ABCB

Backflow Prevention

Research Report

PLUMBING CODE DEVELOPMENT RESEARCH PROJECT

BACKFLOW PREVENTION

RESEARCH REPORT

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Preface

This report is the outcome of research and stakeholder consultation on the current requirements for backflow prevention, conducted as part of the Australian Building Codes Board's (ABCB) Plumbing Code Development Research Project.[1]

The purpose of this report is to document the issues identified through the stakeholder consultation process; further information gathered following that process; and the ABCB's proposed responses which are provided as Recommendations.

[1] Australian Building Codes Board (ABCB). *Annual Business Plan 2014-15; 2015-16; 2016-17.*

Acknowledgements

The ABCB acknowledges the valuable contributions of the individuals and organisations who provided their input into the preliminary research for this report, as well as those who made submissions in response to the 2015 Consultation Paper.

The insight gained through these contributions has proved invaluable in the preparation of this report.

Executive summary

Backflow prevention is a critical measure to prevent plumbing systems and water supplies from being contaminated by unintended reverse flows of polluted water from within installations or properties. However, there are concerns the approach taken to backflow prevention is inconsistent, confusing for industry and potentially inefficient — that the level of protection provided may be either too high or too low, depending on the circumstances.

In response to these concerns, this report has been developed as part of the Australian Building Codes Board's (ABCB) Plumbing Code Development Research Project. It is based on preliminary research and stakeholder responses to a Consultation Paper distributed by the ABCB in 2015. Fifteen submissions were received from government and industry stakeholders within the on-site plumbing, specialist backflow prevention, Network Utility Operator (NUO) and other sectors.

The report addresses the following: the role of the Plumbing Code of Australia (PCA), preventing cross-connections and backflow incidents, Hazard Ratings, installation requirements, and product certification and authorisation.

The PCA has a role in backflow prevention both on-site and for protecting the water supply (called 'containment protection'). While this is also a responsibility of the NUOs, they do not cover all situations, and in some cases also refer to the PCA separately in their regulations. Based on the submissions received and a review of current legislation, the report finds that NUOs need to continue setting requirements for containment protection where they currently do so. However, the report also identified the need for the provisions to be retained within the PCA to ensure coverage is complete and accurate. Given the dual responsibility in this area, this highlights the need for active communication between those responsible for plumbing systems and water supply systems nationally. Currently no forum for dialogue between these groups exists.

It also became apparent that the current requirements in AS/NZS 3500.1[2] for registration and annual testing of backflow prevention devices, essentially a State/Territory administrative function, are not consistently enforced nationally. The likely reason for this may be because the PCA, and the Standard as it is referenced, can only be applied at the time of installation. To enforce mandatory registration and ongoing testing, there needs to be provision directly within relevant State and Territory legislation.

Submissions received generally supported the conclusions of the Consultation Paper that most incidents occur in industrial or agricultural premises, however the number could not be verified.[3] Backflow incidents are not reported or are under-reported, with no formal reporting protocol or

[2] Standards Australia. *Australian/New Zealand Standard 3500.1: Plumbing and Drainage Part 1: Water Services*, 2015.

[3] ABCB. *Plumbing Code Development Research Project – Backflow Prevention Consultation Paper* ('Consultation Paper'). Canberra: Australian Building Codes Board. 2015.

incident database. There is no suggestion however that backflow incidents are widespread or that the current level of regulation is insufficient.

Where cross-connections are otherwise discovered, they are usually due to lack of awareness, poor design or mistakes. This leaves limited scope for regulatory solutions. However, a freely available manual, dedicated to educating practitioners on cross-connection control specifically may help reduce cross-connections. Such a manual exists in the USA, designed for their regulations, conditions and practices, but not for Australia.

Hazard Ratings — either Low, Medium or High — are used in AS/NZS 3500.1 and the NUOs' regulations to classify cross-connections and assist in selection of backflow prevention devices. Yet these Hazard Ratings only describe the potential consequences of a backflow incident; unlike a risk assessment, they do not consider probability. The possible inclusion of probability in the determination of Hazard Ratings has been considered by this report and while there was support for increasing flexibility, there were also concerns about complexity and safety.

Furthermore, there is no uniform system for assigning the Hazard Ratings in Australia, although houses are generally deemed to be Low Hazard (the device is built into the water meter), and most other installations either Medium or High. The current standard provides only a brief definition of each Hazard Rating, along with some typical examples, contained in a non-mandatory appendix ('Appendix G'). This omission of specific direction for practitioners creates a risk for them and the community as choosing the correct Hazard Rating becomes a matter of subjective judgement. Despite this, Appendix G is heavily relied upon for selecting both on-site and containment backflow prevention, is considered a critical reference point, and in some jurisdictions is replicated directly in the protocols published by NUOs.

Those who expressed the above concerns generally recommended that Appendix G be made normative but, considering that the inconsistent application of Hazard Ratings would likely continue under that approach, this is not considered appropriate. To make Appendix G 'normative' would also introduce public policy into AS/NZS 3500.1 through the assignment of minimum Hazard Rating levels for backflow protection for different sites/installations. These minimum Hazard Ratings would reflect a decision as to the level of backflow risk the community is prepared to accept, and as such is a policy decision for governments rather than a technical matter. The preferred alternative may instead be to develop a process for assigning Hazard Ratings directly within the PCA.

It has also been identified that the installation requirements at Part B3, the non-drinking water component of the PCA, do not clearly address protection of non-drinking water services; and Section 4 of AS/NZS 3500.1, the cross-connection and backflow prevention section, has been highlighted as not providing an adequate technical solution for clearances and access for maintenance around backflow prevention devices. Addressing these matters would also assist in improving the haphazard and inconsistent application of backflow prevention.

There is also some confusion over the minimum requirements for containment protection for rainwater tanks. The NUOs believe additional containment protection is required at the meter, while the rainwater industry believes that the Low Hazard devices built into domestic water meters are sufficient because rainwater poses no additional hazard to the water supply. On further consideration of the two submissions, it is suggested that additional containment protection should not be required for an above-ground or partly buried domestic rainwater tank, where the risk could be considered to be low. This should be reflected in the PCA.

The draft report also included details of a number of State and Territory variations, only a minority of which are included within the PCA Appendices. The majority of those not published in the PCA Appendices exist under NUO regulations. These are relevant however, given the dual roles of the PCA already discussed. Replicating these in the PCA Appendices would help ensure it is applied consistently for both on-site and containment protection work.

Finally, the PCA's dual role also extends requirements for product certification and authorisation of backflow prevention devices, namely through the WaterMark Certification Scheme. Although WaterMark is primarily applied under 'on-site' plumbing and drainage legislation, it is also being separately enforced by many NUOs under their regulations. The NUOs however may not currently have a level of involvement in the scheme which reflects their use of it, in the same way that the on-site plumbing regulatory authorities do. Therefore, it important to maintain engagement and consultation with these stakeholders.

To support its conclusions, this report makes nine recommendations which are set out on the next two pages. These recommendations are limited to only what the ABCB can achieve; other issues raised in this report may warrant further consideration by the States and Territories.

Recommendations

List of Recommendations

Recommendation 1

That containment protection requirements should continue to be set by the NUOs, where they currently do so, while also being retained within the PCA.

Recommendation 2

That the ABCB set up a dialogue through the PCC with the NUOs/water entities, for the purpose of raising awareness of the PCA (including AS/NZS 3500), supporting its consistent adoption where appropriate, and otherwise achieving consistency between it and the separate backflow prevention requirements set under NUO regulations.

Recommendation 3

That a non-regulatory 'Cross-connection Control Manual' be developed based on the US-EPA document of the same name, adapted to address Australian practices, conditions and regulatory requirements. Its aim would be to reduce the number of preventable backflow incidents and other water contaminations which occur as a result of mistaken connections and lack of understanding of cross-connection control, as identified in several submissions to this report. The manual should be made freely available online, so as to maximise its uptake by practitioners.

Recommendation 4

Having regard to State and Territory variations, that an amendment to the PCA be drafted deeming above ground or partly buried domestic rainwater tanks as Low Hazard installations, for the purposes of determining the appropriate level of backflow prevention required where a top-up supply is provided. Also, the draft PCA amendment should include a definition of the term 'partly buried'. This would help address the confusion around this matter identified in the report (see Conclusions 8.2(8) and 8.2(9)).

Note: This Recommendation has potential implications for another part of the *Plumbing Code Development Research Project*, specifically the work related to rainwater harvesting and use.

Recommendation 5

That a probability and consequence based (not just consequence) risk assessment model for determining appropriate backflow prevention be developed as a Verification Method for use within the PCA's Performance Solution process, rather than as a part of the Deemed-to-Satisfy Provisions. This may require expert advice in the risk assessment field to ensure the model is robust, and that its use does not compromise protection levels.

Recommendation 6

That new Deemed-to-Satisfy Provisions (DtS) be developed for inclusion in the PCA 2019 Public Comment Draft to replace Appendix G of AS/NZS 3500.1. The new DtS would provide a regulatory solution for assigning a Hazard Rating (Low, Medium or High) to different installations or sites. The new provisions would function similarly to Appendix G although the content would be developed 'from scratch', through a review process undertaken in consultation with the ABCB's Plumbing Code Committee and the NUOs. This recommendation would be implemented subject to a regulatory impact assessment process.

Recommendation 7

That Part B3 of the PCA (Non-drinking water services) be amended to clarify the requirement for backflow prevention to protect non-drinking water supplies, as well as drinking water supplies, from contamination. The current wording only refers to the protection of drinking water supplies.

Recommendation 8

That a proposal be developed for consideration by Standards Australia seeking an amendment to AS/NZS 3500.1 to provide a more specific, prescriptive and minimum necessary technical solution for clearances and access for maintenance around backflow prevention devices.

Recommendation 9

That the scope of the existing ABCB Project: 'PCA Consolidation of State and Territory NCC-related requirements' be confirmed as including relevant backflow prevention (containment protection) regulations set by NUOs.

1 Introduction

Backflow prevention is considered by the plumbing, water supply and related sectors as being a highly important public health and safety measure. However, there are concerns the approach taken to backflow prevention is inconsistent, confusing for industry and potentially inefficient — that the level of protection provided may be either too high or too low, depending on the circumstances.

In response to these concerns, this report has been developed. It is the first review of its kind to be undertaken on a national scale since the Plumbing Code of Australia (PCA) was first published in 2004.

1.1 Backflow prevention and cross-connection control

Backflow is generally defined as: (1) flow in a direction contrary to the normal or intended direction of flow; or (2) the unintended flow of water from a potentially polluted source into a drinking water supply.[4]

The causes of backflow are back-pressure, which is the difference between the pressure within a water service and a higher pressure within any vessel or pipework to which it is connected; and back-siphonage, which occurs when the water supply pressure falls below atmospheric pressure.[5]

For backflow to occur, and for it to affect a drinking water supply, there must be a cross-connection between the source of contamination and the drinking water supply. A cross-connection occurs where pipework conveying water from one source is connected to another water source, either directly or indirectly.[6] A direct cross-connection is one where backflow may be induced by way of either back-pressure or back-siphonage; an indirect cross-connection will only enable backflow to occur when induced by back-siphonage.[7]

Cross-connections may be prevented from allowing contamination of water supplies by providing an air gap or break tank, or by installing backflow prevention devices within the water service on-site, and/or as part of a water meter or other point of connection to a water supply.[8]

Air-gaps are unobstructed vertical distances through free atmosphere, between the lowest opening of a water service pipe or fixed outlet supplying water to a fixture or receptacle and the

[4] Standards Australia, *Australian Standard/New Zealand Standard 3500 Plumbing and Drainage Part 0: Glossary of Terms*, 2003. p 5.

[5] *Ibid.*

[6] *Ibid.* p 13.

[7] JJ Lee, P Schwartz, P Sylvester, L Crane, J Haw, H Chang and HJ Kwon, *Impact of Cross-connections in North American Water Supplies,* Foundation for Cross-connection Control and Hydraulic Research – University of Southern California, AWWA Research Foundation, Denver CO, 2003. p 11.

[8] BRANZ, *Plumbing and Drainage Guide,* 2nd edition, Porirua City NZ: BRANZ Publishing, 2004. p 176.

highest possible water level of such fixture or receptacle. Break tanks are defined as a storage cistern or tank incorporating an air gap, specifically used for backflow prevention.[9] It should be noted however that the term 'backflow prevention device' may be used to refer to mechanical devices as well as air gaps and break tanks.[10]

1.2 Individual, zone and containment protection

Although these three terms are commonly used in backflow prevention, they are not formally defined in the PCA or in AS/NZS 3500. Alternatively, the following definitions have been adapted from the BRANZ Plumbing and Drainage Guide:[11]

- Individual protection: backflow prevention at individual fixture.
- Zone protection: backflow devices at the connection to a zone of fixtures within a site.
- Containment protection: backflow devices at the boundary or point of connection to a site.

1.3 Backflow prevention roles and responsibilities

Containment protection is usually regulated by the Network Utility Operators (NUOs) (water authorities, councils and the like), while zone and individual protection falls within the role of State and Territory plumbing regulatory authorities. As such, it can be said that backflow prevention, as a 'system', is only partially dealt with through the on-site plumbing and drainage regulations and the PCA. However, as will be discussed further in this report, lines of responsibility are not always clear and can vary between jurisdictions.

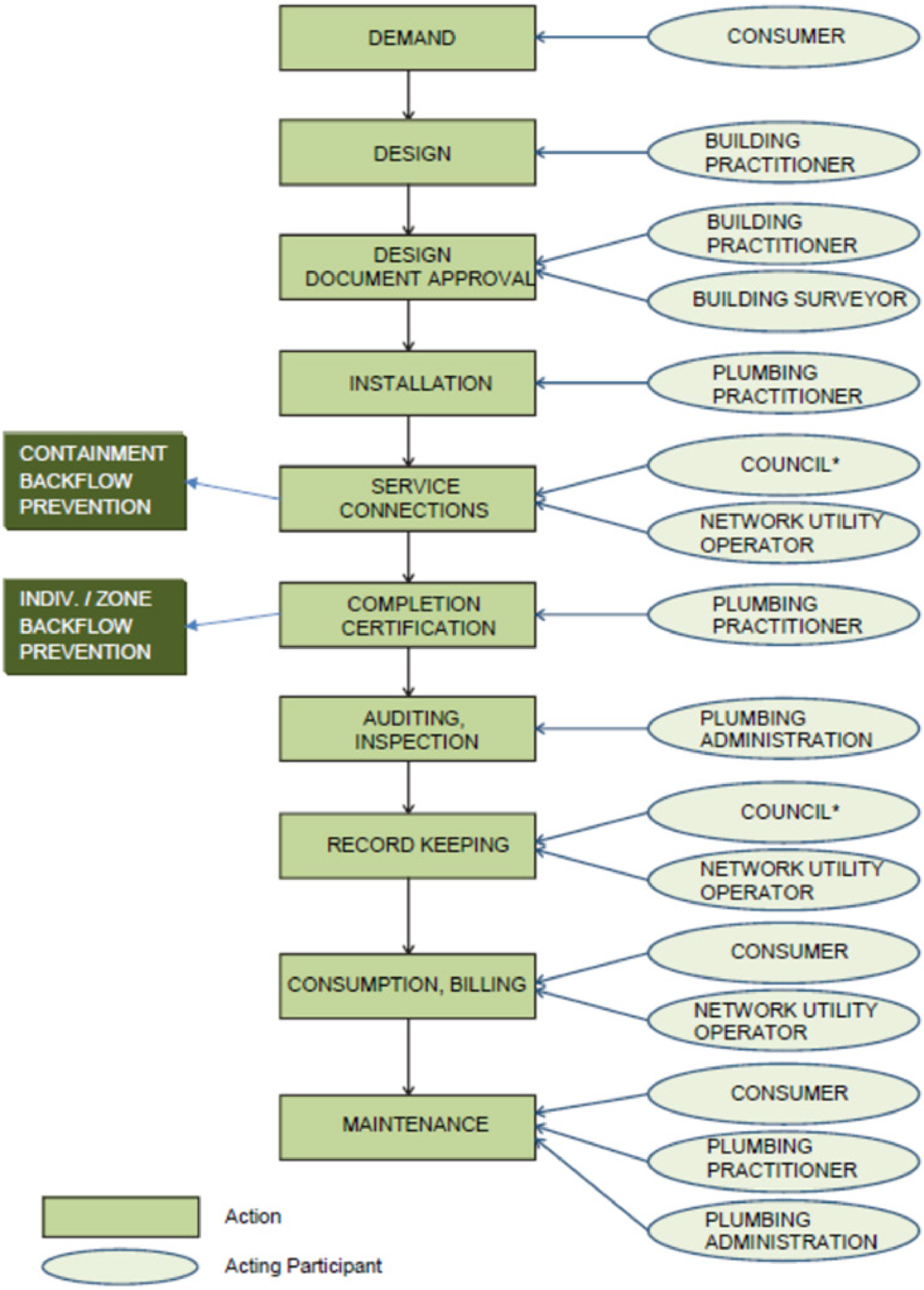
The flowchart on the next page provides a general depiction of the roles and responsibilities generally associated with the implementation of backflow prevention within Australia's on-site plumbing regulatory framework.[12]

[9] *AS/NZS 3500.0:2003*, above n 4, p 4.

[10] *Ibid.* pp 5-6.

[11] *Plumbing and Drainage Guide,* above n 8, p 179.

[12] Flowchart adapted from: Fisher Stewart, *Australian On-site Plumbing Regulatory Framework,* prepared for the Department of Industry, Science and Resources (Cwlth), September 2000. Appendix B, fig 3.



Flowchart: Outline of backflow prevention roles and responsibilities

1.4 PCA enabling legislation

In most States and Territories, backflow prevention primarily falls under two legislative frameworks: one for on-site plumbing and drainage, and one for water supply networks. The PCA is principally adopted by the 'Plumbing Regulations' (the name may vary between jurisdictions) of each State and Territory as the code for on-site plumbing and drainage work, as defined by those regulations. These regulations are sometimes referred to as the PCA's 'enabling legislation' and their role is to "[empower] the regulation of certain aspects of plumbing and drainage installations".[13] Generally, although not in all cases, the backflow prevention role of the PCA under these regulations is limited to protecting the on-site water service rather than the public water supply.

A summary of each State and Territory's PCA enabling legislation, so far as it is relevant to backflow prevention, is provided in **Appendix III** of this report.

1.5 Other legislation which may require compliance with the PCA

In all States and Territories except the Australian Capital Territory (ACT) and Queensland, legislation exists which requires compliance with the PCA (or AS/NZS 3500) for containment protection, but which operates separately to the enabling legislation.

A summary of each these pieces of legislation is provided in **Appendix IV** of this report.

In the ACT, all backflow prevention requirements are captured under the Water and Sewerage Act 2000 and the Water and Sewerage Regulations 2001. In Queensland, all backflow prevention requirements are captured under the Plumbing and Drainage Act 2002 and the Standard Plumbing and Drainage Regulations 2003.

1.6 About the Australian Building Codes Board

The ABCB is a Council of Australian Governments (COAG) standards-writing body that is responsible for the National Construction Code (NCC). It is a joint initiative of all three levels of government in Australia and was established by an Intergovernmental Agreement (IGA) signed by the Commonwealth, States and Territories on 1 March 1994. A new IGA was signed by Ministers, with effect from 30 April 2012.[14]

The ABCB addresses issues relating to safety, health, amenity and sustainability in the design and performance of buildings through the NCC, and the development of effective regulatory systems and appropriate non-regulatory solutions.

[13] ABCB, *National Construction Code Volume Three – Plumbing Code of Australia ('PCA 2016'),* Canberra: Australian Building Codes Board, 2016. Introduction – Legislative Arrangements.

[14] *An Agreement between the Governments of the Commonwealth of Australia, the States and the Territories to continue in existence and provide for the operation of the Australian Building Codes Board*. 30 April 2012.

The ABCB has two primary technical advisory committees, the Building Codes Committee (BCC) and the Plumbing Code Committee (PCC). These committees provide a valuable national forum for regulatory authorities and industry to consider technical matters relevant to building and plumbing regulation reform and play an active role in assisting the Board in meeting its obligations.

1.7 About the National Construction Code

The NCC is an initiative of COAG developed to incorporate all on-site construction requirements into a single code. The NCC comprises the Building Code of Australia (BCA) as Volumes One and Two; and the Plumbing Code of Australia (PCA) as Volume Three.

The NCC provides the minimum necessary requirements for safety, health, amenity and sustainability in the design and construction of new buildings (and new building work in existing buildings) throughout Australia.

The NCC is drafted in a performance format allowing a choice of Deemed-to-Satisfy Solutions or flexibility to develop Performance Solutions based on existing or new innovative buildings, plumbing and drainage products, systems and designs.

2 Background

This report is a review of the requirements for the prevention of the contamination of drinking water, with a focus on existing requirements and information regarding —

- the role of the PCA in protecting on-site water services (i.e. protection from individual hazards, or 'zone' protection) and the public water supply (i.e. through 'containment' protection);
- any gaps or inconsistencies which may exist in how the Performance Requirements of the PCA address cross-connection control and backflow prevention, specifically regarding the risk approach towards potential hazards;
- the current 'Hazard Rating' methodology;
- the suitability and selection of devices, including device registration and testing/maintenance regimes;
- device installation requirements; and
- other related matters.

2.1 Preliminary Research

Preliminary research for this report was gathered in 2014 through —

- a desktop review of relevant publications;
- a survey of Local Governments, to ascertain their role and obtain copies of any regulatory and/or guidance publications they may provide; and
- further targeted stakeholder surveys, distributed via the Backflow Prevention Association of Australia (BPAA), Australasian Fire and Emergency Service Authorities Council (AFAC) and the World Plumbing Council.

2.2 Consultation Paper

In 2015, a Consultation Paper was developed which set out a number of preliminary conclusions drawn from information gathered, and posed a series of questions in relation to those conclusions.

Its purpose was to seek feedback and further information on the accuracy and objectivity of its interpretation of relevant regulatory structures; the completeness of the research base; and the timeliness of the information sources drawn upon. This was to ensure that that such information could be relied upon for providing advice to the Board of the ABCB.

2.3 Draft Report

A draft version of this report was developed in 2015-16. The draft report provided a preliminary set of recommendations in response to the submissions received on the 2015 Consultation Paper.

The draft report and its recommendations were considered and endorsed, with amendments, by the PCC in March 2016.

2.4 Final Report

This document is the final version of the report. It incorporates changes requested by the PCC following their consideration of the Draft Report. The Board endorsed the recommendations of this Final Report in June 2016. Work has since commenced to implement these recommendations.

3 The role of the PCA

The role of the PCA in backflow prevention regulation varies widely due to differing regulatory approaches taken by each State and Territory. In most jurisdictions, the PCA can be applied to both on-site and containment protection. Legislation regarding on-site plumbing is naturally interlinked with water supply legislation as the two work together to delineate where responsibilities under each start and end.

The Consultation Paper sought to explore the separation, or delineation, of responsibilities between plumbing regulations and NUO legislative requirements so as to clarify the role of the PCA itself. This is because the PCA includes requirements explicitly directed at protecting the NUO's drinking water supply (i.e. containment protection),[15] yet so far it appears to have been developed and promoted on an understanding it would only be adopted under 'on-site' plumbing regulations (i.e. for zone and individual protection only).

This section of the report sets out stakeholders' views on the role of the PCA, and provides recommendations on how to achieve clarification of its role.

3.1 Risk management

The key difference between containment and zone/individual backflow protection requirements is in the risk being managed. In the former, the risk is to public health whereas in the latter, the risk is only to the occupants of the site.

In relation to whether or not containment protection should be regulated under the PCA, the Water Services Association of Australia (WSAA) explained this difference as follows:

> *The Network Utility Operator has to be able to directly control or influence the level of risk it is prepared to accept and is best placed to be able to effectively and efficiently manage compliance.*

Other submissions, also suggesting that containment be regulated by the NUOs, referred to the provision of safe drinking water;[16] the obligation to protect community water supplies under legislation;[17] and asset protection responsibilities.[18]

However, an important distinction needs to be made. That is, if containment protection were "regulated under the PCA", this would not necessarily mean it becomes solely the responsibility of the plumbing regulatory authorities, as opposed to the NUOs. Rather, what would be more

[15] See for example: *PCA 2016,* above n 13. cl BP1.1.

[16] *Sub.* Sydney Water.

[17] *Subs.* South East Water, Backflow Prevention Association of Australia, City West Water. The legislation being referred to was *Water Act 1989* (Vic) s 163; and the *Water (Estimation, Supply and Sewerage) Regulations 2014* (Vic) rr 11, 12.

[18] *Sub.* Hydro Systems.

likely is a broader agreement to achieve consistency regarding the adoption of the PCA under water supply legislation. There were no suggestions to transfer responsibilities between regulatory authorities.

At the same time, the fact that containment protection requirements are within the legislated responsibilities of the NUOs does not mean the same could be deleted from the PCA. This is because there are a number of examples of water supply legislation where the PCA is adopted, or where compliance with it is required. This legislation may be compromised if containment protection were removed from the mandatory Performance Requirements of the PCA.

3.2 Achieving consistency

A number of submissions supported incorporating containment protection into the PCA on the basis of achieving consistency between the requirements set nationally in the PCA and those of the State/Territory and local NUOs.

The Housing Industry Association (HIA) commented:

> *It seems excessive that all levels of Government continue to develop legislation around this issue, with the primary objective to improve public health and safety. A national approach should be possible which changes little of the current stringency or expectation for occupant safety.*

Other arguments addressing the need for consistency were based on the potential for confusion in industry when NUOs each develop separate standards, and whether or not Table G3 of AS/NZS 3500.1[19] should be relied upon (despite not being a normative part of the Standard).[20] Appendix G of AS/NZS 3500.1 will be discussed more broadly at **5.8** and **5.9**.

It was also suggested that as the work of installing and testing containment backflow prevention devices falls within the scope of licensed plumbing work, it should be regulated under the PCA.[21] However, it should also be noted that the scope of PCA cannot simply follow the scope of what is 'licensed plumbing work' given that is highly variable between jurisdictions.

3.3 Role of Network Utility Operators

The Rainwater Harvesting Association of Australia (RHAA), in their submission, took the position that backflow prevention should be regulated through the PCA so as to balance the role of NUOs in setting standards for containment protection. This was explained as follows, noting that the

[19] *AS/NZS 3500.1*, above n 2.

[20] *Subs.* Office of the Technical Regulator SA (regarding Table F3), Master Plumbers and Gasfitters Association Western Australia, Housing Industry Association.

[21] *Sub.* Master Plumbers Association of Queensland.

RHAA's comment was limited to backflow prevention for mains water connected to rainwater harvesting systems:

> *The RHAA does not support regulation by Network utility Operators due to their potential conflict of interest in how water supplies should operate. Regulation should be through the PCA who should ensure they seek advice from both inside and outside the water industry.*

Currently, it is considered that the ABCB (referred to above as the PCA) are in a position to provide the independent advice sought by the RHAA submission. The PCA is developed and changes considered based primarily on the advice of the PCC. The PCC includes representatives from the on-site plumbing regulatory authorities and national industry groups.[22] It does not currently include any NUO representatives so if anything, their influence is possibly too little, rather than too large.

3.4 Role of Local Governments

Requirements for containment protection are generally set either by the NUOs themselves or by plumbing regulatory authorities. However, in some States Local Governments also play a role.

In New South Wales, Local Governments may act as both NUO and plumbing regulator, particularly outside of Sydney.[23] The Local Government survey conducted by the ABCB found that these Local Governments issue separate policies in relation to backflow prevention, mainly for containment protection.[24] Although most NSW Local Government backflow prevention policies refer directly to either AS/NZS 3500.1 or the NSW Code,[25] one Council who responded to the survey indicated they refer to the PCA.

Local Governments in Queensland play a similar role to those in New South Wales. Many regulate backflow prevention through their own policy documents, with most of these policies referring directly to AS/NZS 3500.1. However, one Council directly referenced the PCA Performance Requirement BP1.2 as part of its backflow prevention policy.

3.5 Containment to protect other water supplies

So far, discussion of containment protection has, perhaps inadvertently, only focussed on protecting the NUO's drinking water supply. This approach implies that the drinking water supply

[22] For further information on the role and representation of the PCC, see: http://www.abcb.gov.au.

[23] New South Wales Fair Trading, *Local plumbing regulators in NSW: On-site plumbing compliance and inspections,* Advisory Note. 2013.

[24] *Consultation Paper,* above n 3. Appendix A.

[25] 'NSW Code' means the *NSW Code of Uniformity for Plumbing and Drainage*, the predecessor code to the PCA for plumbing and drainage regulation in NSW. The final edition of the NSW Code was published in 2006.

is the only water supply source that requires protection. However, the submission by the South Australian Office of the Technical Regulator (OTR) called for a broader approach:

> *Backflow prevention protects assets as well as drinking water. Some non-drinking water systems have backflow prevention installed to protect the point of connection e.g. aquifers, dams, recycled water systems, treated effluent systems etc.*
>
> *Other sites such as the Adelaide Oval redevelopment are serviced by 4 types of water supply of which only one is drinking water. Backflow prevention has then been installed on each one of these systems to prevent cross contamination between each supply.*

It was also highlighted by the OTR that while "[c]ontainment protection is usually the role of the Network Utility Operator…there are situations requiring containment that are not the responsibility of the NUO". This suggests that the concept of containment protection has broader application than simply protecting 'drinking water' supplies.

The OTR's submission highlights a valid issue that has received little attention so far in this report; that the backflow requirements of the PCA appear to only protect drinking water supplies. They do not seek to prevent contaminations occurring via cross-connections between non-drinking water supplies from different sources.

3.6 Testing and maintenance — current requirements

Testing and maintenance requirements were the subject of a large number of the comments contained within the submissions received on the Consultation Paper. The paper discussed the testing and maintenance requirements introduced in the 1998 revision of AS/NZS 3500.1, and issues surrounding the continued inclusion of these requirements in what is now a PCA referenced document, rather than a primary regulatory code.[26]

Under the current requirements, for Medium and High Hazard installations, the backflow prevention device must be a registered testable device and must be tested on an annual basis, or be an air gap or break tank registered with the appropriate authority to enable annual inspections.[27] The need for annual inspections was first identified in a survey undertaken in 1990 by the Brisbane City Council. It found many building owners were bridging air gaps post-installation, compromising their reliability as a backflow prevention measure.[28] At that time only

[26] AS/NZS 3500.1 is no longer the primary regulatory code, but is now one option for compliance with the Performance requirements of the PCA. It is called up as a referenced document, and so is subject to certain limitations. These limitations are set out in cl A1.2 of the PCA and in the ABCB *Protocol for NCC Referenced Documents.*

[27] *AS/NZS 3500.1*, above n 2. Table 4.1; cl 4.4.6.

[28] Brisbane City Council, *A Survey of Air Gap Protection Devices,* November 1990.

air gaps and break tanks were allowed for Very High and High Hazard (now called High and Medium Hazard) installations.[29]

While such a system appears necessary, at least based on the Brisbane City Council survey, under the NCC it is no longer appropriate that it be regulated through a referenced document. This is because under the PCA, a referenced document cannot create an obligation on property owners/occupiers to register and annually test backflow prevention devices.[30] Such clauses are not able to be enforced, as compliance with the PCA is only enforceable at a point in time (e.g. at installation), not as an ongoing obligation.[31] Also, its DtS Provisions are only one option for compliance (the other being the Performance Solution option).[32]

There is also a matter of public policy associated with the mandating of registration and testing for certain backflow prevention devices. This is a risk mitigation measure that should be managed by governments, rather than through a technical committee.[33]

3.7 Testing and maintenance — enforcement

The issues raised above around enforceability of the current requirements appear to be consistent with stakeholders' experience. In Victoria, City West Water, South East Water and Yarra Valley Water, and two individual submissions, highlighted confusion around who is responsible for enforcing the regulated requirements for the maintenance and testing of zone and individual (testable) backflow prevention devices. Similar issues were also highlighted by plumbing industry groups outside Victoria.[34]

It was then suggested that backflow prevention devices be included in Victoria's Essential Safety Measures Maintenance Manual, or its equivalent in other jurisdictions, to enable a similar reporting and auditing process as for cooling towers and fire protection systems.[35] This would resolve the public policy issue described above, although ultimately such a decision would be up to each State/Territory Government, as separate regulatory changes would be required.

[29] Standards Association of Australia, *Australian Standard 3500 National Plumbing and Drainage Code – Part 1: Water Supply,* 1990, Table 4.1.

[30] ABCB, *Protocol for NCC Referenced Documents*. Online: www.abcb.gov.au.

[31] See **Appendix III**.

[32] *PCA 2016*, above n 13. cl A0.5.

[33] *ABCB Position Paper on the NCC, Referenced Documents and Public Policy Statements* [2013], reproduced at **Appendix II** of this report.

[34] *Subs.* Backflow Prevention Association of Australia, Master Plumbers Association of Queensland.

[35] Building Commission Victoria (now Victorian Building Authority), *Essential Safety Measures Maintenance Manual,* as made under the *Building Regulations 2006* (Vic).

It was noted by practitioners that clause 4.4.6 (Testing and Commissioning) of AS/NZS 3500.1 is not enforced, although some backflow plumbers maintained their own databases.[36] The Master Plumbers and Gasfitters Association Western Australia (MPGAWA) also noted, “[a]t present the WA state regulator does not take responsibility for this and does not maintain a database register”.

The WSAA raised concerns there was a regulatory gap regarding ‘compliance management related to the testing of backflow prevention devices within a property. They stated that “[t]he plumbing regulators are currently unable to effectively manage this aspect of backflow prevention without enhancement of their plumbing specific regulations”.

From a plumbing regulator’s point of view, the OTR advised that they “rely on AS/NZS 3500.1 clause 4.4.6 for commissioning and retesting testable backflow prevention devices on installation and every 12 months. The OTR have approximately 30,000 registered devices which are maintained on a database including containment, zone and individual testable devices”.

The issues around enforcement matters raised in the above submissions confirm the concerns first raised by the Consultation Paper around using a PCA referenced Standard to establish an obligation to register and annually test devices. The requirements appear to be being ignored, especially with respect to zone and individual devices (containment devices may be covered under some NUO-administered testing and maintenance schemes).

That said, the current disregard for the testing and maintenance requirements of AS/NZS 3500.1 also appears to be having little, if any, consequence on public health and safety. In the submissions referred to above, no backflow incidents were attributed to this issue.

3.8 Safety of untested and unmaintained devices

As raised in submissions by the NUOs, BPAA, Master Plumbers Association of Queensland (MPAQ), MPGAWA and the OTR, many testable devices are being installed, but then not maintained, leaving it unknown if these devices remain fit for purpose, especially once at least twelve months have passed since installation. The issue is that AS/NZS 3500.1 allows testable devices, as an alternative to air gaps or break tanks in Medium and High Hazard installations, but only on the basis they are regularly tested and maintained. Otherwise an air gap or break tank must be used.[37]

The overall policy objective of the requirement is to ensure that such devices will be maintained, and will not be compromised, such that they will continue to function throughout their serviceable life.[38] It should be noted that in AS/NZS 3500.1, testable devices are also required to be

[36] *Subs.* Wenning Technical Services (regarding private databases), Backflow Management Services Pty Ltd.

[37] *AS/NZS 3500.1: 2015*, above n 2. cl 4.5, Table 4.1.

[38] *PCA 2016*, above n 13. cl BO1(f). See also: *A Survey of Air Gap Protection Devices*, above n 28.

registered; the only non-registrable devices are non-testable devices, the use of which is limited by Table 4.1 to Low Hazard installations only.

In particular, the WSAA commented regarding Low Hazard devices:

> *AS/NZS 3500.1:2003 (without amendment) nominated that low hazard devices needed to be checked as operational at least every 2 years. This requirement was removed as part of the amendment process (1 & 2). Without this requirement or similar, low hazard devices are left unchecked for many years (indefinitely), with no certainty that the device remains operational. NUO 20mm [and] 25mm water meters with integral dual check valves (low hazard) are replaced at scheduled intervals (maximum 8 years). Clarity in this area would be of benefit.*

While the background of that change to the Standard is not known, it is considered that such a requirement would have been difficult to enforce for the reasons already discussed.

The OTR offered an explanation of the reasons why testing and maintenance requirements can be difficult to implement:

> *Identification of backflow prevention devices has been an issue for the plumbing industry and customers particularly when attempting to locate a specific device installed in the field.*
>
> *This has caused problems with identifying and/or locating the device serial number especially when the device is located in a remote or difficult location e.g. within an in-ground box.*
>
> *This increases concern for the health and safety of the property owner if the device is consequently not retested and determined to be compliant.*
>
> *SA Administration [OTR] manages a backflow prevention device database which registers each device and this information is analysed annually by a computer which generates annual testing notifications.*
>
> *If the information provided by the plumber is incorrect the process of registering and retesting the device is time-consuming and can lead to incorrect data being recorded. In circumstances where this results in records being duplicated, the device may never get re-tested which can cause additional health and safety matters.*

The issues raised by this part of OTR’s submission further highlight the difficultly with the current requirements. Even where they are enforced, in their current form, they impose a significant administrative burden.

4 Cross-connections and backflow incidents

This section seeks to identify any gaps or inconsistencies which may exist in how the PCA Performance Requirements address cross-connection control and backflow prevention, specifically regarding the risk approach towards potential hazards. It draws on the preliminary research undertaken as part of preparing the Consultation Paper, as well as the information contained in submissions.

4.1 What is a backflow incident?

In defining the nature and extent of the issue, it is important to distinguish between cross-connections and backflow incidents. A cross-connection may be identified before any water supply is actually contaminated, whereas a backflow incident is a combination of a cross-connection and some other ‘force’ acting upon the contaminant causing it to enter the water supply. These ‘forces’ must be either water pressure — as in backpressure — or a vacuum in atmospheric pressure — as in back-siphonage.[39]

Naturally, cross-connections would be much more frequent than actual backflow incidents where a water supply was contaminated, however at the same time every unprotected cross-connection is itself a potential backflow incident waiting to occur.

There is also the possibility of a water supply being contaminated by way of a cross-connection, but where no backflow occurs. These are generally caused by mistaken connections. A recent example of this is the mistaken connection of Class A (highest quality) recycled water to a drinking water system at a school in Victoria.[40]

4.2 Backflow incidents — described in the Consultation Paper

Based on preliminary research, the Consultation Paper described the risk factors for a backflow incident, and the extent that they increase its probability of occurring. While difficult to quantify, the paper set out a series of indicators from which the following, initial general conclusions were drawn:

- Backflow incidents predominantly occur in industrial type buildings and other premises which would be considered High Hazard.
- Where not in or associated with buildings, a significant proportion of incident sites involve agricultural plumbing connected to a drinking water supply.

[39] United States Environment Protection Agency, *Cross-connection Control Manual,* 2003. pp 12-13.

[40] Department of Health and Human Services (Vic), *Recycled water cross-connection incident: Health information for Mt Ridley College*, public information release, 26 October 2015.

- Other than for the Class 8[41] (industrial) classification, no clear correlation can be made between any NCC building classification and Hazard Rating with respect to the probability of a backflow incident occurring.

- The high frequency of incidents in non-classifiable sites (not in or appurtenant to any building) indicates that building classification may not be an accurate indicator of risk posed by the premises to the drinking water supply.

The data on causes of incidents presented a particularly interesting overview with respect to regulatory approaches to the prevention of backflow. If it is accurate that most incidents are caused by unintentional cross-connections, rather than design issues, this would point to a need for more education and enforcement of existing regulations, rather than increased regulation.

There were no significant patterns that could be identified regarding the most likely sources of contamination, although non-drinking water supplies and tanks featured heavily.

Another interesting conclusion was that the most common consequence of a backflow incident appeared to be a complaint to the water supplier, rather than the (reported) occurrence of any illness or fatality.

4.3 Backflow incidents — stakeholders' experiences and views

Many stakeholders reported differences between the conclusions drawn in the Consultation Paper (discussed above) and their own experiences. The MPGAWA summarised this as:

> *The Australian evidence indicates that the nature of backflow incidents is consistent with the data outlined in the consultation document. The number of incidences reported is probably not a true reflection because not every backflow event is recorded as an incident. We believe, mainly through anecdotal evidence, that the network operators experience many events where the incident is not reported and therefore the public is generally unaware of the existence of backflow. Any events that cause minor illness (stomach upsets, etc) are often overlooked as food poisoning where potentially, all burst water mains could be considered backflow incidents.*

Many other stakeholders, from both the plumbing and water supply industries also suggested that the nature of incidents, but not the number, stated in the Consultation Paper was consistent with their experience.[42]

Sydney Water, in their submission, advised that they experience over 5,000 main breaks a year, each having the potential to draw water back into the network. Main breaks cause a loss of pressure to nearby property services, which can then lead to back-siphonage. If there is no

[41] For the definition of 'Class 8' building, see *PCA 2016,* above n 13. Part A4.

[42] *Subs.* South East Water, Backflow Prevention Association of Australia, Master Plumbers Association of Queensland, Water Services Association of Australia, City West Water, Yarra Valley Water.

containment protection in place, then water from within the property will re-enter the main, and may then enter the plumbing systems of properties downstream.

Irrigation Australia Limited (IAL), representing the Australian irrigation industry, was also critical of the statistical underpinning of this part of the Consultation Paper:

> *IAL notes that many of the statistics used in the research report are either out of date, refer to international experiences, or both.*
>
> *IAL advocates fact-based decision making. Without current, relevant and applicable facts and statistics, fact-based decision making can be problematic. With the often out-of-date and/or irrelevant statistics presented in this [Consultation Paper], IAL is unable to determine if there is a substantial current issue in the Australian market, or if there is a problem, what the nature and causes of the problem may be.*

With respect to the performance of backflow prevention devices, where a backflow force does act upon a (protected) cross-connection, the HIA's submission noted that:

> *There is little evidence of incidents or health issues occurring from the failure of backflow prevention devices in Australia. Any of this information is normally held by the relevant state health authorities and should be disclosed to determine the extent of the risk.*

Hydro Systems also noted in their submission that they were unaware of any incidents occurring that involved their products.

The above suggests the extent of the occurrence of backflow incidents in Australia is unknown, and may not be significant. The evidence that has so far been gathered does not cover all of Australia (indeed in some cases locations are unknown), covers a wide timespan, and is not definitive (i.e. it is not a record of every incident, but is a selected sample of only some incidents). As noted by IAL's submission, this makes it near impossible to form a sound statistical basis upon which to assess the adequacy of the current requirements, other than to conclude that they are not inadequate, and that any future proposal to increase their stringency would require new evidence to be produced.

4.4 Cross-connections

The Consultation Paper in its discussion of backflow incidents focussed mainly on those incidents where a water supply was contaminated. Cross-connections, in their own right were not discussed, despite being similarly hazardous. A cross-connection becomes a backflow incident as soon as it is subject to either back-siphonage or backpressure. It is also possible that a cross-connection will contaminate a water supply without any backflow occurring (e.g. when a mistaken connection is made between drinking and non-drinking water supplies).

A cross-connection can exist for a substantial period of time before it poses any hazard, due to the unpredictable nature of the hydraulic factors that cause backflow within the water supply itself,[43] or simply because certain outlets are not used for a long time. This means that the number of cross-connections in existence will generally always be higher than the number of backflow incidents, and as such will always be to some extent under-reported.

A number of submissions received on the Consultation Paper addressed the issue of cross-connections and mistaken connections, as distinct from backflow incidents. These submissions highlighted a wide variety of reasons why these issues occur and how they are discovered; these are discussed further at **4.6**.

4.5 Hydraulic factors

Preliminary research into backflow risk factors, carried out by the ABCB during the first half of 2014 (see Consultation Paper), yielded some information on the hydraulic factors that cause backflow to occur where an unprotected cross-connection is present.

Hydraulic contributing factors, as identified in a 2008 article[44] were the following:

- The venturi effect (as velocity increases, pressure decreases)
- Backpressure of gas into water
- Thermal expansion of water
- Compressed air
- Loss of pressure (main breaks, fire service draw-downs)

An article published in a recent edition of the journal *Risk Analysis,*[45] set a framework for estimating the adverse health effects of contamination (backflow) events, based on the behaviour of contaminants in a water supply system. This framework is a means of determining the likely adverse impact of contaminated water from a backflow event, dependent on two factors: the influences of 'decay', and the 'upper bounds'.

In broad terms —

- 'Decay' refers to the rate at which the contaminant spreads throughout the infected system, as influenced by how it reacts with water, chlorine and oxygen, and the system's pipe

[43] *Impact of Cross-connections in North American Water Supplies,* above n 7, p 3.

[44] AM Petrillo, 'Backflow Happens', *Reeves Journal*, June 2008. pp 66-9.

[45] M Davis, R Janke & M Magnuson, 'A Framework for Estimating the Adverse Health Effects of Contamination Events in Water Distribution Systems and its Application', *Risk Analysis,* 34-3, 2014. pp 498-513.

materials. The rate of decay affects how long a contaminant remains before it dissipates, or becomes inactive.

- 'Upper bounds' refers to the limit of impact, which is a function of: (a) the mass of the contaminant (how much went in); and (b) the population of the system (how many people could be exposed). This may appear obvious however it is important to note that (a) will always limit the effect of (b), simply because the amount of contaminant is finite. As it spreads out over a large system population (as in (b)), the dosage per person falls below harmful levels. Of course, for some contaminants, non-harmful dosage levels are extremely low.

It should be noted that the framework is more complex than the above description, which is provided only as a summary.

4.6 Why cross-connections occur

This section describes the reasons why cross-connection occurs, i.e. whether or not the cross-connection led to a backflow incident. It covers issues related to the adequacy of the regulatory system, as well as those related to education and awareness, and the occurrence of unregulated activities post installation.

The Consultation Paper sought information from stakeholders regarding the contributing factors to backflow incidents they were aware of.

The BPAA advised that:

> *The overwhelming contributing factors are human error and lack of knowledge (not enough training in the field of backflow prevention). Incidences have usually occurred when internal plumbing works have been undertaken after the building construction. An example is the cross-connection of drinking water and recycled water (i.e. the connection of drinking fountains to irrigation systems, DIY plumbing projects carried out by owner occupiers and or unqualified plumbers).*
>
> *The general understanding of backflow and cross-connection control is poorly understood by general plumbers as there is very limited reference to backflow prevention devices and backflow prevention device testing and maintenance taught in the apprenticeship.*

The BPAA's position was consistent with other submissions.[46]

With regard to training it was also noted that in South Australia backflow prevention had been specifically endorsed on the trade licence but that this is no longer the case.[47] While in Western

[46] *Subs.* Master Plumbers Association of Queensland, Water Services Association of Australia (re DIY plumbing), City West Water, Master Plumbers and Gasfitters Association Western Australia, Yarra Valley Water.

[47] *Sub.* Office of the Technical Regulator SA.

Australia the backflow prevention course has only been a compulsory subject for Plumbing Contractors' licences since 2007.[48]

The lack of understanding may also extend to experienced licensed plumbers and consultants, as noted by Backflow Management Services:

> *Backflow prevention is a specialised area of plumbing. There would be cases of experienced licensed plumbers making cross-connections without realising that they have inadvertently created a possible contamination of the water system. I believe that even some Hydraulic Consultants struggle to understand the complexities of backflow prevention, when it comes to the design of plumbing systems (as I have seen 1st hand with some of their drawings). So when you have this happening with experienced people in the industry, the public are definitely going to be making potential cross-connections resulting in possible contamination.*

From a plumbing regulator's viewpoint, the OTR advised:

> *The types of incidents that the S.A. Administration have been involved with vary from incorrect design and installation, deliberate interconnection of bore water with drinking water, a large number of recycled water residential services being interconnected with drinking water that were either reported by the NUO or disclosed as part of the plumbing audit conducted by the OTR. Most of these incidents have led to expiation fines being issued.*
>
> *Some such incidents are attributable to a lack of understanding amongst members of the community about the possible consequences of having plumbing installed in non-compliance of the standards. A case in point would be instances of consumers altering pipework where a large number of backflow valves do not function correctly due to their not being annually tested.*

4.7 Confusion with AS/NZS 3500.1

Although confusion with AS/NZS 3500.1 is the basis of much of this report, interestingly, it was not considered a major contributing factor compared to the issues discussed above. Rather, it was suggested that most incidents are attributable to on-site plumbing, as well as unregulated activity such as hoses being left in tanks and the installation of non-compliant bypasses.[49] The inconsistent enforcement of clause 4.4.6 of AS/NZS 3500.1 was also cited as causing some confusion in industry.[50]

[48] *Sub.* Master Plumbers and Gasfitters Association Western Australia.

[49] *Subs.* Backflow Prevention Association of Australia, Master Plumbers and Gasfitters Association Western Australia.

[50] *Sub.* Wenning Technical Services Pty Ltd.

4.8 Rainwater tanks

The WSAA also raised a specific concern regarding the installation of backflow prevention for rainwater tanks:

> *In the last 5 years the Victorian Government has been giving grants to home owners to install rainwater tanks and connect them to their house (toilet and laundry or whole house). The installation of an above ground rainwater tank at a property requires, at a minimum, the installation of a low risk device for containment protection. In many cases, plumbers completing the installation of such tanks, are not aware that a backflow device is required at the water meter. Often they indicate their belief that because the tank has a backflow device installed at the pump, they are then compliant with the regulation and standards. To ensure compliance with AS/NZS 3500.1:2003, many NUO annually inspect properties that do, or should have containment devices installed. These inspections have found that some sites have no devices and some only have zone or individual protection. This is potentially an issue for NUOs as these sites go unprotected until an audit is completed and the issue is raised with the new occupier of the site. The standards are clear, that the highest level device needs to be installed for containment protection; however NUO continue to find properties that fail to comply with the standards for either installing a device for zone, individual or containment. There needs to be a greater emphasis in the regulation or standards to ensure that the plumber installs the appropriate containment protection device.*

Alternatively to the WSAA's comments on backflow prevention for rainwater tanks, the RHAA submitted that:

> *[R]ainwater always has a low hazard rating. There are two reasons for this.*
>
> *Firstly several hundred thousand Australians drink rainwater every day and there is no noticeable negative health impact. It is therefore not possible that rainwater has a medium or high hazard rating. In the ABCB Plumbing Code Development Research Report 'Rainwater Harvesting and Re-use', section 3.5 it states that "Generally, State & Territory health authorities consider rainwater safe to drink…".[51] This would reinforce that rainwater has a low hazard rating.*

These submissions highlight conflicting views as to the appropriate protection of NUO drinking water and rainwater supplies from one-another. On the one hand there is a view that existing standards are not being adequately enforced, on the other hand they are seen as too stringent. These comments indicate that stored rainwater has no clear hazard rating, although Table G3 of AS/NZS 3500.1 and the evidence cited suggests a Low hazard rating.

[51] Note: the passage quoted then stated that health authorities "do not recommend drinking rainwater where a reticulated drinking water supply is available" (at [3.5] pp 17-18). This note has been included for the purpose of clarifying the views of the health authorities cited in the *Consultation Paper*.

4.9 Unregulated activity

Unregulated activity covers any actions done after the plumbing system is installed. This includes where a system that may have been compliant is compromised by a later alteration or addition that causes a new, unprotected cross-connection. It is referred to as 'unregulated' because it may be carried out as unlicensed plumbing work, and may not be installed compliant to any standard. In other cases, the activity does not require a licensed plumber, such as connecting a garden hose to a tap. Several submissions cited post-installation actions as an issue, for example 'illegal bypasses' and hoses left in tanks. It was also noted that where these actions occurred in commercial / industrial situations they were "mainly attributed to attempts to save costs and lack of knowledge".[52]

These comments are consistent with the findings of the Consultation Paper, regarding the prevalence of unregulated activity as a contributing factor in backflow incidents:

> *This [analysis] provided an interesting overview regarding different approaches to backflow prevention. In particular, the finding that relatively few incidents related to poor system design, valve failure or inadequate backflow prevention (total 35%), compared with those caused by accidents, mistakes, illegal modifications and the like (52%); areas where, arguably, the technical content of codes and standards are less effective.*[53]

> *[I]t was found that tanks and non-drinking water services were the source of the pollutant/contaminant in 1/3 of reported backflow incidents. This appears consistent with the earlier observation that 50% of incidents were caused by unintended cross-connections. This particular category included cross-connections where a drinking water hose was left in a tank and incidents where drinking water pipework was wrongly connected to non-drinking water pipework.*[54]

[52] *Subs.* South East Water, Backflow Prevention Association of Australia, Master Plumbers Association of Queensland, City West Water, Yarra Valley Water, Sydney Water.

[53] *Consultation Paper,* above n 3 [4.4] p 20.

[54] *Ibid.* [4.4] p 21.

5 Effectiveness of the Hazard Rating System

This section describes the systems used for determining the level of ‘hazard’ posed to water supplies by cross-connections. It sets out background information on the Hazard Rating system in Australia and addresses the key questions raised in the Consultation Paper regarding probability and consequence, containment, and the role and use of ‘Appendix G’ of AS/NZS 3500.1.

5.1 What is a Hazard Rating?

A ‘Hazard Rating’ is a type of consequence assessment. It describes the potential health consequences of water contamination in terms of three levels of hazard — low, medium and high. It is set out within Section 4 of AS/NZS 3500.1, and is applied to the consequences of an unquantified amount of exposure to a contaminant which may enter a water supply via a cross-connection.

As noted in the background information of this report, there are three Hazard Ratings provided for under AS/NZS 3500.1. These are —

- High Hazard: any condition, device or practice that, in connection with the water supply system, has the potential to cause death.
- Medium Hazard: any condition, device or practice that, in connection with the water supply system, has the potential to endanger health.
- Low Hazard: any condition, device or practice that, in connection with the water supply system, constitutes a nuisance but does not endanger health or cause injury.

It is important to note that a Hazard Rating is not a risk assessment, as a risk assessment process considers both the likelihood and consequence of a given event, not just its consequence.[55]

5.2 Purpose of Hazard Ratings

The purpose of the Hazard Rating system is to provide a consistent method of classifying the risk posed by cross-connections in a plumbing system. These classifications are then used to determine the selection of backflow prevention for each cross-connection, and as a trigger for certain devices to be included in registration and testing programs.

The Hazard Rating process is applied on two levels: first to address specific hazards which may exist on the premises (zone and individual protection), and second to address the overall hazard posed by the premises to the water supply to which it is connected (containment protection).

In some jurisdictions, the highest Hazard Rating identified within the premises determines the lowest Hazard Rating which can be assigned to the site. For example, if the highest rating used

[55] ISO 31000: 2009, cited in the ABCB *Manual for the Assessment of Risks of Plumbing Products,* 2013.

for zone protection within the premises is High Hazard, the lowest level of containment protection must also be High Hazard. The logic behind this is that NUOs, that are usually responsible for containment protection, assume some failures of zone and individual protection measures will occur, and so require that containment devices provide at least an equivalent level of protection.[56]

For housing, there is a general assumption among NUOs and Local Governments that these premises are Low Hazard. This recognises that largely the same conditions exist on these sites, and also enables containment backflow prevention to be provided within the property water meter (up to 25 mm diameter) which is usually provided by the NUO.

5.3 Development of the Hazard Rating system

The following outlines the development of the Hazard Rating system since its introduction as part of the AS 3500.1 1990: National Plumbing and Drainage Code, Part 1: Water Supply, which used a 5 level system, rather than the current 3 levels. The 5 level system is of interest to this report because, unlike the current consequence-based approach, it also included consideration of likelihood, particularly for the purpose of identifying hazards of the Medium, Low and Very Low levels.

The 5 level Hazard Rating system (as it was in 1990) is reproduced below:

- Very High: the process or activity has the potential to involve disease producing micro-organisms or chemicals of lethal toxicity.
- High: the process or activity has the potential to involve uncontrolled growth of micro-organisms not expected to be of pathological types or chemicals of moderate toxicity.
- Medium: the process or activity has the potential to involve chemicals or substances which would not normally be detrimental to health if consumed in moderate quantities. Growth potential of micro-organisms is restricted. The exposure of the water supply to the contaminant may be infrequent or incidental.
- Low: the process or activity has the potential to involve chemicals or substances which would not be detrimental to health if consumed but are undesirable in a water supply, or exposure of the water supply to contaminants is an unlikely event.
- Very Low: A potential cross-connection which would normally be classified as 'Low' but which experience has shown to be of negligible hazard.

The 'Medium' rating was similar to 'High' but with an allowance for a reduction in probability; the same could be said of the 'Very Low' rating, compared to 'Low'. The 5 level system was replaced with the current 3 level system when AS 3500.1: 1990 was revised and re-issued in 1992. The 3

[56] E.g. Sydney Water, *Getting Connected: How to connect to Sydney Water Services and what to do once you are,* Pub. no. SW217 6/12. 2012. p 37.

level system was retained though AS/NZS 3500.1.2: 1998[57] and continues to be used in AS/NZS 3500.1.

The changes resulting from the move to a 3 level system are that the 'High' rating has been merged with the 'Very High' rating; the 'Very Low' rating has been removed; and the consequences of all potential contaminants are now assumed to be the same. This is regardless of whether or not they are organic, their potential for growth, and without consideration of the likelihood of exposure of the water supply to the contaminant.

5.4 Balancing probability and consequence — stakeholder views

With regard to whether the Hazard Rating system adequately considers both probability and consequence, it is clear that the current system only considers consequence, not probability. In the Consultation Paper, stakeholders were asked if they believed this approach is adequate, or if they believe the probability of a backflow event actually occurring should also be a part of the Hazard Rating system.

The Consultation Paper's discussion of probability and consequence raised specific issues for Network Utility Operators, who have different objectives and priorities to those in the on-site plumbing industry.

From the point-of-view of three Victorian NUOs, in separate submissions, it was stated that:

> *As the NUO, our position is to minimise the risk to our assets and customers and [so] the consequence is more important than the probability.*[58]

The WSAA (a national representative body for NUOs) however took a different view:

> *The current hazard rating system is limiting and should consider likelihood/probability in the risk assessment. Although consequence is a major concern for NUO, only considering a potential consequence slants the risk to potentially a higher level than in reality. Such an approach tends to increase cost and regulatory impact.*

The OTR, while not a NUO, has regulatory responsibilities that cover both the on-site and 'network' sides of the point of connection.[59] On the role of probability in determining hazard ratings, they sounded a note of caution:

[57] In 1996, AS/NZS 3500.1.2: Acceptable Solutions was published in combination with Part 1.1: Performance Requirements. This format applied across the AS/NZS 3500 series from 1996 until 2003, when the Performance Requirements were removed.

[58] *Subs.* South East Water, City West Water, Yarra Valley Water.

[59] *Water Industry Act 2012* (SA) s 9.

When dealing with High and Medium Hazard Ratings the use of probability could have serious consequences particularly if the hazard rating were downgraded due to probability and a backflow incident occurred.

The perspectives of stakeholders in the plumbing, backflow and related industries usually differed, but were sometimes were consistent. The BPAA, MPAQ and others took a view similar to that of the Victorian NUOs (quoted above), describing their approach in terms of the responsibilities of NUOs compared to on-site plumbers:

The role of the NUO is to minimise the risk to their assets and protect the quality and integrity of the water supply therefore the consequence of a backflow event is more important than the probability of the event occurring.

The responsibility of the plumber is to assess the risk based on the potential consequence of a backflow event. They have little understanding of the ultimate consequence.

Hazard ratings must be based on the consequence as the probability is too subjective and open to individual interpretation.[60]

One submission from a backflow industry practitioner went even further, by supporting the status quo position:

The Hazard rating system currently in place is more than adequate. The rating should be based on the consequence and have nothing to do with the probability. I see that the Cross-connection Hazard Rating is to outline that during a backflow incidence, a High Hazard has the ability to cause death, regardless of whether the probability is more or less likely to happen.[61]

The MPGAWA made the suggestion that there is a role for both probability and consequence in assessing backflow hazard, but that the analysis should be weighted to place more importance on consequence:

The network operator's main concern is to minimise risk to their assets and protect the quality and integrity of the water supply, therefore the <u>*consequence*</u> *of a backflow event is more important than the* <u>*probability*</u> *of the event occurring. It is the responsibility of the licensed plumbing contractor to assess risk based on the potential consequence of a backflow event with guidance from AS/NZS 3500.1:2003. The general plumber would have little understanding of the potential consequence. Hazard ratings should be based on a consequence and probability matrix. (Underlining in original.)*

[60] *Sub.* Backflow Prevention Association of Australia. Also: *Subs.* Wenning Technical Services, Master Plumbers Association of Queensland.

[61] *Sub.* Backflow Management Services Pty Ltd.

The RHAA submission was more supportive of the increased use of probability:

> *The RHAA supports a Risk Management analysis over a Hazard Rating assessment in order to avoid the scenario of national plumbing regulations for an event that has never occurred.*

As they currently stand, neither the PCA nor AS/NZS 3500.1 provide any solutions on how a probabilistic assessment of the risk of backflow might be undertaken. Some guidance exists in Appendices F and G of AS/NZS 3500.1 however it is presented as typical examples, rather than in the form of a risk-assessment matrix, or the like.

5.5 Determining Hazard Ratings

The Consultation Paper identified that Australia has at least 14 different systems for assigning a 'Hazard Rating'.[62] The correct system applicable at the time depends on whether the backflow prevention is required by a plumbing regulatory authority or NUO; which State or Territory the installation is in; and under the PCA, whether you are using the Deemed-to-Satisfy Provisions or developing a Performance Solution.

Most systems are based on the three-level system set out in AS/NZS 3500.1, however many authorities (particularly NUOs) re-publish the Hazard Ratings in their own documents. This provides them with the ability to override the Standard, and enables their stakeholders to avoid the need to purchase a Standard simply to access the Hazard Rating system.

With both the PCA and AS/NZS 3500.1 being at different times the primary regulatory document, a new layer of complexity has arisen regarding Hazard Ratings. Under the PCA, the Hazard Ratings contained in the standard are a Deemed-to-Satisfy Solution, with practitioners also having the option of using an alternative approach. Where the Standard remains the primary document, i.e. through direct referencing in other regulations, assigning a Hazard Rating using AS/NZS 3500.1 is the only compliance option.

To learn more about how this complexity affects the application of Hazard Ratings in practice, the Consultation Paper asked stakeholders to identify the factors they take into account when using AS/NZS 3500.1 for determining a Hazard Rating and to nominate whether this was for containment, zone or individual protection.

5.6 Hazard Rating factors for containment protection

Among several stakeholders, representing the backflow and plumbing industries as well the NUOs, a common set of factors were identified that are taken into account in assigning Hazard Ratings for containment protection.

[62] This is based on a count performed as part of research for the *Consultation Paper* (above n 3) in 2014.

According to the BPAA, these were:

- *Building class (i.e. industrial/commercial).*
- *Internal processes carried out within the property (i.e. manufacturing, products stored, alternative water supplies).*
- *Ease of future access to the property to undertake audits.*
- *The potential for tenancy changes resulting in the potential for internal process changes.*

A similar list to the above was also provided in several other submissions.[63] Other practitioner views were similar, as shown in the following two quotes:

> *For Containment: The type of facility, the processes that are being done at the facility and the building classes when deciding especially for irrigation purposes what device to use & the use of Appendix F & G tables.*[64]

> *In all cases, I take into account the potential contaminant.*[65]

Adding further detail from NUO point-of-view, the WSAA identified the following factors and processes used by its members:

> *The land use is reviewed when making an assessment of the risk generated by the property. It should be noted this is only an initial risk rating and if further investigation is required to confirm actual activities that take place on site. The complexity of plumbing will also come into consideration.*

> *A database is managed/maintained of* <u>*site containment backflow prevention devices only.*</u> *Zone & individual backflow devices installed within the development are the responsibility of the designer / licensed plumbing contractor / property owner.*

> *To determine the site containment backflow requirements, information contained within AS/NZS 3500.1 Appendix F & G (site, zone & individual backflow) is used. This information is used as a guide only. Zone & individual backflow factors have a bearing on site backflow hazard rating. However, an NUO can only manage/monitor the site containment backflow and cannot confirm that the zone or individual devices are operationally compliant. For this reason they require the site containment device to be the same or higher in hazard rating than the highest zone or individual device.*

[63] *Subs.* South East Water, Master Plumbers Association of Queensland, City West Water, Yarra Valley Water.

[64] *Sub.* Backflow Management Services Pty Ltd.

[65] *Sub.* Wenning Technical Services Pty Ltd.

> *The Hydraulic Design Assessment process is utilised as the main tool to identify the level of site containment backflow. (Underlining in original)*

Others stakeholders confirmed that they rely on AS/NZS 3500.1, particularly Appendices F and G, for guidance in determining Hazard Ratings.[66]

5.7 Hazard Rating factors for zone and individual protection

All submissions which identified factors used in assigning zone and individual Hazard Ratings referred to AS/NZS 3500.1. Some further detail was offered by the BPAA, who expanded on how this standard is applied:

> *In zone and individual protection it is a mix of the AS/NZS 3500.1 guide lines when there is little knowledge of the connected equipment. In addition to this it is dependent on the health hazard of the process or additives used.*

Four other submissions also offered similar advice. [67]

5.8 Role of 'Appendix G'

Appendix G of AS/NZS 3500.1 provides examples of cross-connections, described in terms of building and installation types, along with recommended Hazard Ratings and corresponding device selections. It covers individual, zone and containment protection (even though the Standard itself does not require containment protection), and provides examples for both testable and non-testable devices.

In the 1990 edition of AS 3500.1 the content of 'Appendix G' was normative and located within Section 4. It was presented as a series of tables for selecting devices for individual, zone and containment backflow protection. These normative tables were relocated and relegated to an informative appendix in the 1992 edition. The original reasoning behind that change is unknown.

5.9 Stakeholders' issues with Appendix G

In the Consultation Paper, it was identified that while the Hazard Rating system within AS/NZS 3500.1 defines levels of hazard, it gives no prescriptive solution for applying each defined level to a particular site/installation. The nearest available alternative is to use the guidance provided in Appendix G of the standard. However, being informative only, the appendix does not need to be followed to achieve compliance with the Standard,[68] and so cannot be used in a

[66] *Subs.* Office of the Technical Regulator SA, Master Plumbers and Gasfitters Association Western Australia.

[67] *Subs.* South East Water, Master Plumbers Association Queensland, City West Water, Yarra Valley Water.

[68] Standards Australia, *Standardization Guide SG-003: Standards and other publications,* v1.8. 2014. [3.7.4] p 8.

Deemed-to-Satisfy Solution. This anomaly imposes a level of subjective judgement and risk on practitioners.

In order to investigate this issue, stakeholders were asked: "When using AS/NZS 3500.1, do you rely on Appendix G to help determine Hazard Ratings, and if so to what extent (i.e. do you use it every time, or only in some cases)?" [69]

The MPGAWA supported the above conclusion, with respect to individual and zone protection, describing their concerns with Appendix G as follows:

> *Other than containment, Appendix G is used extensively, unless it is blatantly obvious what the rating will be, for example the water supply feeding an acid tank. However, Appendix G is <u>informative</u> only, which can cause compliance issues.*

Others including the BPAA, MPAQ and some Victorian NUOs also commented that while the Appendix is used as a reference point, its content is too broad, confusion arises around it being 'informative' only, and it should be 'made normative'.[70]

On the issue of the Appendix being 'too broad', the following criticism was also offered by a practitioner within the backflow industry:

> *In the first instance [I rely on] Tables G1, G2 and G3. However, Table G3 is not helpful as numerous types of properties are not listed. Therefore the nature of connection either listed in Tables G1 or G2 could assist in determining the containment hazard rating.*[71]

From the point-of-view of the NUOs specifically, Sydney Water noted that the appendix is used only to identify examples, and will be overridden by the NUO's own requirements. They cited fire services and trade waste agreements as two examples.[72] The WSAA provided further detail on these points:

> *Yes [we do rely on Appendix G]. AS 3500.1 Appendix G has been a very helpful & informative guide in determining risk assessments of properties.*
>
> *It is not used every time as not every example of a property is listed in Appendix G (Appendix G could be expanded for broader coverage) but it does provide good supporting evidence/information when engaging with plumbers and customers.*

[69] *Consultation Paper*, above n 3. [9.3] p 54.

[70] *Subs.* South East Water, Backflow Prevention Association of Australia, Master Plumbers Association of Queensland, Backflow Management Services Pty Ltd (supporting the Appendix being made normative), City West Water, Yarra Valley Water.

[71] *Sub.* Wenning Technical Services Pty Ltd.

[72] *Sub.* Sydney Water.

Some utilities, such as Hunter Water, use their own Site Containment Backflow Prevention Standards as their main document when determining the site containment hazard rating and Appendix G as a guide only.

6 Installation requirements

This section discusses issues where the PCA and/or AS/NZS 3500.1 were identified as being unclear on the installation of backflow prevention devices. The discussion covers aspects of installation not already discussed in previous sections.

6.1 Plumbing Code of Australia (incl. AS/NZS 3500.1)

In the Consultation Paper, it was noted that the current PCA Objectives, as well as some Performance Requirements, reflect an intention that the code be applied for the purposes of protecting the NUO's water supply from contamination due to backflow. This implies that the code can apply to containment protection, notwithstanding the issue of its role being unclear, as discussed in that Paper.

The current PCA Performance Requirements add complexity in that they are unquantified, absolute statements, rather than descriptions of a required level of performance. That is, they simply state that the 'likelihood' of contamination of a water service must be 'avoided'. Whereas, in performance terms, the required level of performance would be expressed such that the risk of contamination must be as low as reasonably practicable, even if this too is unquantified.

At the Deemed-to-Satisfy level, there is further potential for confusion where the requirements for backflow prevention are divided between AS/NZS 3500.1 (or Part 5), and B1.4.

PCA Deemed-to-Satisfy Provision B1.4 states the following:

> *B1.4 Cross-connection control*
>
> *Where a property is served by a non-drinking water supply—*
>
> *(a) a backflow prevention device suitable for the degree of hazard and sized to suit the capacity of the drinking water service must be fitted to the drinking water service at—*
>
> *(i) the meter; or*
>
> *(ii) the point of connection, where a meter is not installed; and*
>
> *(b) a low hazard backflow prevention device must be fitted to each external drinking water hose tap outlet.*

Like the Performance Requirements, these provisions appear to cover both on-site and containment backflow prevention matters.

The same can be said of the State and Territory variations published in the PCA Appendices. For example, the backflow prevention requirements for rainwater tanks in NSW and SA also cover containment protection.

Outside the PCA, there are a significant number of further technical requirements which are generally prescriptive (i.e. they are not subject to a performance-based approach), and are set by authorities such as Local Governments and NUOs. These technical requirements vary the application of AS/NZS 3500.1 to rainwater tanks, properties having non-drinking water supplies, and backflow prevention for fire services, and mostly relate to containment protection.

The Consultation Paper posed the following question to stakeholders:

Thinking about the installation requirements for backflow preventions devices contained within the PCA, AS/NZS 3500.1, or local regulations, can you identify any areas where these are unclear, unnecessary or overly complex?

The following issues were identified and described in the submissions received.

6.2 Practitioner training needs

A general need was identified for more training in backflow prevention, and it was suggested that a new, nationally consistent manual be developed. The MPGAWA described this as follows:

> *Installation requirements have too many grey and unclear areas that cause confusion for the average plumber who has not been adequately trained in backflow protection. The appendices in AS/NZS 3500.1:2003 should be more technically based and designated normative rather than informative as they remain currently. The MPGA is of the view that the average plumber requires more training in backflow assessment, installation and testing requirements. Consideration should be given to the development of a national backflow prevention assessment manual that would be adopted nationally to eliminate the inconsistencies between jurisdictions. This would include assessment of sites to determine the type and level of protection required.*

Several other submissions from the plumbing and backflow prevention industries and NUOs expressed a similar view.[73] This topic is further discussed in the conclusions and recommendations.

6.3 Device location and accessibility

The requirements around the location of devices was raised by three submissions, each addressing a slightly different aspect.

The OTR commented:

> *The installation and location requirements in AS/NZS 3500.1 Clause 4.6.2 and 4.6.3 should be reviewed and updated to provide comprehensive installation requirements.*

[73] *Subs.* South East Water, Backflow Prevention Association of Australia, Master Plumbers Association of Queensland, City West Water, Yarra Valley Water.

The requirement for relief drains located not less than 300 mm above the surrounding surface should be reworded to reflect appropriate distances and wording above finished surface level using the same wording as found in the AS/NZS 3500 review.

Suggested review various manufacturers installation instructions and incorporate [into] the wording of AS/NZS 3500.1.

Two submissions from practitioners also highlighted issues with this aspect of AS/NZS 3500.1:

In AS/NZS 3500.1 [clause] 4.6.2.2 Accessibility. It is unclear to plumbers about the requirements of Backflow devices to be installed in Accessible locations, specifically around the wording of ease of maintenance and clearance around device to test and repair the device. As in earlier questions, Backflow Prevention is a specialised area of plumbing, and a lot of installation plumbers do not realise what is involved when it comes to servicing and maintaining the installed devices.[74]

The safe location and provisions of maintenance of testable devices needs clarification.[75]

6.4 Other issues — PCA

In addition to the above, a number of other issues were raised, with regard to both the PCA and parts of AS/NZS 3500.1.

The Consultation Paper noted, with respect to Performance Requirement BP3.3(a),[76] that:

This Performance Requirement operates in a similar way to BP1.2(a), except that here the likelihood of contamination of drinking water generally must be avoided; there is no reference to whether the drinking water is contained in a pipe, tank or other container. Also, given there is no reference to avoiding the likelihood of contamination of non-drinking water supplies, it could be interpreted that no form of backflow protection is required for those supplies.[77]

In response, the OTR advised in their submission:

The comment from the [Consultation] Paper that BP3.3(a) could be interpreted as meaning that no form of backflow protection is required on those [non-drinking water] supplies is not supported by the SA Administration. As previously discussed, backflow

[74] *Sub.* Backflow Management Services Pty Ltd.

[75] *Sub.* Wenning Technical Services Pty Ltd.

[76] Performance Requirement BP3.3(a) states the following: "A *non-drinking water* service must be designed, constructed and installed in such a manner as to— (a) avoid the likelihood of contamination of *drinking water*…" (*PCA 2016,* above n 13).

[77] *Consultation Paper,* above n 3. [7.1] p 37.

prevention is required on sub-surface irrigation to protect non-drinking water supplies i.e. from the ingress of Treflan.

In addition to the requirement to fit a low hazard backflow prevention device on each external hose tap as per B1.4(b), consideration should be given to requiring the installation of a backflow prevention device of the same hazard rating when the hose tap is installed within 18 m of a zone protected area as required under AS/NZS 3500.1 clause 4.4.3.

6.5 Other issues — AS/NZS 3500.1

In addition to that already discussed above, the WSAA submission also raised a number of further issues in relation to AS/NZS 3500.1:

Clause 4.4.1(a) and (b) nominate individual and zone devices but do not refer to containment devices.

Figure 4.1 shows individual and zone devices on the diagram yet on the same diagram nominates site containment "where required". If there is a hazard individual utilities require site containment the same or of higher hazard rating.

AS/NZS 3500.1 Section 4 can be interpreted as 'that as long as there is a device relative to the identified hazard located on the water supply line, then the water supply line upstream of the device is considered drinking water'. Does this mean that no containment device is required by the standards?

The suggestion that the Standard does not require containment is correct if the words of the Standard are read in isolation. However, when read in conjunction with relevant regulations and/or the PCA, the Standard could be applied to containment protection. As such these comments serve to reinforce the earlier discussion in this report regarding confusion about regulatory responsibilities for containment protection.

6.6 State and Territory variations and additions to the PCA

In the State and Territory Appendices to the PCA, there are several variations and additions for the design and installation of backflow prevention. Although no specific comments were received regarding these, they remain current and relevant to the purposes of this report. The discussion of them has been retained from the Consultation Paper, as follows.

New South Wales

Additional requirements to AS/NZS 3500.1 are inserted in the PCA to require the identification of valves installed below ground, and to specify air gap measurement and cross-connection control for cooling towers;[78] and to vary the backflow prevention measures for residential rainwater tanks serving single dwellings. The variations require buried or partly buried tanks to have a non-

[78] *PCA 2016*, above n 13, cl NSW B1.2; fig NSW Figure B1.2.

testable dual-check valve with atmospheric port for containment protection, and a non-testable device for zone protection. For rainwater tanks serving other than single dwellings, the variation refers back to the NUO.

For non-drinking water services, in particular treated greywater services, top-up lines from the drinking water supply are to be protected by an air gap, and which prevents the connection of treated greywater services to “drinking water, rainwater, or other sources of supply”.[79] For the purposes of Class 1a and 10 buildings, AS/NZS 3500.5 is not adopted as a referenced document in NSW. Additionally, Part B4 of the PCA, which contains requirements regarding backflow prevention for fire-fighting water services, is not part of the PCA for the purposes of the *Plumbing and Drainage Act 2011* (NSW).

Northern Territory

Under the *Building Act*, Part B4 of the PCA does not apply to fire-fighting water services.[80] This may affect the requirements for backflow prevention to these services.

Queensland

As with New South Wales, AS/NZS 3500.5 is not adopted. Similar to the NT, Part B4 is also not adopted for fire-fighting water services.[81]

South Australia

Additional requirements to AS/NZS 3500.1 are inserted to provide for a risk assessment process to be applied for buried or partly buried rainwater tanks. This has the potential to reduce the backflow prevention required under clause 14.4.1 of AS/NZS 3500.1. The risk assessment may take into account design, installation and environmental factors.

These include connection to a drinking water supply, risk to water quality from air pollution, risk of contamination from ground or surface water, and the nature and extent of precautions taken to prevent contamination from catchment areas or ground/surface water.[82] The completed risk assessment is then submitted to the OTR.

6.7 Other State and Territory requirements

This Section describes further technical requirements for backflow prevention which are included in State and Territory regulations, including those made by NUOs, but which are not included in

[79] *Ibid.* cl NSW B3.2(a)(i)(B).

[80] *Building Regulations* (NT) r 4; *PCA 2016,* above n 12, pt NT Part B4.

[81] *Standard Plumbing and Drainage Regulation 2003* (Qld) r 8A(1).

[82] *PCA 2016*, above n 13, cl SA B1.2(a).

the State and Territory Appendices to the PCA. Such requirements exist in New South Wales (at the Local Government level), the Northern Territory, Queensland and Tasmania.

No submissions commented on these variations. However, the discussion of them has been retained from the Consultation Paper as it is considered relevant.

New South Wales Local Governments

Research conducted for the Consultation Paper found that, generally, Local Governments enforced the requirements set at the State level — i.e. the PCA. New South Wales Local Governments' additional requirements for backflow prevention are summarised in the following paragraphs.

Cross-connection control

Properties with a reclaimed water supply must have a High Hazard device on the Network Utility Operator's drinking water supply. The device must be either a registered break tank, or a reduced pressure zone device (RPZD). This requirement is similar to B1.4 in the PCA, except that the Hazard Ratings and acceptable devices have been prescribed. In some council areas, only an RPZD is allowed.

Backflow prevention for rainwater tanks

Specific to rainwater tanks—

- Where partially buried, for backflow (zone) protection purposes, a rainwater tank is to be treated as fully buried (varies AS/NZS 3500.1 Table 14.1).
- Rainwater tanks must have a 'visible' air gap between the Network Utility Operator's (NUO) supply and the tank (varies AS/NZS 3500.1 Table 14.1).
- Where a rainwater tank has a top-up line, it must be registered with council as a break tank (a 'registered break tank').
- There must be an air-gap at the entry to the tank (from the top up line) (varies AS/NZS 3500.1, clause 14.3.3(c)).
- The air-gap must be at least 100 mm.
- Hose taps must be fitted with an atmospheric vacuum breaker (varies PCA clause B1.4(b) which allows any type of Low Hazard backflow prevention device to be used).
- Zone protection must be a dual check valve: non-testable, for either a buried or above ground tank (varies Section 4 of AS/NZS 3500.1).

These requirements appear to reflect the rainwater tank provisions of the *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008* (NSW), as made under the *Environmental Planning and Assessment Act 1979* (NSW).

Northern Territory

In the Northern Territory, the Power and Water Corporation's (PWC) Backflow Prevention Manual describes their requirements for containment backflow prevention. These requirements refer directly to AS/NZS 3500.1, with the following variations:

- For Medium and High Hazard properties, containment protection may be omitted where the property is supplied from a meter greater than DN 80, where there is only one hazard on the property, and that hazard is protected by a zone protection device accepted by the PWC. The hazard must present a 'relatively low risk' to the drinking water supply.

- The zone protection device referred to above must be testable, and will be placed on the PWC's testing database as if it were a containment device. This concession does not enable device registration and testing obligations to be avoided.

- For residential properties with a rainwater system with a pump connected, a non-testable dual-check valve, with atmospheric port, must be provided on the downstream side of the property water meter. No offtakes are permitted between the meter and that valve.

- For residential properties with an on-site bore pump, similar requirements to those above apply regarding containment protection at the PWC property water meter.

- For fire services, backflow prevention is not required between the water meter and a registered break tank if there are no tappings (offtakes) made on pipework between these two points.

- Where a separate fire service is installed, only automatic fire sprinkler systems and fixed fire hydrants can be connected to the fire service. If a break tank is not used, as a minimum, a testable spring-loaded single check valve must be installed as containment protection. The risk of backflow is considered to be mitigated by the remote monitoring of fire sprinkler systems by the fire brigade; the use of lay-flat hoses is considered to mitigate the risk of back-siphonage.[83]

Queensland

In Queensland, Mandatory Parts MP4.2 and MP4.3 of the Queensland Development Code (QDC) cover supplementary water supplies for residential and commercial buildings respectively. They

[83] Power and Water Corporation of the Northern Territory, *Backflow Prevention Manual*, Version 1, 1 July 2009. p 10.

are called up under the *Building Act 1975* (Qld). The relevant Performance Requirements state that:

> *Water from a tank must not contaminate the potable water within a reticulated town water supply system.*[84]

The QDC may be complied with by either meeting the relevant Performance Requirements (an 'Alternative Solution'), or by complying with the following Acceptable Solutions:

> *Where a tank is installed, the reticulated town water supply system is protected from the potential of back-flow, by the installation of—*
>
> *(a) a back-flow prevention device that complies with AS/NZS 3500: 2003; or*
>
> *(b) for a tank, a dual-check valve with an atmospheric port.*[85]

While Queensland does not adopt Part B4 of the PCA (Fire-fighting water services), there are requirements for backflow prevention for these installations in the Queensland Plumbing and Wastewater Code (QPW), Part 6. Like the QDC, the QPW Code is performance-based. The two relevant Performance Requirements are:

> *[P1] Fire services connected to the water service provider's infrastructure have an appropriate testable backflow prevention device installed.*
>
> *[P2] Installed testable backflow prevention devices have appropriate isolating valves and are fitted for easy removal.*[86]

Similar to the QDC, the QPW Code may be complied by either meeting the Performance Requirements, or by complying with the Acceptable Solutions. The Acceptable Solutions are either the installation of a WaterMark certified device, or a non-certified testable spring-loaded single check valve.

For testable backflow prevention devices, the following Acceptable Solution is provided:

> *A testable backflow prevention device—*
>
> *(a) has resilient-seated isolation valves located immediately upstream and adjacent to the device; and*
>
> *(b) is fitted in an accessible position; and*

[84] *Queensland Development Code* (Qld), Mandatory Part 4.2: Rainwater tanks and other supplementary water supply systems, Version 2.0, 2013, p 9.

[85] *Ibid.*

[86] *Queensland Plumbing and Wastewater Code,* as published 19 January 2011, p 17.

(c) *is connected with either flange or barrel union fittings for easy removal and replacement; and*

(d) *is locked in the open position; and*

(e) *otherwise complies with the applied provisions*.[87]

Tasmania

In Tasmania, requirements for containment backflow prevention are set by the Tasmanian Water and Sewerage Corporation (TasWater). For the most part, these requirements refer to AS/NZS 3500.1, however there are a number of additional specific requirements, including the following:

- Installation of containment devices is to be in accordance with TasWater's Standard Drawings.
- Connections shall allow for 'simple' removal and replacement of the device.
- All testable boundary backflow prevention devices must be installed above ground, with a 300 mm clearance to finished surface level in an area not subject to freezing or ponding.

The additional requirements for backflow prevention for fire services in Tasmania are generally consistent with those applied in the Northern Territory, as described above. However, specific requirements are prescribed for the selection of devices according to the site Hazard Rating.

If the Hazard Rating is High or Medium, the boundary backflow prevention device installed on the fire service must be a "testable double detector check assembly with water metered low flow bypass".

If the Hazard Rating is Low, then the boundary backflow prevention device installed on the fire service must be a testable single check detector assembly with a 50 kPa rated spring, with a metered low flow bypass.[88]

[87] *Ibid.* For 'applied provisions' see *Standard Plumbing and Drainage Regulations 2003* (Qld) sch 1. The 'applied provisions' include the parts of the QDC discussed above.

[88] Tasmanian Water and Sewerage Corporation, *TasWater Boundary Backflow Containment Selection Requirements,* issue no. DRAFT-03, 30 May 2013 [6.1-6.7] pp 6-10.

7 Product certification and authorisation

The Consultation Paper highlighted that all backflow prevention devices are required to be certified and authorised in accordance with the PCA. However, a lack of clarity was also identified regarding the scope of this requirement.

Currently, the PCA does not define which types of backflow prevention devices must be certified and authorised, and so for the purposes of the PCA, the presumption is that all devices are included. The problem with this is that, strictly speaking, [registered] break tanks and [registered] air gaps are also defined as 'backflow prevention devices',[89] yet the former is also tank, and water tanks are listed on the Watermark Certification Scheme List of Exempt Products. For the latter, its inclusion in the WaterMark Certification Scheme would appear to be an anomaly as it is not a product *per se*; it is a design feature.

There is also uncertainty as to whether or not the product certification and authorisation requirements of the PCA (i.e. WaterMark) are applicable under regulations which are by an authority other than the on-site plumbing regulator, but which also call up the PCA.

A number of comments were made in submissions on these points; they are discussed as follows.

7.1 Requirements for containment, zone and individual protection

On the question of whether the current product certification requirements for backflow prevention devices extend to those used for containment (which may not be regulated under the PCA), stakeholders were consistently of the view that this is — or should be — the case.

The BPAA advised:

> *Containment, zone and individual protection devices should all be WaterMarked and be subjected to the same testing, maintenance and registration requirements.*
>
> *Where the NUO regulates containment protection it ensures that the product is registered, tested and maintained by the owner. However in most cases zone and individual protection devices across Australia are not currently subjected to the same level of scrutiny and maintenance and testing is left at the discretion of the owner/occupier.*

This view was also reflected in several other submissions.[90] Two submissions from practitioners both stated that the same requirements apply for all three applications:

[89] *AS/NZS 3500.0: 2003,* above n 4.

[90] *Subs.* South East Water, Master Plumbers Association of Queensland, City West Water, Master Plumbers and Gasfitters Association Western Australia, Yarra Valley Water.

In my experience, the same product certification requirements apply for backflow prevention devices regardless of whether they are used for containment, zone or individual protection.[91]

The same product certification requirements apply for backflow prevention devices used for individual/zone protection and containment protection. Of course some devices, such as detector check valves are only ever installed as containment protection.[92]

The above statements were checked against the relevant WaterMark specification for backflow prevention devices, AS/NZS 2845.1, and it was found that that Standard did not limit its application to only on-site backflow prevention devices;[93] it also applies to those used for containment protection. It is also important to note that a current Objective of the WaterMark Certification Scheme is to reduce the risks of contamination of “the water resource” and of “water supplies”, extending its application beyond just on-site plumbing and drainage.[94]

The WSAA confirmed in their submission that product certification applied equally to devices used for containment, as for zone and individual protection:

All products connected to the water supply need to be WaterMarked and this applies to boundary and internal devices. If we step away from having certified products (WaterMarked) connected to the water supply then this would have the potential to increase the risk of backflow occurring.

7.2 Product standards

In addition to asking stakeholders if the same requirements applied for all types of backflow protection, the Consultation Paper asked stakeholders about inconsistencies in the standards they currently apply.

Two submissions addressed this part of the question. The OTR advised that AS/NZS 2845.1 is applicable but no inconsistencies were noted. The RHAA advised that in addition to current backflow prevention standards, dual check valves are also required in rainwater harvesting systems under ATS 5200.477.[95]

[91] *Sub.* Backflow Management Services Pty Ltd.

[92] *Sub.* Wenning Technical Services Pty Ltd.

[93] Standards Australia, *Australian Standard/New Zealand Standard 2845 Water supply—Backflow prevention devices Part 1: Materials, design and performance requirements,* [1.1-1.2] pp 9-10, 2010.

[94] *PCA 2016*, above n 13. [2015] cl G1.3(b)(iii), (v).

[95] Standards Australia, *Australian Technical Specification (ATS) 5200.477 Technical Specification for plumbing and drainage products Part 477: Rainwater/mains supply changeover devices*'. 2006.

8 Conclusions and Recommendations

This sections sets out the conclusions and recommendations of this report.

8.1 Clarifying the role of the PCA

(1) Both the NUOs and the PCA have a role to play in ensuring the provision of containment backflow prevention. The NUOs have a legislated responsibility to manage risks posed to their assets and the public from connected properties, while the PCA provides for similar situations not covered by water supply legislation. There are also cases where the PCA is called up by this legislation, separately to the on-site plumbing legislation.

(2) Currently there exists no forum for dialogue between the ABCB/PCC and the water supply sector (NUOs) regarding the PCA. This is a concern because the PCA is relied upon by several pieces of NUO legislation, and even where it is not, there is still a need for co-ordination to address current inconsistencies between the PCA and the in-house requirements developed by NUOs, so as to avoid issues arising through future changes in either sector.

(3) For the above reasons it is not viable for containment protection to be regulated entirely under water supply legislation, or transferred wholly into the PCA. A co-ordinated approach will be required, with the aim of maintaining consistency between the two.

Recommendation 1

That containment protection requirements should continue to be set by the NUOs, where they currently do so, while also being retained within the PCA.

Recommendation 2

That the ABCB set up a dialogue through the PCC with the NUOs, for the purpose of raising awareness of the PCA (including AS/NZS 3500), supporting its consistent adoption where appropriate, and otherwise achieving consistency between it and the separate backflow prevention requirements set under NUO regulations.

(4) The current backflow prevention requirements, set out in Section 4 of AS/NZS 3500.1 (especially clause 4.4.6) contain an ongoing requirement to carry out annual inspections/testing of Medium and High Hazard backflow prevention devices (including air gaps and break tanks). The purposes of this are to prevent air gaps and break tanks being compromised post-installation, and to ensure the ongoing proper function of mechanical devices.

(5) However, as identified in many of the submissions received, these requirements are not being consistently enforced, particularly with respect to zone and individual backflow prevention. For containment devices, ongoing maintenance programs and enforcement are usually the responsibilities of the NUO/water entity.

(6) The likely reason why the current requirements are not adequately enforced may be that in their current form, they are not enforceable. This is because they are contained in a referenced document of the PCA, which only applies at the installation stage and which cannot impose ongoing obligations upon property owners or occupiers to carry out testing or arrange inspections.[96] To become more clearly enforceable, the ongoing testing and maintenance would need to be regulated specifically by the States and Territories. This would, however, require amendments to legislation in some States and Territories.

(7) Other issues with the current requirements are that they impose an administrative burden on regulatory authorities to keep records, with databases being heavily dependent on the variable accuracy of the information provided by installers. Providing that information also imposes a regulatory burden on the industry itself.

(8) Many submissions noted that there are now likely to be many untested and unmaintained devices currently in use, with the effectiveness of such devices being unknown. Concerns were also raised regarding the risk to health from untested devices. However, little evidence was provided[97] of such failures occurring or having any actual consequences for public health, indicating that the risk from these devices may be overstated, or that there is likely over-regulation in these requirements.

(9) The suggestion was made in a number of submissions that backflow prevention be included in the Victorian Essential Safety Measures Maintenance Manual, and similar documents in other jurisdictions. This approach would enable the requirement to be transferred out of its current, potentially unenforceable, location within AS/NZS 3500.1.

(10) It should be noted however that the decision to establish a separate, enforceable annual inspection/testing regime for backflow prevention devices would need to be made by individual State and Territory Governments, as it is outside the role of the ABCB. Therefore, no recommendation is made in relation to conclusions 8.1(4) to 8.1(10).

8.2 Cross-connections and backflow incidents

(1) Backflow incidents are the result of either backpressure or back-siphonage causing a contaminant to enter a water source via an un-protected cross-connection. Not all cross-connections are immediately discovered, and there are also cases where a cross-connection is made and causes contamination without backflow occurring. These are usually mistaken connections.

[96] See **Appendix III** and **Appendix IV** of this report for a summary of the role of the PCA under relevant State and Territory legislation.

[97] From the evidence made available to the ABCB it was difficult to ascertain what proportion of incidents were attributable to the failure of an untested or unmaintained backflow prevention device.

(2) Submissions received generally supported the conclusions of the Consultation paper in that most incidents do occur in industrial or agricultural premises, however the number of incidents could not be verified. As such, the evidence obtained so far can only be considered to be anecdotal at this stage; further verification would be required to support a statistical analysis.

(3) It has been identified that this is because backflow incidents are not reported or are under-reported. There appears to be no formal reporting protocol or incident database in existence in Australia. It was also suggested that some cases of illness from water contamination may have been misclassified as food poisoning.

(4) In any case, there was no suggestion made that contamination of water supplies (by way of backflow) is a widespread or pressing problem in Australia. This indicates that the current level of protection provided by the Australian backflow prevention system, despite its flaws, is sufficient.

(5) Examples cited in some submissions predominantly involved what would be considered unregulated activity, consistent with the discussion provided in the Consultation Paper. That is, most cross-connections appear to have been made after the original plumbing installation had been completed. Others were the result of mistakes related to a lack of awareness of cross-connection control and/or unlicensed work.

(6) Where poor original design is evident in the plumbing installation, this appears to be primarily occurring in installations which may not have been completed by a licensed practitioner (i.e. 'DIY plumbing').

(7) These findings point to a need for further education and awareness material specific to the issue of cross-connection control, to support the existing requirements, rather than a need for further regulation. In the USA, such material already exists in the form of the United States Environment Protection Authority's (US EPA) Cross-connection Control Manual. The US EPA manual is a freely available 52 page non-regulatory guideline which provides a detailed technical explanations of how cross-connections occur. It also describes the hydraulic principles of backflow and backflow prevention, along with examples and case studies. There appears to be no equivalent manual available in Australia which addresses Australian practices, conditions and regulatory requirements, and which is freely available online.

Recommendation 3

That a non-regulatory 'Cross-connection Control Manual' be developed based on the US-EPA document of the same name, adapted to address Australian practices, conditions and regulatory requirements. Its aim would be to reduce the number of preventable backflow incidents and other water contaminations which occur as a result of mistaken connections and lack of understanding of cross-connection control, as identified in several submissions to this report. The manual should be made freely available online, so as to maximise its uptake by practitioners.

(8) Regarding the issue of backflow prevention for rainwater tanks (where a mains water top up supply is provided), there is confusion over the minimum requirements for containment protection. The NUOs (WSAA) believe that additional containment protection is required at the meter, while the rainwater industry (RHAA) believes that the Low Hazard devices built into domestic water meters are sufficient; that rainwater poses no additional hazard. On consideration of the two submissions, it appears that additional containment protection should not be required for an above-ground or partly buried domestic rainwater tank.

(9) Currently, the PCA does not specifically address the installation of rainwater tanks, and there is some confusion over the requirements which apply to their installation. These issues are further discussed in the ABCB's Rainwater Harvesting and Use Research Report. Nonetheless, the above described confusion highlights the need for a clear, Deemed-to-Satisfy position on containment protection for rainwater tanks.

Recommendation 4

Having regard to State and Territory variations, that an amendment to the PCA be drafted deeming above ground or partly buried domestic rainwater tanks Low Hazard installations, for the purposes of determining the appropriate level of backflow prevention required where a top-up supply is provided. Also, the draft PCA amendment should include a definition of the term 'partly buried'.

Note: This Recommendation has potential implications for another part of the *Plumbing Code Development Research Project*, specifically the work related to rainwater harvesting and use.

8.3 Effectiveness of the Hazard Rating system

(1) NUO and plumbing stakeholders were divided in their views on whether probability should be used in assessing backflow risk. For example, the WSAA was supportive, yet a number of Victorian NUOs expressed concerns. Similarly, the rainwater industry (RHAA) were supportive, while other plumbing groups and the OTR also expressed concerns.

(2) The arguments in support of using probability were that it would increase flexibility and reduce the potential for over-regulation inherent in the current, consequence-based assessment system.

(3) The concerns raised were that probability is too subjective and that it would introduce too much complexity for plumbers. Also, it was suggested that probability could potentially be used to downgrade Hazard Ratings, posing a risk to health.

(4) These concerns, while significant, can be managed by minimising complexity and ensuring that any probability model developed has both NUO and on-site plumbing industry and regulatory support, and is provided with sufficient explanatory information. This can be achieved by developing the probability model as a part of the Performance

Solution process initially, most likely as a PCA Verification Method,[98] which would essentially make its use voluntary, and limit it to those practitioners with the need and capacity to develop and verify solutions not covered by the Deemed-to-Satisfy Provisions.[99]

(5) If a Verification Method pathway were adopted, this would enable a model to be developed which took into account unique factors such as site conditions, system design and usage, specific hazards and the like, and link these factors directly to the different forms of backflow prevention, through a risk assessment process. A simple version of this already exists in the USA, under the Uniform Plumbing Code.[100] It could form the foundation of such a model being developed in Australia.

Recommendation 5

That a probability and consequence based (not just consequence) risk assessment model for determining appropriate backflow prevention be developed as a Verification Method for use within the PCA's Performance Solution process, rather than as a part of the Deemed-to-Satisfy Provisions. This may require expert advice in the risk assessment field to ensure the model is robust, and that its use does not compromise protection levels.

(6) There is no uniform system for assigning Hazard Ratings is Australia. Compliance with the current system set out within AS/NZS 3500.1, is based on a Hazard Rating first being assigned. To support this process the standard provides only a one sentence definition of each Hazard Rating, and some guidance on typical examples which cannot be relied upon for regulatory purposes. This creates a risk for practitioners and the community where the correct application of the Standard (by choosing the correct Hazard Rating) becomes a matter of subjective judgement.

(7) For containment protection, a variety of different processes and requirements exist within the regulations published by NUOs (much of which is based on the guidance in AS/NZS 3500.1). Hazard Ratings may also be based on building type, accessibility, internal processes and water supplies, and potential tenancy changes.

(8) For zone and individual protection, Hazard Ratings are usually assigned based on the guidance in Appendix G of AS/NZS 3500.1, along with the health hazard of the processes or additives used on site, where known.

(9) Despite its non-regulatory status, Appendix G is relied upon heavily for both on-site and containment aspects of backflow prevention, and is considered a critical reference point.

[98] See *PCA 2016,* above n 13. cl A1.1: 'Verification Method'.

[99] *PCA 2016*, above n 13. cl A0.6 (sets out the role of Verification Methods in the PCA).

[100] IAPMO, *Uniform Plumbing Code,* Table 6-2, 2009. See: *Consultation Paper,* above n 3. [4.1] p 15.

Its status as an Informative Appendix only, as noted in a number of submissions, raises compliance concerns given that this means it cannot be relied upon as regulation.

(10) In some jurisdictions, the non-mandatory content of the appendix is replicated directly into the mandatory protocols published by the NUOs, thereby providing their practitioners a regulatory solution for assigning containment Hazard Ratings to sites. This creates a further inconsistency within the current requirements.

(11) The submissions which expressed the above concerns, generally recommended that the Appendix be made normative. However, the same could be achieved by developing a solution for assigning Hazard Ratings directly within the PCA. The PCA provisions would set out which sites and installations are to be assigned Low, Medium or High Hazard Ratings. The appropriate backflow prevention device would be then be selected and installed in accordance with Section 4 of AS/NZS 3500.1. These provisions would provide either a set of criteria, or a list of common scenarios and Hazard Ratings (or both) in a similar way as Appendix G.

(12) The reason it would not be appropriate to simply re-designate Appendix G ‘normative’ is that doing so would introduce a matter of public policy into the AS/NZS 3500.1. The matter of public policy is the determination of minimum levels of backflow protection, as this sets the level of risk to the community posed by plumbing installations. Setting limits on this risk is a decision for governments, on behalf of the community, rather than a technical matter.

(13) It was also noted by some stakeholders that the content of Appendix G was too broad, and incomplete. This indicates a desire for a review to be undertaken in any case, however if a solution were to be developed in the PCA, this could be done with the direct input of the PCC and the support of the NUOs.

Recommendation 6

That new Deemed-to-Satisfy Provisions (DtS) be developed for inclusion in the PCA 2019 Public Comment Draft to replace Appendix G of AS/NZS 3500.1. The new DtS would provide a regulatory solution for assigning a Hazard Rating (Low, Medium or High) to different installations or sites. The new provisions would function similarly to Appendix G although the content would be developed ‘from scratch’, though a review process undertaken in consultation with the ABCB’s Plumbing Code Committee and the NUOs. This recommendation would be implemented subject to a regulatory impact assessment process.

8.4 Installation requirements

(1) Two areas were identified where the current PCA and/or AS/NZS 3500.1 are unclear on specific technical matters. Part B3 of the PCA does not clearly address an identified need for backflow protection for non-drinking water services; it appears to be have been drafted (perhaps unintentionally) to only protect drinking water. Section 4 of AS/NZS 3500.1 was identified as not providing an adequate technical solution for clearances and access for maintenance around backflow prevention devices. It was suggested that such information could be included based on a survey of manufacturers' installation specifications.

Recommendation 7

That a proposal be developed for consideration by Standards Australia seeking an amendment to AS/NZS 3500.1 to provide a more specific, prescriptive and minimum necessary technical solution for clearances and access for maintenance around backflow prevention devices.

(2) It was is noted that the current wording of AS/NZS 3500.1 may imply that containment protection is not required at all, when the intent of the wording is to clarify that it is not required by the Standard (it is required under water supply legislation).

Recommendation 8

That Part B3 of the PCA (Non-drinking water services) be amended to clarify the requirement for backflow prevention to protect non-drinking water supplies, as well as drinking water supplies, from contamination. The current wording only refers to the protection of drinking water supplies.

(3) This report has identified a large number of State and Territory variations to the PCA and AS/NZS 3500.1. Some are included within the PCA Appendices, others are not. The majority of those which are not published in the Appendices exist under NUO, rather than on-site plumbing and drainage regulations. However, they are relevant given that the PCA applies to containment protection and is in some cases called up by the NUOs anyway.

(4) This suggests that the scope of the existing work underway within the ABCB to consolidate 'plumbing and drainage related regulations' into the PCA Appendices should be extended to include relevant NUO regulations. Replicating these in the PCA Appendices would ensure that where the PCA is applied for containment protection work, compliance pathways would be consistent with the relevant NUO's requirements.

Recommendation 9

That the scope of the existing ABCB Project: 'PCA Consolidation of State and Territory NCC-related requirements' be confirmed as including relevant backflow prevention (containment protection) regulations made by NUOs.

8.5 Product certification and authorisation

(1) The requirement for product certification and authorisation of backflow prevention devices (namely, WaterMark) is applied uniformly regardless of whether the device is to be used for individual, zone or containment protection purposes.

(2) Although the requirement to use WaterMark certified backflow prevention devices exists under the PCA, which is primarily applied under 'on-site' plumbing and drainage legislation, it is also being separately enforced by many NUOs, under their regulations. This is evidenced by the WSAA submission, and by parts of the legislation summarised in the appendices of this report.

(3) The relevant WaterMark Specification, AS/NZS 2845.1, does not make any distinction in its application between zone, individual or containment protection devices; it is applicable to all three.

(4) No issues were raised regarding specific product standards.

(5) It is for the reasons above that active engagement and consultation with the NUOs should continue, especially in light of the conclusions of this report.

Acronyms and abbreviations

The following acronyms and abbreviations appear in this report.

ABCB, means the Australian Building Codes Board.

above n, followed by a number, is used in the footnotes to direct the reader to an earlier footnote, generally for the purpose of locating the full details of a source cited.

ACT, means the Australian Capital Territory.

Appendix G, is used for referring to Appendix G of AS/NZS 3500.1 which deals with examples of potential cross-connections, and types of backflow protection.

AS/NZS 3500, unless stated otherwise, means Australian / New Zealand Standard 3500: 2015 Plumbing and Drainage. Where a specific Part is referred to, these are: Part 0 [2003] Glossary of Terms; Part 1 Water Services; Part 2 Sanitary Plumbing and Drainage; Part 3 Stormwater Drainage; Part 4 Heated Water Services; and Part 5 [2012] Housing Installations.

BPAA, means the Backflow Prevention Association of Australia.

Class (of building), where followed by a number, has the meaning that it has Part A4 of the PCA.

COAG, means the Council of Australian Governments.

Consultation Paper, means the *Plumbing Code Development Research Report – Backflow Prevention Consultation Paper 2015*, published in June 2015 by the ABCB.

HIA, means the Housing Industry Association.

IAL, means Irrigation Australia Limited.

Ibid., used in the footnotes, means 'in the same place' (L *'ibidem'*). It is used to refer to a source cited in the footnote above.

MPAQ, means the Master Plumbers Association of Queensland.

MPGAWA, means the Master Plumbers and Gasfitters Association – Western Australia.

NCC, means the National Construction Code Series, as published by the ABCB.

NSW, means New South Wales.

NT, means the Northern Territory.

NUO, means Network Utility Operator(s). This term refers to entities who undertake the distribution of drinking water or non-drinking water to multiple properties via a water reticulation network. They are also referred to as water entities. Depending on relevant legislation in each State and Territory, a NUO or water entity may be wholly or partially publicly or privately owned.

OTR, means the Office of the Technical Regulator (SA).

PCA, means the Plumbing Code of Australia, which is Volume Three of the NCC.

PCC, means the Plumbing Code Committee. The PCC is the peak technical advisory body to the ABCB, with responsibility for technical matters associated with the PCA.

Qld, means Queensland.

RHAA, means Rainwater Harvesting Association of Australia (formerly known as the Australian Rainwater Industry Development Group).

SA, means South Australia.

Sub. / Subs.*,* used in the footnotes and followed by a name (e.g. "*Sub.* Sydney Water"*)*, means 'Submission by' / 'Submissions by'. These footnotes refer to the submissions listed at **Appendix I.**

Tas, means Tasmania.

VBA, means the Victorian Building Authority.

Vic, means Victoria.

WA, means Western Australia.

WSAA, means the Water Services Association of Australia.

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Water New Zealand, *Boundary Backflow Prevention for Drinking Water Supplies,* 2nd edition, June 2013.

Appendix I. List of submissions

Submissions to the Consultation Paper which preceded this report were received from the following stakeholders (listed in order of receipt):

- South East Water (Vic)
- Wenning Technical Services Pty Ltd (Vic)
- Office of the Technical Regulator – Plumbing (SA)
- Backflow Prevention Association of Australia
- Rainwater Harvesting Association of Australia
- Backflow Management Services Pty Ltd (Vic)
- Master Plumbers Association of Queensland
- Hydro Systems (NSW)
- Water Services Association of Australia
- City West Water (Vic)
- Master Plumbers and Gasfitters Association Western Australia
- Yarra Valley Water (Vic)
- Housing Industry Association of Australia
- Sydney Water (NSW)
- Irrigation Australia Limited

Appendix II. NCC referenced documents and public policy statements

Embodied in the NCC are public policy statements that express community expectation for acceptable standards of building construction and plumbing and drainage installations. They form the basis from which building and plumbing regulations are developed.

The technical provisions of the NCC are supported by referenced documents. These documents provide a means of compliance with the requirements of the NCC. They show how a material, a product or an assembly is to be designed, manufactured, tested, installed or maintained to achieve a specific level of performance.

Referenced documents are the preferred means of satisfying the requirements of the NCC for the majority of practitioners. Another solution may be used provided that it is demonstrated that the NCC performance requirements are met.

Public policy issues involve risk assessment. There is no single applicable means of evaluating risk for the range of issues in the NCC. Acceptability of a level of risk involves many considerations of which safety is only one. Decisions will still have to be made based on judgement and experience.

The ABCB, by virtue of an agreement between the Australian, State and Territory Governments, is the body responsible for developing building and plumbing regulatory policy proposals on behalf of the community. These public policy statements are to be placed in the NCC and not in the referenced documents. Currently, some public policies are implied in referenced documents.

The ABCB will develop proposals for these policy decisions to be taken with due consideration for the technical, economic, social and political aspects of the problem, after consultation with the relevant stakeholders. The ABCB will be responsible for defining public policy risk at an appropriately rigorous level.

Explicit boundaries between the NCC and referenced documents will be drawn on a case by case basis depending on the state of available knowledge, the development of the technologies and the nature of the issues involved.

The requirements of the NCC will be extended or reinforced to enable referenced documents to be developed accordingly. The process for the production and approval of referenced document will be determined and published by the ABCB. Any public policy statements that are currently placed in Referenced Documents will be progressively removed when the referenced documents are reviewed and re-established in the NCC.

Extracted from the *ABCB Protocol for NCC Referenced Documents*, 2013.

Appendix III. Summary of PCA enabling legislation

This Appendix provides an outline of the primary 'enabling' legislation for the PCA ('plumbing and drainage Acts') which also require compliance with the PCA.

It provides general information only and is not intended as legal advice. For the latest version of any Act or Regulation described below, please contact the State/Territory Government Publisher.

(A) Water and Sewerage Act 2000 (ACT)

Section 44C(1) defines the ACT 'plumbing code' as the PCA, including the ACT Appendix. Sub-section (2) provides that the application of the PCA may be controlled by regulations. Section 49 relevantly provides that such regulations may make provisions in relation to: (e) standards for plumbing or sanitary drainage work and the approval of materials to be used in that work; and (f) the connection of equipment to infrastructure related to the supply of water or to drains or sewers. Backflow prevention (containment, zone and individual) is regulated under those provisions.

(B) Water and Sewerage Regulations 2001 (ACT)

Regulation 18 requires all work on a water service or hot water service taking water from a water supply network to comply with the 'plumbing code' (PCA, as defined in the Act). Work on property service pipes of not less than 50 mm diameter must also comply with a plan certified under the Act.

Regulation 22 deals with backflow prevention specifically. It requires that a plan certifier must not approve a plan unless it includes appropriate backflow protection for the water supply of the Territory,[101] installed in accordance with the plumbing code,[102] and with testable devices registered with the Construction Occupations Registrar and be tested in accordance with AS/NZS 2845.3.[103]

(C) Plumbing and Drainage Act 2011 (NSW)

Section 7 requires 'plumbing and drainage work' to comply with the PCA. Plumbing and drainage work is relevantly defined as the construction of, or work on, a plumbing installation that connects, directly or indirectly, with a NUO's water supply system, *downstream from the point of connection*

[101] *Water and Sewerage Regulations 2001* (ACT) r 22(1), (2).

[102] *Ibid.* r 22(3).

[103] *Ibid.* r 22(4), (5). AS/NZS 2845.3 means *Australian Standard/New Zealand Standard 2845 Water supply—Backflow prevention devices: Part 3 Field testing and maintenance of testable devices,* as amended from time to time (r 3 – Dictionary).

to a NUO's water supply system (emphasis added).[104] This excludes the construction of, or work on, NUO, local council or county council water mains.[105] Work upstream of a point of connection (e.g. a property service) is therefore considered to be a matter for NUOs.[106]

The *Plumbing and Drainage Regulation 2012* (NSW) does not make any specific provisions with respect to backflow prevention, relevant to this report.

(D) Building Act (NT); Building Regulations (NT)

Section 52 of the *Building Act* provides for the adoption of codes and standards; this includes both the BCA and PCA. The PCA applies to plumbing work, "other than plumbing or drainage services vested in the Power and Water Corporation established by the *Power and Water Corporation Act".*[107]

The *Building Regulations* provide that the PCA applies "to any building that can be classified according to use under Part A3.2 of the [BCA] and to any building work referred to in the Act or in the [BCA]".[108]

This would indicate that the PCA applies to backflow prevention where it occurs in, or in relation to, a building so described in the BCA.

(E) Plumbing and Drainage Act 2002 (Qld)

Under this Act, the PCA is adopted by way of regulations made under section 145 which provides at (2) that a "[a] regulation (the Standard Plumbing and Drainage Regulation) may be made about plumbing and drainage work, including about inspecting plumbing and drainage work".[109]

Within the Act itself, 'plumbing' is relevantly defined as "an apparatus, fitting or pipe for supplying water to premises from a service provider's infrastructure or a water storage tank and for carrying water within premises".[110] 'Plumbing work' is defined as including "installing, changing, extending, disconnecting, taking away and maintaining plumbing".[111]

[104] *Plumbing and Drainage Act 2011* (NSW) s 7(1)(a).

[105] *Ibid.* s 7(5)(c).

[106] New South Wales Fair Trading, *Point of Connection Explanatory Notes,* Plumbing Industry Technical Note 3/2013, pp 1-2.

[107] *Building Act* (NT) s 4 – Definitions.

[108] *Building Regulations* (NT) r 4(1).

[109] *Plumbing and Drainage Act 2002* (Qld) s 145(2).

[110] *Plumbing and Drainage Act 2002* (Qld) s 3 – Definitions.

[111] *Ibid.*

Plumbing and drainage work is regulated as either Compliance Assessable work, or as Notifiable Work.[112] Compliance Assessable work is any work that is not Minor, Unregulated or Notifiable work.[113] Notifiable work is defined by the Regulations (see below). In either case, the *Standard Plumbing and Drainage Regulation 2003* applies.

(F) Standard Plumbing and Drainage Regulation 2003 (Qld)

Regulation 8A applies the PCA to plumbing and drainage work. Relevant to backflow prevention, Notifiable Work includes installing, replacing or removing a testable backflow prevention device, including a dual check valve with an atmospheric port.[114] Notifiable Work also includes extending, altering, replacing or removing existing water supply piping; new installations are not included. Alternative Solutions under the PCA are also not included.

New water service installations (including required backflow prevention), determinations of required backflow prevention, and all Alternative Solutions are therefore Compliance Assessable work (not Minor or Unregulated work).

Compliance assessment is carried out by Local Governments, who also carry out inspections on behalf of participating water providers.[115] The *Standard Plumbing and Drainage Regulation 2003* does not allow Local Governments to vary its provisions, although they may add to them.[116] Because Compliance Assessable work can include water supply connection,[117] the PCA may be applicable to both on-site and containment backflow protection.

(G) Queensland Plumbing and Wastewater Code

Part 6 of the QPW Code, which is applied under Regulation 8B of the *Standard Plumbing and Drainage Regulations 2003* (Qld), relevantly sets Performance Requirements and Acceptable Solutions for non-certified testable backflow prevention devices for fire services.

Where there is an inconsistency between the QPW Code and the PCA, the QPW Code prevails to the extent of the inconsistency.[118]

[112] *Ibid.* See: divs 1-4A regarding Compliance Assessable Work, and div 4B regarding Notiable Work.

[113] *Ibid.* s 3 – Definitions.

[114] *Standard Plumbing and Drainage Regulation 2003* (Qld) sch 2.

[115] *Plumbing and Drainage Act 2002* (Qld) s 86AA.

[116] *Ibid.* r 3.

[117] *Plumbing and Drainage Act 2002* (Qld) s 85(7), (7A), (7B).

[118] *Standard Plumbing and Drainage Regulation 2003* (Qld) r 9.

(H) Water Industry Act 2012 (SA)

Under Section 66(1), the Technical Regulator may publish Standards "relating to plumbing, including plumbing work or any equipment, products or materials used in connection with plumbing".[119] Plumbing is relevantly defined as "water plumbing work, sanitary plumbing work or draining work on the customer's side of any connection point".[120] The 'connection point' is the point at which the customer's pipes connect to the water infrastructure, and the 'water infrastructure' includes that connection point (i.e. a meter, and/or a containment backflow device).[121]

Although the Technical Regulator may also make Standards in relation to other works, the above shows that a standard made regarding plumbing applies only to on-site plumbing work. Such a standard has been made and it adopts the PCA.[122]

(I) Building Act 2000 (Tas)

Section 57 requires plumbing work to comply with the Tasmanian Plumbing Code (TPC) and the Act. The TPC sets requirements for plumbing work, plumbing installations and plumbing products; and the testing of plumbing products and plumbing systems.[123] The TPC adopts the PCA, and is replicated as variations and additions in the Tasmanian Appendix to the PCA.[124]

Note: since the completion of this report, the *Building Act 2000* has been replaced by the *Building Act 2016.* Please contact the Tasmanian State Law Publisher for a copy.

(J) Plumbing Regulations 2014 (Tas)

Under the regulations, plumbing work must comply with the PCA, as well as any permit or special plumbing permit documentation.[125] For backflow prevention, regulation 10 requires General Managers (of municipal areas) to keep registers of individual, zone and containment devices; regulation 52 requires property owners to maintain testable devices in accordance with the PCA.

119 *Water Industry Act 2012* (SA) s 66(1)(b).

120 *Ibid.* s 4 – Interpretation.

121 *Ibid.*

122 *Plumbing Standard* (SA), made by R. Faunt, Technical Regulator. 6 January 2012.

123 *Building Act 2000* (Tas) s 58(1).

124 *Ibid.* s 58(2). Although the Act refers to the 'Tasmanian Plumbing Code', this is now taken to be a reference to the 'Plumbing Code of Australia' including the Tasmanian Appendix.

125 *Plumbing Regulations 2014* (Tas) r 31.

(K) Building Act 1993 (Vic)

Adoption of the PCA by regulation is enabled under section 221ZZZW, which allows the PCA to be applied to any matter contained within the PCA. This potentially means that whatever is dealt with in the PCA at the time may be regulated under this section of the Act. Classes of plumbing work are defined by the regulations, and may be regulated under any of the 'plumbing laws', which include the *Building Act 1993* and the *Water Act 1989.*[126] However, regulations made under the *Building Act 1993* cannot prescribe standards for work on water supply infrastructure.[127]

(L) Plumbing Regulations 2008 (Vic)

The PCA forms a part of the Plumbing Regulations.[128] Relevant to backflow prevention, water supply plumbing work, within the regulations, is defined as "the construction, installation, replacement, repair, alteration, maintenance, testing or commissioning of …any part of a heated or cold water service that is connected to a drinking water supply from the point of connection to the water supply to the points of discharge of the service".[129] As 'point of connection' is not defined in the regulations, the definition given in the PCA[130] would apply, thereby potentially including containment protection, depending on the ownership of the relevant backflow prevention device/s.[131]

'Backflow prevention work' is defined as work on any of the devices listed in column 1 of Table 4.1 of AS/NZS 3500.1.[132] In addition to the PCA as described above, backflow prevention work must also comply with AS/NZS 2845.2.[133]

(M) Plumbers Licensing Act 1995 (WA)

The adoption of codes and standards (such as the PCA) by regulations made under this Act is provided for in sections 59J and 59L, and such regulations may apply to, *inter alia,* "[s]tandards

[126] *Building Act 1993* (Vic) s 221B.

[127] *Ibid.* s 221ZZZV(1)(a)(ii).

[128] *Plumbing Regulations 2008* (Vic) r 7, subject to rr 8-9 and sch 2.

[129] *Ibid.* r 34(1)(a)(i).

[130] 'Point of connection' is relevantly defined in the PCA as "for a water service… the point where the service pipe within the premises connects to the *Network Utility Operator's* property service or to an alternative water supply system" (cl A1.1).

[131] *Plumbing Regulations 2008* (Vic) r 10(2)(a)(iii) excludes from the definition of 'plumbing work' any work in relation to a supply or reticulation system owned by or exclusively vested in an Authority that has a water district or a sewerage district under the *Water Act 1989* (Vic).

[132] *Ibid.* r 36.

[133] *Ibid.* sch 2, pt 8, cl 18. AS/NZS 2845.2 means *Australian Standard/New Zealand Standard 2845 Water Supply—Backflow prevention devices Part 2: Air gaps and break tanks*, as issued, published or remade from time to time.

to be observed in, or in connection with, the carrying out of plumbing work".[134] This would cover backflow prevention work.

(N) Plumbers Licensing and Plumbing Standards Regulations 2000 (WA)

Plumbing work is relevantly defined in the regulations as "[involving] the installation, alteration, extension, disconnection, repair or maintenance of pipes and other fittings used or intended to be used for the supply of potable water from a meter assembly to the points of use within any property".[135] Backflow prevention is considered to be 'major plumbing work' and as such must be provided with a notice of intention prior to commencement, and a certificate of compliance upon completion.[136]

Major plumbing work however does not include "work carried out by or on behalf of a water services provider in connection with the undertaking, maintenance or operation of water services works of the water services provider".[137] This means that the PCA applies under this Act to all backflow prevention, except backflow prevention of the NUO. Its application to containment devices is therefore dependent on the who owns and is responsible for those devices.

[134] *Plumbers Licensing Act 1995* (WA) sch 3.

[135] *Plumbers Licensing and Plumbing Standards Regulations 2000* (WA) r 4(1)(a).

[136] *Ibid.* rr 41-2.

[137] *Ibid.* r 3(1).

Appendix IV. Summary of other relevant legislation that requires compliance with the PCA

This Appendix provides an outline of relevant State and Territory NUO legislation ('water Acts') which also requires compliance with the PCA, or AS/NZS 3500, and which applies to containment backflow prevention, yet operates separately from the PCA enabling legislation.

It provides general information only and is not intended as legal advice. For the latest version of any Act or Regulation described below, please contact the State/Territory Government Publisher.

Note: In the ACT, all backflow prevention requirements are captured under the *Water and Sewerage Act 2000* and the *Water and Sewerage Regulations 2001*. In Queensland, all backflow prevention requirements are captured under the *Plumbing and Drainage Act 2002* and the *Standard Plumbing and Drainage Regulations 2003*. For information on these, refer to the previous Appendix.

(A) Hunter Water Act 1991; Sydney Water Act 1994; Water Industry Competition Act 2006 (NSW)

These Acts regulate work in connection with the water supply pipes of NUOs in NSW by providing for the setting of standards including the adoption of the PCA.[138] This adoption of the PCA operates separately to the *Plumbing and Drainage Act 2011* (NSW).[139]

(B) Hunter Water Regulation 2015; Sydney Water Regulation 2015; Water Industry Competition (General) Regulation 2008 (NSW)

Under the first two of these regulations, plumbing and drainage work that affects the Network Utility Operator's pipes, but is not covered by the *Plumbing and Drainage Act 2011* (NSW), must comply with the PCA.[140] It must only use fittings which the Corporation has approved, and such approvals must be in accordance with AS 5200.000.[141] Under the *Water Industry Competition (General) Regulations 2008* (NSW), there are no specific requirements regarding compliance with

[138] *Hunter Water Act 1991* (NSW) s 69; *Sydney Water Act 1994* (NSW) s 99; *Water Industry Competition Act 2006* (NSW) s 73.

[139] *Hunter Water Act 1991* (NSW) s 69(4); *Sydney Water Act 1994* (NSW) s 99(2A); *Water Industry Competition Act 2006* (NSW) s 73(3).

[140] *Hunter Water Regulation 2015* (NSW) r 21; *Sydney Water Regulation 2011* (NSW) rr 6A, 8; .

[141] *Hunter Water Regulation 2015* (NSW) r 22; *Sydney Water Regulation 2011* (NSW) r 9. In these regulations, AS 5200.000 means *Australian Standard 5200.000—2006 Technical Specification for Plumbing and Drainage Products—Procedures for certification of plumbing and drainage products,* published by Standards Australia.

the PCA, however conditions may be set for water supply connections under the certificate of compliance process.[142]

(C) Water Supply and Sewerage Services Act (NT)

Under this Act, cross-connections with water supply infrastructure may only be made in accordance with the "National Plumbing and Drainage Code".[143] This could be taken to be a requirement to comply with the current edition of AS/NZS 3500, without reference to the PCA as the Standard is named, and is called up 'as in force from time to time'. The difficulty is that "in force" may refer to the latest version of the Standard regardless of any other reference, or it could be a reference to the version referenced by the PCA, on the basis of consistency where the Standard is referenced by the PCA and the PCA by the *Building Act*.

(D) Water Industry Act 2012 (SA)

In South Australia, all backflow prevention requirements are captured under the *Water Industry Act 2012*, although not under the *Plumbing Standard 2012*, which does not apply on the opposite of the customer's side of the connection point, nor to the actual connection point. These areas are covered under a separate regulating power. However, given the same Act applies in both cases, its regulations would presumably be made consistent. As such, they would either apply the PCA, or at least maintain consistency with it, on both sides of the point of connection.

(E) Water and Sewerage Industry Act 2008 (Tas)

Under this Act, a plumbing permit or special plumbing permit may not be granted unless the relevant regulated entity (NUO) has issued a certificate for that work.[144] This captures work that is certifiable work under section 113 of the *Building Act 2000* (Tas).[145] A regulated entity may refuse to issue a certification if the work falls outside the scope of its connections policy, which sets out the circumstances in which the regulated entity will permit a connection or relocation or adjustment of a connection to its water infrastructure.[146]

142 *Water Industry Competition (General) Regulation 2008* (NSW) r 24AG.

143 *Water Supply and Sewerage Services Act* (NT) s 92. "National Plumbing and Drainage Code" is defined in the Act as "Australian Standard AS 3500 (as in in force from time to time) published for Standards Australia International Limited (A.C.N. 087 326 690) or the Standards Association of Australia as constituted before 1 July 1999. "Cross-connection" has a similar meaning as in the current (2003) edition of *AS/NZS 3500 Plumbing and Drainage Part 0 – Glossary of Terms* (at p 13).

144 *Water and Sewerage Industry Act 2008* (Tas) s 56TB.

145 *Ibid*. s 56TD.

146 *Ibid.* s 56U.

An example of a connections policy, relevant to the above, is TasWater's Boundary Backflow Containment Selection Requirements manual, This manual currently refers directly to AS/NZS 3500.1: 2003, but also sets additional conditions for certifications.[147]

(F) Water Act 1989 (Vic)

This Act deals with a broad range of water matters, and although it does not specifically refer to backflow prevention, it does contain within its regulating powers the ability to adopt codes and standards for purposes relevant to the Act.[148] Backflow prevention is regulated under this Act, by way of the *Water (Estimation, Supply and Sewerage) Regulations 2014* (Vic), discussed below.

(G) Water (Estimation, Supply and Sewerage) Regulations 2014 (Vic)

Under these regulations, a water corporation may require a property owner to fit a backflow prevention device, and in doing so must specify the type of device and its installation.[149]

The regulations do not specify any code or standard, although there is a guidance document available which has been adopted by most Network Utility Operators. This is the *Backflow Prevention Containment Guidelines*, developed in 2011.[150] In it the PCA is referred to as the technical requirements for device selection, Hazard Rating (for containment), maintenance and testing, and installation, in conjunction with the NUO's legislative requirements.

(H) Water Services Act 2012 (WA)

Connections to the water supply by individual property owners may be approved only once the licensee (NUO) has taken into account the risk of contamination of the water supply.[151] Only approved fittings may be used in connection with a water supply.[152] Regulations may be made to prevent the contamination of water, and for that purpose may adopt published documents.[153]

[147] *Boundary Backflow Containment Selection Requirements,* above n 99.

[148] *Water Act 1989* (Vic) s 324.

[149] *Water (Estimation, Supply and Sewerage) Regulations 2014* (Vic) r 11.

[150] *Backflow Prevention Containment Guidelines*, Victoria. June 2011.

[151] *Water Services Act 2012* (WA) s 94.

[152] *Ibid.* s 91.

[153] *Ibid.* s 222.

(l) Water Services Regulations 2013 (WA)

Under these regulations, the licensee may direct a property owner to install a backflow prevention device if they believe that connected plumbing work presents a contamination risk.[154] The selection and installation of a backflow prevention device must be in accordance with "AS 3500.1: 2003".[155] It is unclear if this adoption of the Standard would now be subject to the PCA, given that WaterMark is applied under section 91 as described below.

Section 91 of the Act specified approved fixtures and fittings as those which are certified under the WaterMark Certification Scheme.[156]

[154] *Water Services Regulations 2013* (WA) r 42(1).

[155] *Ibid.* r 42(4), (5). The wording here specifically refers to that Standard as quoted. This would likely be read as a reference to "AS/NZS 3500.1: 2003", as that is the nearest correct version, and under these regulations, a reference to an Australian Standard includes reference to the year of publication (r 3(1)).

[156] *Ibid.* r 49(1).

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