications.*

8 Government of Western Australia – State Law Publisher
Health (Air-handling and Water Systems) Regulations 1994, August 2003.
see www.slp.wa.gov.au *>acts and regulations > A to Z browse regs > H.*

9 Environmental Protection Authority (South Australia)
Air conditioning and Pipework Systems, October 2005.
see www.epa.sa.gov.au/guidelines.html

10 Water Corporation (WA)
Industrial Waste Information Brochure – Commercial Climate Control Waste - IWPUB19, 2003,
see www.watercorporation.com.au/P/publications_industrial_waste_information.cfm

11 Swan River Trust (WA)
a. Policies
Discharge of Cooling Tower Waste, July 2002, Property Council Of Australia
http://propertycouncil.gravitymax.com.au/advoc/page.asp?622=270133&E_Page=17720

b. Reports
Perth Air-Conditioner Waste Discharges, June 1999, Sinclair Knight Merz

12 Department of Human Services (Victoria)
Legionella Link- Managing the Health Risks, February 2005.
see www.health.vic.gov.au/environment/legionella/resources.htm

13 National Environmental Health Forum
Guidance for the Control of Legionella, 1996,
see http://enhealth.nphp.gov.au/council/pubs/ecpub.htm > Water Series.

14. Department of the Environment and Water Resources (Australia)
Ozone and Synthetic Greenhouse Gases,
see www.environment.gov.au/atmosphere/ozone/index.html

Appendix B - Statutory requirements and approvals relevant to this note include:

What's regulated	Statute	Regulatory office
Land zoning and development approval	*Planning and Development Act 2005*	Local Government (Council)
		Department for Planning and Infrastructure
Statutory policies covering wetlands, drinking water catchments and estuaries	*Environmental Protection Act 1986, Part III Environmental Protection Policies:*	Minister for the Environment advised by the Environmental Protection Authority
Impact of significant development proposals on the values and ecology of land or natural waters	*Environmental Protection Act 1986, Part IV: Environmental Impact Assessment*	
Regulation of prescribed premises that could pollute;	*Environmental Protection Act 1986, Part V: Environmental Regulation*	Department of Environment and Conservation – regional office
Prohibited discharge of specified contaminants	*Environmental Protection (Unauthorised Discharges) Regulations 2004*	
Approval to discharge waters into managed waterways	*Waterways Conservation Act 1976*	Department of Water – regional office
Discharges into the Swan-Canning Estuary	*Swan River Trust Act 1988* *Swan and Canning Rivers Management Act 2006 (from 2007)*	Swan River Trust
Storage of fuels, solvent, explosive and dangerous goods	*Explosive and Dangerous Goods Act 1961* and associated Regulations	Department of Consumer and Employment Protection
Management of human wastes Community health issues	*Health Act 1911* *Health (Air-handling and Water Systems) Regulations 1994*	Local Government Department of Health
Emergency response planning	*Fire and Emergency Services Authority of WA Act 1998*	Fire and Emergency Services Authority
Discharge to sewer (industrial waste permit) or to main drain	*Metropolitan Water Supply, Sewerage and Drainage Act 1909*	Water Corporation
	Country Towns Sewerage Act 1948	Designated water services provider

Note: Copies of relevant statutes are available from the State Law Publisher at Internet site www.slp.wa.gov.au.

Appendix C - Sensitive water resources

Clean water resources used for drinking, sustaining aquatic and terrestrial ecology, industry, and aesthetic values, along with breathable air, rank as the most fundamental and important needs for viable communities. Water resources should remain within specific quality limits to retain their values, and therefore require stringent and conservative protection measures. Guidance on water quality parameters necessary to maintain water values are published in the Australian Government's *National Water Quality Management Strategy Guidelines* (see web page www.deh.gov.au/water/quality/nwqms/index.html).

The Department of Water strives to improve community awareness of catchment protection measures for both surface water and groundwater as part of a multi-barrier protection approach to maintain the quality of water resources.

To be considered sensitive, water resources must support one or more of the environmental values described below. Human activity and land uses pose a risk to water quality if contaminants can be washed or leached into sensitive water resources in discernible quantities. These water resources include shallow groundwater accessed by water supply wells, waterways, wetlands and estuaries. Community support for these values, setting of practical management objectives and implementation of sustainable protection strategies are seen as key elements in protecting and restoring the values of these water resources.

Sensitive water resource values include:

a Public drinking water source areas (ie *water reserves, catchment areas* or *underground water pollution control areas*) proclaimed or assigned under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, *Country Areas Water Supply Act 1947* or the *Health Act 1911.*

b Private water supply sources, including the following uses

- human or stock consumption;
- commercial or industrial water supplies (with specific qualities that support the activities eg aquaculture, cooling, food or mineral processing or crop irrigation); or
- garden or municipal water supplies (which can affect people's health or wellbeing).

c Groundwater aquifers that sustain important ecological functions e.g. cave ecology.

d Waterways (excluding engineered drains or constructed features) with ecological and/or social values such as aesthetic appeal, boating, fishing, tourism, and swimming, including:

- waterways of *high conservation significance* as described in the Environmental Protection Authority's Draft Guidance Statement 33 *Environmental Guidance for Planning and Development* (Section B5.2.2) see www.epa.wa.gov.au, select EIA > *guidance statements*
- waterways managed under the *Waterways Conservation Act 1976*, ie the Avon, Peel-Harvey, Leschenault, Wilson Inlet and Albany Waterways Management Areas
- waterways managed under the *Swan and Canning Rivers Management Act, 2006*

Note: many waterways in the state remain to be scientifically evaluated and their value classified. Any such waterways that are substantially undisturbed by human activity, should be considered to have high conservation value unless proven otherwise.

e Wetlands possessing recognised or probable conservation values (generally excluding those highly disturbed, unless subject to active management to restore specified environmental values), and including

- RAMSAR wetlands (see internet site www.ramsar.org)
- wetlands of *high conservation significance* as described in the Environmental Protection Authority's Draft Guidance Statement 33 *Environmental Guidance for Planning and Development* (Section B4.2.2), see www.epa.wa.gov.au , select EIA > *Guidance statements*;
- wetlands described by Department of the Environment and Heritage (Australia) in *A Directory of important wetlands in Australia,* (see web page www.deh.gov.au/water/wetlands/databases.html, or the Department of Environment and Conservation web page www.naturebase.net/content/view/813/861/);
- *conservation* and *resource enhancement* category wetlands identified in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset, all wetlands identified in the *South Coast Significant Wetlands* dataset and high value wetlands identified in the *Geomorphic Wetlands Augusta to Walpole* dataset.

Note: many wetlands in the state still need to be scientifically evaluated and classified. Any such wetlands that are generally undisturbed by human activity, should be considered to have high conservation value, unless proven otherwise. The Augusta to Walpole wetland dataset to date has not been subject to a detailed evaluation process.

The Department of Conservation and Environment is the custodian of wetland datasets and is responsible for maintaining and updating the information within them. The datasets can be viewed or downloaded from the internet site www.dec.wa.gov.au, select *Department of Environment > tools, systems and data > Geographic Data Atlas > inland waters > wetlands.* Guidance on viewing the wetlands is provided on the same website at *water > wetlands > data > wetland mapping > how to view wetland mapping* or phone the department on 9334 0333.