Legionellosis & building water services
An environmentally engineered disease

Service design & installation considerations

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Legionella Management Advisory Group

The current state of play, planning & preparation ?

3 P's can become 6!

Are we prepared to acknowledge the risk ?

Are we prepared with knowledge ?

Are we prepared with an appropriate plan ?

Proper Planning Prevents ……

World Health Organisation
2007

Legionella and the prevention of Legionellosis

Distributed water is likely to contain some microorganisms, including legionellae. It is therefore reasonable to assume that all systems that use water could be seeded with microorganisms during construction, repair and maintenance, even if the water is treated. Risk factors that can promote the proliferation of legionellae include temperature, water quality, design, material used in construction and the presence of biofilms.

Australian National Statistics

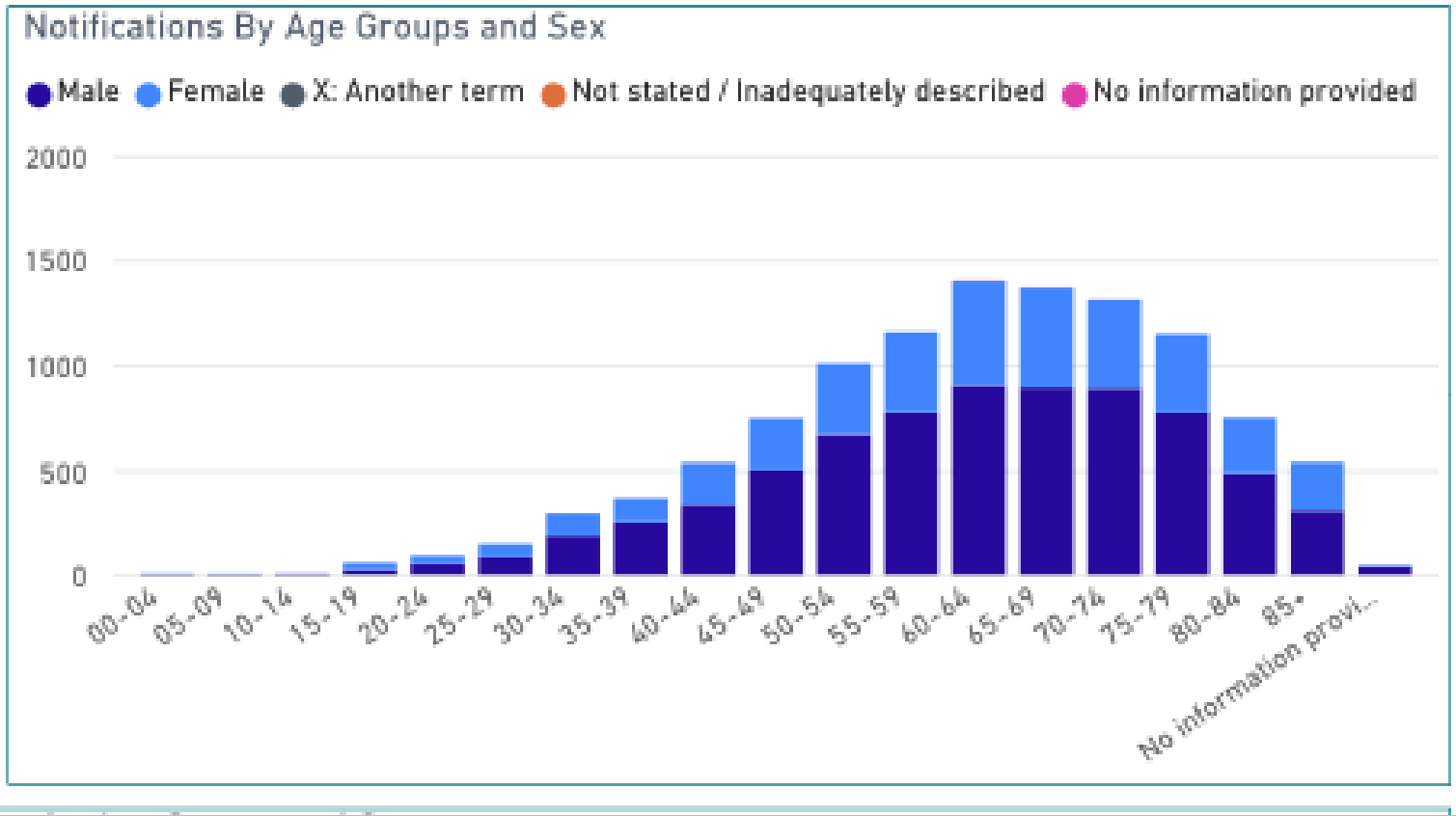
Annual Legionnaires disease cases

Notifications Received By Jurisdiction

State	008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
ACT	4	2	6	1	0	1	2	1	2	0	7	1	2	5	5	2
NSW	90	91	97	109	103	108	70	98	136	136	178	147	168	226	265	101
NT	1	3	3	5	3	6	7	7	0	1	0	4	8	11	8	0
QLD	30	55	42	46	71	164	93	80	49	64	54	61	69	79	141	39
SA	21	44	31	41	37	63	41	26	29	38	34	46	55	42	55	19
TAS	1	1	6	7	12	6	8	8	9	8	9	23	19	20	26	11
VIC	54	50	68	73	71	66	87	71	74	100	121	120	126	127	121	68
WA	71	51	54	75	85	93	116	74	69	37	45	36	80	73	59	32
Total	**272**	**297**	**307**	**357**	**382**	**507**	**424**	**365**	**368**	**384**	**448**	**438**	**527**	**583**	**680**	**272**

Australian National Statistics

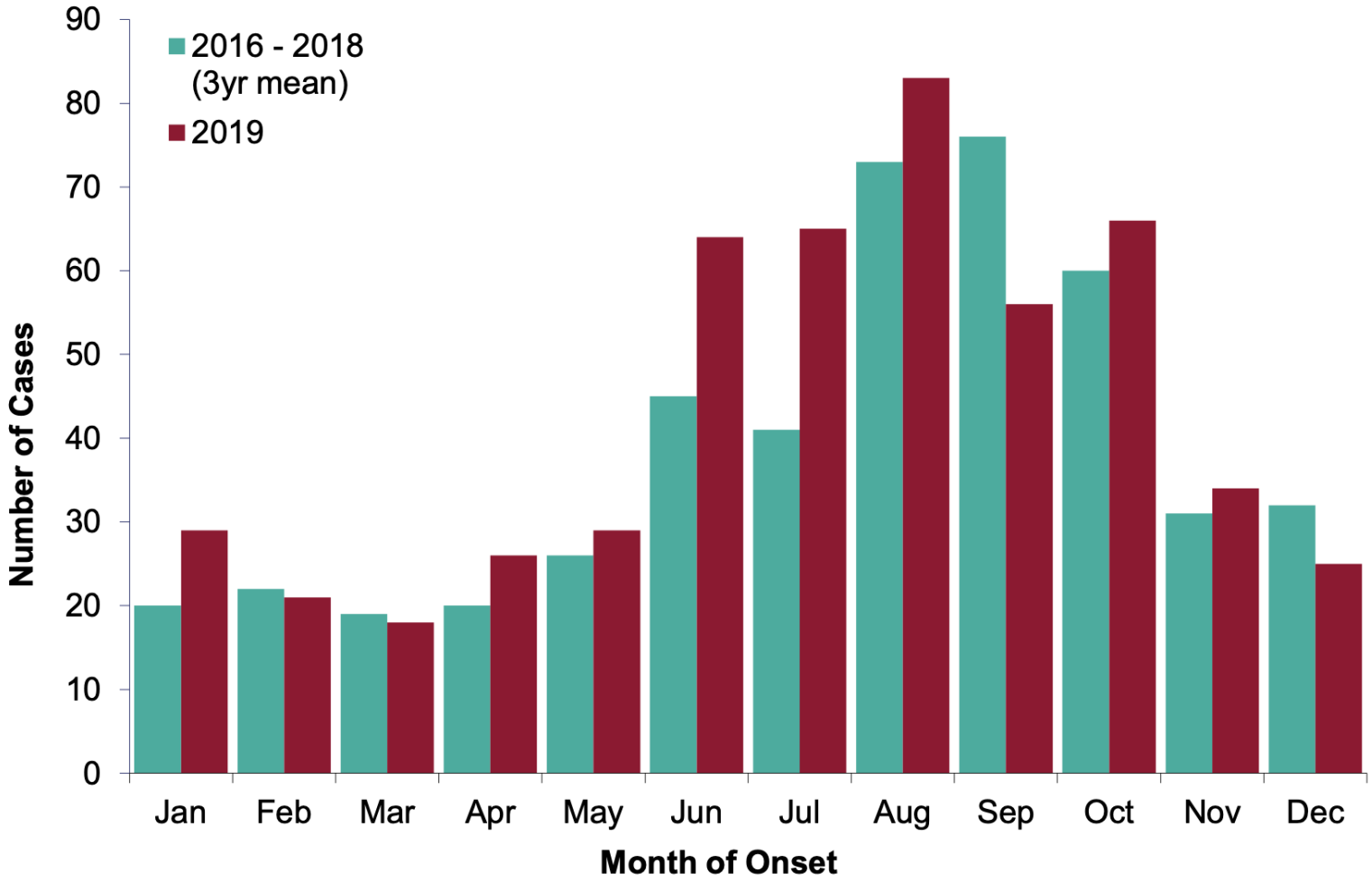
Cases by age & gender



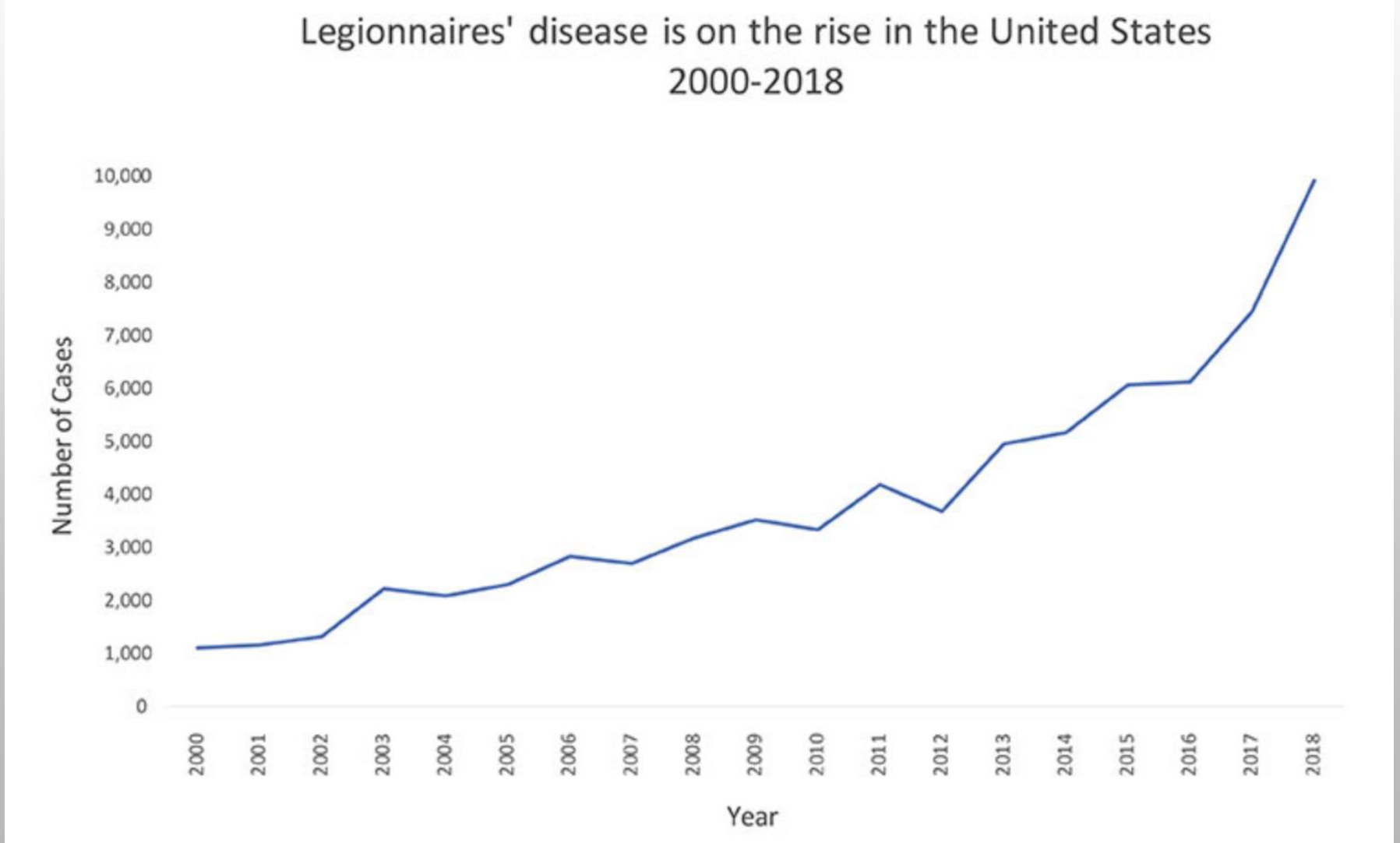
UK Statistics

SOURCE – PUBLIC HEALTH ENGLAND

Figure 2: Confirmed* cases of LD by month of onset (December 2019 against monthly mean for previous three years)

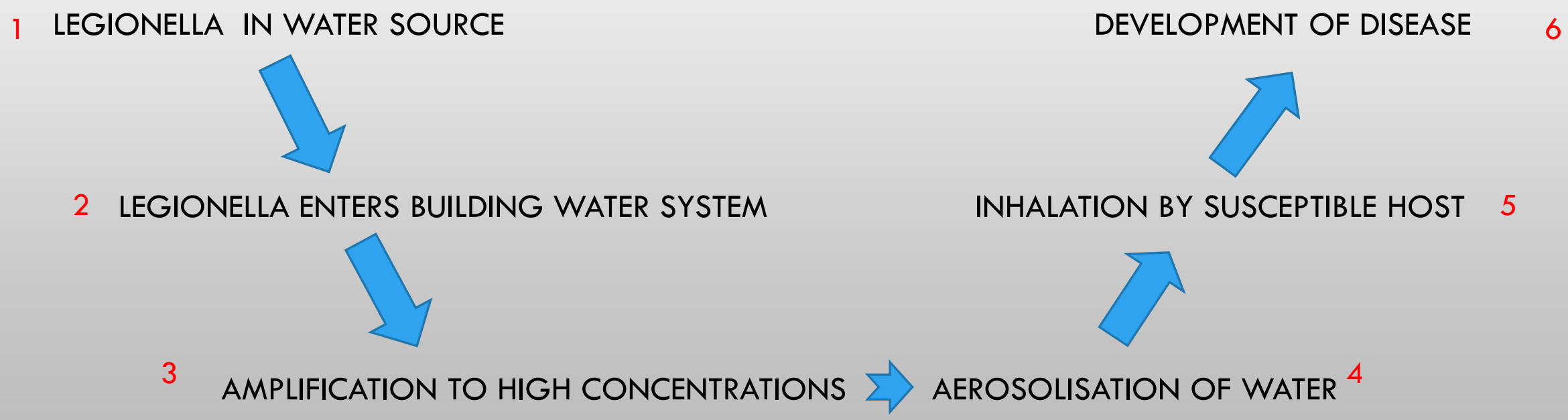


The USA
Centers for Disease Control & Prevention



The Causal Chain of Legionellosis

The phases or conditions that need to be in place for an infection to occur



System analysis – to begin with

National Construction Code 2022 vol 3

Plumbing Code of Australia – B1P1

Explanatory Information: Unintentional heating of cold water services

- Where installed in a location subjected to extreme summer temperatures (such as the roof space of a building), cold water services have the potential to become unintentionally heated. This can pose a hazard as the cold water supply may reach temperatures in excess of 45° Celsius, increasing the potential for scalding.
- To reduce the likelihood of unintentional heating of cold water services, consideration should be given to—
  - (i) avoiding long runs of pipework in locations exposed to solar heat gain; or
  - (ii) applying insulation, either directly to the pipework, or by using additional ceiling insulation material between the pipework and the solar heat source.
- Avoidance of unintentional heating of cold water services in known areas of extreme summer temperatures may also assist in reducing water usage through drawing off of water which has become excessively heated.

PCA 2022

A design game changer?

B2P6 Legionella control

[2019: BP2.5]

Heated water must be stored and delivered under conditions which avoid the likelihood of the growth of a Legionella bacteria count greater than or equal to 10 Legionella colony forming units (cfu) per millilitre.

System Analysis

Plumbing Systems

- *Pipework that allows heat transfer* **:-**
  proximity and/or poor insulation
- *Pipework that allows stagnation* **:-**
  capped ends, branches installed for future use, bypass valves, dead legs such as infrequently used fixtures or taps
- *Age and condition of pipes* **:—**
  biofilm or scale buildup, use of flexible hoses / connectors

Mitigating the Legionella colonisation risk

- Designers = architects and hydraulic consultants, have many factors to be considered along with building use & design constraints.
- Installers have an equally critical part to play
- Water risk management is a complex issue & needs to be acknowledged
- The risk needs to understood & documented
- There is no silver bullet in Legionella prevention or remediation

World Health Organization

LEGIONELLA AND THE PREVENTION OF LEGIONELLOSIS

2007

Poor design and construction will inevitably compromise attempts to implement effective control measures, which in turn will have a serious impact on *legionella* control.

Plastics Pipes and Microbial Growth

3. MICROBIAL GROWTH

It is well known that Legionella may occur in all types of piping materials. Evidence is conflicted concerning whether a particular material is more effective than the other at inhibiting the formation of biofilm[2]. However, it is concluded that in long-term service, there is no difference whether the pipes are copper or polymeric[3]. Ultimately, it is the design of the system and the conditions under which it is operated that are the major influential factors.

PIPA report continued

Irrespective of the pipe material, poor design in piping systems has been proven to be the major driver for the proliferation of bacteria (including Legionella) in pipes. Aspects to be avoided include:

- Long stagnation times, e.g., in permanently capped ends
- It is recommended that cold water lines are kept below 25°C, and the operating temperatures of hot water lines are kept above 60°C.
- Cross contamination to non-drinking water services
- Over-dimensioning of pipes

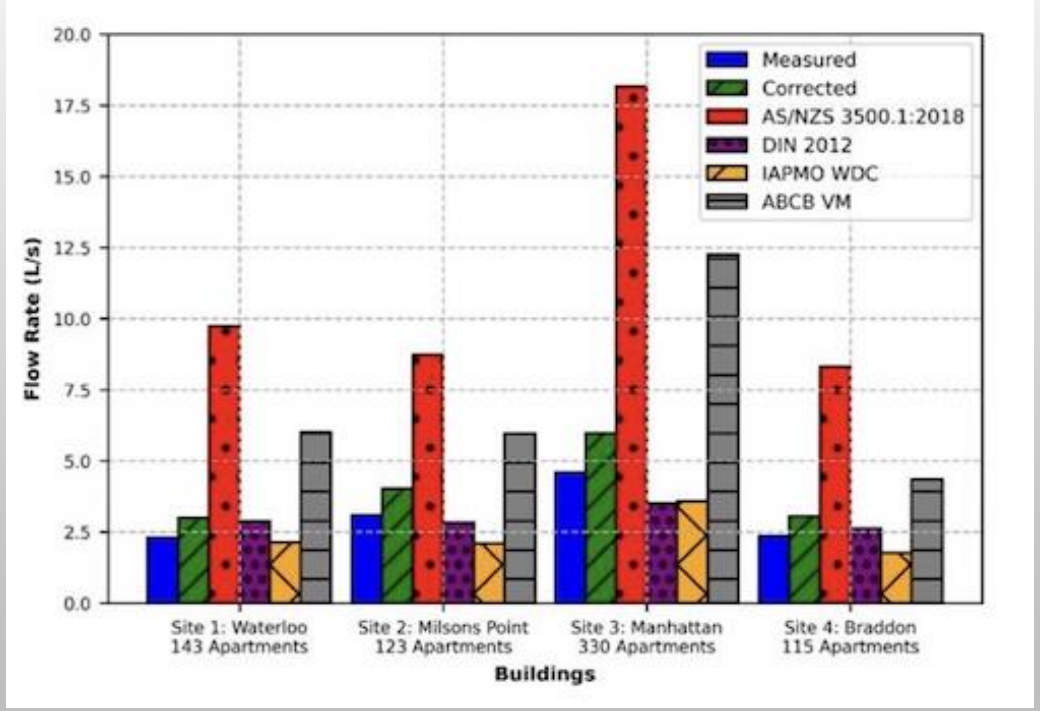
Temperature is a key factor the survival of Legionella

- Growth range >20^0c - <46^0C
- Explosive growth 35^0 – 46^0 C
- At 60 °C (140 °F): They die within 32 minutes
- At 65 °C (151 °F): Legionellae die within 2 minutes
- 70 to 80 °C (158 to 176 °F): Sanitising range, instant at 70^0C

Research by Thomas Wise

Consulting engineer - Perth

His tip – Keep the surface area as small as possible



ABCB Warm Water Guide

5.1.3 Dead legs in branch lines

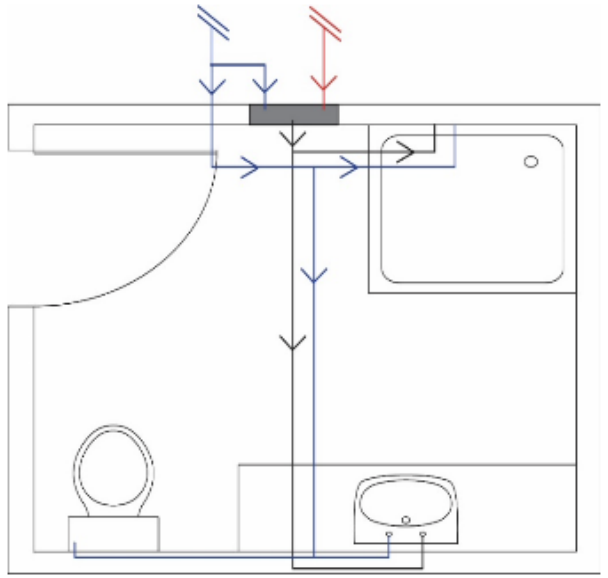
Where an infrequently used fixture is located at the end of a branch line, water can cool around that fixture, heightening the risk of bacterial growth. This can create what is known as a 'dead leg'. Both the pipe diameter and length are contributing factors in the amount of water contained in a dead leg.

An understanding of the risks associated with dead legs will assist in ensuring they are suitably addressed. These risks can be reduced by having the most frequently used fixture the furthest from the mixing valve and branches from the main line to other fixtures kept as short as possible. An example is shown at Figure 5.1.

- Branch lengths from the warm water system should be kept to a minimum to limit the distance of pipework to infrequently used taps and fixtures. A branch length containing less than 2 litres or one that is less than 10 lineal metres is generally acceptable. Another way to measure it is to limit the time taken for heated water to reach the outlet to no more than 30 seconds.

TMV warm water pipe work

Figure 5.1 Typical bathroom pipework layout



Trying to avoid this !

The *Legionella* mantra

- Keep it clean
- Keep it cold
- Keep it hot
- Keep it flowing

CASE STUDY

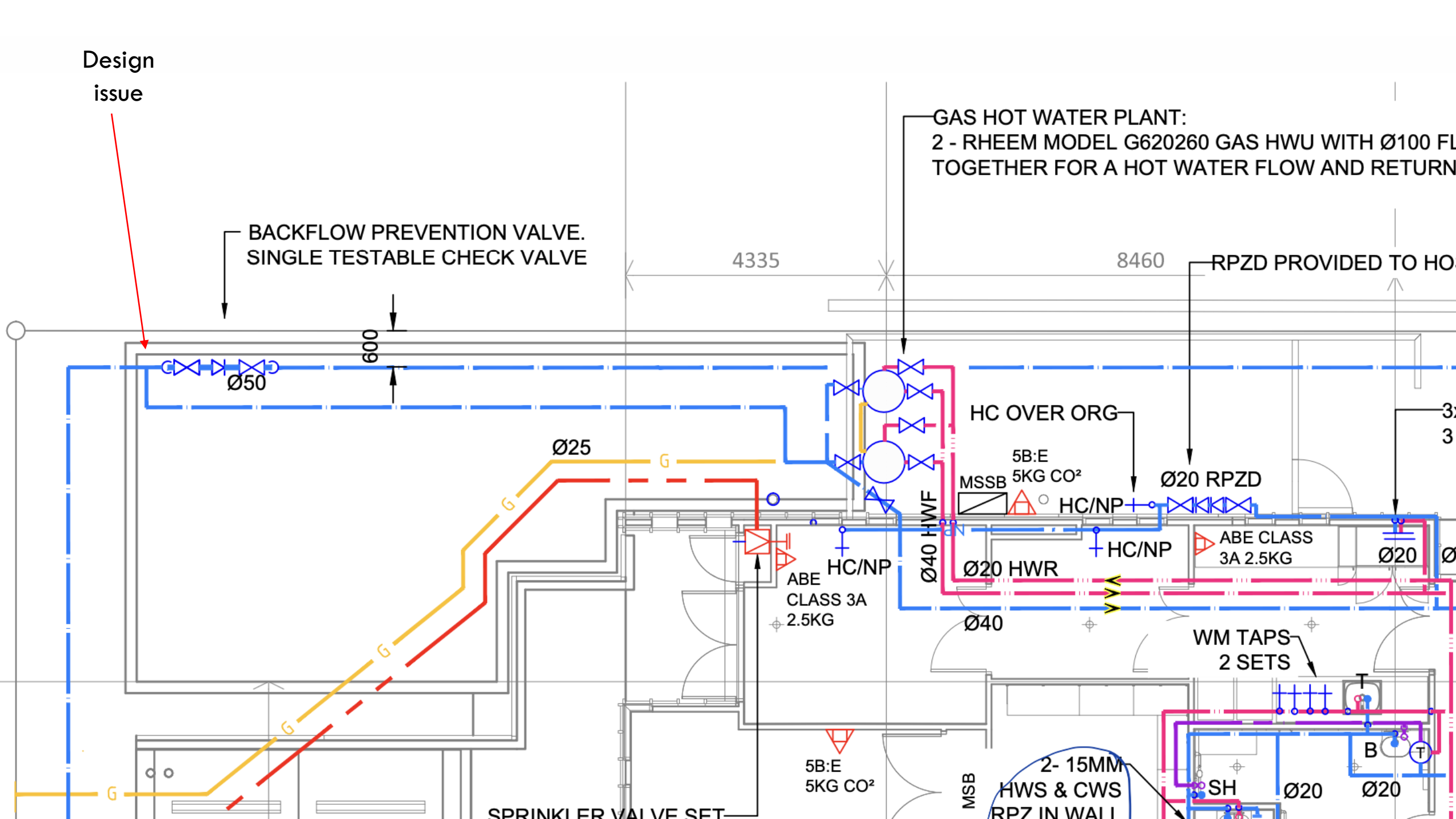
- Specialised care facility – 14 bathrooms plus staff facilities
- 4th anniversary scheduled sampling detected Legionella throughout the building
- Site inspection revealed presence of biofilm in discharge from an RPZ in wall mounted cabinet
- Regular scheduled maintenance and monitoring carried out. TMV's service annually.
- Remediation measures – air scouring and chemical dosing then flushing of all pipework and fixtures on site.
- Validation sampling following remediation – low HPC's and undetectable Legionella bacteria

12 months latter

- Legionella detected again
- Hot water system replaced due to issues with maintaining temperature
- Remediation steps - air scouring followed 3 weeks latter by chemical treatment and flushing
- 2 weeks latter water samples taken, result is positive for Legionella

CASE STUDY

- Site has residual chlorine in water supply of .5ppm
- Peak flow times typically between 7am – 10am daily
- 2 x storage gas water heaters replaced with 1 x combined 315L storage/continuous flow with return temp set for 62deg C
- Drinking water inlet service 125mm poly approx. 40mtrs long connecting 32mm copper drinking water service to building, 125mm line continues past the building as fire service
- 25mm service branched off inlet service, installed external to the building feeding all external hose cock's, rarely used.


Design issue
BACKFLOW PREVENTION VALVE.
SINGLE TESTABLE CHECK VALVE
GAS HOT WATER PLANT:
2 - RHEEM MODEL G620260 GAS HWU WITH Ø100 FL
TOGETHER FOR A HOT WATER FLOW AND RETURN
4335
8460
RPZD PROVIDED TO HO
600
Ø50
Ø25
HC OVER ORG
5B:E
5KG CO²
MSSB
Ø20 RPZD
HC/NP
Ø40 HWF
HC/NP
ABE CLASS
3A 2.5KG
Ø20
ABE
CLASS 3A
2.5KG
HC/NP
Ø20 HWR
Ø40
WM TAPS
2 SETS
5B:E
5KG CO²
MSB
2- 15MM
HWS & CWS
RPZ IN WALL
SH
Ø20
Ø20
B
SPRINKLER VALVE SET

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If we de-risk with knowledge, there should be no unintended consequences

"We should keep in mind that sanitation and hygiene are the greatest human achievements in terms of extending life expectancy, and we must seize every opportunity to raise awareness and make these benefits available to all"

Prof Martin Exner
Director of the Institute for Hygiene and Public Health – University Bonn - Germany