



Legionella Control – Basics and Developments

Ian Childs – Director

NEW DIRECTIONS INTERNATIONAL BUSINESS SERVICES PTY LIMITED ABN.49.083.183.751 t/a
NEW DIRECTIONS IN BUILDING SERVICES® NEW DIRECTIONS IN BUSINESS SAFETY® FIRE ASSESS®



about **Ian Childs**

 Member – Technical Committee ME/62 with Standards Australia

(AS/NZS 3666 part 1~4 – Air handling and water systems of buildings – microbial control)

(AS 1851 Sect.13 – Servicing of HVAC and Smoke Control)

(AS1682 part 1 & 2 – Manufacture & Installation of Fire Dampers, Smoke Dampers & Air Dampers)



 Fellow Member – (and past State President and National Vice President;) Institute of Plant Engineers of Australasia [F.IPEA]



 Companion Member – Institute of Plant Engineers [Comp.IEAust]

 Professional Member – Fire Protection Association of Australia

 (Founding) Member – Australian Institute of Emergency Services [M.AIES]



 Member (and Sydney Chapter Vice Chairman) – Engineers Australia's Society of Building Services Engineers [M.SBSE]

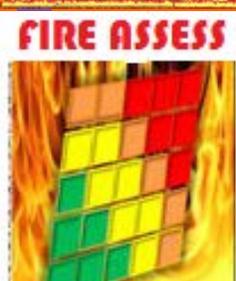


 Member – Engineers Australia's Society of Fire Safety [M.SFS]



 Committee Member – Chartered Institute of Building Services Engineers [Aff.CIBSE]

 Recipient of the National Australia Medal with two bars & ESM for service to the NSW State Emergency Services



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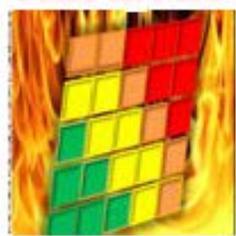


SES



Program

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Infections



The infective agent



Cooling water systems



Commissioning and maintenance



Where to?



Emerging issues



Conclusion



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Infections





Legionellosis

 Legionnaires' disease - an acute pneumonia

 Pontiac fever

 Similar to influenza but has a high attack rate

 Theories

-  an allergic reaction to Legionella
-  inhalation of dead Legionella
-  Inhalation of stray bacterial cells



Effect on central nervous system

Effect on the central nervous system sometimes includes

- 🇺🇸 Lethargy
- 🇺🇸 Confusion
- 🇺🇸 Delirium
- 🇺🇸 Disorientation
- 🇺🇸 Depression
- 🇺🇸 Hallucinations
- 🇺🇸 Insomnia
- 🇺🇸 Slurred speech
- 🇺🇸 Amnesia
- 🇺🇸 Coma



Philadelphia 1976

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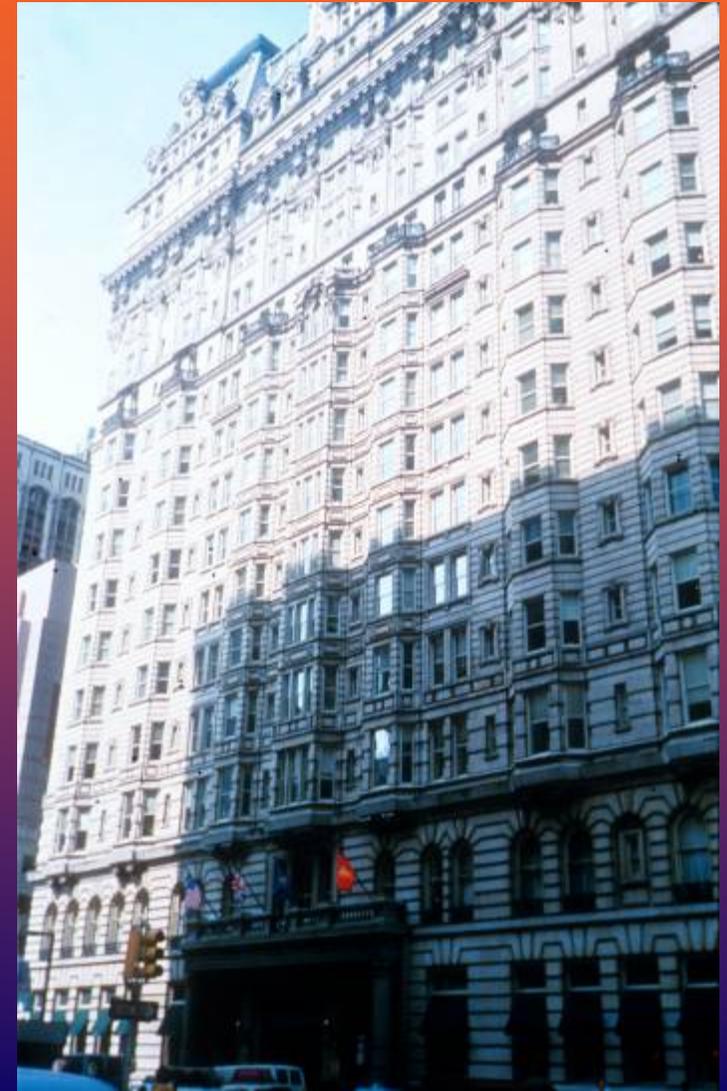


Bellevue Stratford

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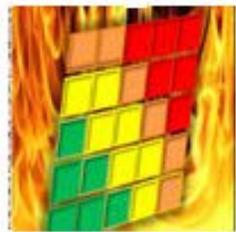
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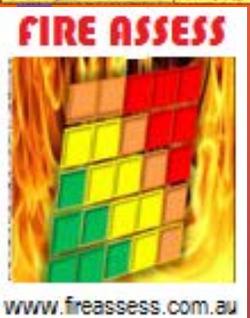
Broad Street

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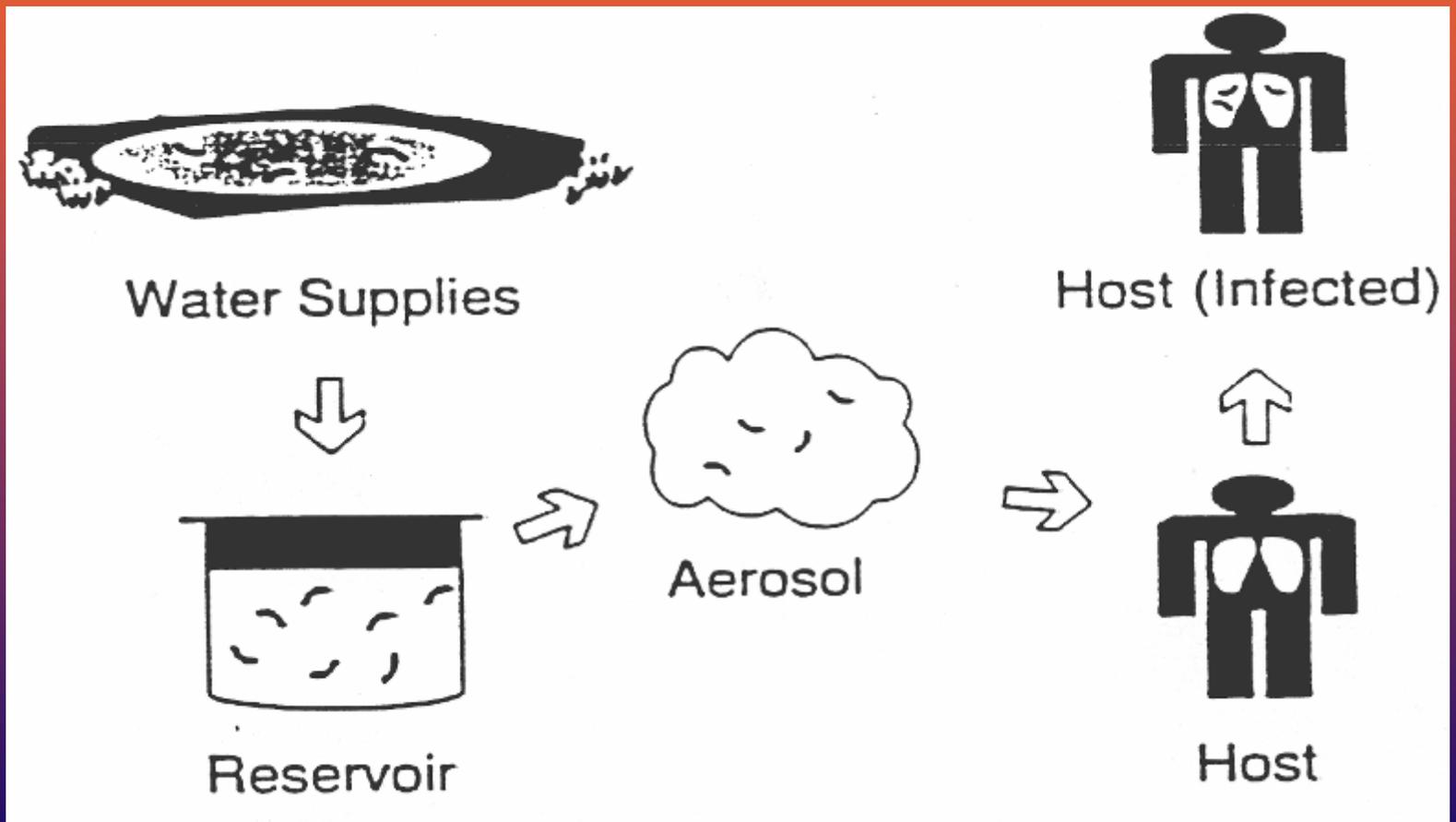


The Philadelphia outbreak

Group	L.D Cases	Fatalities
American Legion Members	182	29
“Broad Street” Community Group	39	5
Total	221	34



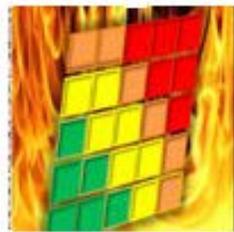
Chain of causation





Fruit & Vegies

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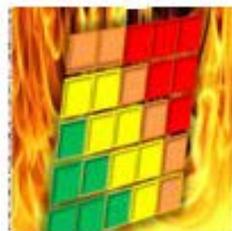
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Mister at Bogalusa, Louisiana

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Australia too?





1979 Melbourne evap. Condenser Industrial

1979 Ballarat Shower system in Psych. Hospital

1985 Wollongong cooling tower Social club

1986 Adelaide cooling tower in hospital

1987 Wollongong cooling tower for pharmacy

HB32 developed as interim & AS/NZS3666 committee formed

1988 Adelaide potting mix

1988 Sydney cooling tower at bowling club

1989 Burnie Tas cooling tower at hospital

1992, 1993, 1994, 1995 & 1998 Sydney West

2000 Melbourne Aquarium cooling tower 125 infected 4 died

Vic DHS mandated controls and RMP's

2010 NSW Public Health Act strengthened

2016 Sydney Cooling Tower at Club 15 people infected

2018 NSW Health introduced mandatory testing & RMP's

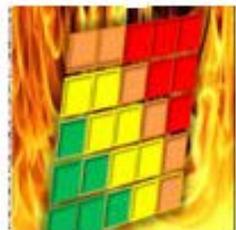
2019 January Sydney 4 people infected

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Mister

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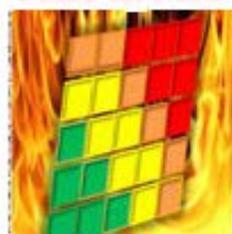
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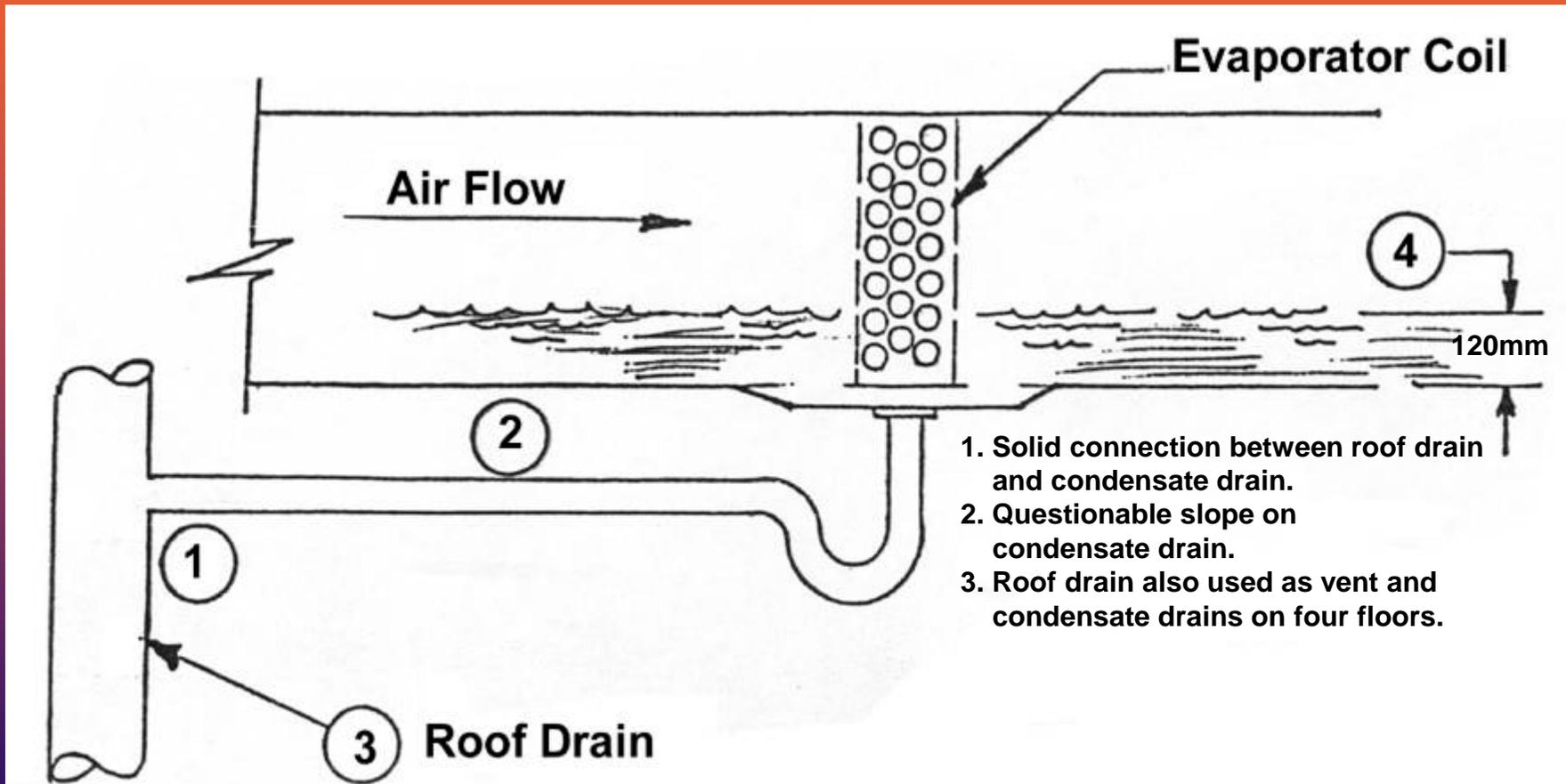


Stafford Hospital

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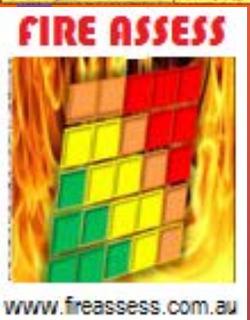


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Spa Pools





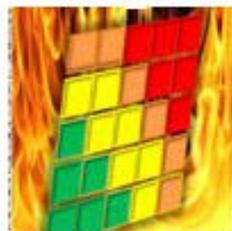
Cutting fluid





The Infective Agent

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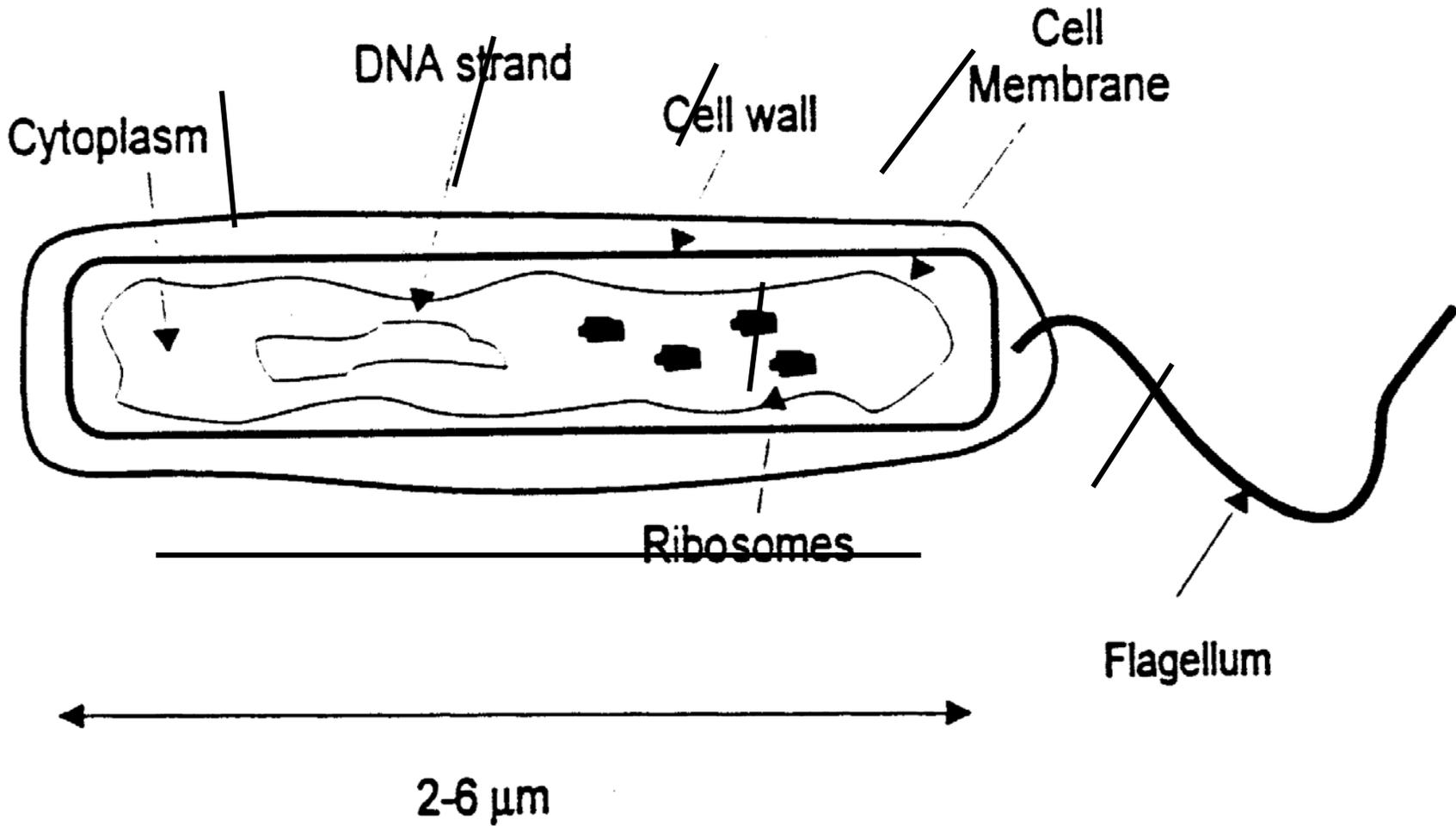


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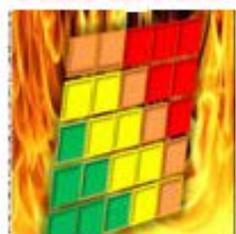


Legionella bacterium





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Legionella species

L.adelaidensis (a)

L.anisa

L.birminghamensis

L.bozemanii SG 1&2

L.brunensis

L.cherrii

L.cincinnatiensis

L.dumoffii

L.erythra

L.fairfieldensis (b)

L.feeleii SG 1&2

L.geestiae

L.gormanii

L.gratiana

L.hackeliae SG 1&2

L.israelensis

L.jamestownensis

L.jordanis

L.lansingensis

L.longbeachae SG 1&2

L.londonensis

L.maceachernii

L.micdadei

L.moravica

L.nautarum

L.oadriddensis

L.parisiensis

L.pneumophila SG 1-16

L.quateirensis

L.quinlivanii SG 1&2
(a)

L.rubrilucens

L.sainthelensis SG 1&2

L.santicrucis

L.shakespearei

L.spiritensis

L.steigerwaltii

L.tucsonensis

L.wadsworthii

L.waltersii (a)

L.worsleiensis

(a) first identified at Adelaide

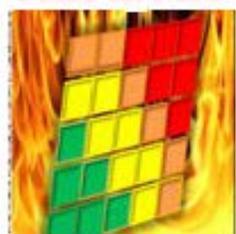
(b) first identified at Melbourne



Savannah River estuary

Research by Dr. Carl Fliermans

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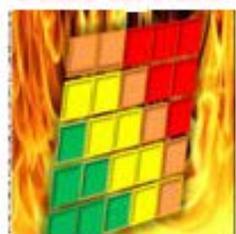


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Location km. Upstream	Salinity ppt	L. Pneumophila counts per mL
320	0.05	1100
190	0.06	2800
34	0.50	140
0	18.1	110
3 km from mouth in Atlantic	34.5	Below detection



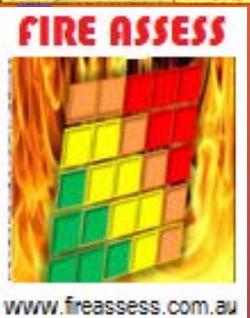
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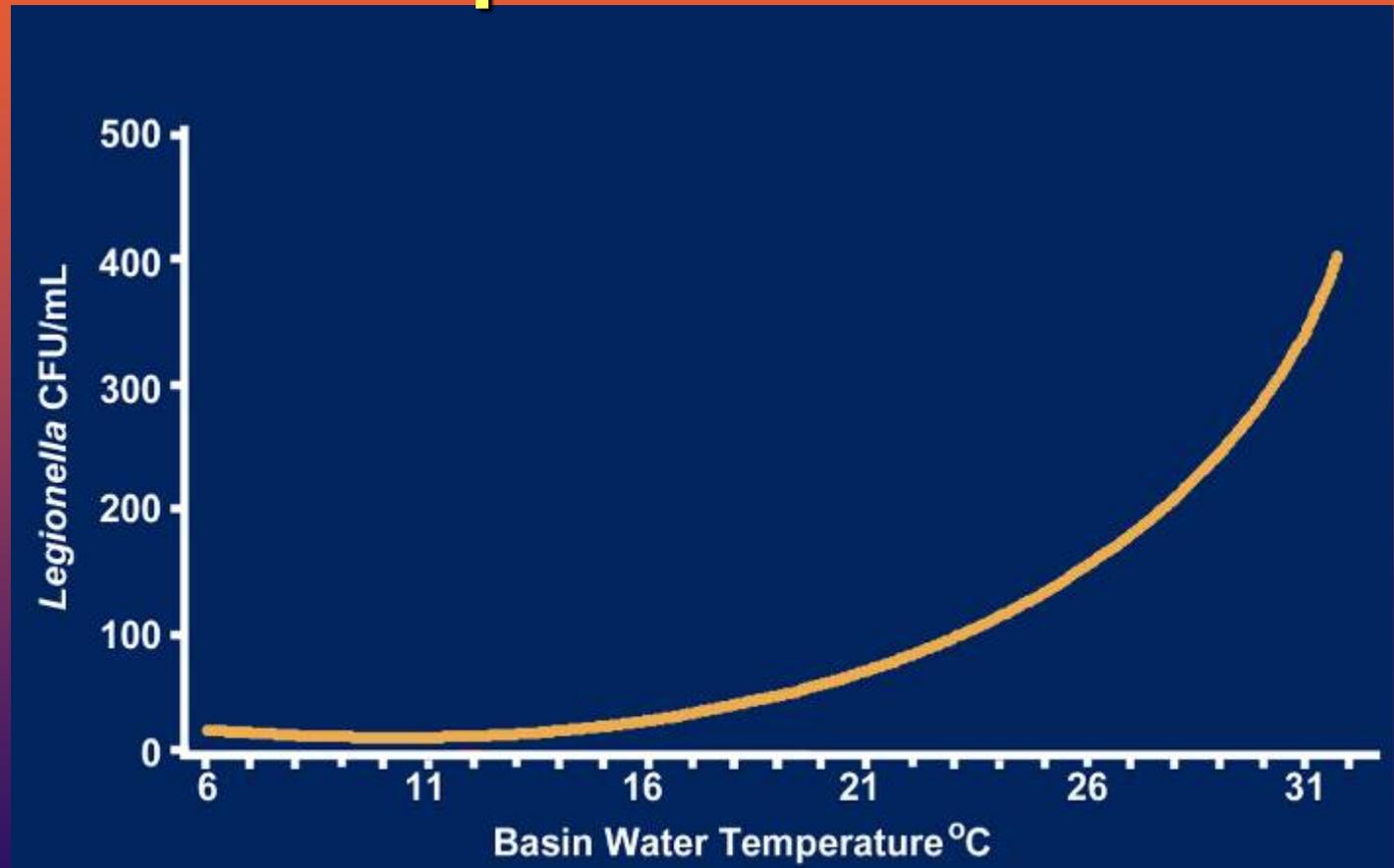
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Salient features of Legionella growth

-  **Temperature**
-  **Biofilm**
-  **Association with protozoa, bacteria**
-  **Nutrients**

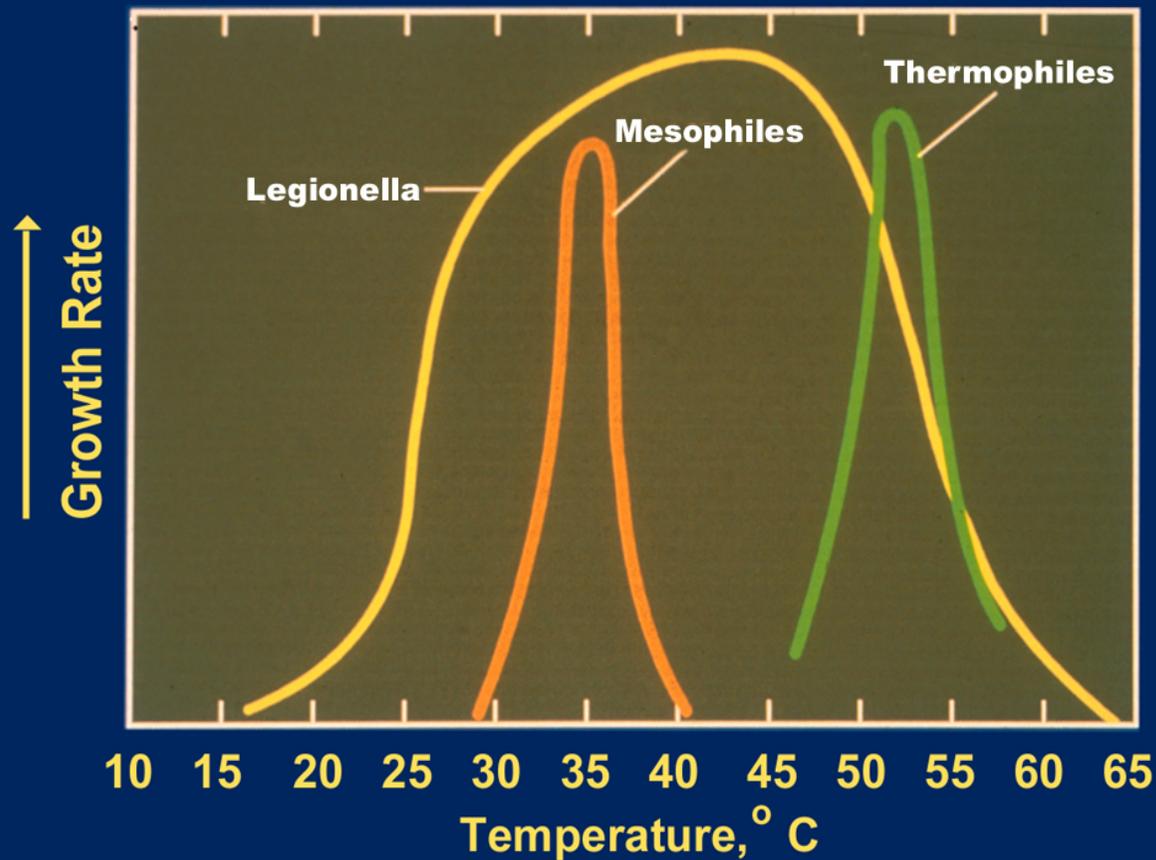


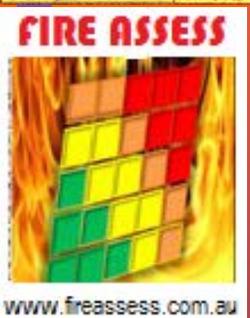
Variation of *Legionella* counts with basin water temperature



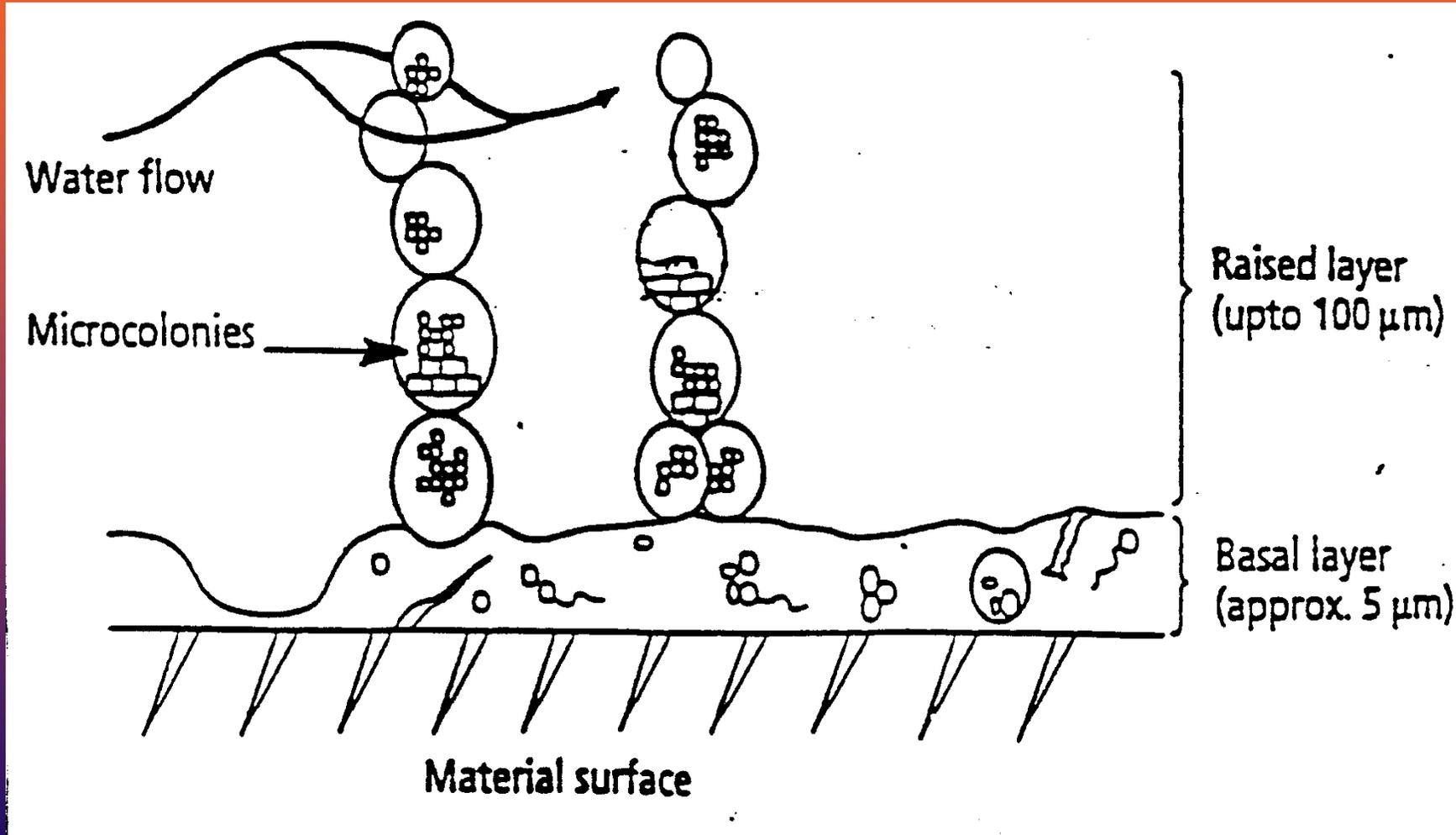


Temperature dependence





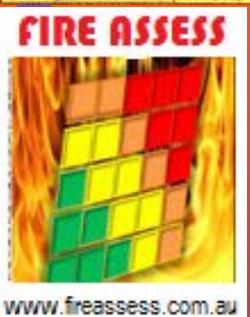
Biofilm – it's a jungle down there



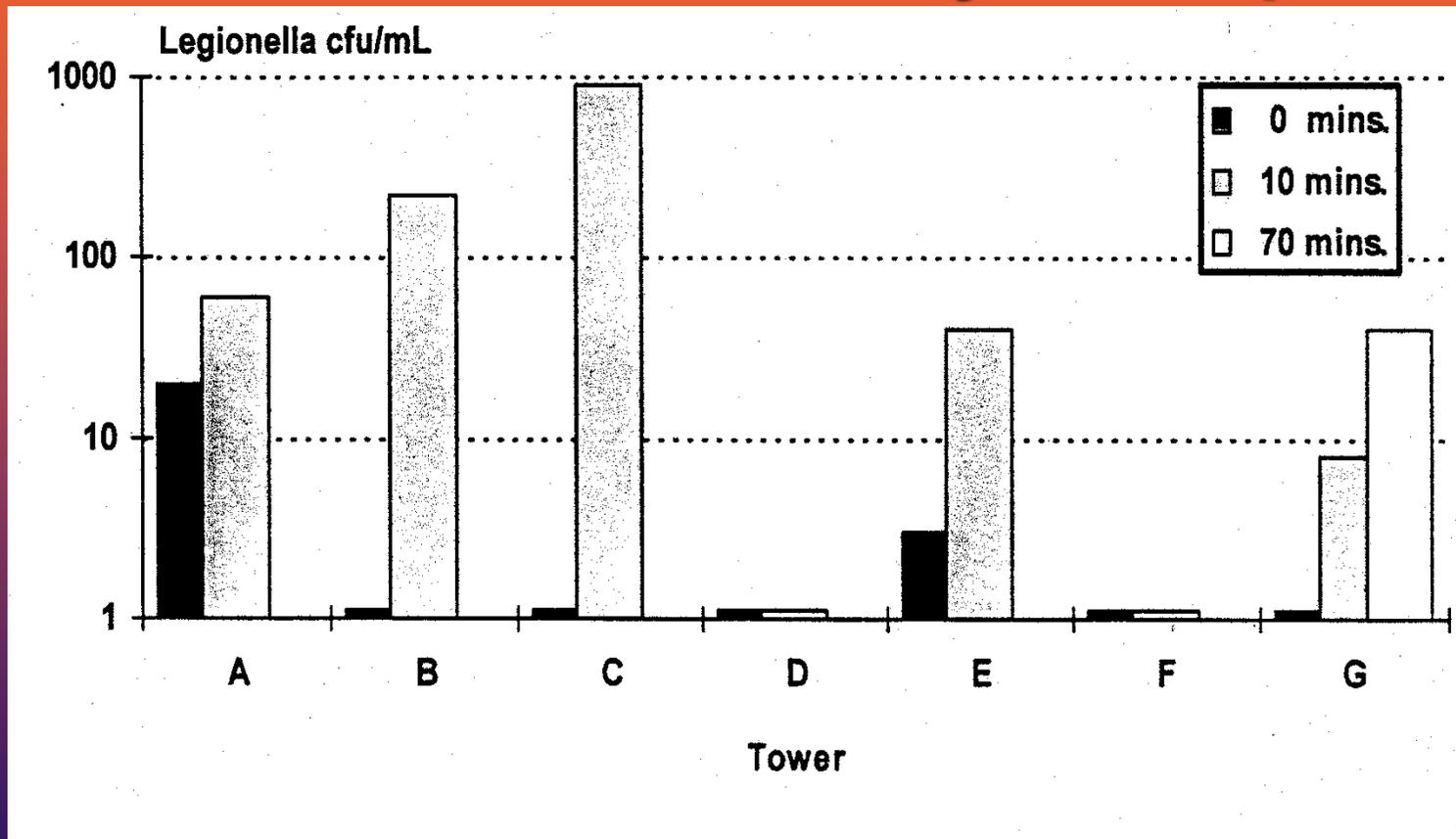


Practical significance of biofilms:

- Increased frictional resistance to fluid flow
- Water quality deterioration
- Bacterial multiplication
- Biodeterioration / corrosion
- Disinfection resistance



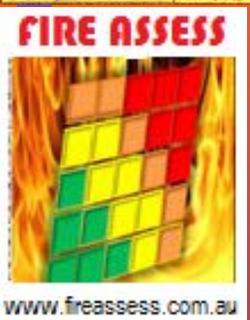
Legionella counts from cooling tower systems before and after system operation



(Adelaide research by Clive Broadbent)



Fluid shear stresses



System	Parameter	Pipe Size mm		
		25	50	100
1. Low Stress, low pressure loss design (100 Pa/m, copper or plastic)	Velocity, m/s	0.4	0.75	1.2
	Reynolds No.	8980	33700	107820
	Friction factor	0.011	0.01	0.0085
	Shear stress, N/m ²	0.22	0.70	1.5
2. High Stress, high pressure loss design (1000 Pa/m, copper or plastic)	Velocity, m/s	1.6	2.6	3.8
	Reynolds No.	35940	116800	341420
	Friction factor	0.06	0.045	0.035
	Shear stress, N/m ²	19	38	63





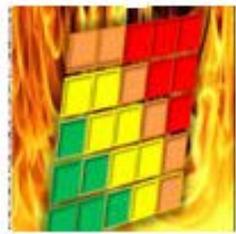
Spa pool

Sample	Legionella	TBC
Bulk water, cfu/mL	10	700
Debris at filter, cfu/gram	3×10^4	2×10^6
Water drained from dead space at bottom of filter, cfu/mL	2×10^5	3×10^6

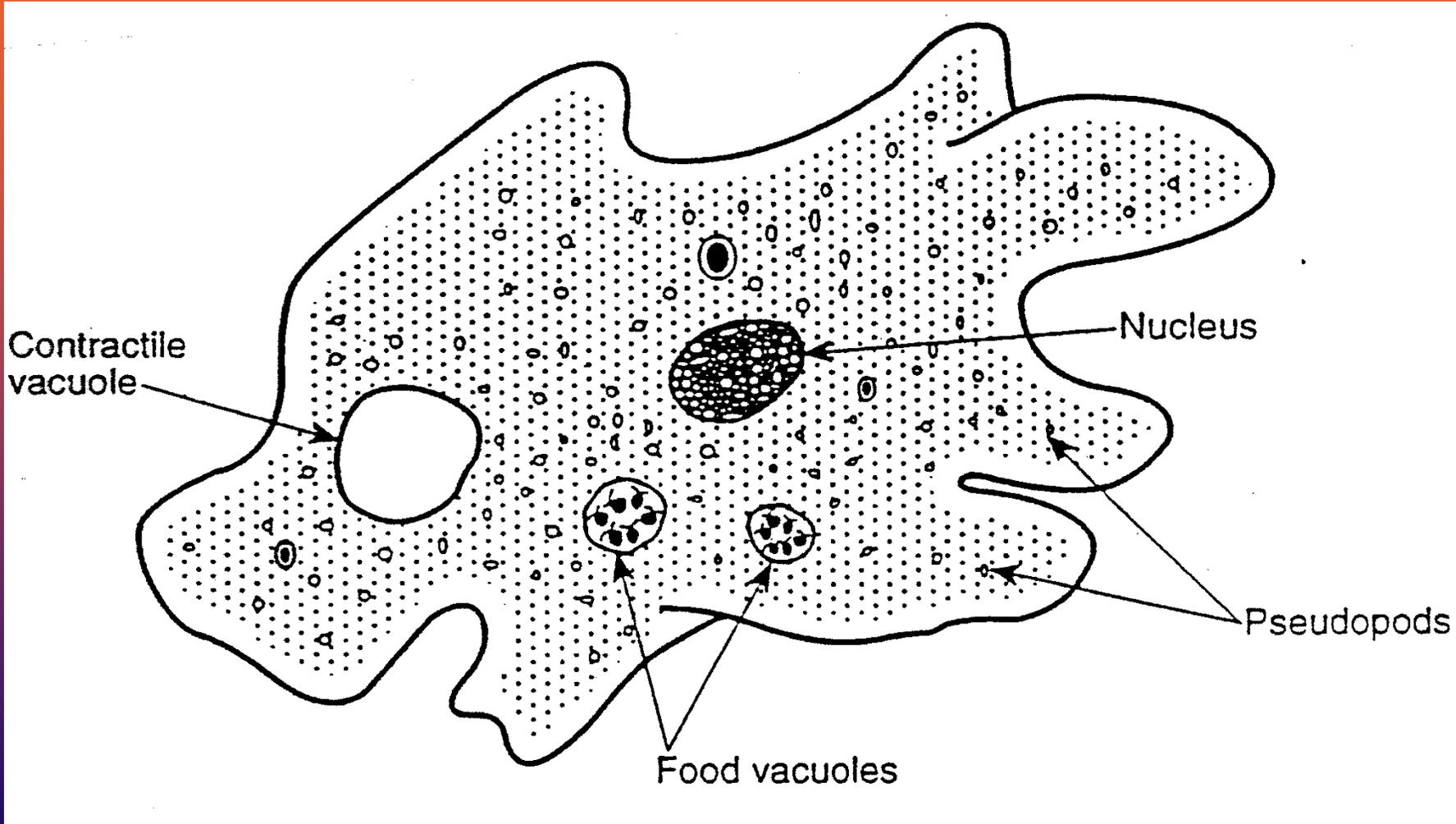


Amoeba

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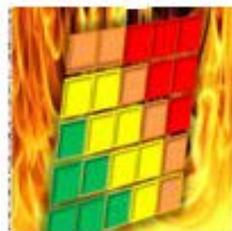
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Amoeba engulfing Legionella

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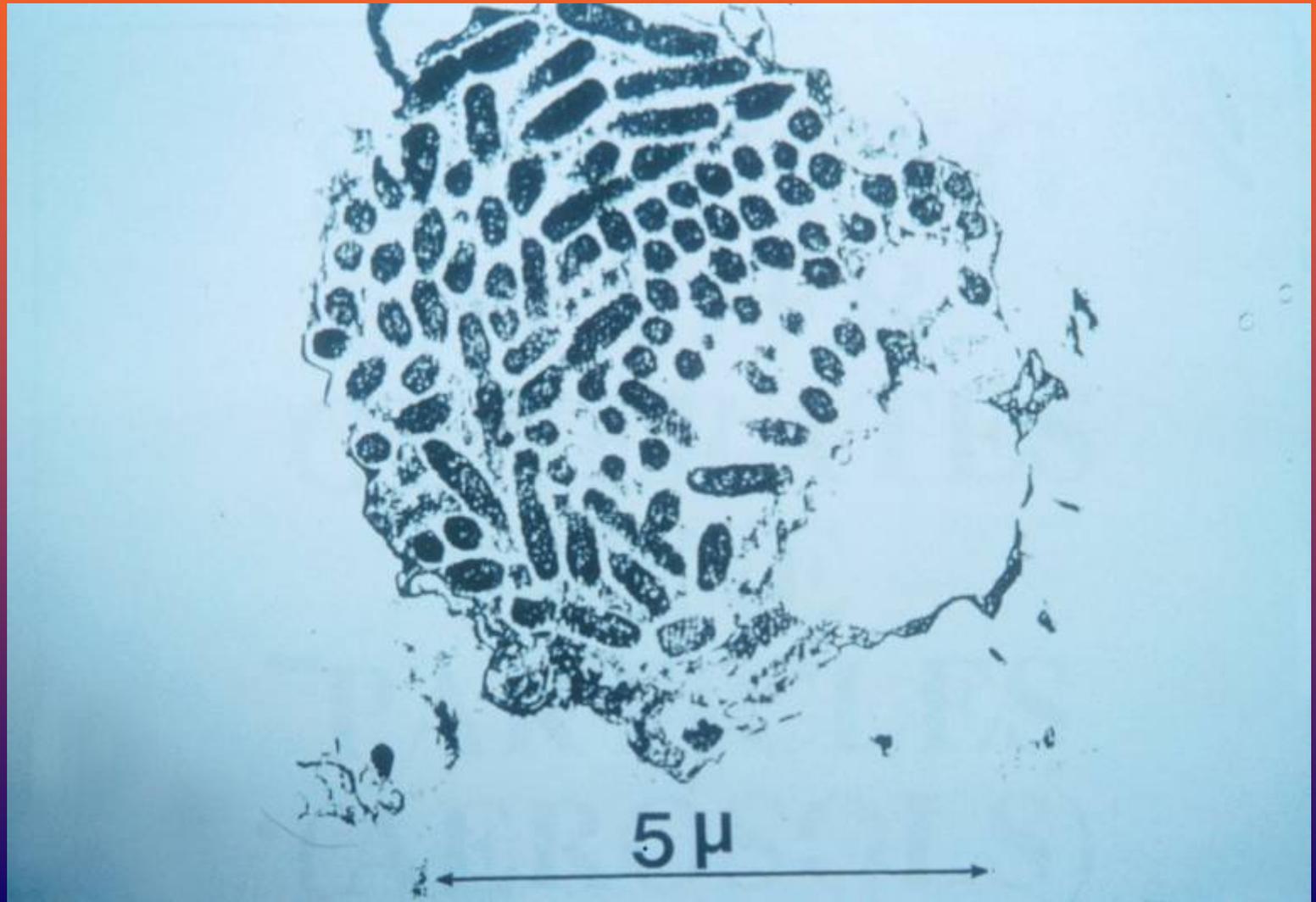


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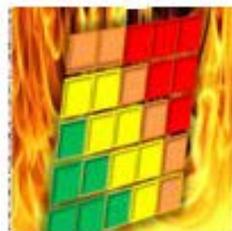
Vesicle



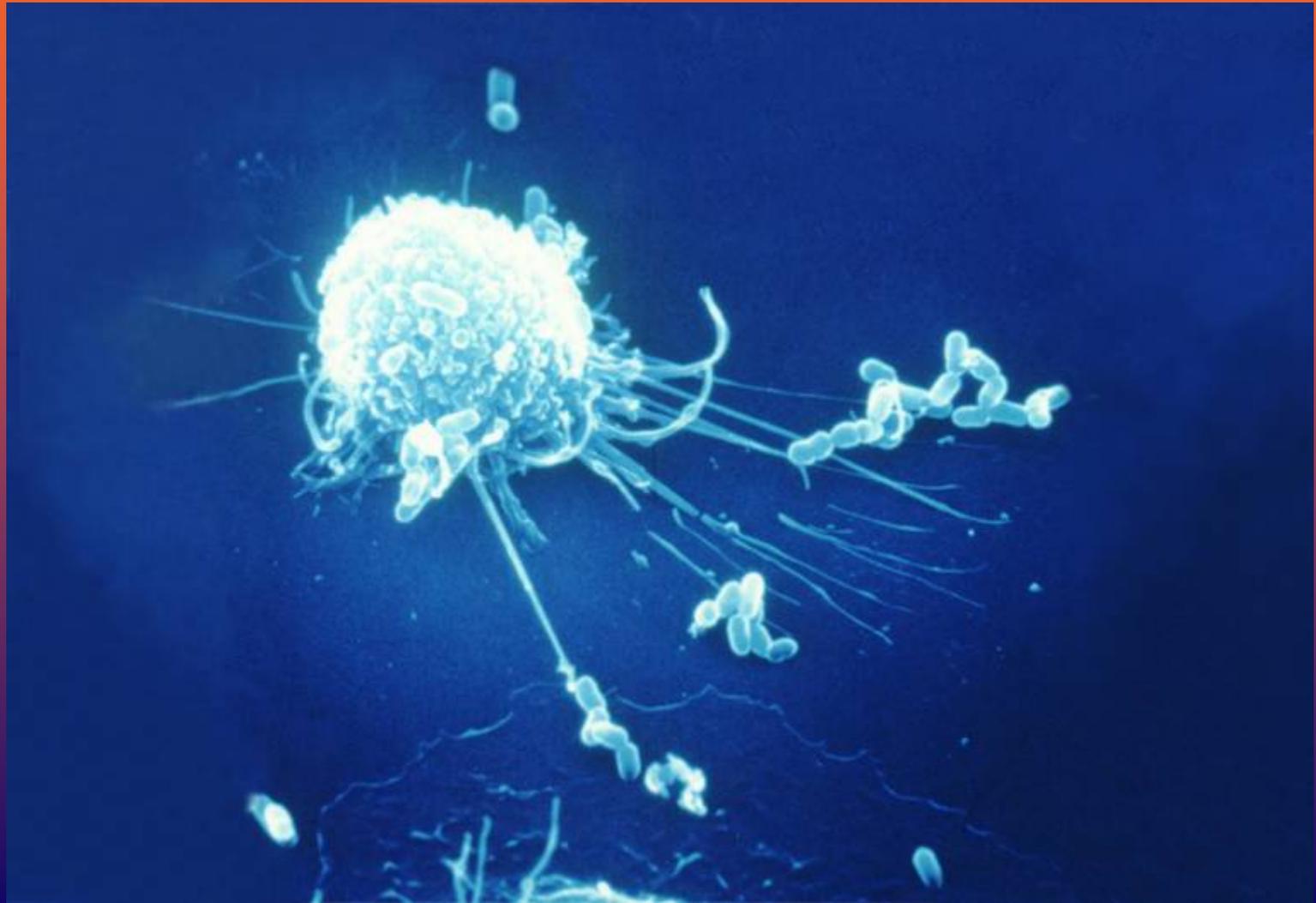


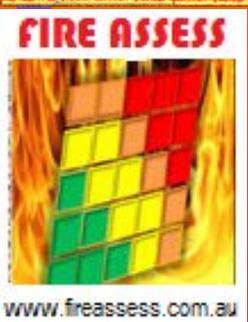
Macrophage *(White Blood Cell)*

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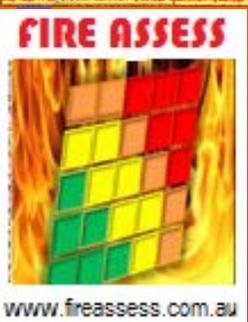
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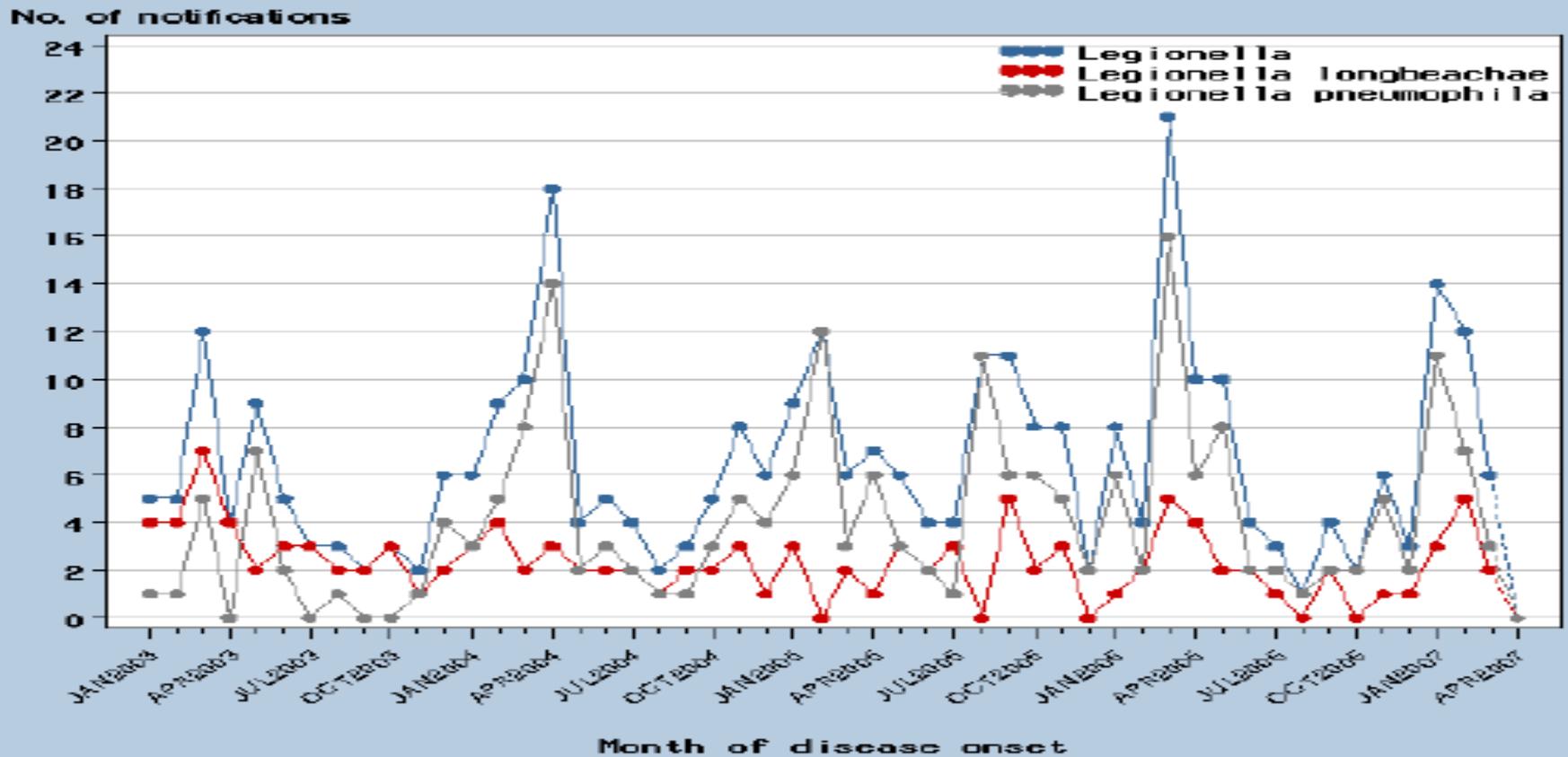
Legionella counts at outbreak sources (Aus.)

 Parramatta	(1993) 28,000 cfu/mL
 Burnie	(1989) 230,000
 Merrylands	(1989) 165,000 (evap condenser)
 Adelaide	(1985) 10,000
 Melbourne	(2000) 6,900 and 3,000 (Lp not 1 - 15,000) (aquarium)
 Wollongong	(1987) 2,300 (not representative)
 Fairfield	(1992) 550 (not representative) (MacDonalds)
 Sydney	(2007) not yet published (Royal Automobile Club)



Legionella counts at outbreak sources (NSW)

Legionella notifications in NSW residents, by month of disease onset. January 2003 to April 2007

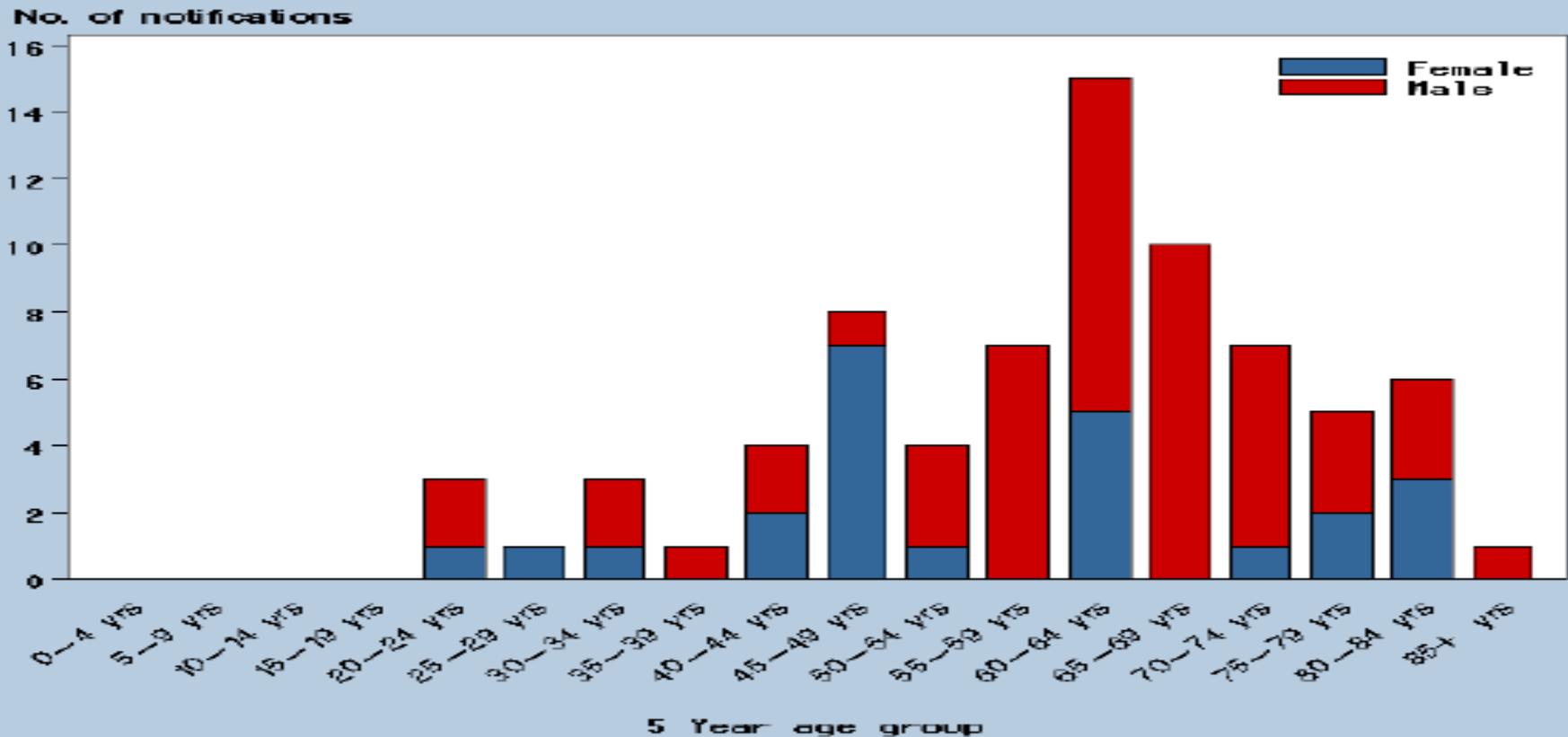




Legionella counts at outbreak sources (NSW)



Legionella notifications in NSW residents, by five year age group, sex and month of disease onset. 01Apr2006 - 31Mar2007

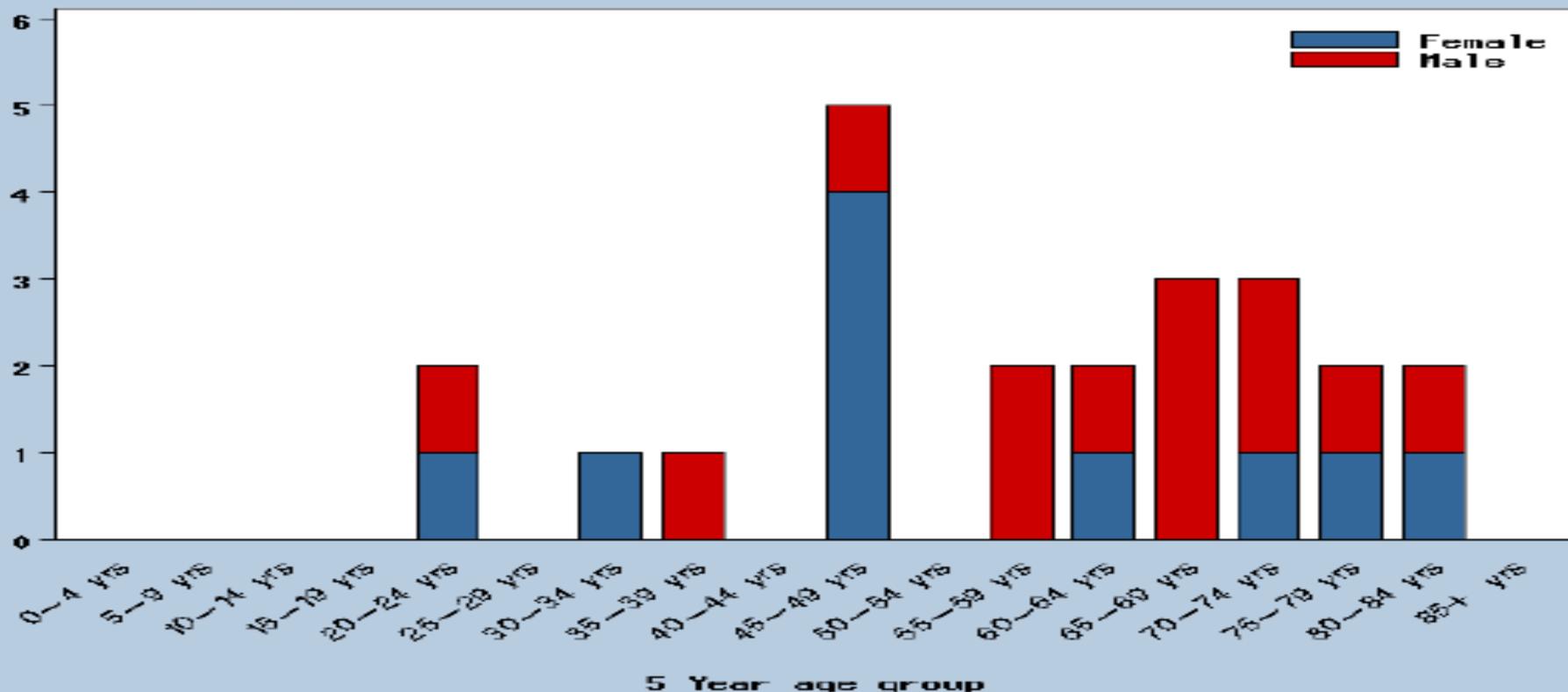




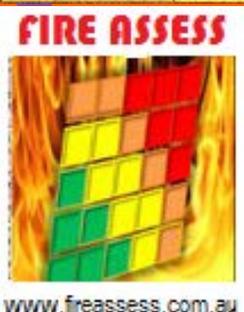
Legionella counts at outbreak sources (NSW)

Legionella longbeachae notifications in NSW residents, by five year age group, sex and month of disease onset. 01Apr2006 - 31Mar2007

No. of notifications



Last updated on: 2 April 2007
 Excludes cases where sex or age is unknown.

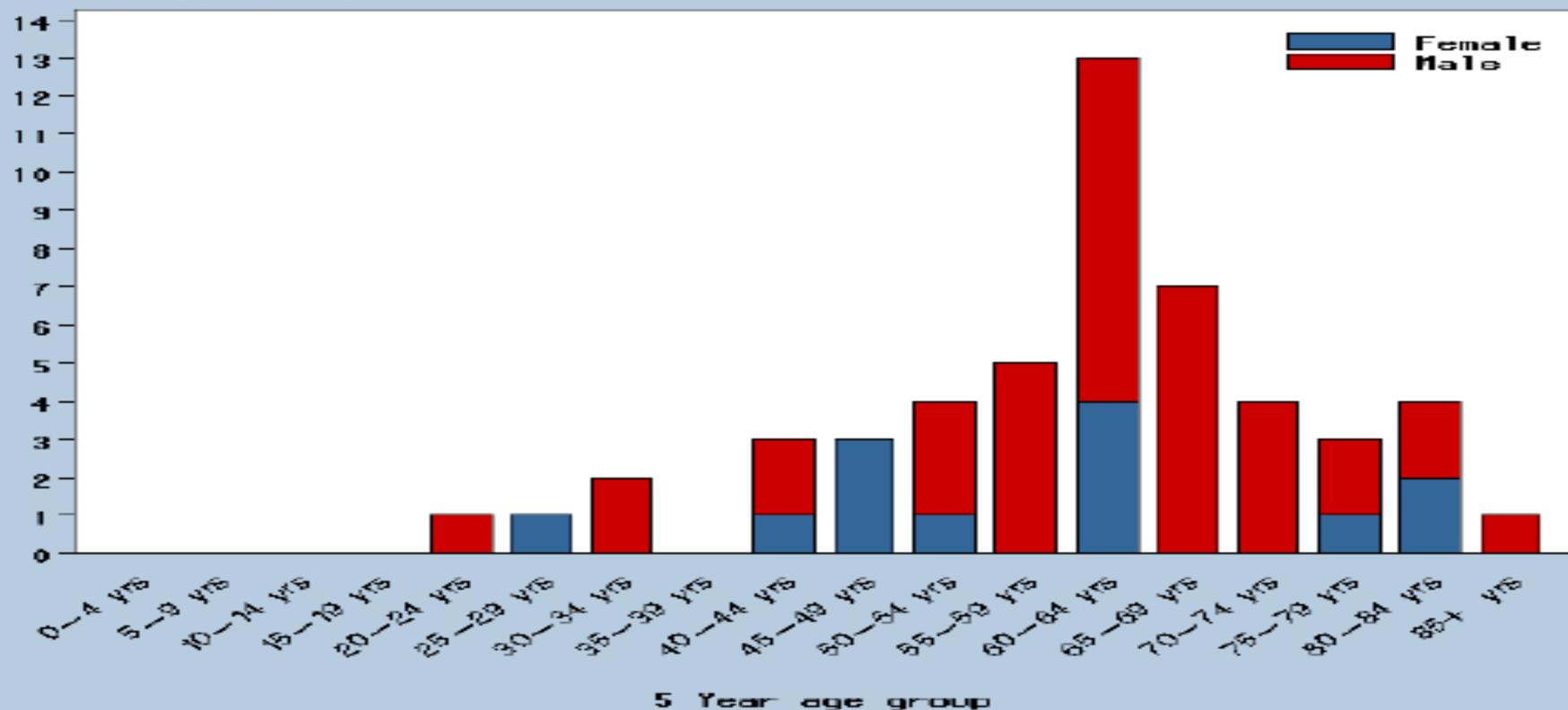




Legionella counts at outbreak sources (NSW)

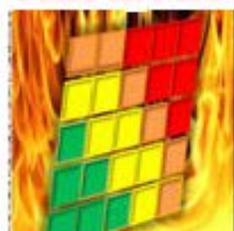
Legionella pneumophila notifications in NSW residents, by five year age group, sex and month of disease onset. 01Apr2006 - 31Mar2007

No. of notifications



Last updated on: 2 April 2007
 Excludes cases where sex or age is unknown.

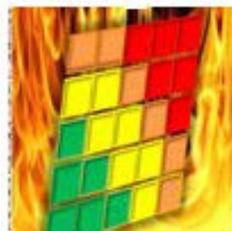
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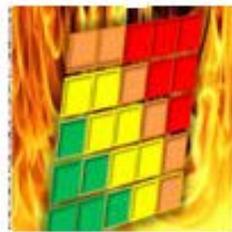
3. Cooling Water Systems



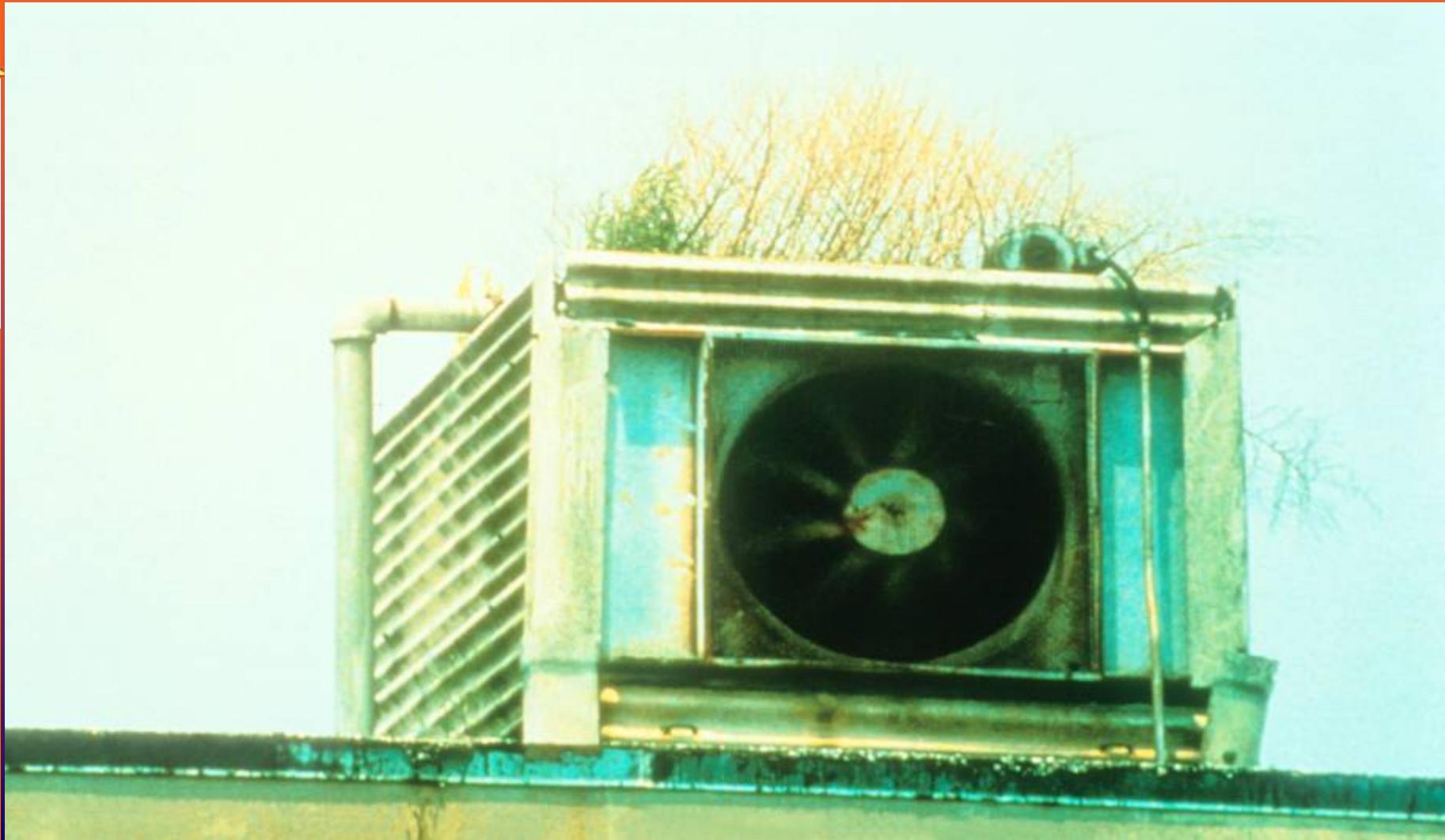


Lawnmower?

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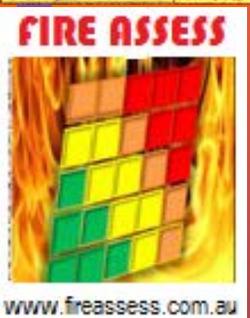


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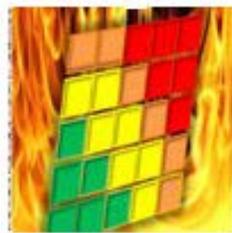
Heat rejection by evaporation





Towers on roof

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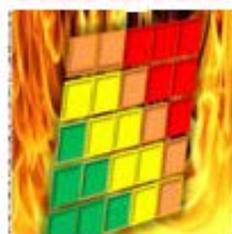
Parramatta Police Centre

Note: the non-compliant fan access ladders (AS1657)



Towers indoors

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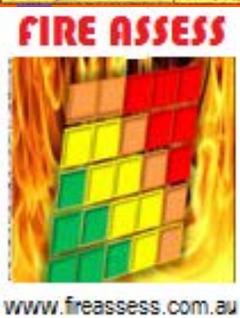


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Canberra

Air velocity of intakes up to 15m/s and allowance for ~20,000 L/s of OA make up air was required

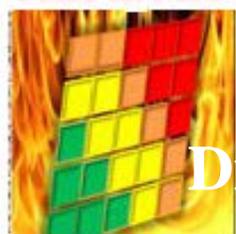


Tower discharge

- **Plume** (steam vapour with little to no viral containment – harmless – except for possible off gassing of chemicals, etc.)
- **Drift** (water droplets containing suspended bacteria)



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Components

Fan & Cowl

Drift eliminators

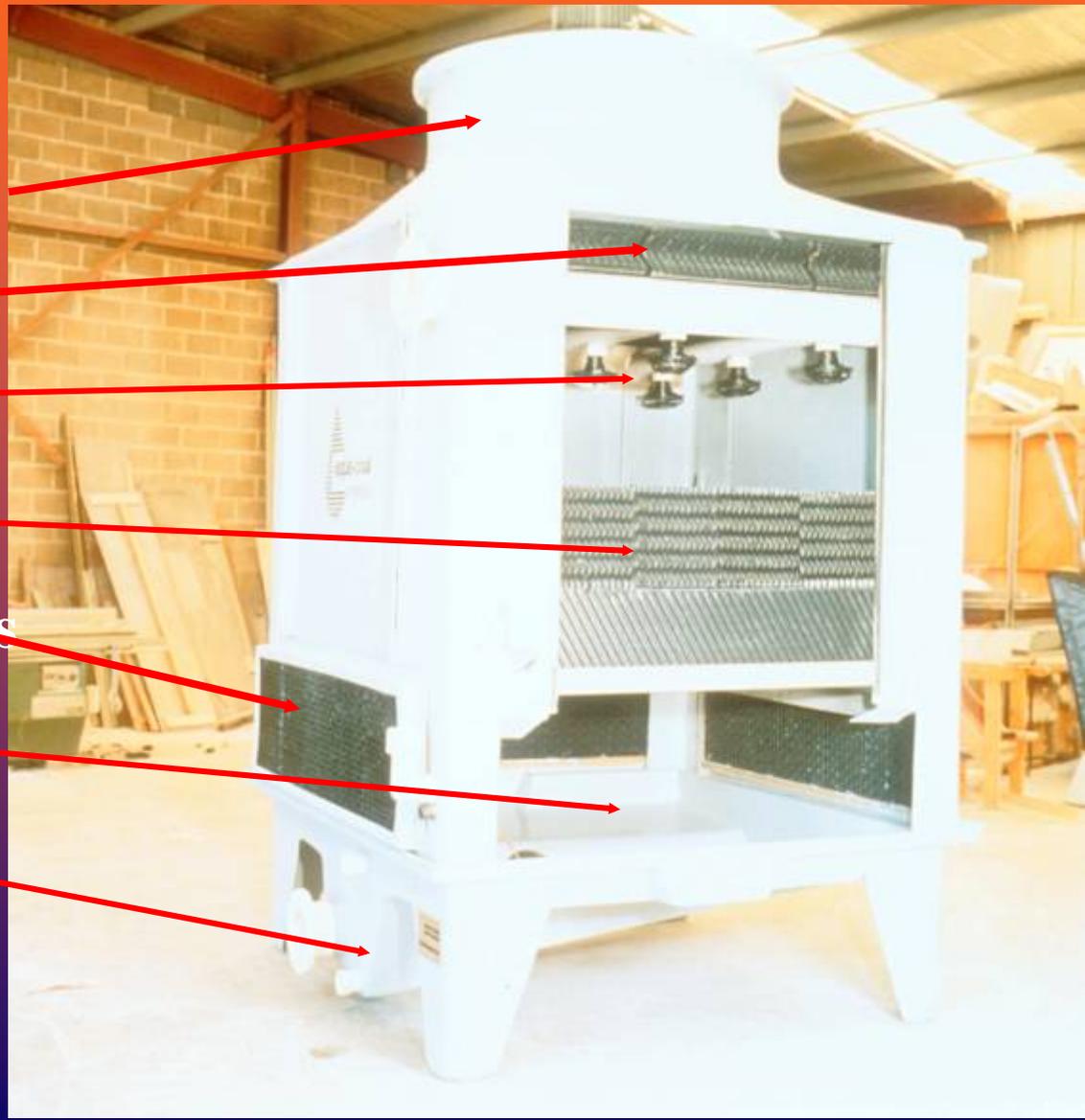
Distributor – spray nozzles

Fill

Intake solar & splashout filters

Basin

Sump

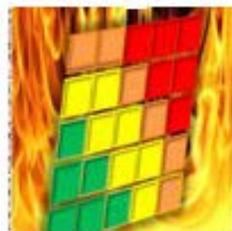




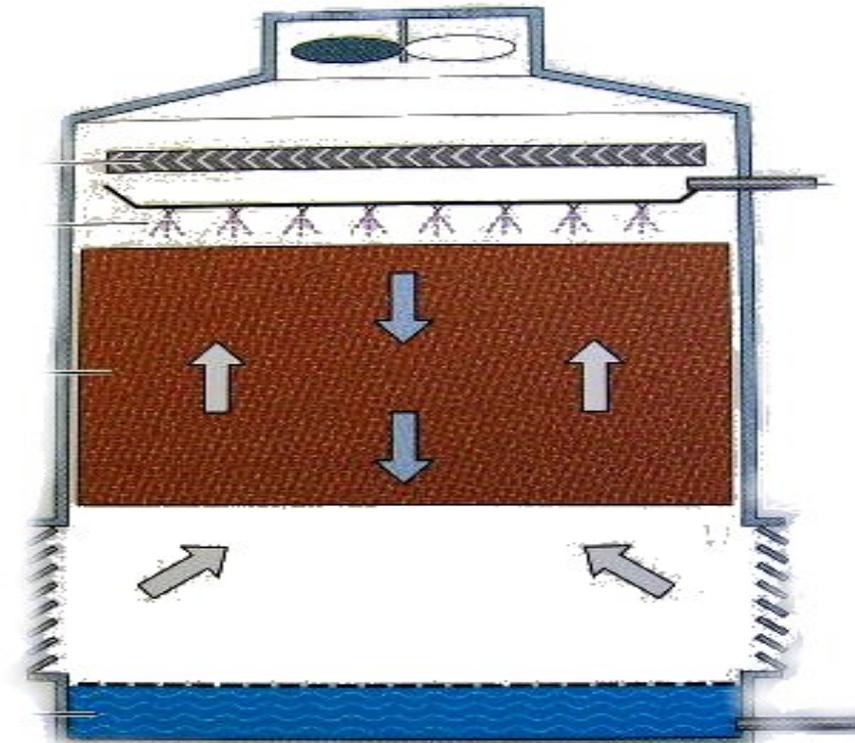
Cooling Tower Types

Induced Draft Counterflow

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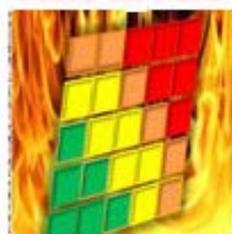




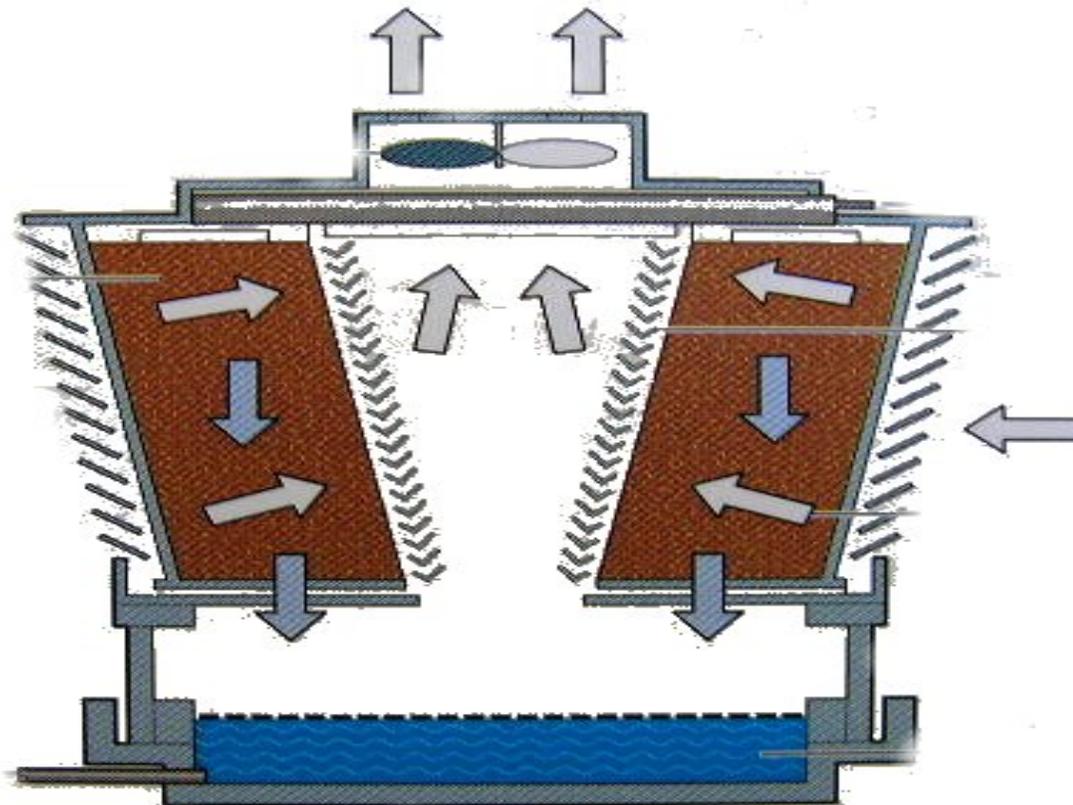
Cooling Tower Types

Induced Draft Crossflow

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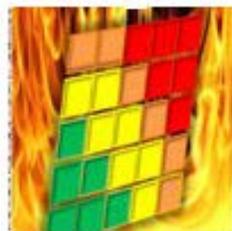




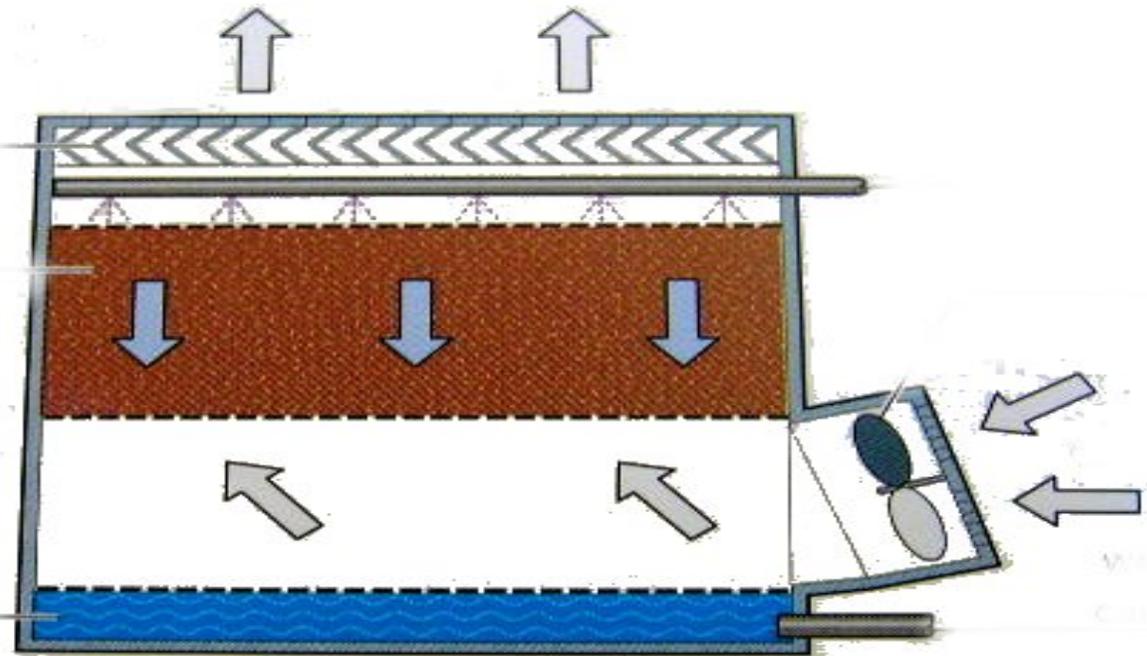
Cooling Tower Types

Forced Draft Counterflow

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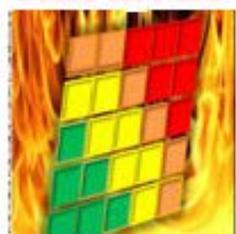




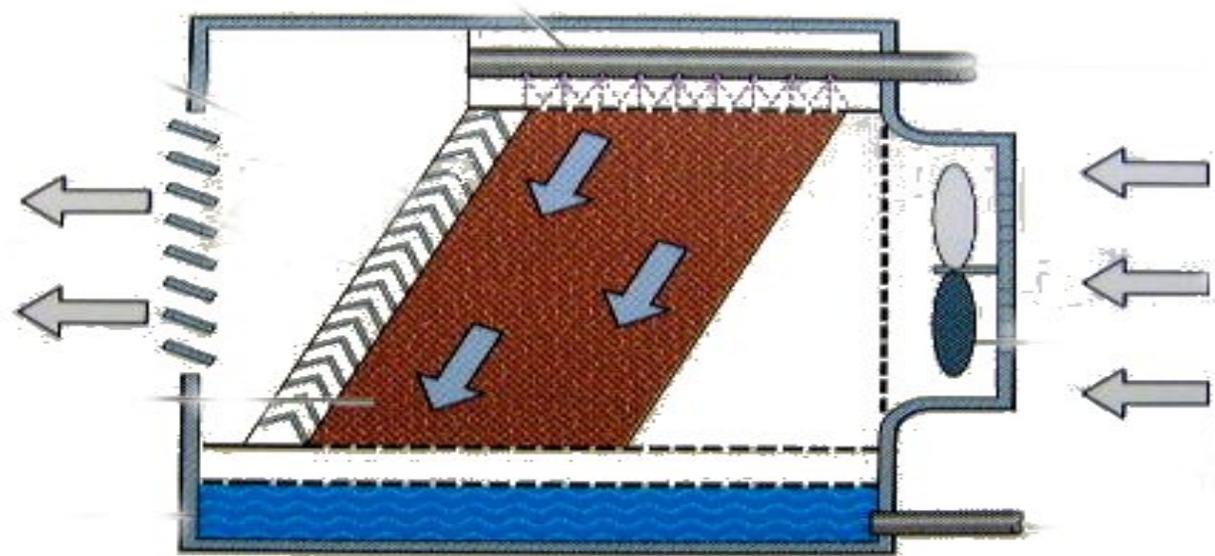
Cooling Tower Types

Forced Draft Crossflow

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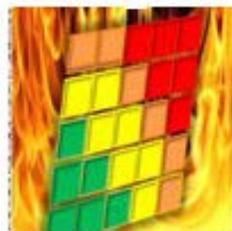
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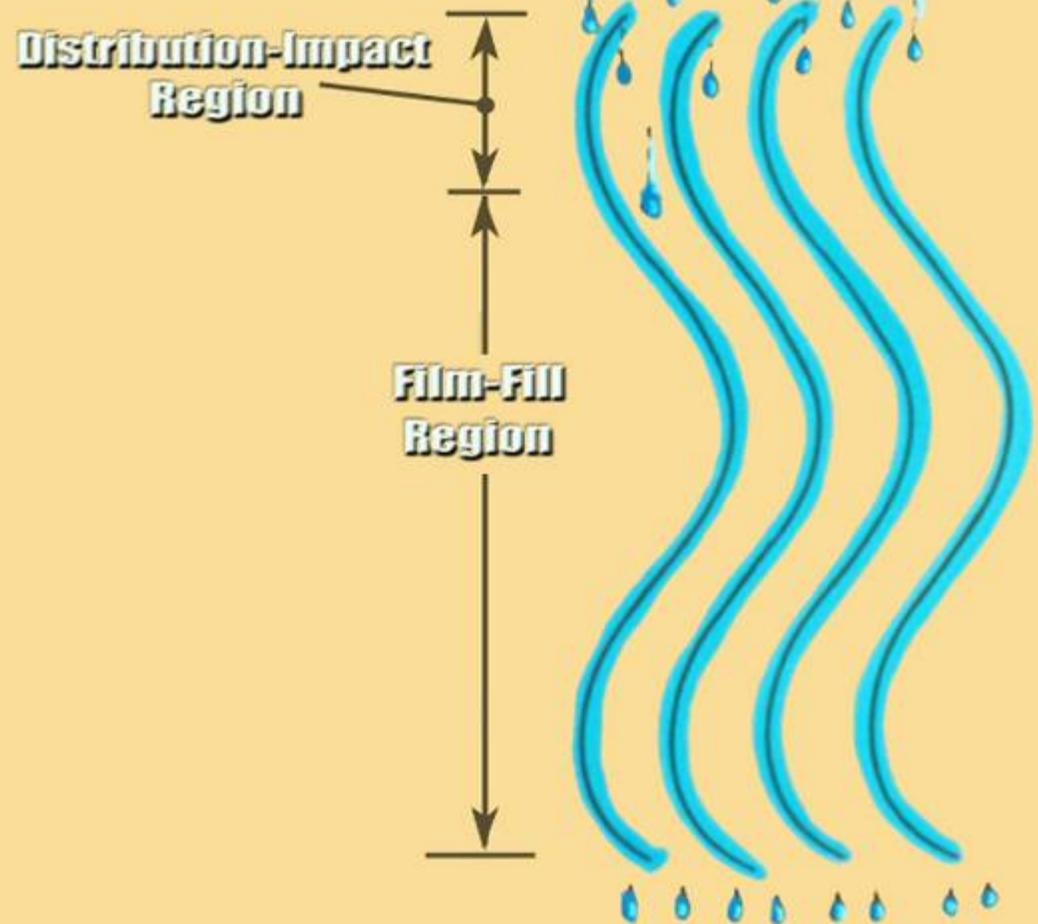
Film fill

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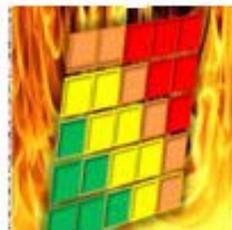
FILM -TYPE FILL PACKING





Fill clogged

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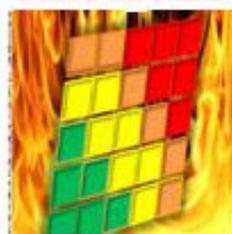
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Modern Fill media

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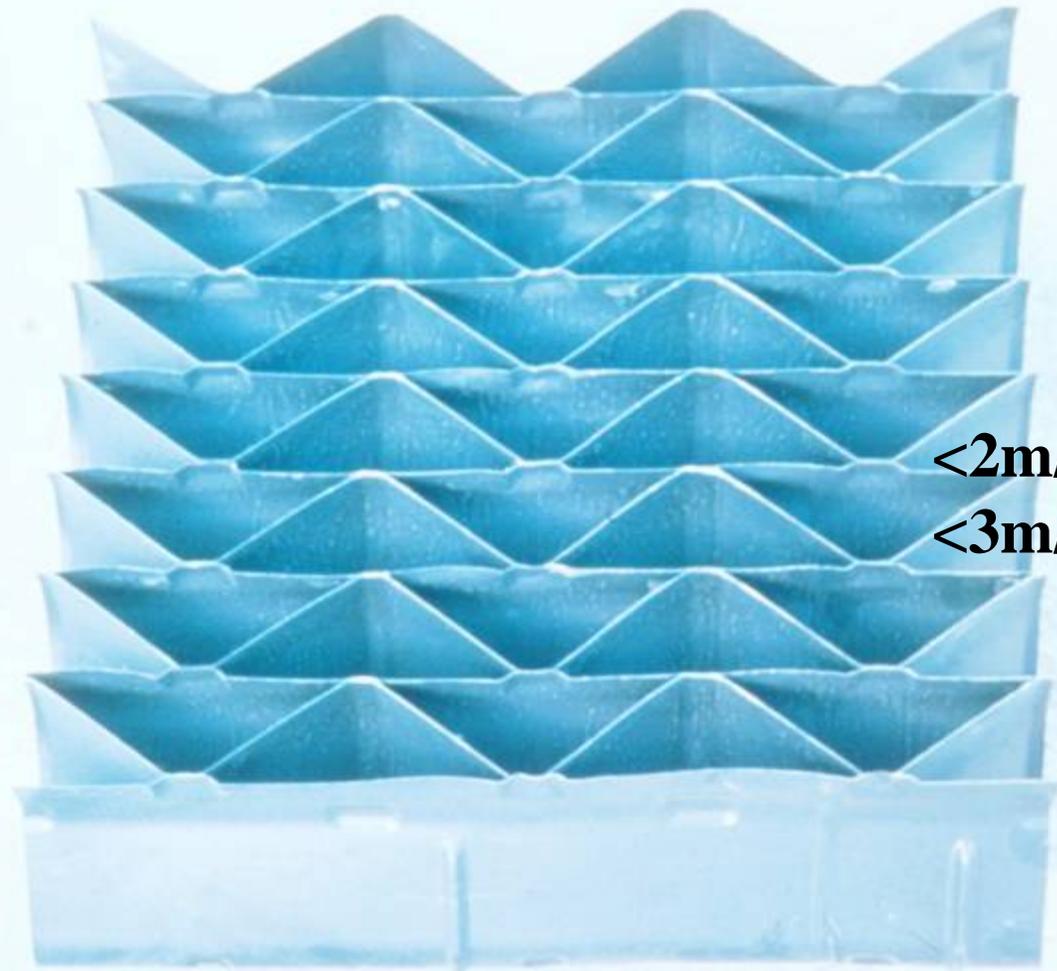
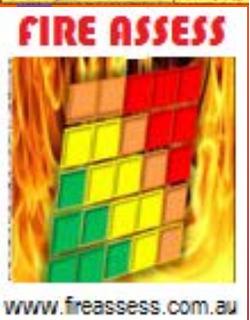


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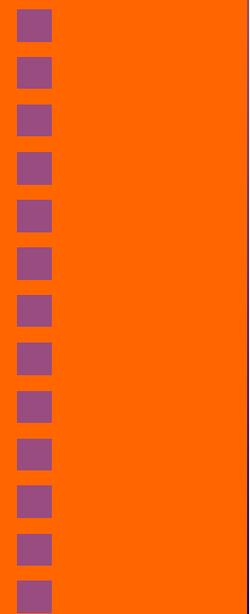




Drift eliminator



<2m/s = best
<3m/s = ineffective





Drift eliminator

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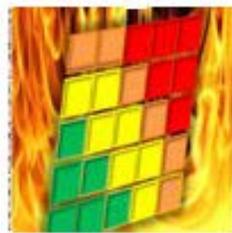


drift eliminator



Drift eliminator

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Drift loss

- Droplets in exhaust
- Water consumption
- Chemicals emitted
- Energy impact
- Health impact

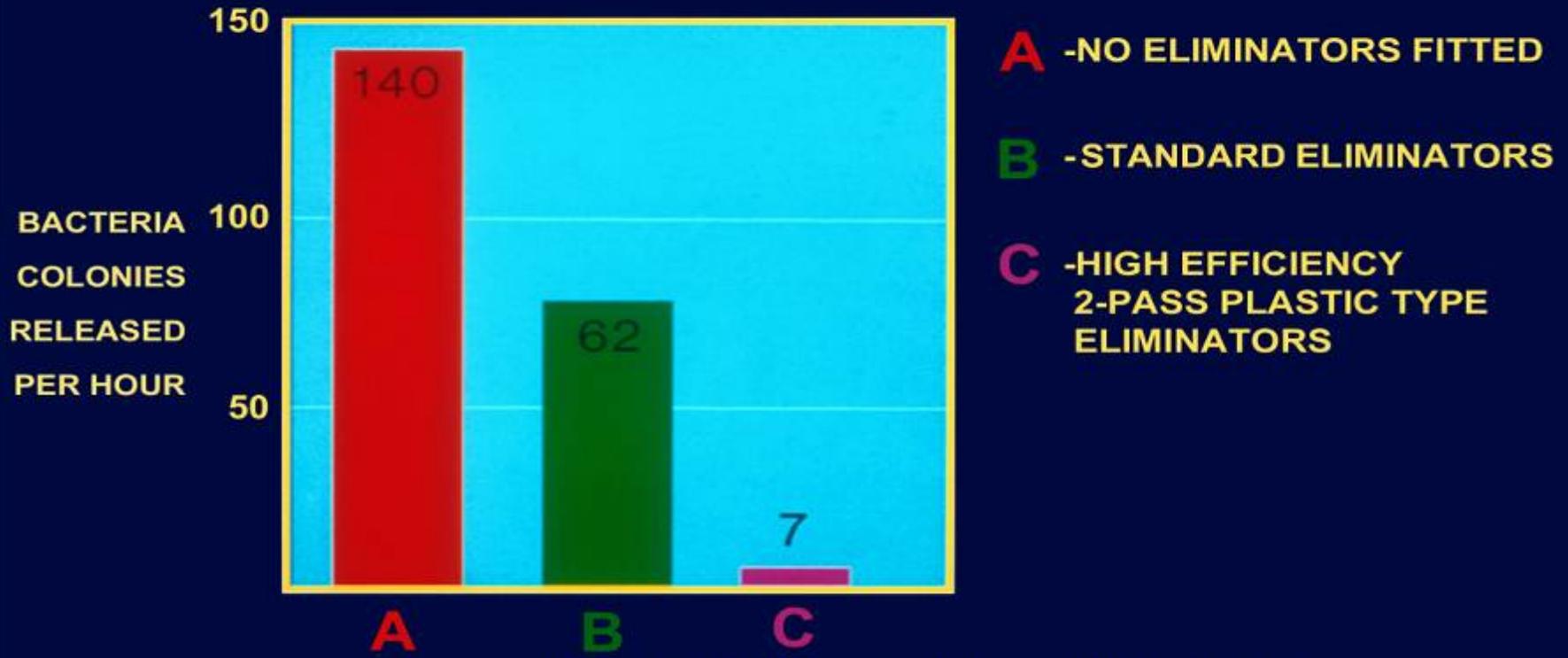


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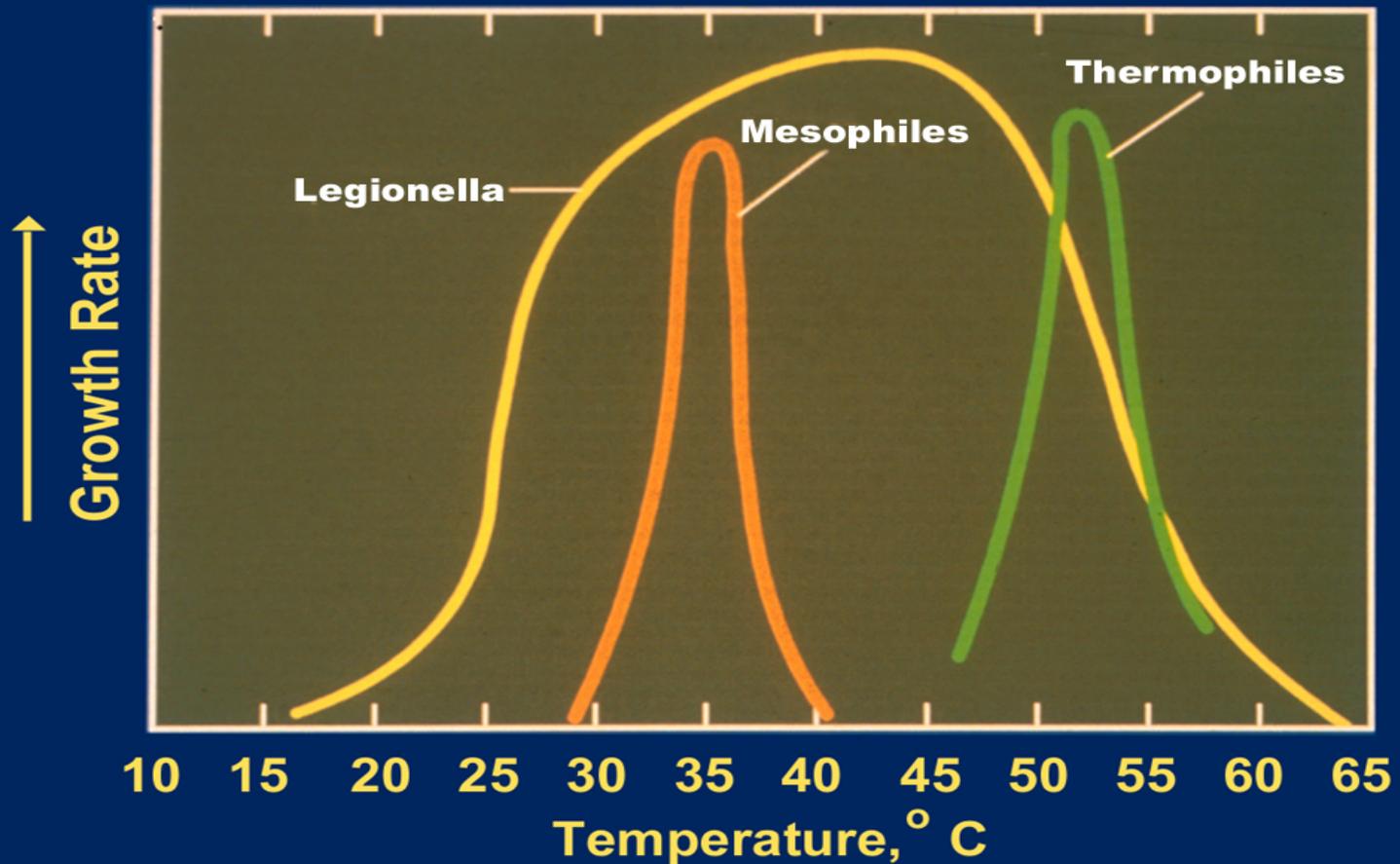
Legionella and drift eliminators



(Source-Dr. P.J. Dennis of Thames Water Services)



Temperature dependence



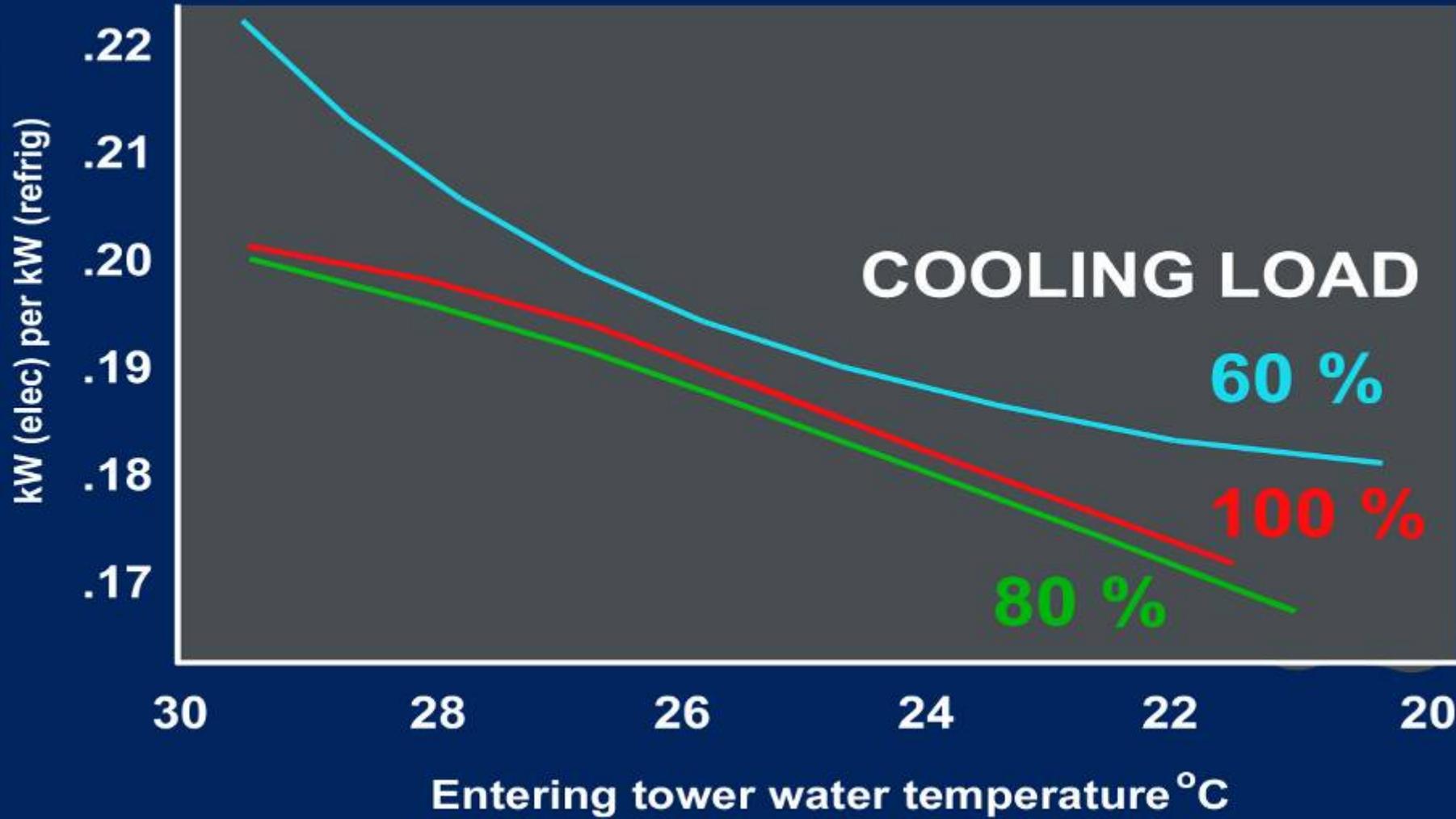


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kW v. Cooling tower water temperature





Cooling tower water temperature

Other considerations:

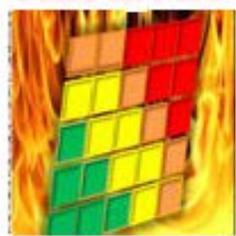
What sort of equipment is this condenser water supplying

If supplementary A/C or screw chillers are connected, you should get expert advice before you lower the condenser water temperature as you could liquid slug the compressor/s and cause substantial damage.

On the other hand a modern centrifugal or reciprocating chiller would operate very well at much lower temperatures



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Water treatment at cooling towers

- Control of scale & fouling
- Control of corrosion
- Control of microbiological organisms



Biocides

- Purpose

Control of microbial population, minimise fouling

- Two types

Oxidising - act by damaging cells. Fast acting, effective against wide range, rapidly used up and non-penetrant

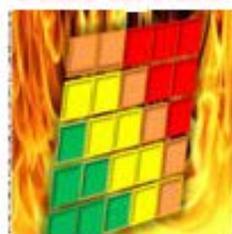
Non-oxidising - act by poisoning cells. Slower acting, activity may vary between organisms, less rapidly used up, and penetrant

Effective biocide treatment depends on suitable contact time at the correct dosage

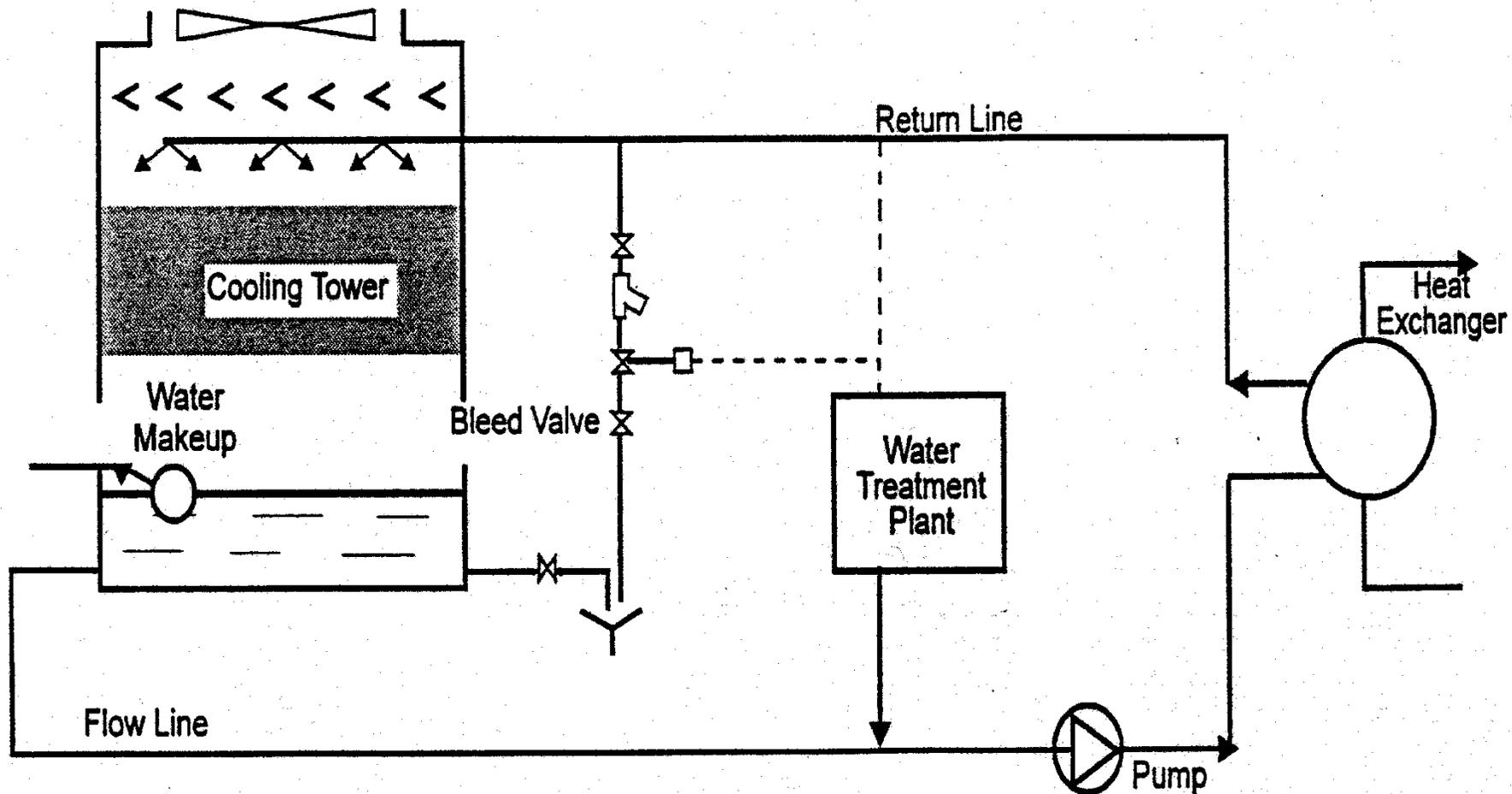


Biocide dosing

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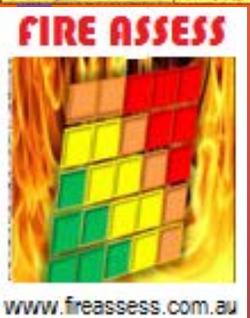
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Effect of decontamination on cooling tower water *Legionella* concentrations

- Mean time from detected and sterilised, till undetected
= 5.0 +/- 5.0days
- Mean time once clear, without biocide to redetected
= 16.5 +/- 10.7 days



Results of biocide challenge tests on *Legionella* tower water

Biocide	n	Days to Zero	Days to Return	n ✓	T.B.C Drop
Fentichlor	9	6.0	20.1	8	No
BCD	9	5.7	17.3	9	Yes
BNPD	11	16.2	7.5	5	No
Chlorine decontamination	20	5.0	17.0	20	Yes

n = number of challenges
n ✓ = number of successful challenges



ASHRAE biocide study

Cyanocarbonate

- carbamate (454 ppm)

- Ineffective

Polymeric quaternary

- amine (80 ppm)

- Ineffective

Isothiazolin (150 ppm)

- Ineffective

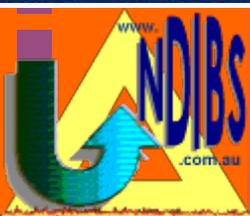
Glutaraldehyde (150 ppm)

- Effective but short lived
(24 to 72 hrs)

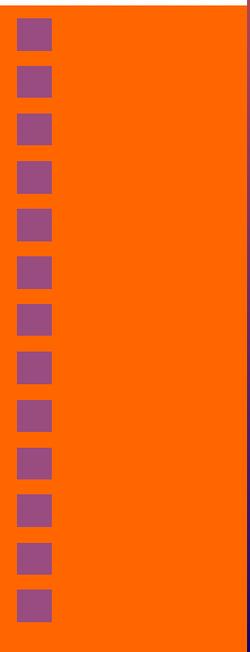
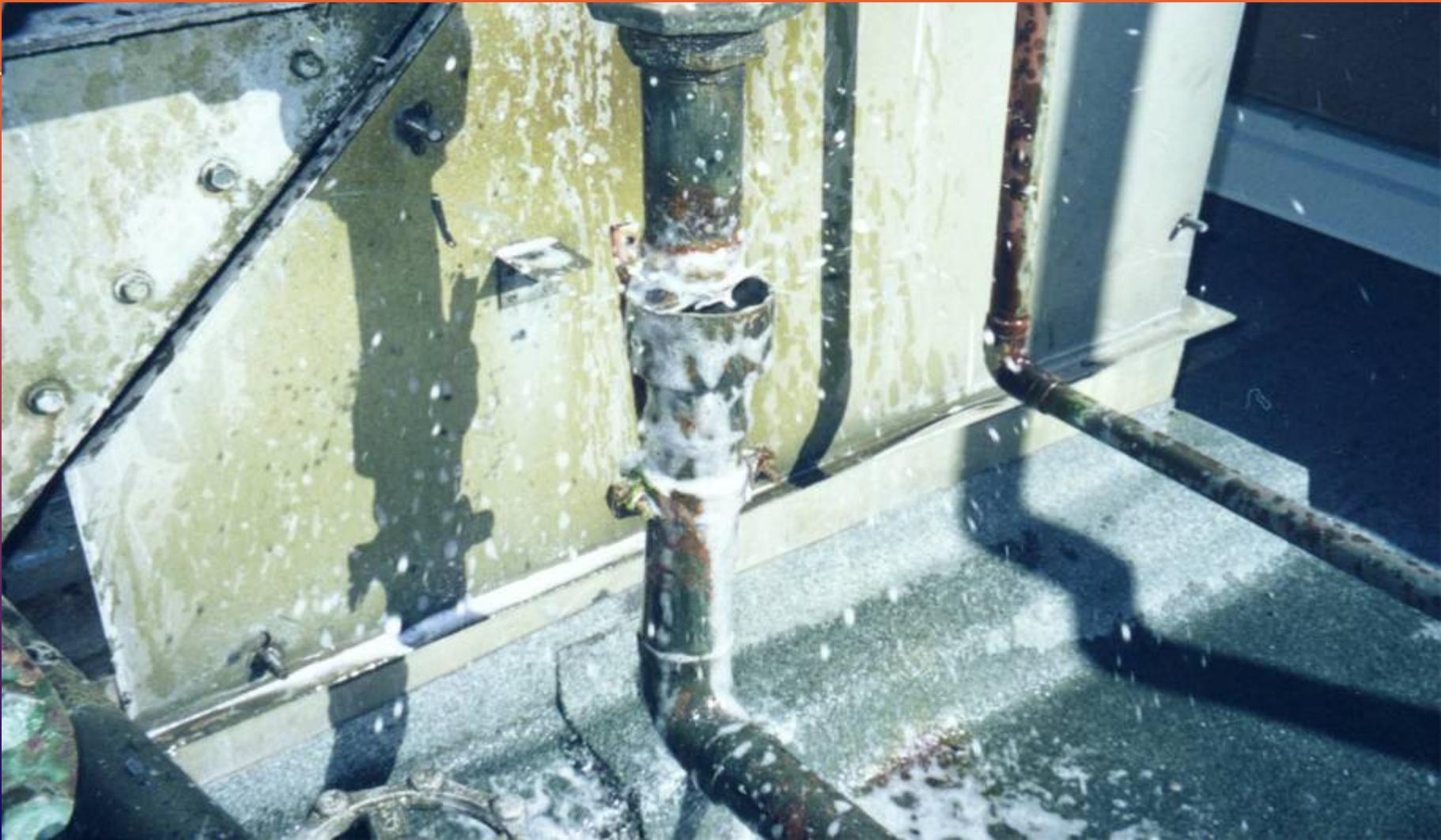
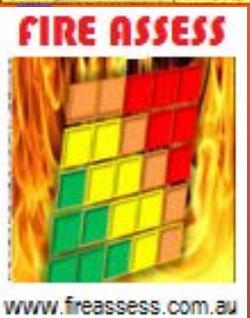
BCD (10 ppm)

- Effective while 0.2 to 1.0 ppm
free chlorine residual maintained.
Economical and reliable

**Conclude: “uniqueness of each site must be considered
when developing any treatment regime”**

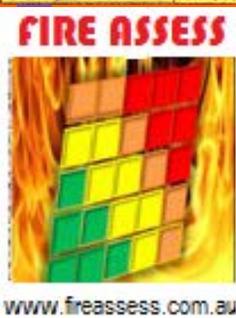


Overflow – chemical loss





Spills

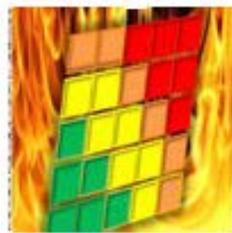


Chemical containment bunding is required



Containment

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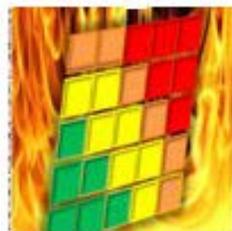
www.fireassess.com.au



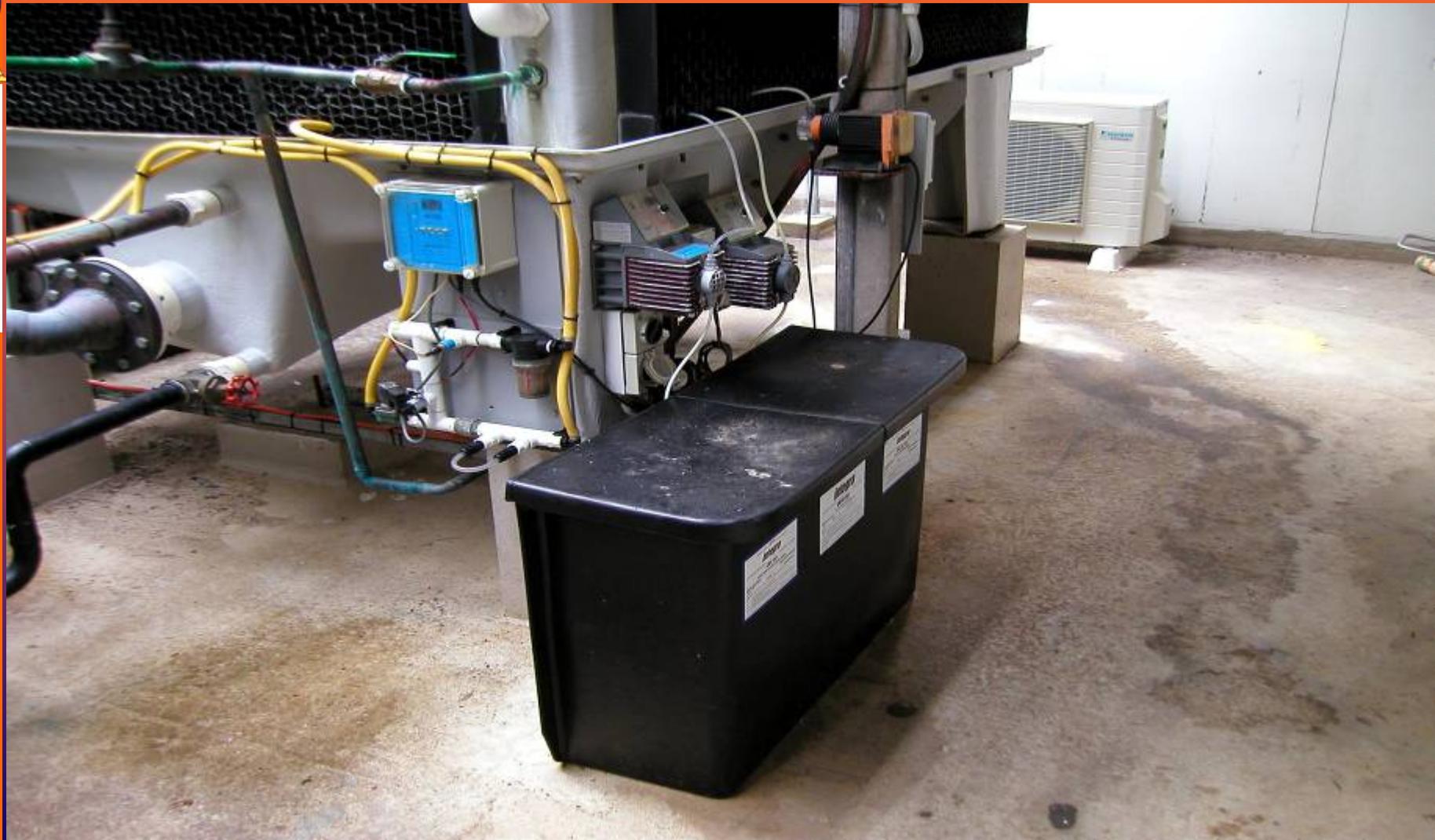


Containment

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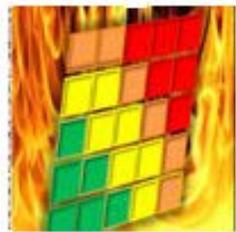
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Containment

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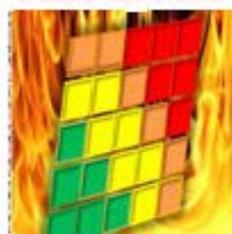
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The old way

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The drip feeder was derived from a hospital saline drip.

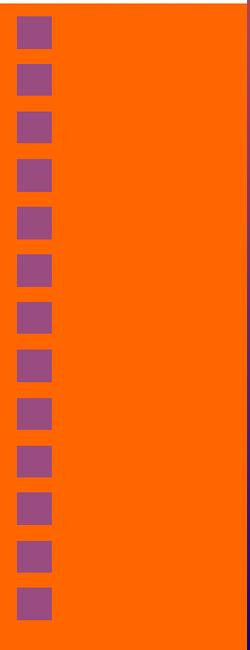
It was developed in Australia *by Ruben Roberts of Maxwell Chemicals after a stay in hospital where he was placed on a drip feed*

While it was cheap... its reliability was/is questionable and it did not respond to system changes or operation





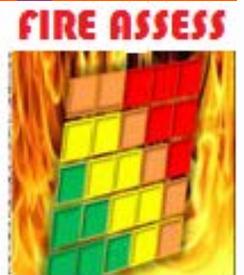
Nutrients



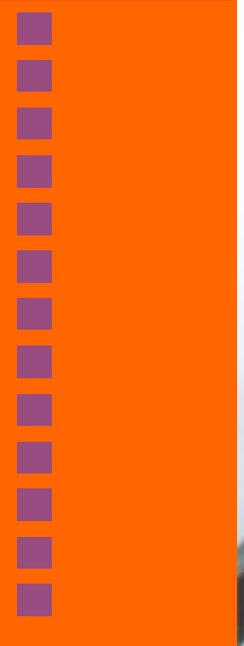
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NEW DIRECTIONS IN BUSINESS SAFETY® FIRE ASSESS™



Windage



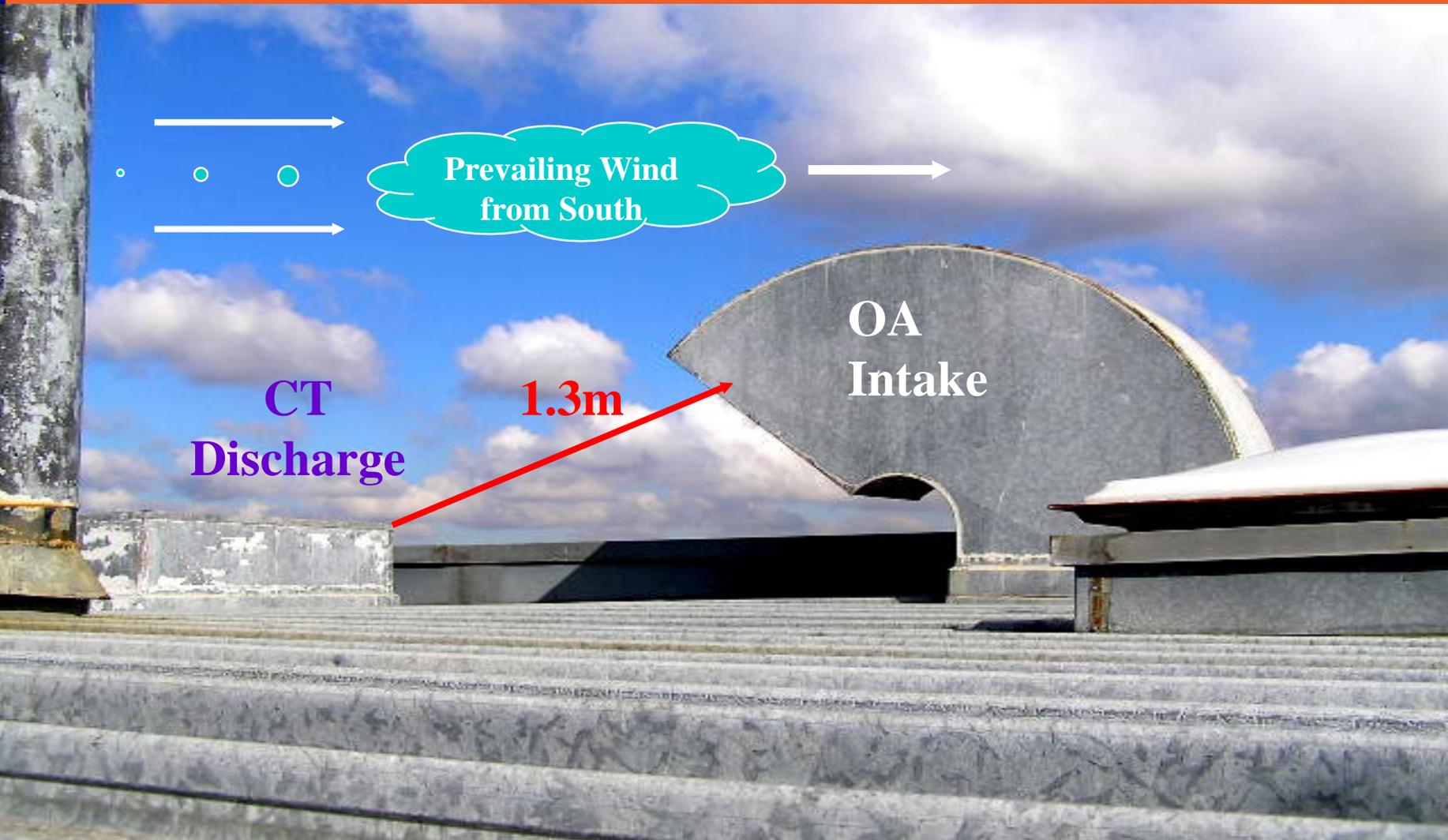
www.fireassess.com.au





The NDIBS logo features a stylized 'U' and 'A' with the text 'NDIBS' and 'www.ndibs.com.au'. Below it is the 'FIRE ASSESS' logo with a colorful grid pattern and the website 'www.fireassess.com.au'.

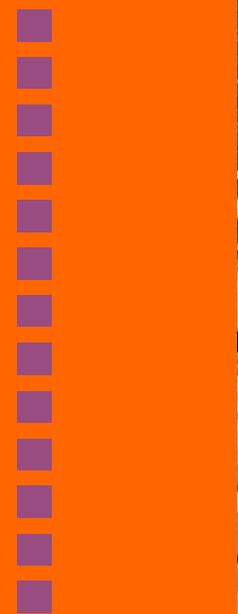
Windage



CT
Discharge

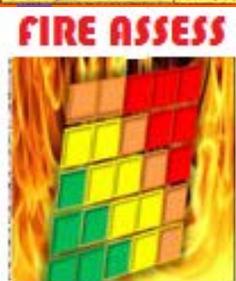
1.3m

OA
Intake





Algae on the top deck



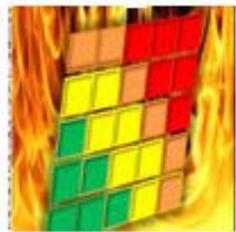
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Algae in the basin

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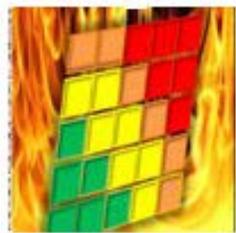
www.fireasses.com.au





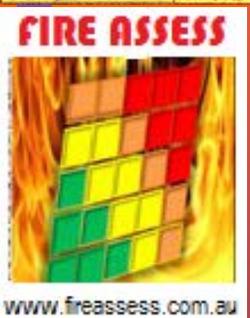
Future connection - problem

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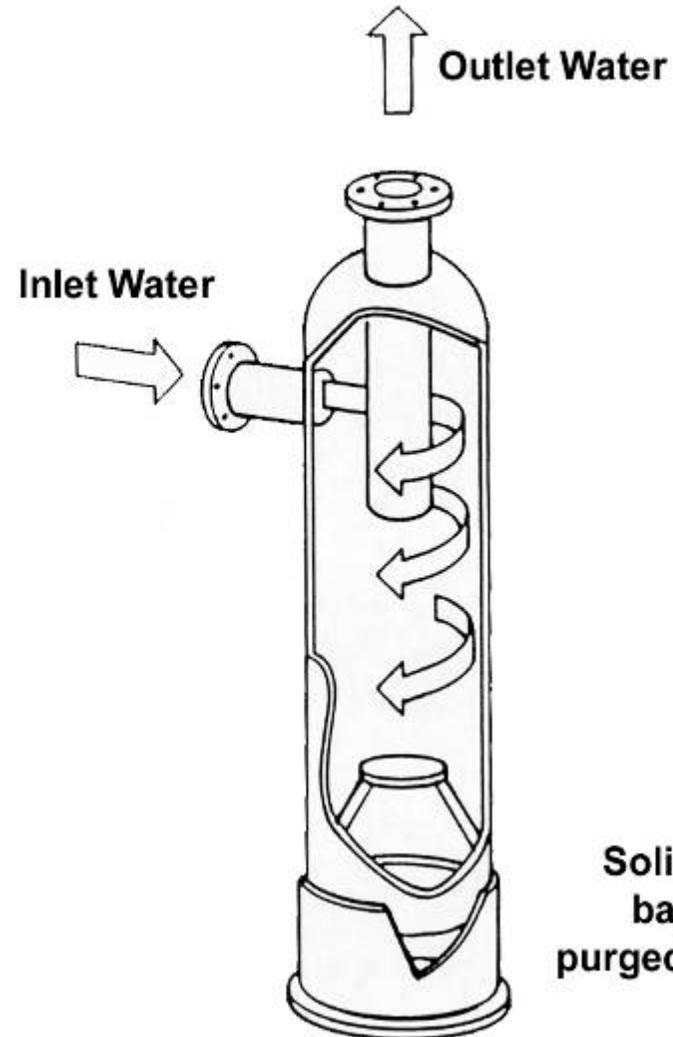


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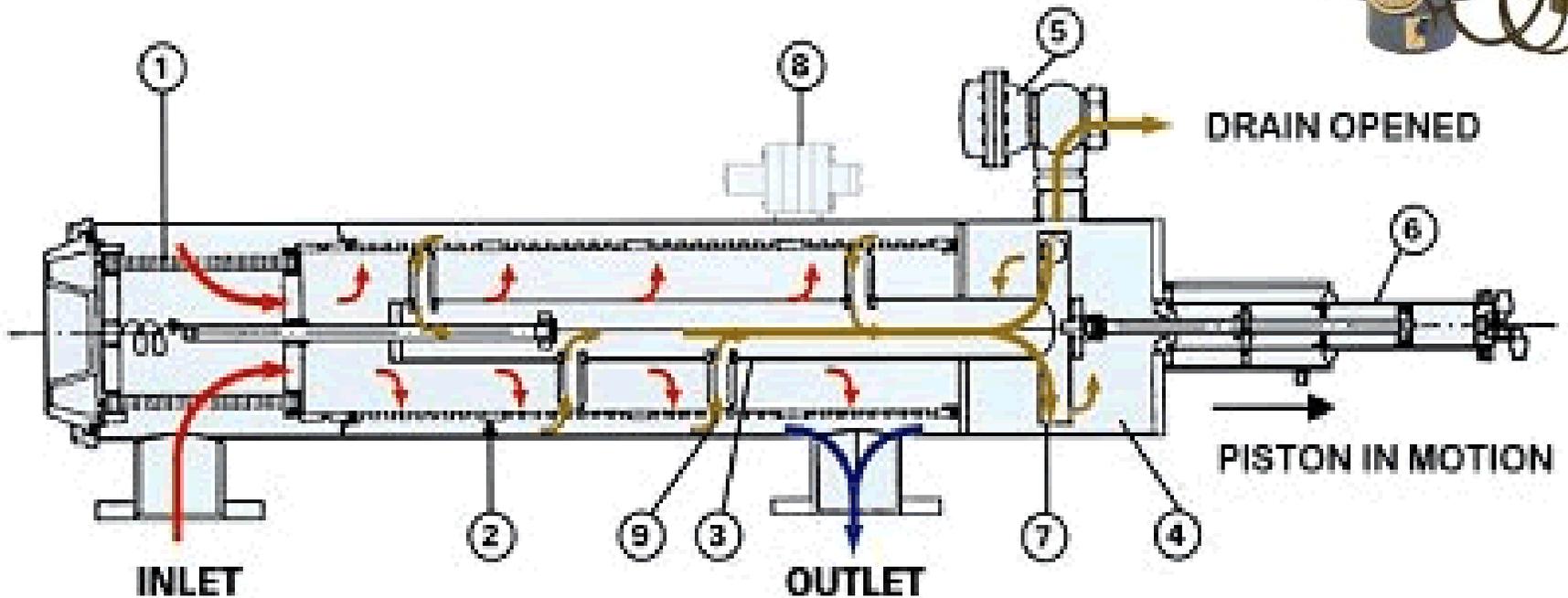
Centrifugal separator



Solids collect in base and are purged automatically



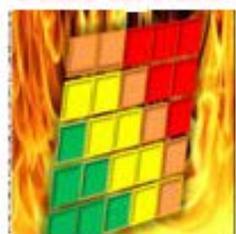
Self Cleaning (side stream) filters





Sand filters

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Tracking through sand means that the chemicals fail to disinfect at the bowl perimeter.

When exposed to sunlight incubation occurs, elevating microbial growth

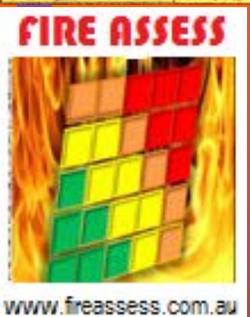




Spray nozzles

Damaged or broken nozzles mean ineffective distribution





IR20070213_0757

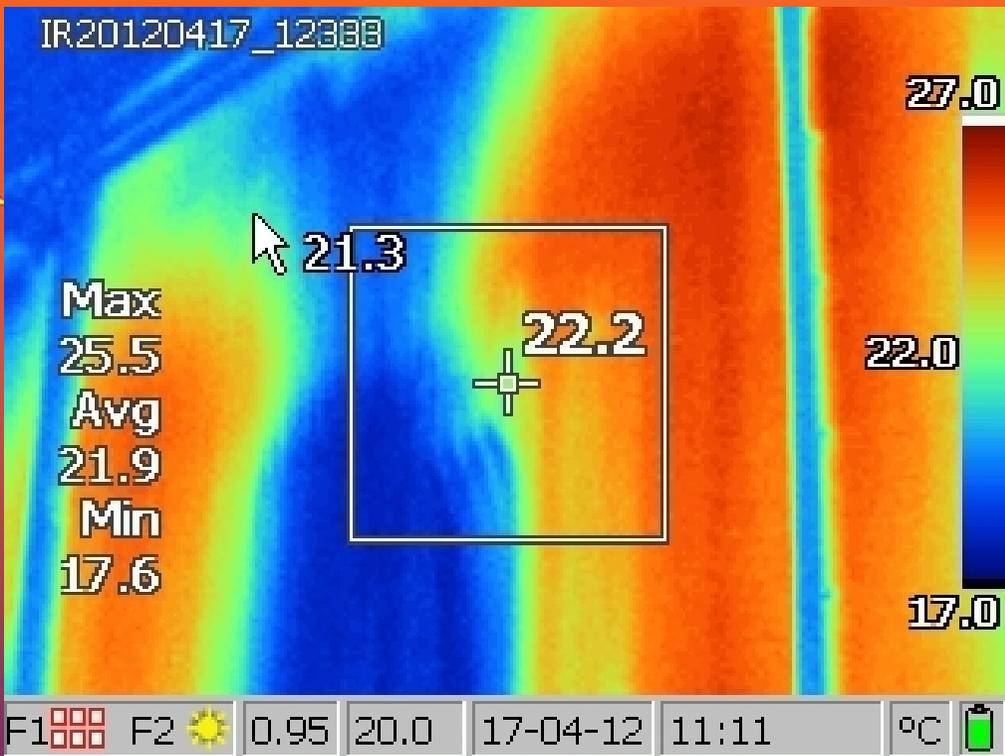


Max
38.3
Avg
33.4
Min
25.3

F1 F2 0.95 20.0 13-02-2007 12:23 °C

Distribution





Distribution

Fill not sealed into retainer allowing water to bypass fill.





Dosing Pumps

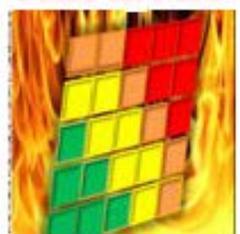
Recently audited active system

Biocide dosing **peristaltic pump bladder** had been inoperative for some time.

No service record describing this malfunction

This type of pump should never be installed exposed to direct sunlight

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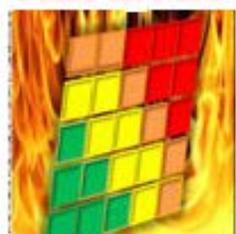




Deadleg

– bacterial growth, biocide ineffective

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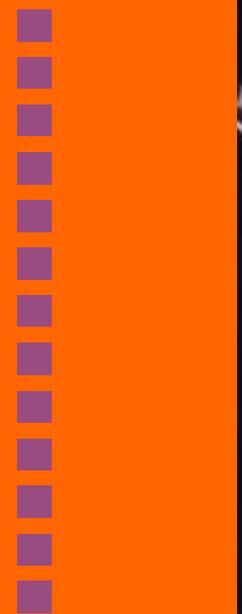
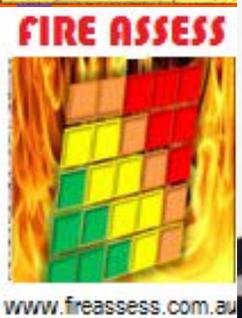


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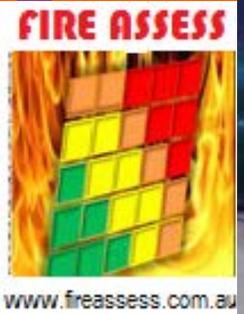


Removal





Deadleg



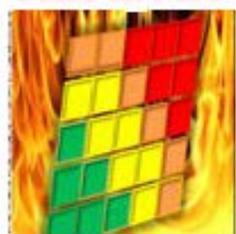
REMOVE

Importance of cleaning strainers as part of cleaning system routine (after fully circulating)

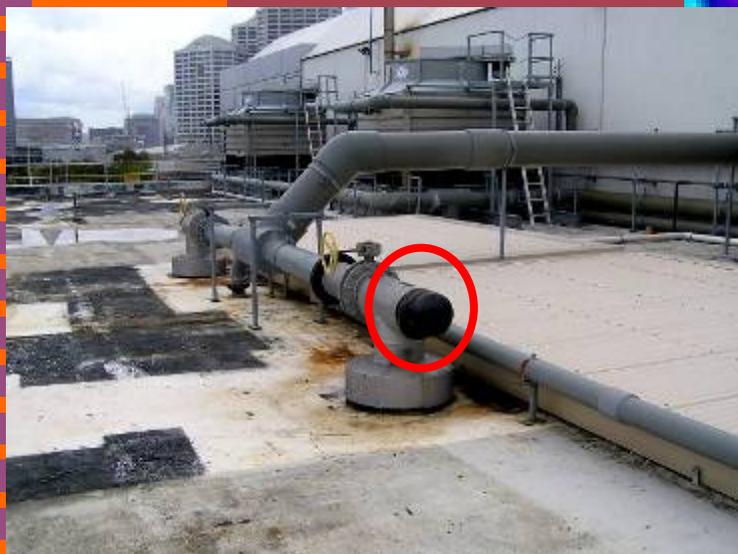
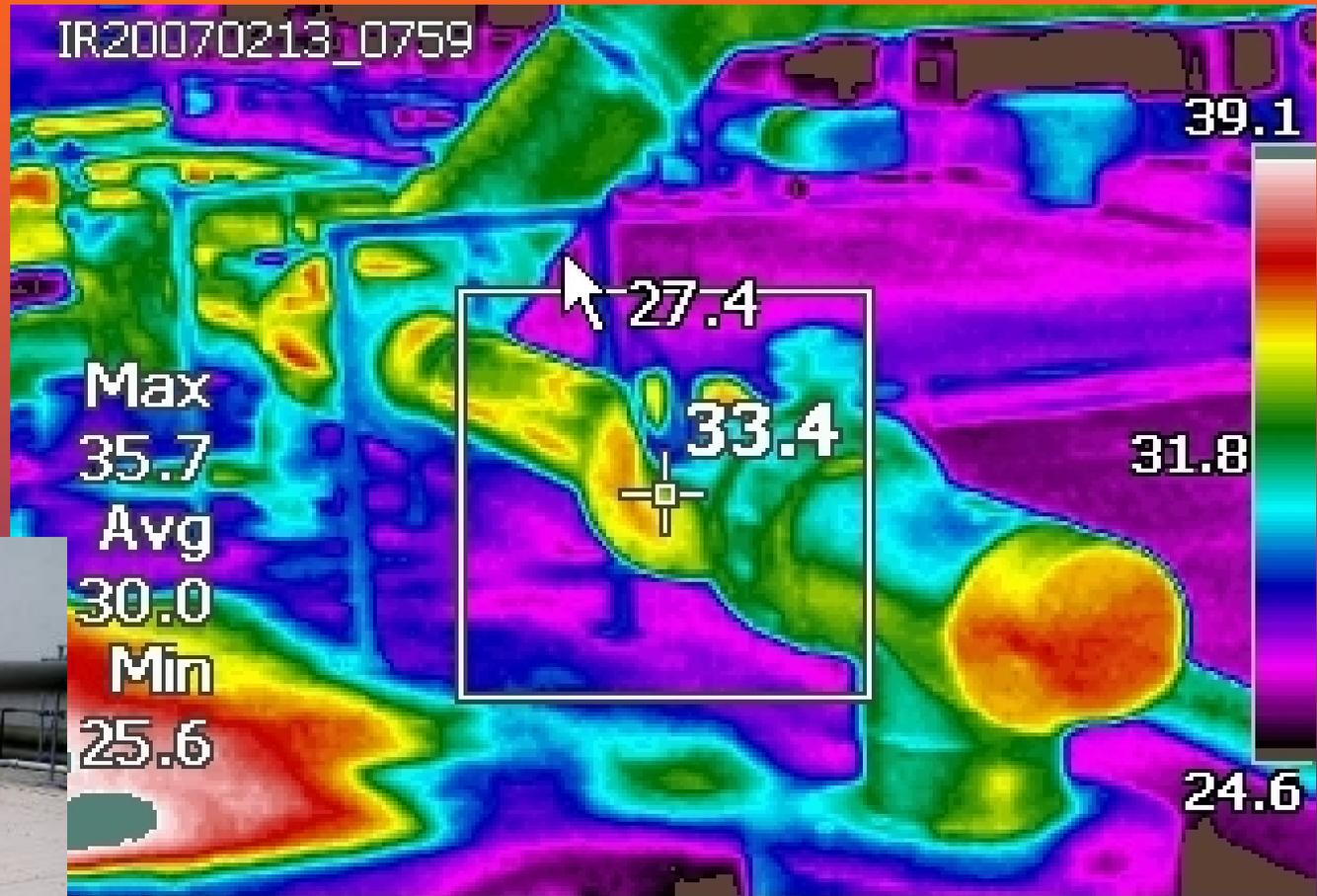


Deadleg

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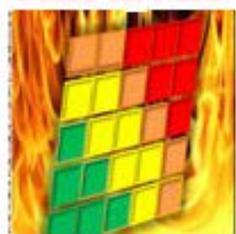


F2 ☀ 0.95 20.0 13-02-2007 12:25 °C 🔋



Deadleg

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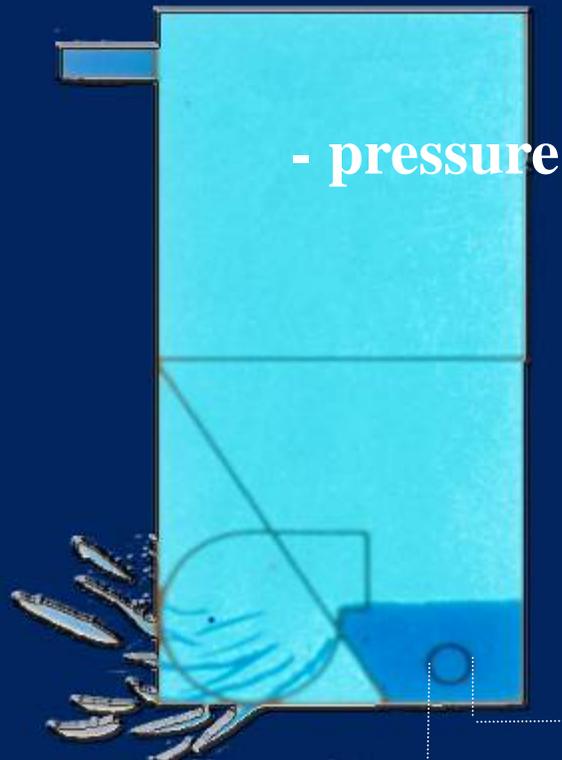
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Towers imbalanced

(Overflow)

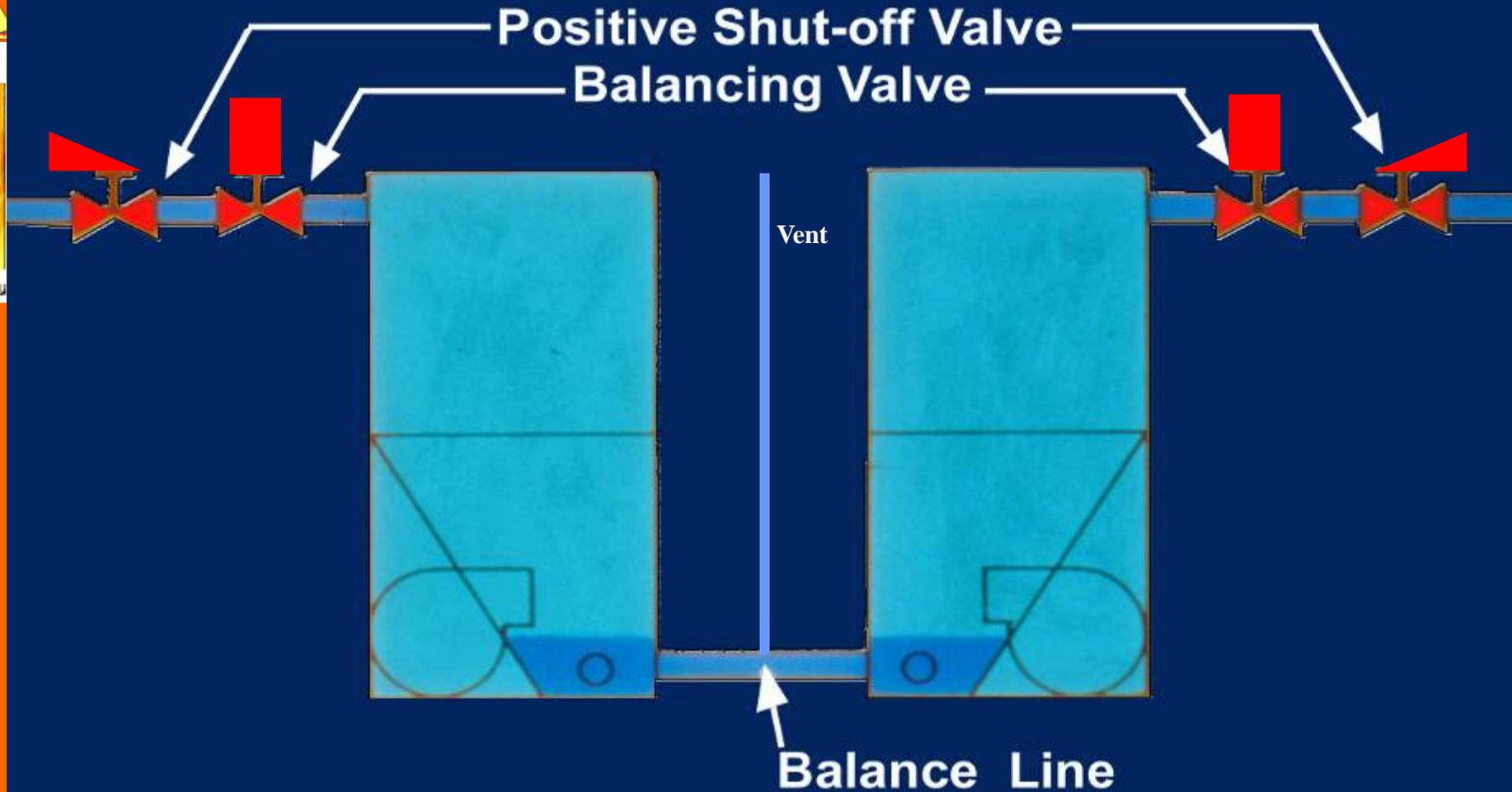


(Drawing Air)



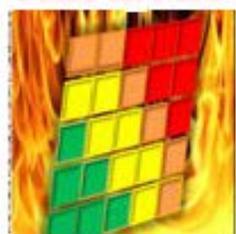


Piping guidelines





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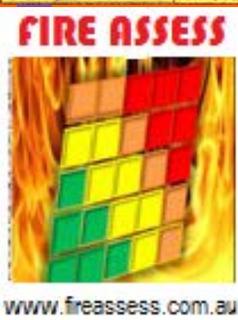
Balance line – drain or purge



Balance line should be level and ideally the same diameter as the suction pipe

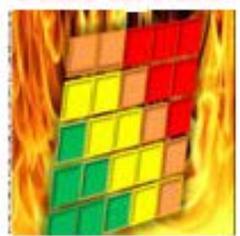


Balance line too low





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Small water systems - predilection

-  No outbreaks from power station towers
-continuous
-  Many outbreaks from evaporative condensers
-intermittent
-  Ratio area-to-volume

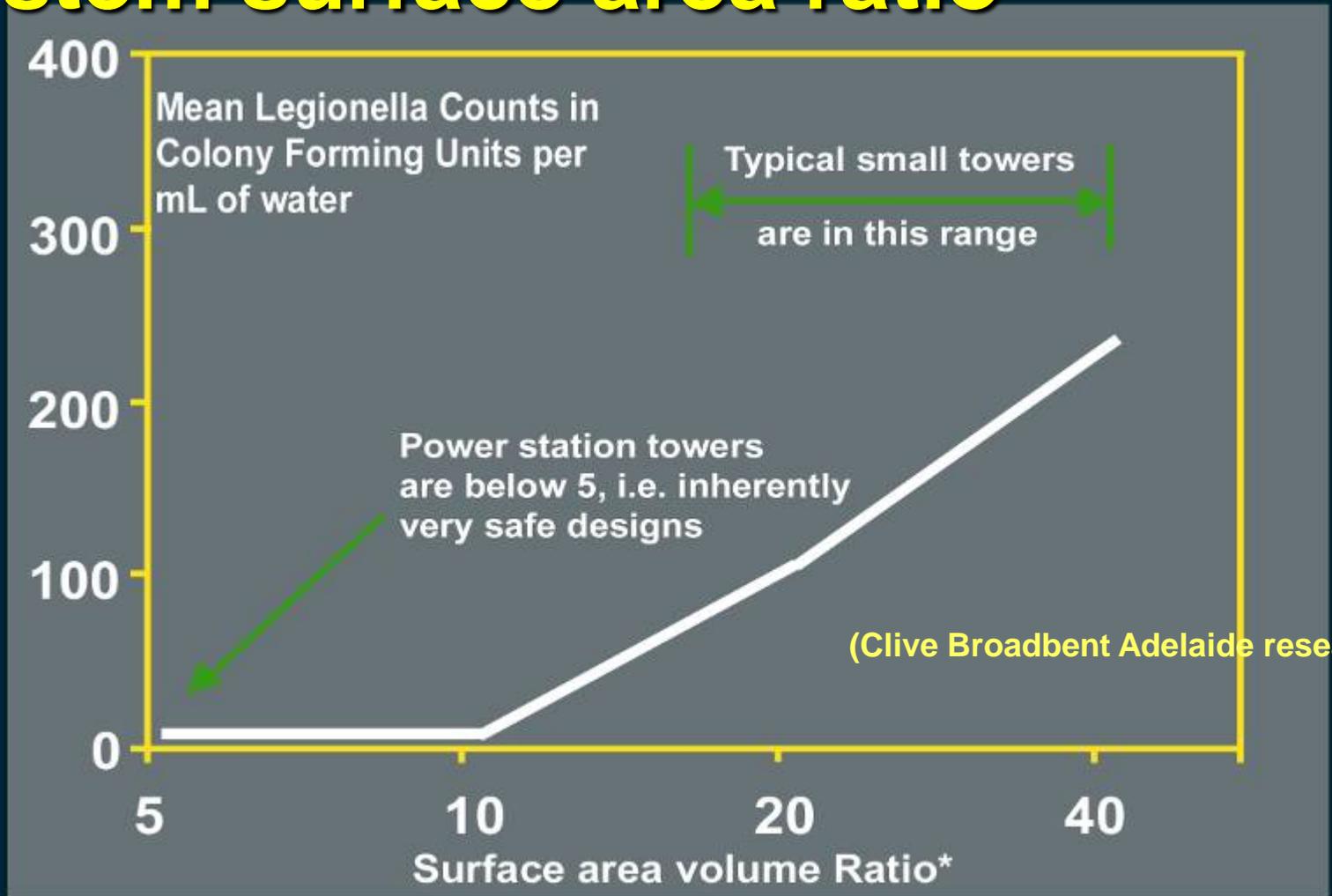


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System surface area ratio

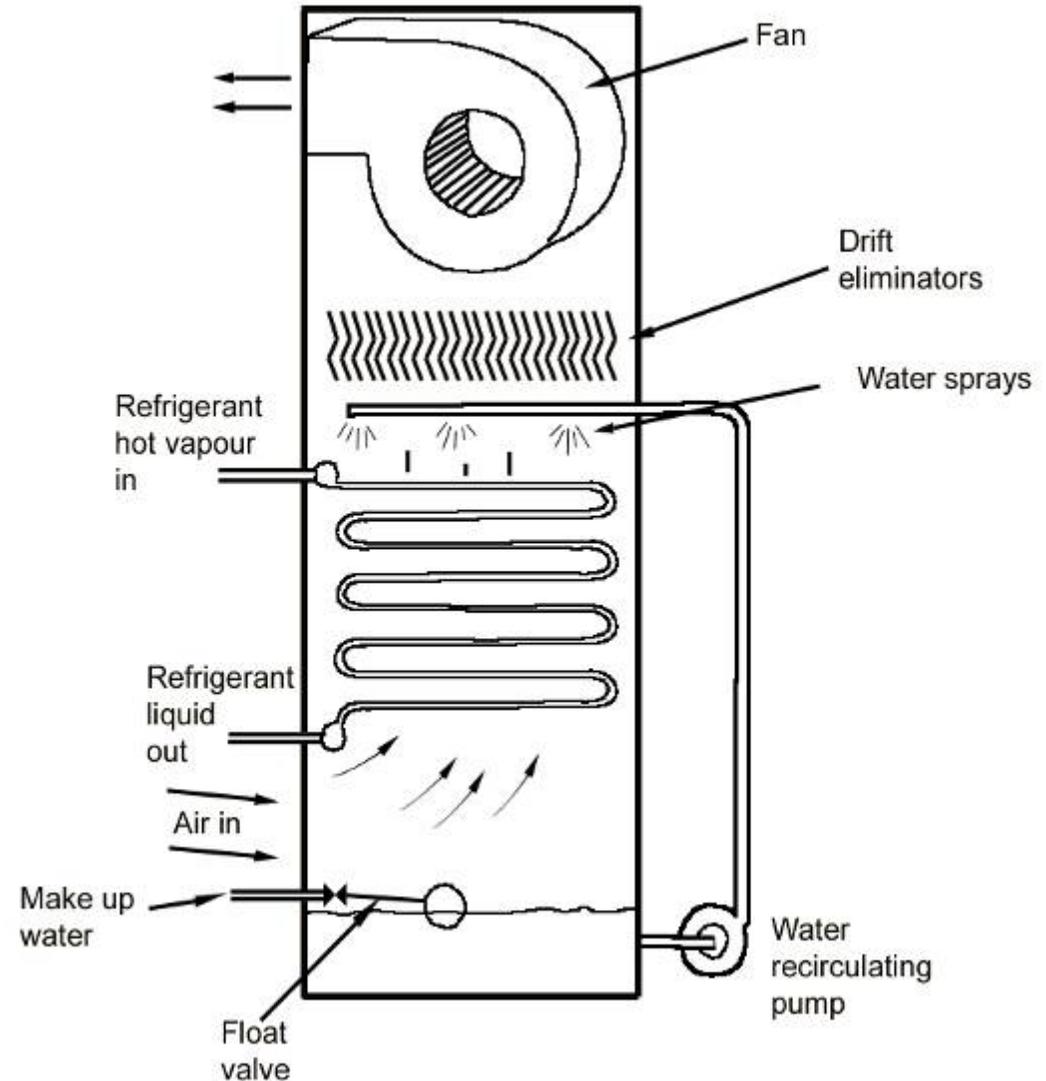


*Surface areas calculated from permanently wet surfaces only (consitent units)



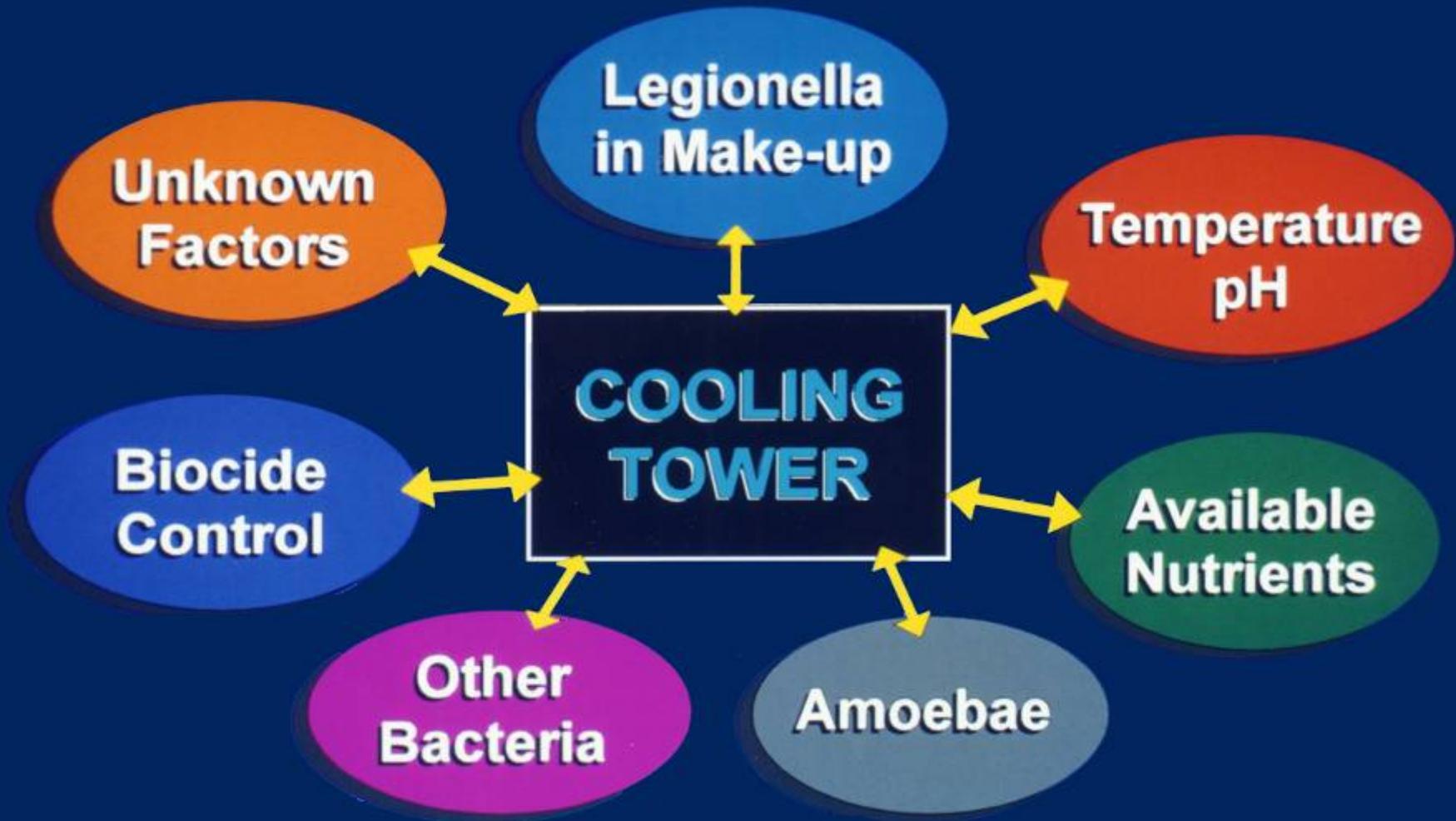
Evaporative condenser

Water temperature has very little difference (ΔT)



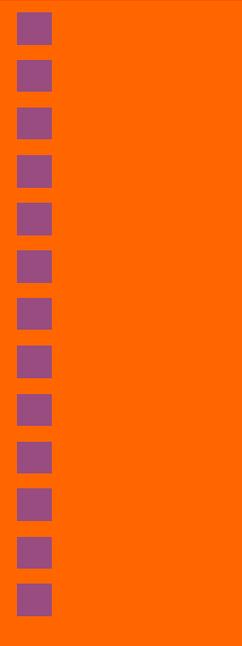


Factors influencing *Legionella* growth





Take a break....





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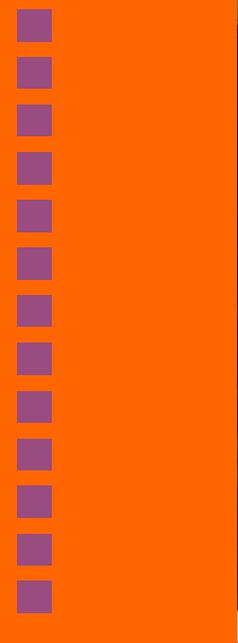
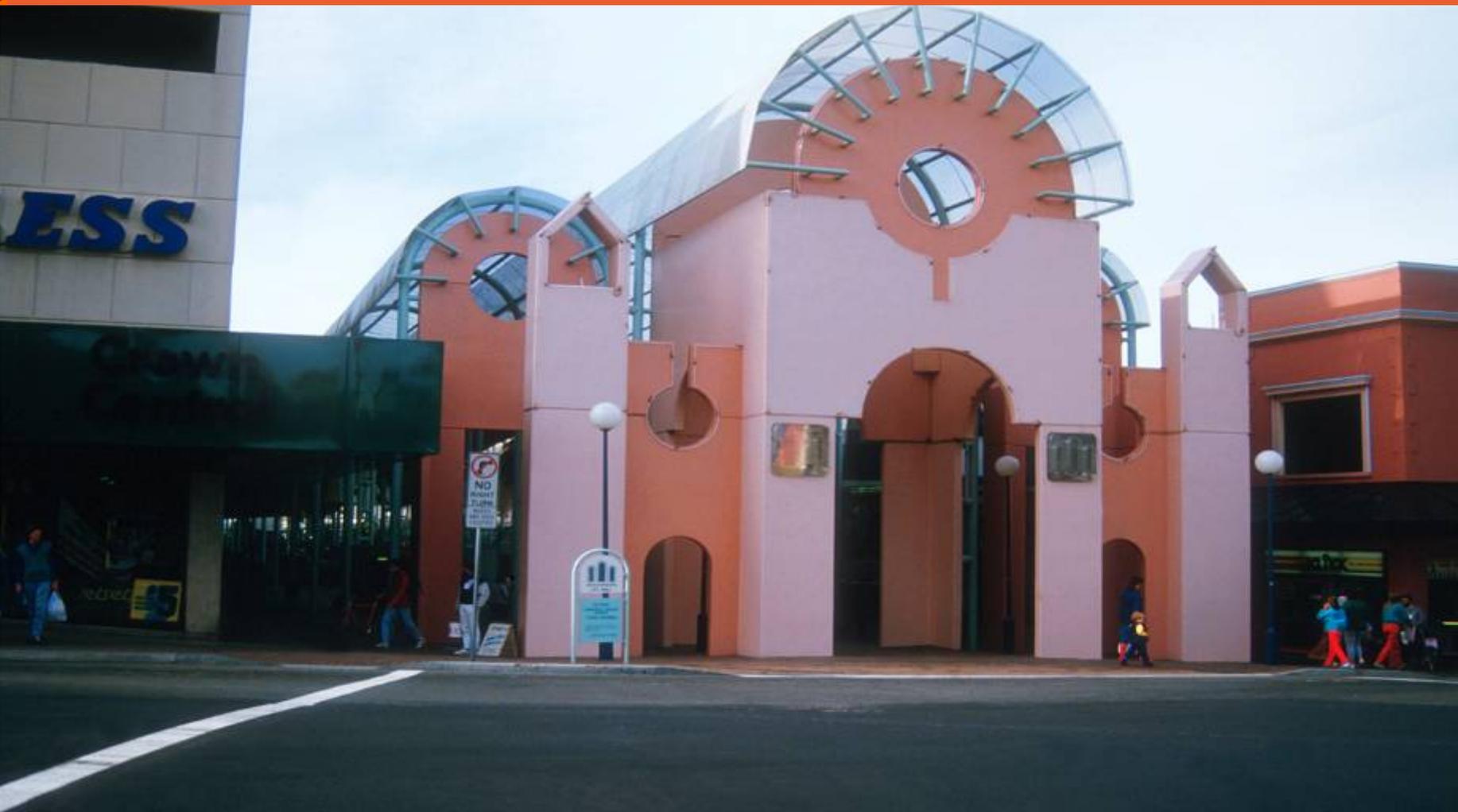
4. Commissioning and Maintenance



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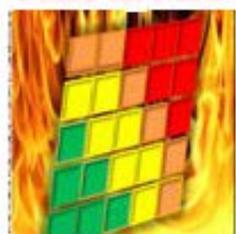


Wollongong





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Outbreak source - stagnation

Chemist shop A/C
Proprietor didn't use
A/C during week,
Weekend manager
switched it on as soon
as he entered the shop





Barrow-in-Furness



Previously known for:

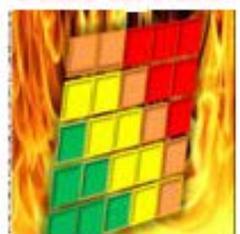
-  **Vickers-Armstrong, now BAE Systems**
-  **Nuclear submarines**
-  **Port**

Now also known as a place where:

-  **7 people died and over 40 were effected with Legionella**



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Source

Maintenance access covered
Extremely poor installation
design.

While all this poor design
contributed there was also
very poor maintenance

Council Contracts Manager
terminated service agreement
and was charged with
Industrial Manslaughter





The logo for NDIBS (New Directions in Building Services) is displayed, featuring a stylized 'U' and 'A' with the text 'NDIBS.com.au'. Below it is a graphic for 'FIRE ASSESS' showing a grid of colored squares (red, yellow, green) on a fire background. The website 'www.fireassess.com.au' is also visible at the bottom of this section.

Public exposure - USA



Philadelphia walkway

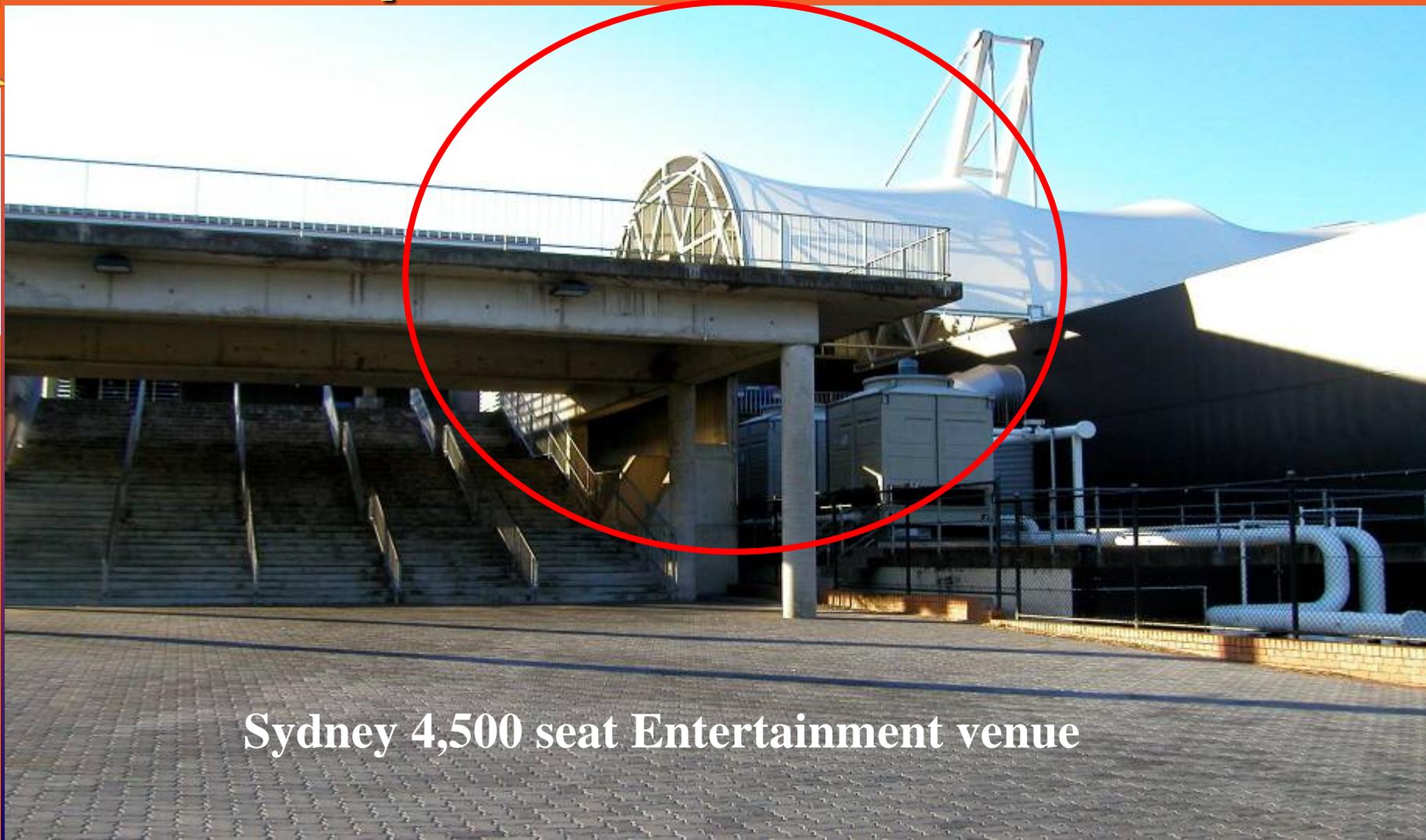


Public exposure - Australia

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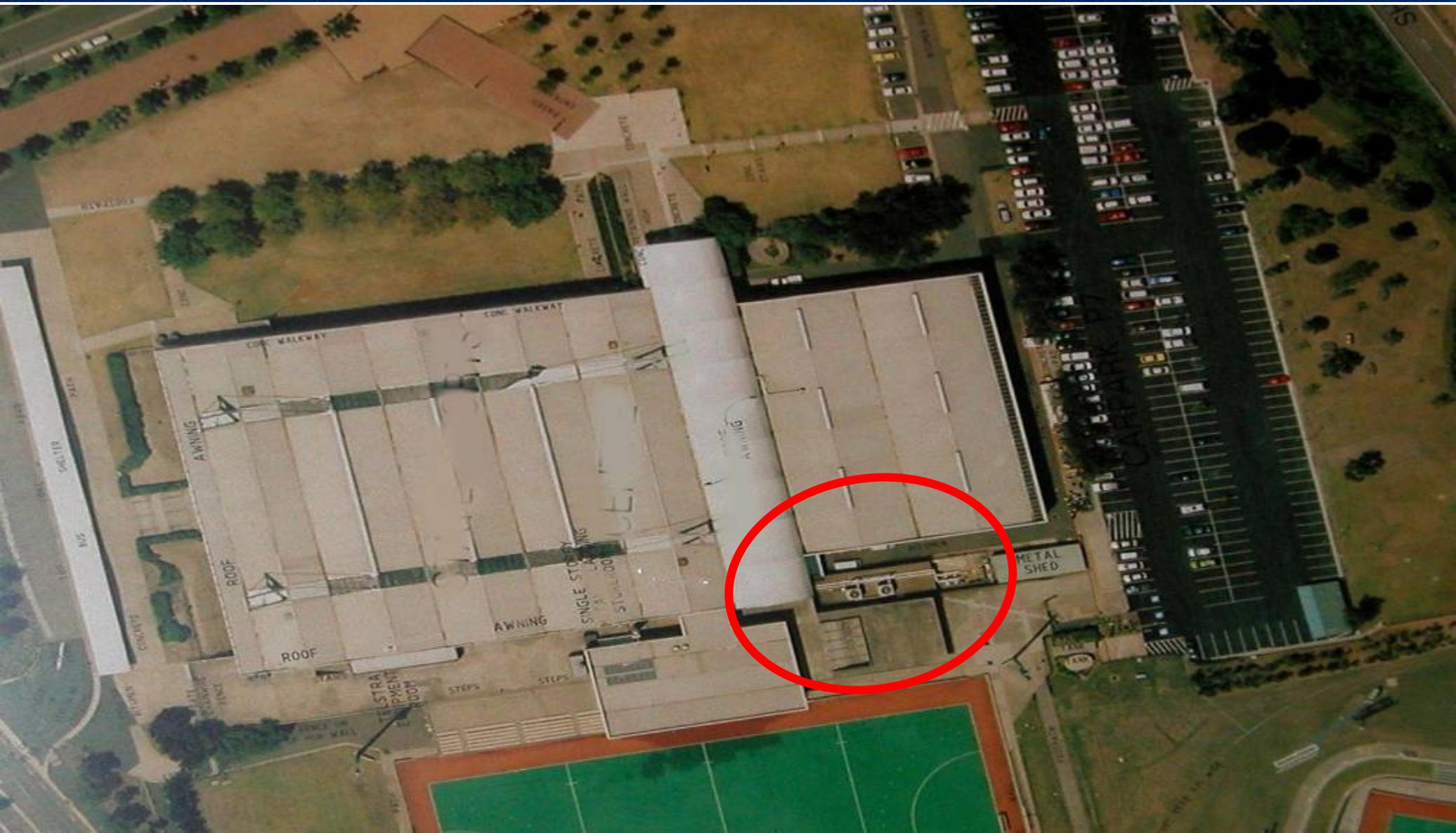
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Sydney 4,500 seat Entertainment venue



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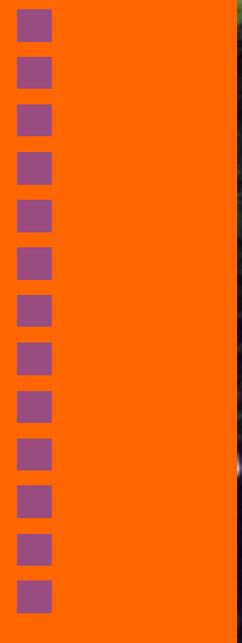
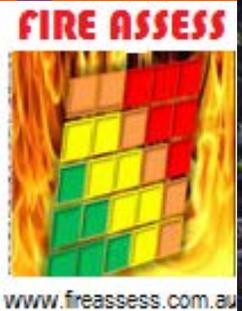
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Discharge to public pathway





Competing with trees





Plant Management?



Conduit fastened over access





Commissioning

-  handing over a project that is safe, from makers to users
-  includes setting to work
-  precommissioning
-  is not just testing and balancing
-  is ensuring system performs as an integrated whole
-  requires perseverance



The HVAC commissioning process

Successful commissioning includes

-  planning, reporting, from project inception
-  ongoing training program
-  attention to health and safety
-  as well as ensuring systems actually function as intended
-  Requirement to provide complete “as built” documentation & O&M Manuals

We recommend that you check out the www.webfm.com.au system for completing your O&M requirement



Poor commissioning when



construction slippage



contractor weariness



emphasis on short cuts



client haste to occupy

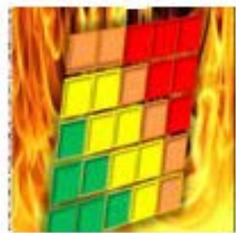


early handover



Outbreak – Christchurch NZ

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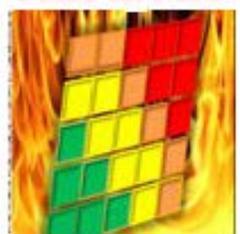
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Details

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New CBD office building



No water treatment at commissioning nor for next 6 months



Prevailing winds: tower to OA intake



IAQ complaints, then



Legionnaires' disease outbreak – 7 confirmed cases

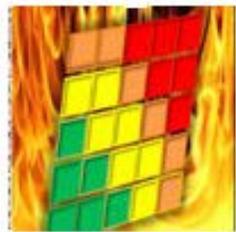


Potential to cause major epidemic



Startup

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Details

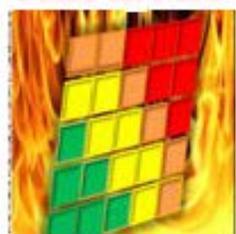
-  Spec. required hydrostatic tests, precleaning, flushing before operation, auto water treatment, fouling removal
-  Chemical inhibitor in system
-  No biocide
-  Water dumped from system 2 weeks before startup
-  Refilled
-  Contractor initiated starting, testing without biocide
-  Outbreak followed startup (21 cases)
-  Cases up to 2.5 km away



Outbreak

- Melbourne Aquarium

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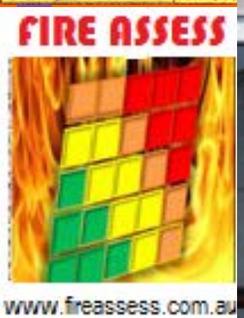


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Melbourne Aquarium Pumps





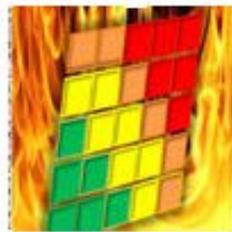
NEW DIRECTIONS IN



Melbourne Aquarium

Tower 1

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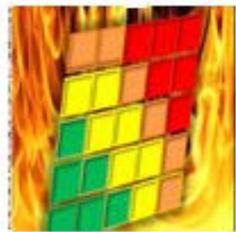


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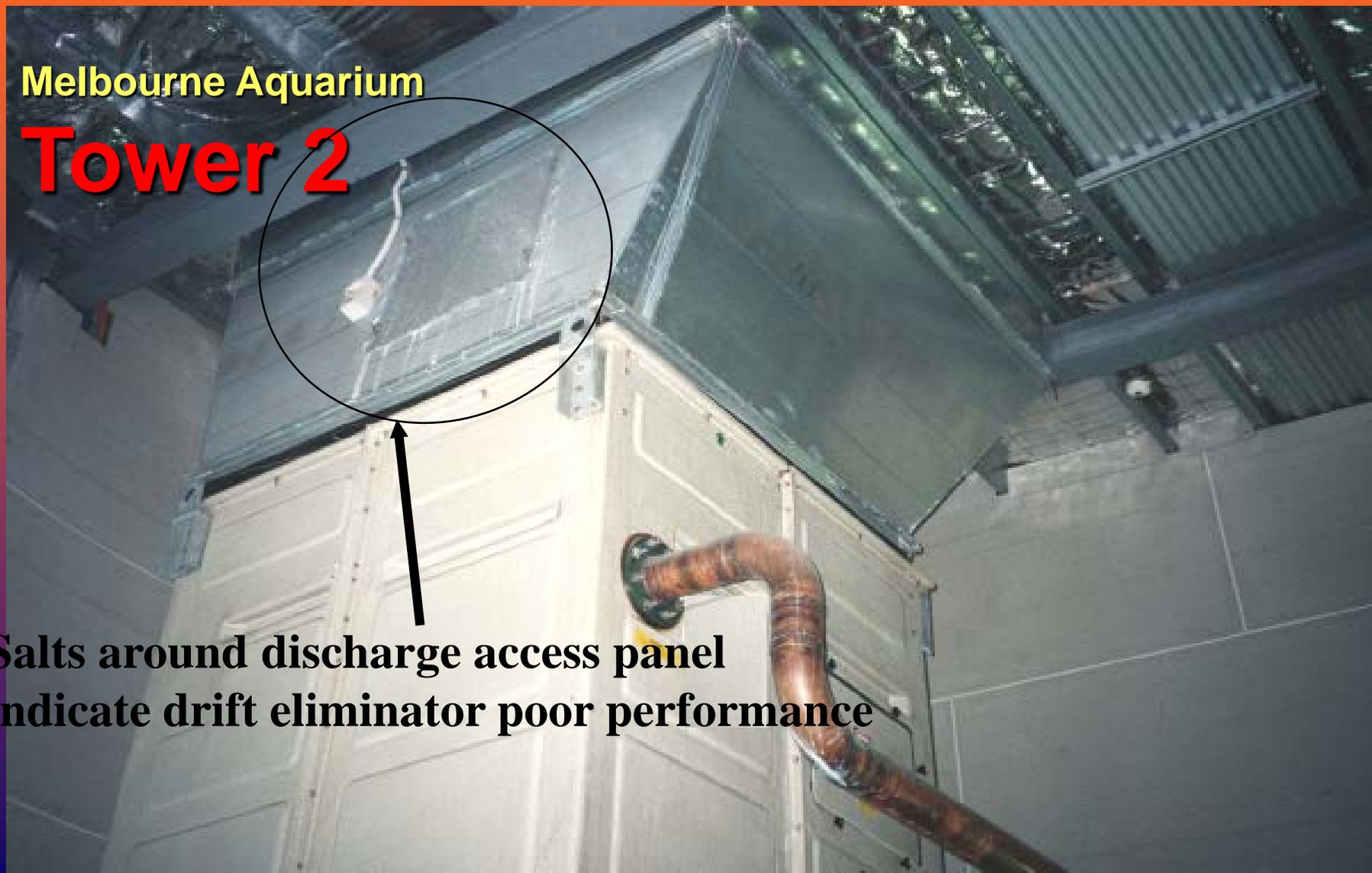
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Melbourne Aquarium

Tower 2



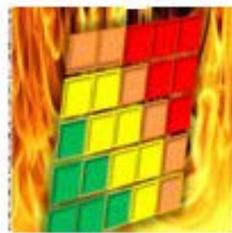
**Salts around discharge access panel
indicate drift eliminator poor performance**



Melbourne Aquarium

Piping

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Melbourne Aquarium

Chemical drums



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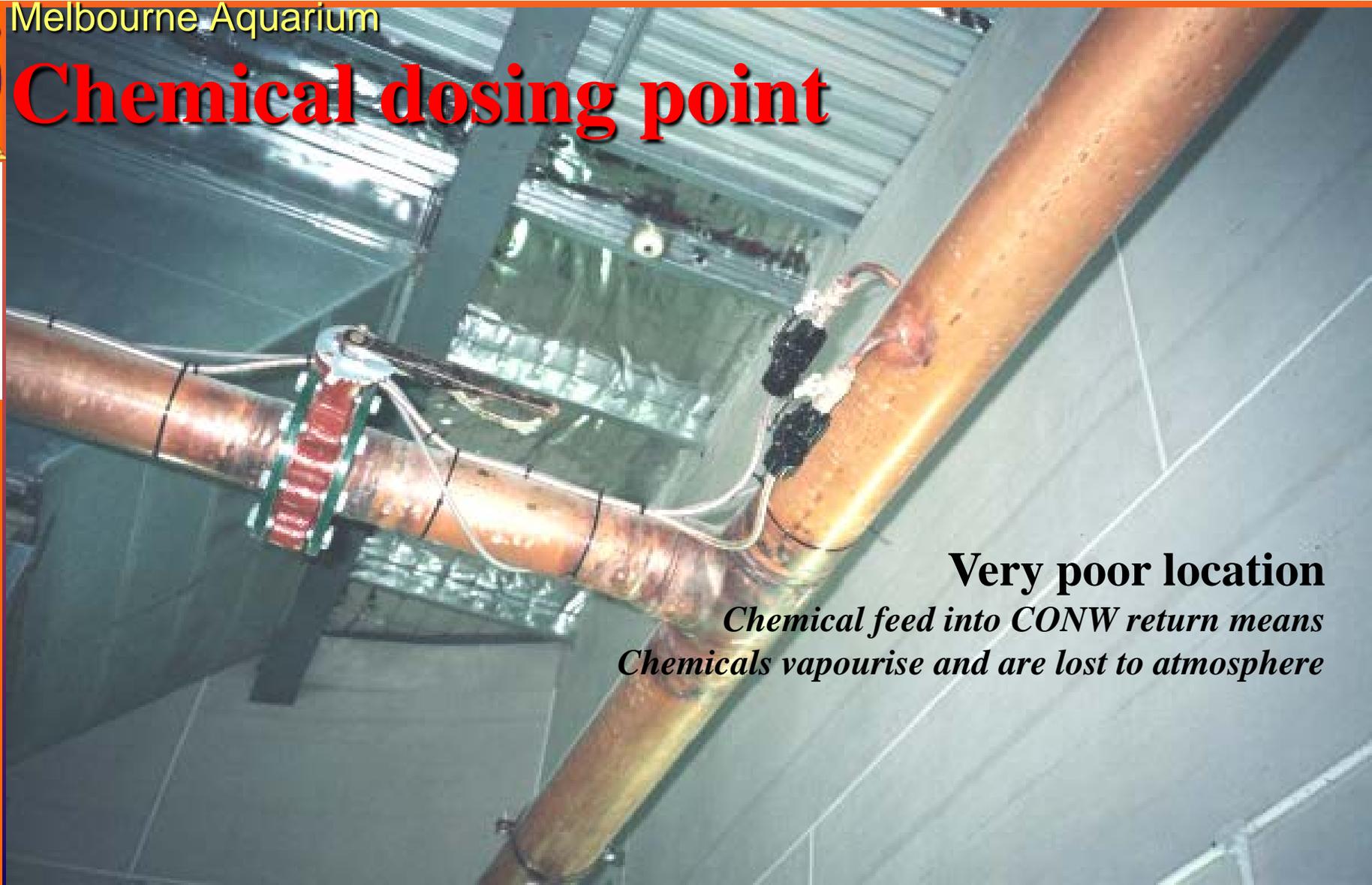


No bunding



Melbourne Aquarium

Chemical dosing point



Very poor location
*Chemical feed into CONW return means
Chemicals vapourise and are lost to atmosphere*



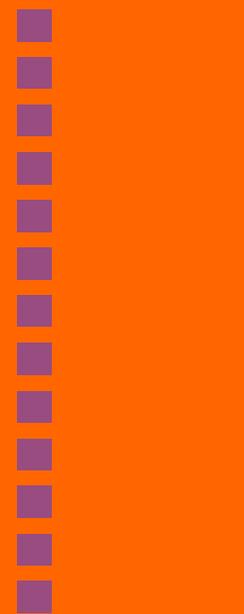
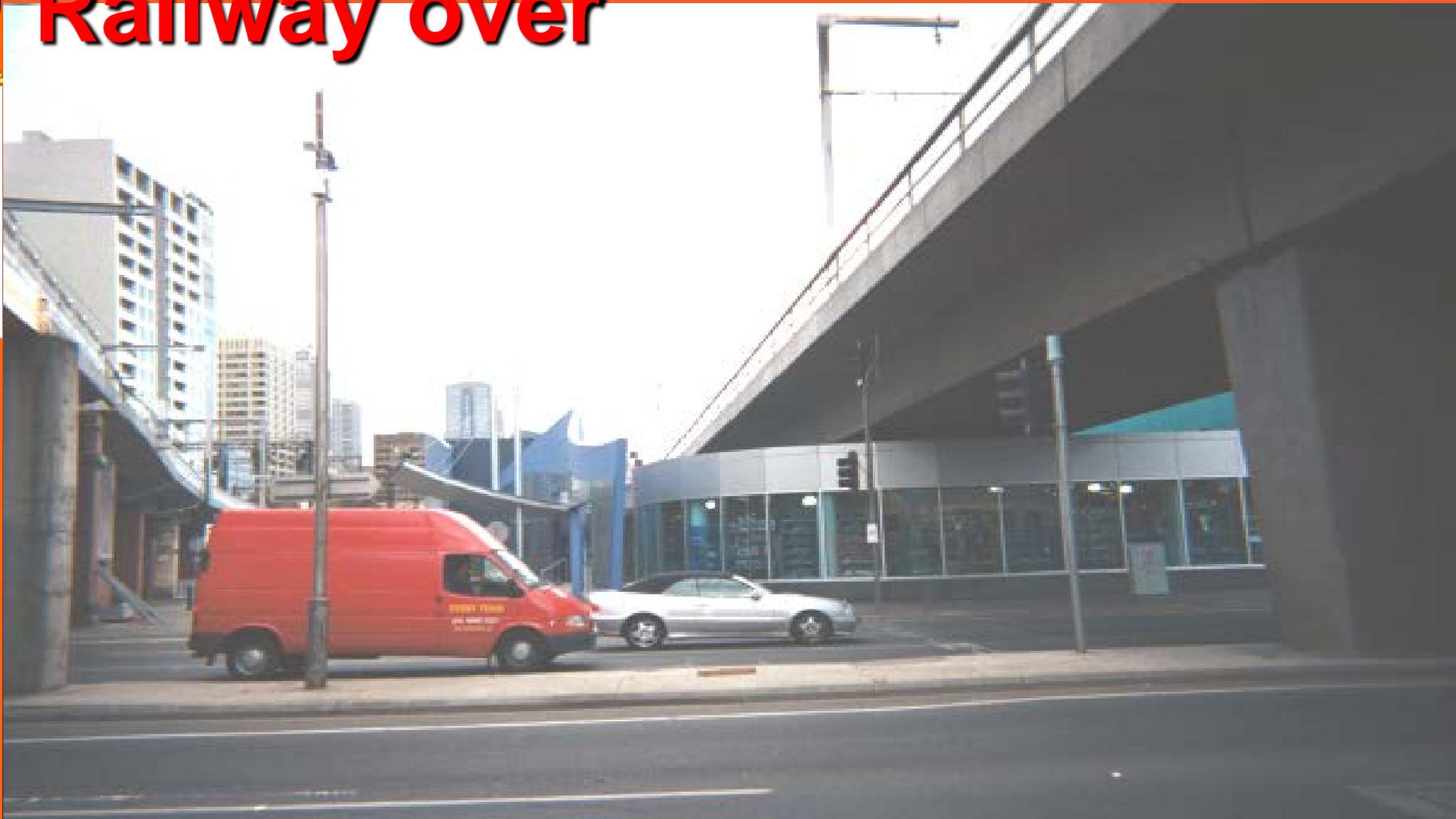


Melbourne Aquarium

Railway over

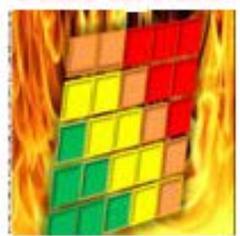
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Details



Site dust load high



Piping/pumping irregularities



No balance line between towers



Return piping at high level



No anti-syphon trap



Overflow on pump shutdown



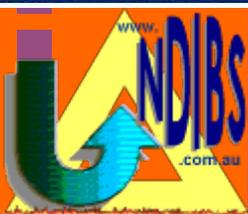
Plant, incl. chillers, on manual control



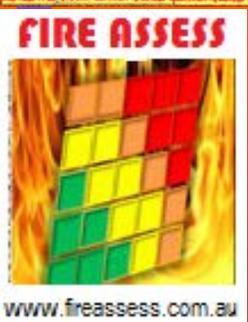
Melbourne Aquarium

Details

-  Chemical injected at return line
-  Componentry (dosing pump) unreliable
-  Only one biocide in use
 -  non-oxidising
 -  low concentration
-  Contractual difficulties
-  125 confirmed cases of L.D.



Melbourne Aquarium **Message**



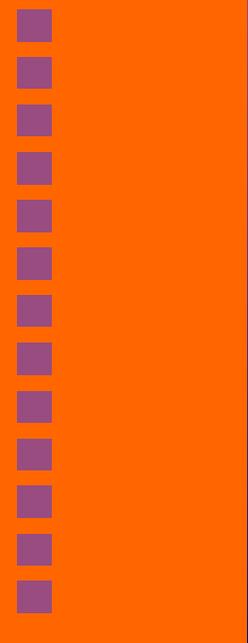
Each of these cooling towers 500 kW or less (150 ton) heat rejection



Disinfection was poor



Small systems may not receive adequate attention at commissioning – or ongoing maintenance – yet present the greatest public health hazard

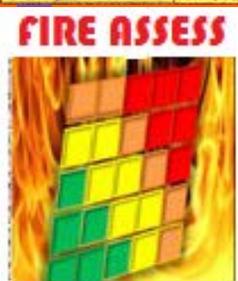


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Sydney New Years 06/07





Sydney across the road Upgrade???





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Legionella Taskforce Update

the July 2017 amendment to the NSW Public Health Act. This introduced the requirement to conduct Risk Management Plans on top of mandatory monthly legionella sampling introduced January 2018.

The RMP shall use a prescribed template and be required by:

Group A - 30Nov'18, then Group B - 31Mar'19, and then Group C - 30Jun'19 and such timing shall be specified for the three groups to allow for an even distribution over the calendar year for accredited assessors to provide coverage.

The service provider must supply a 3-monthly report on the system.

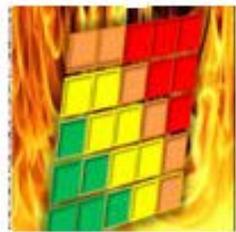
Auditing shall also be introduced and this shall be focussed upon a 12-month period of servicing and must be re-audited on or within a 5-year period. .

All reporting must go to the Local Council for processing, evaluation and consideration.

<http://www.health.nsw.gov.au/environmental/legionellacontrol>



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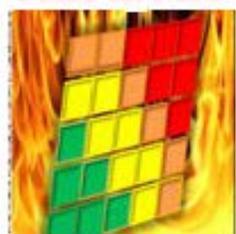
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6. Where to



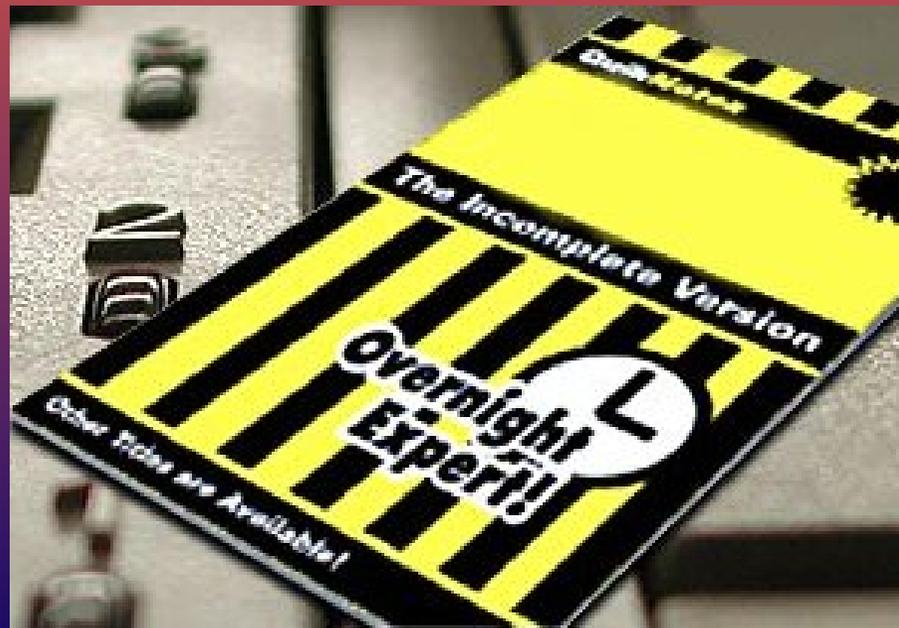


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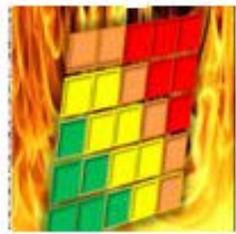
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The greatest failure: the failure to learn





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Risk

Management





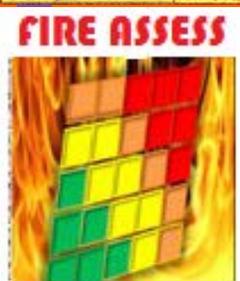
Standard whole property risk model





AS/NZS 3666-2011 - Microbial Control

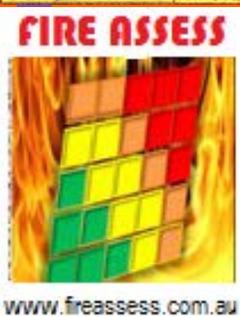
- Part 1 - Design, installation, commissioning**
- Part 2 - Operation, maintenance**
- Part 3 - Performance-based maintenance of cooling water systems**
- Part 4 - Performance based maintenance of Air Handling Equipment**



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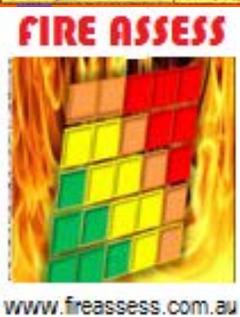
Risk Management

- Identification
- Assessment
- Evaluation
- Controlling actions
- Monitoring



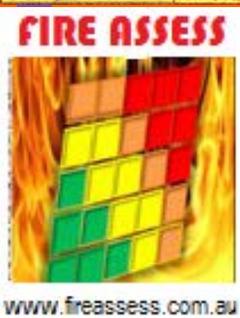
Risk factors

- Stagnant water
- Nutrient availability
- Poor water quality
- System deficiencies
- Location and access



Management of controls

- Water chemistry
- Temperature
- Stagnation
- Maintenance
- Monitoring



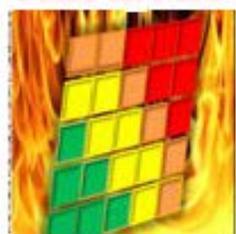
Risk factors to assess

- Water quality, including makeup
- Water temperature
- Microbial trends
- Tower siting, condition
- System size, mode of operation
- Drift elimination



Monitoring and verification

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- Independent surveillance
- Total bacterial count
- Biocide level
- Water chemistry, temperature
- Corrosion
- Legionellae
- Records



Sample bottles

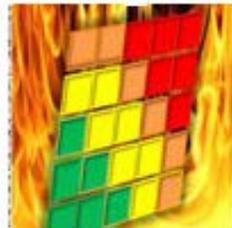


The wall area of the sample bottle does make a difference after a few hours



Respirator

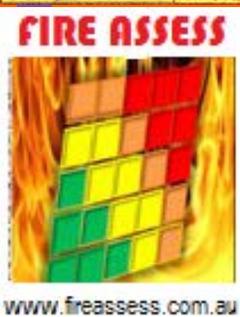
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PPE
Wear it

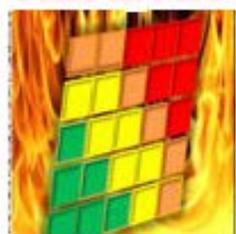


Public health control strategies

-  **Standards**
-  **Regulation**
-  **Registration**
-  **Education**
-  **Risk management**



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Websites - some guidelines

Australian health authorities (all states)

www.enhealth.nphp.gov.au/council/pubs/ecpub.htm

American ASHRAE guideline is at

www.baltimoreaircoil.com or www.marleyct.com

Victoria

www.health.vic.gov.au/environment/legionella

NSW

www.health.nsw.gov.au/csd/lisb/acts/index.html

Comcare

www.comcare.gov.au/pdf_files/Legionnaires-Disease.pdf

Clive Broadbent & Associates

www.broadbent.com.au

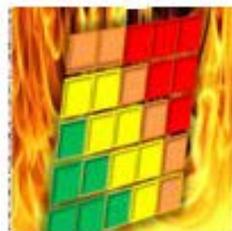
New Directions In Building Services

www.ndibs.com.au www.fireassess.com.au



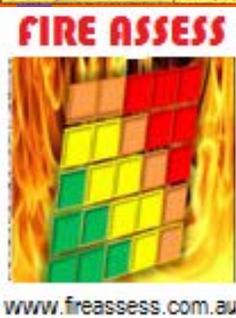
6. Emerging issues?

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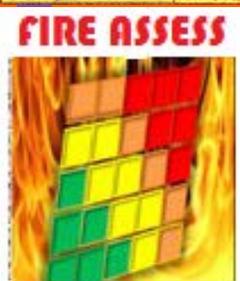


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**Range of pathogens
including nontuberculous
mycobacteria (NTM)**



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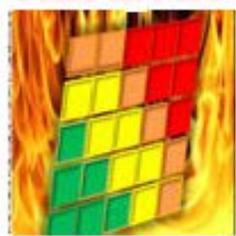
Rise in frequency of NTM-caused diseases

- ❑ not person-to-person
- ❑ pathogenic strains found in towers (over 75% positive)
- ❑ a biofilm organism
- ❑ virulence enhanced when cycled through protozoa
- ❑ association with popular non-oxidising biocides found
- ❑ disseminated in aerosol



Legionella-like organisms

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 **unnamed**

 **don't grow on culture**

 **cycle through protozoa (protists)**



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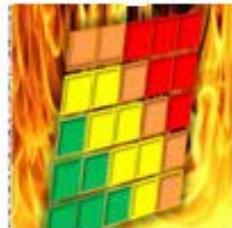
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Grey water applications



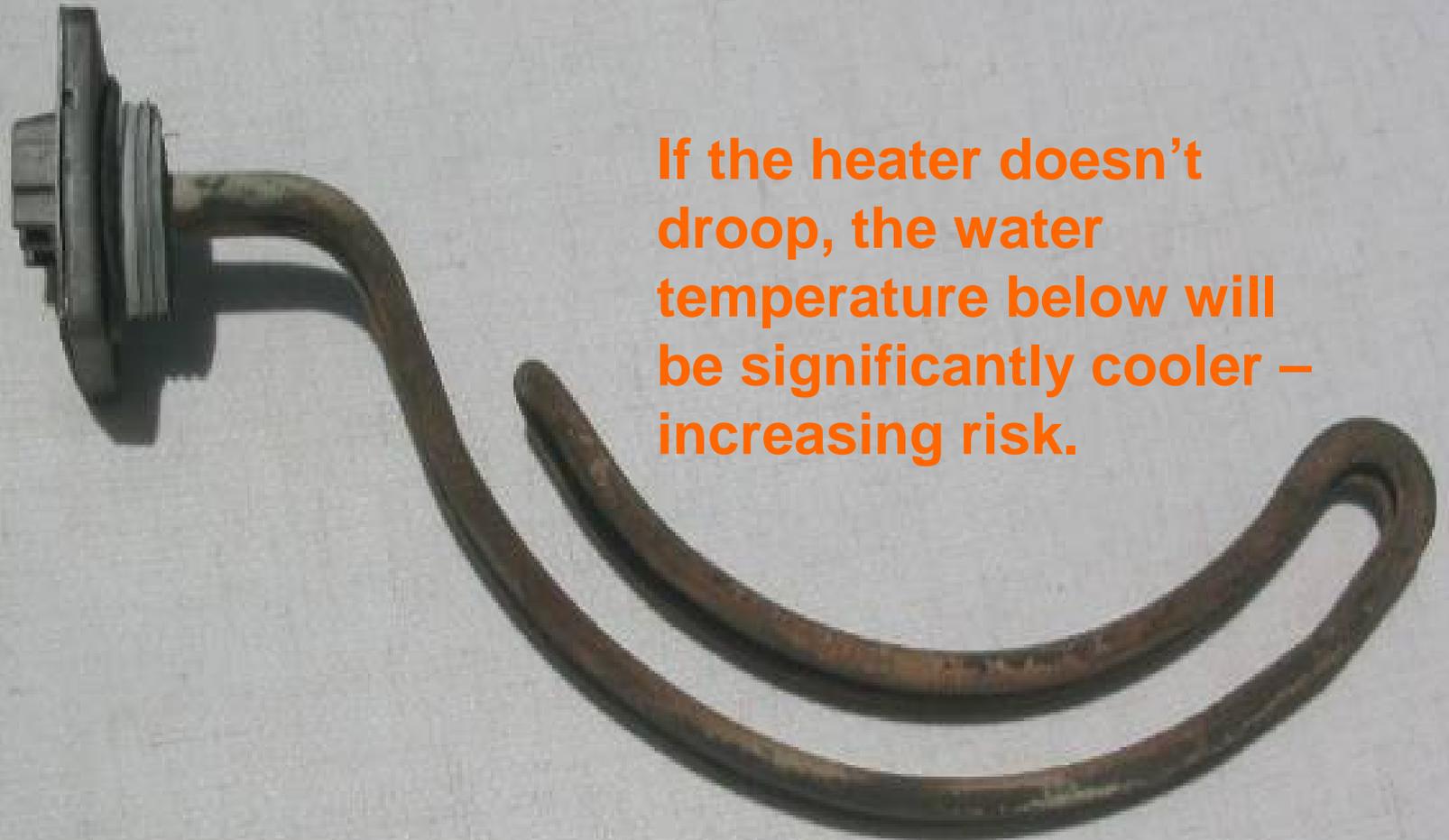


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Electric element



If the heater doesn't droop, the water temperature below will be significantly cooler – increasing risk.

Note that electric storage water heaters are being phased out



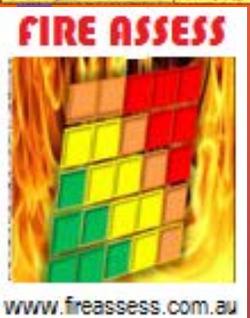
7. Conclude

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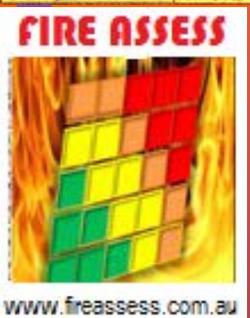
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-  careful design
-  water treatment at construction, commissioning
-  ongoing use of dual biocides, suited to the system
-  operation and maintenance
-  follow risk management principles, incl. total microbial control
-  sampling (bottle effect)
-  keep records
-  keep learning



Design features

- Convenient accessible openings
- Components that can be removed
- Sumps that can be readily drained
- Materials compatible with use of disinfectant and hosing with water jets
- Use of components that minimise corrosion
- Efficient drift eliminators
- Minimal internal components such as structural brackets which can collect sediment
- Surfaces which can be readily cleaned
- Protection of wetted surfaces from direct sunlight



Operation & maintenance features

-  **Layout of system**
-  **Correct and safe operating procedures**
-  **Maintenance, cleaning and disinfection procedures and their frequency**
-  **Regular water treatment regimes**
-  **Bleed rate**
-  **Testing requirements**
-  **Disinfectant levels**
-  **Safety precautions**
-  **Person or contracting agency responsible**



Operation & maintenance features

Testing requirements

 pH

 total dissolved solids or conductivity

 bacterial counts

Person or contracting agency responsible for:

 overseeing and recording the work

 ensuring that the plant operates normally



Cooling tower checklist

Tower

 Make, model, size, system volume and location

Physical

 Corrosion, water loss, eliminators, leaks, access, deadlegs, appearance, temperature

Chemicals

 Biocides, inhibitor, bunding, dosing, injection point, storage, labelling

Monitoring

 TBC, Legionella, pH, TDS, corrosion, results

Records

 Manuals, service books, log book, test results



Cooling tower checklist cont..

Air Handling

-  Intakes, filters

Safety

-  Operator access, MSDS, PPE

Performance

-  Water treatment company, mechanical contractor

Options

-  Leave as is, modify, replace

Risk

-  Public health, management, report, water volume, wetted areas



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Monitoring

-  **Total bacterial count**
-  **Biocide level**
-  **Water chemistry, temperature**
-  **Corrosion**
-  **Legionellae**
-  **Records**

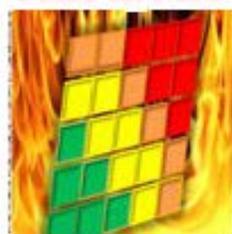


Water testing - meaning of results

- High HCC
- Fluctuating HCC
- Positive *Legionella*
- Negative *Legionella*



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Thank you for your attention



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1300-AS4655 / 1300-274655

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Alex Childs Mob.0413-416-811

e-mail: ndibs@ndibs.com.au

www.fireassess.com.au

www.ndibs.com.au

www.safeworkmethod.com.au

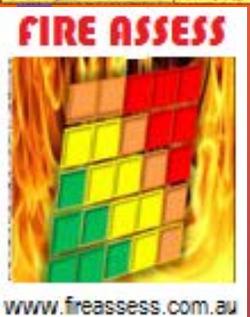




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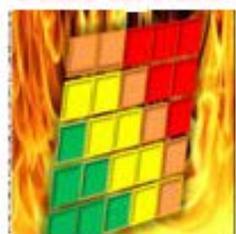
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Helping identify RISK



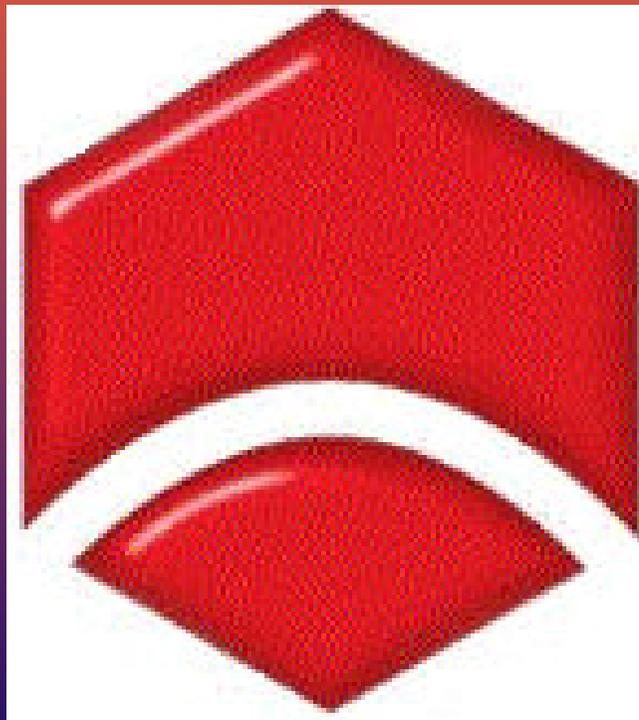
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Even more:

Where appropriate, consider joining
Engineers Australia's Society of Building Services Engineers



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