

RISKS OF CROSS CONNECTIONS TO WATER CORPORATIONS



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ABSTRACT

This paper discusses the risks that existing cross connections pose to Water Corporations and the provision of quality water to its communities. An event that occurred at Gippsland Water in 2015 led to the Corporation addressing the factors that contribute to cross connections. Based on this analysis a number of practices to support the identification of cross connections were identified with Gippsland Water finding that cross connections were not limited to the normal operational flows at a water treatment plant. Furthermore the Corporations examination of cross connection prevention methods identify the circumstances that support removal as opposed to isolation of cross connections and the use of Backflow / Non Return Valves (NRV) as an effective prevention mechanism. In conclusion this paper essentially highlights the importance for Water Corporations to adopt a multifaceted approach to a cross connection identification and isolation process that minimises unnecessary risks to its operations.

1.0 INTRODUCTION

In April 2015 Gippsland Water was alerted to a mains break in Morwell and undertook routine procedures to repair and resolve the issue. Following the repair, tests and associated data showed continued deterioration in water quality, leading to further investigation into the matter. Over the course of four days the issue rapidly escalated which left the organisation no choice but to issue a boil water alert. Investigations which involved extensive testing and analysis led to the discovery of an old legacy cross connection that was enabling raw water to make its way into the treated reticulation system. What followed this event were further investigations and discussions throughout the Water Corporation to determine how future events could be minimised and how other cross connections could be identified and isolated. The purpose of this paper is to provide a detailed account of the Morwell event to highlight the importance of Water Corporations knowing where their cross connections may be located. In addition, this paper will outline considerations that were key to Gippsland Water's ability to identify cross connections throughout the Water Corporation and will share the primary learnings.

2.0 DISCUSSION

“Cross Connection” is a physical connection between a possible source of contamination and the public drinking water system piping. This connection, if not properly protected, can lead to the contamination of the drinking water system (Illinois American Water 2016).” In April 2015 Gippsland Water attended a mains break in the town of Morwell located in Victoria's Gippsland Region. The initial isolation of the mains break was unsuccessful. Consequently a much wider isolation was required, impacting the supply to 50 properties. Following repairs, the normal practice of flushing was undertaken, but turbidity levels were higher than normal with water discoloration remaining within the affected area. Over the next 24 hours Gippsland Water's service centre received numerous customer calls reporting dirty water, prompting additional system flushing and further checks on chlorine residual levels and turbidity readings. These checks returned abnormal results. Over the following days, extensive testing and flushing of the system was continued due to the lack of improvement in areas of the reticulation system, and deterioration of water to unsatisfactory levels.

Subsequently a boiled water alert was issued to customers in the affected areas whilst the team continued to investigate the possible contaminated area. The investigation identified an old cross connection where raw water was making its way into the reticulation system at approximately 8 L/s (See figure 1). The offending valve was not marked on current drawings. Consequently when the isolations were being made for the mains break, the offending valve was opened causing raw water to flow into the reticulation system. It was later found that this cross connection was used years ago to top up the reticulation system when flow demands were high. This was at a time when quantity rather than quality was a primary focus and water regulations were less advanced and stringent.

The decision to isolate the offending valve saw a fast improvement in water quality. This event was the precursor to further investigations into the existence of other cross connections being present.

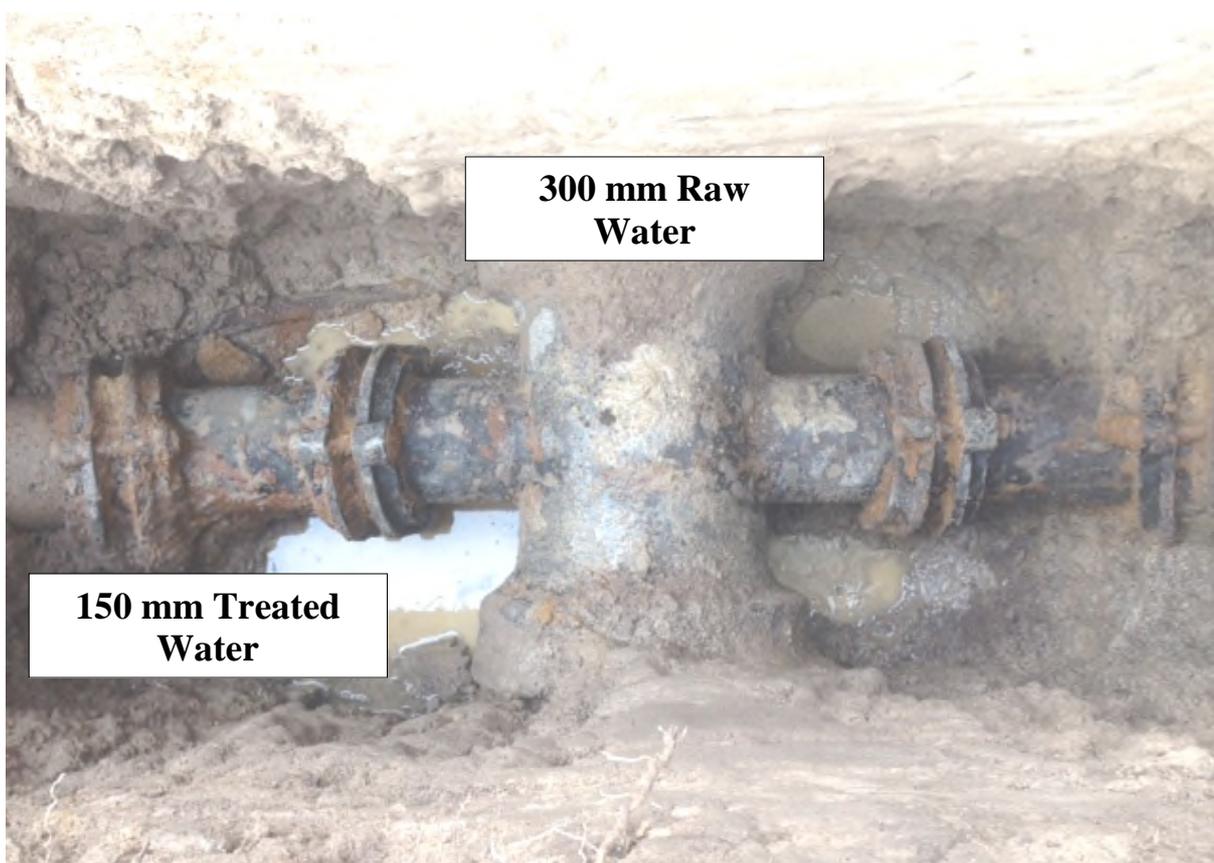


Figure 1: *Treated water and raw water cross connection*

2.1 Factors Contributing to the Existence of Cross Connections

The investigation process highlighted numerous factors contributing to the existence of cross connections within the Water Corporation. The most common were as a result of the following circumstances: Historically cross connections were installed as part of routine processes 30 – 40 years ago, when potable supplies were not routinely disinfected and were therefore not considered a significant risk. Infrastructure from these times still remains. Secondly, Water Corporations were historically focussed on quantity over quality, and as such infrastructure was quickly installed to support demand. Finally, changing of operational staff over many years contributed to the loss of corporate and system knowledge/information about where pipework lies and specific plant knowledge was lost which can cause any new pipework to be connected incorrectly.

2.2 Historical Quality Standard Differences

Anecdotal evidence from the longest serving Technicians highlighted the shift in focus from meeting volumetric demand to the emphasis on water quality (to minimise contamination and risk to public health), in line with the Australian Drinking Water Guidelines.

Historically the isolation of cross connected pipework was achieved by the standard practice of closing a valve. At Gippsland Water this is no longer current practice. Instead, the approach to the isolation of cross connections is to ensure that there is an ample physical barrier between it and the functional pipework. Gippsland Water's view is that the isolation of a valve is not a stringent control measure to reduce the risk because of their tendency to leak and fail over time or be inadvertently operated.

2.3 Practices to Support the Identification of Cross Connections

Following the Morwell event, changes in practice were implemented to support a more efficient identification and isolation process of cross connections. These practices include;

Reviewing drawings;

Plant and site drawings are predominantly the first point of consultation when seeking to identify where pipework goes. Therefore it is critical that drawings are kept up to date after any changes have been made. Drawings are an important tool that can be used to identify cross connections.

Following pipework (Walk the Line);

Being able to identify pipework and where it is connected is important prior to any works being done or operation of valves etc. Gippsland Water colour codes chemical dosing lines so that staff can't confuse them with other pipework and accidentally connect into it. Quite often physically following pipework will reveal potential cross connections that might not be clearly shown on drawings.

Consultation with longest serving employees;

As previously noted, anecdotal evidence from long serving operations employees highlighted the historical practice of opening valves that were connected to the raw water lines and topping up (referred to as shandyng) the reticulation system when demand was high in response to low flows within the reticulation system. Many of these valves still exist as they were never removed or noted in system plans.

Examples of cross connections identified in the application of improved practices include;

A cross connection was identified at a water treatment plant where it was possible to bypass the filtration stage of the process and put clarified water straight into the treated water storage. The Practical Guide to the Operation and Optimisation of Media Filters (Peter Mosse and Bruce Murray) best explains the purpose of the Filtration process as follows; "Filters represent the final step for the removal of particles (hazards) both living (*Cryptosporidium*, *Giardia*) and non-living (turbidity) from drinking water, and therefore represent a vital step in the operation of the plant. For the majority of conventional water treatment plants with coagulation, flocculation, media filtration and chlorine disinfection, the ONLY barrier to *Cryptosporidium* is physical removal by filtration.

Essentially, missing a complete barrier will increase the risk to water quality.

Changes in practice enabled Gippsland Water to determine that cross connections were not limited to the normal operational flows at a water treatment plant and could also be found in carrier water lines for chemical dosing and potable water lines feeding areas of the plant.

2.4 Cross Connection Prevention

It is imperative that cross connections that bypass critical parts of the treatment process are removed immediately, as it is these types of hidden cross connections that can be an unrealised risk. Such cross connections were typically installed many years ago and their continued existence poses an increased risk to water quality by operators who may mistakenly bypass critical points or accidentally bypass these processes due to a lack of familiarity with the plant.

2.5 The role of Backflow / Non Return Valves (NRV) in Cross Connection Prevention

All household water connections consist of a water meter which has backflow prevention installed to prevent any backflow or cross connections within the property from affecting the mains reticulation and creating a water quality incident. At our water treatment plants, we are not required to install water meters, as we are not customers, so we tend to take our potable water from either the treated water storage or directly from the mains leaving the plant. It has been found that a lot of these lines have no backflow prevention, so if conditions were right there is a strong possibility that a backflow initiated water quality incident could happen. For example, at one of our plants a potable water line that feeds our carrier water lines for chemical dosing had no backflow prevention, and this could result in chemicals back flowing into the mains reticulation system.

2.6 Examples of Cross Connections

A potable water flushing line was used for flushing the clarifier pipework that would block up with sludge on occasions. This flushing line was directly fed from the treated water mains going into the reticulation system and had no Non Return valve or Back pressure valve and was only isolated by an old spindle valve. If conditions were right there is a high possibility that clarifier sludge could make its way into the reticulation system (Figure 2).



Figure 2: Clarifier de-sludge line cross connection

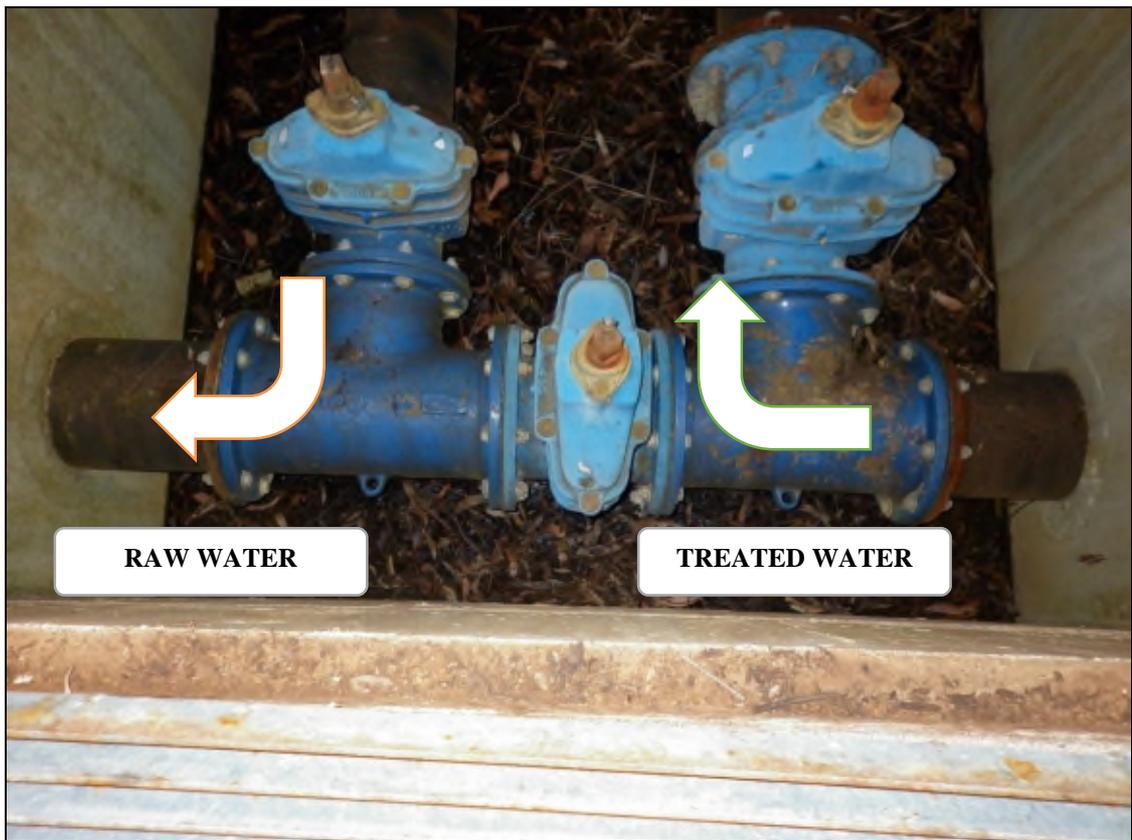


Figure 3: Raw water and treated water cross connection

3.0 CONCLUSION

As the Morwell event highlights, cross connections in Water Corporations that go undetected or unattended pose a serious risk to water quality, and the impact of service delivery to communities. To identify and isolate cross connections Water Corporations can review, improve and implement practices for identification and isolation. Such practices may include consultation with a diverse set of resources including key organisational personnel, mechanical drawings and pipework plans. Of equal importance is to ensure operational staff have a thorough understanding of historical practices and how such practices may impact current operations. Finally, in order to prevent the threat that cross connections pose to water quality, isolation is imperative. However, the cross connections that bypass critical process units at water treatment plants pose a higher risk, hence removal of such connections is the most effective prevention.

4.0 ACKNOWLEDGEMENTS

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5.0 REFERENCES

Mosse P and Murray B

Practical Guide to the Operation and Optimisation of Media Filters, October 2009

Illinois American Water 2016

Cross connection and Backflow prevention

<http://www.amwater.com/ilaw/water-quality-&-stewardship/cross-connection.html>