WHAT'S REALLY IN OUR TAPS? – A RISK MANAGEMENT PERSPECTIVE

Ian Ho, Harrison Grierson
Judith Carstens, Harrison Grierson

ABSTRACT

Historically, the focus on water treatment has been on the design and construction aspect of plant and process equipment to remove known and identified contaminants in the raw water.

However, over the past decade, Regulatory authorities have required local governments and water suppliers to develop a better understanding of the raw water catchment and water infrastructures including identification of any potential risks to water supply.

In New Zealand, this process has been administered by the Ministry of Health (MoH) through the requirement of Public Health Risk Management Plans (PHRMPs) which have been completed by the water suppliers for each catchment and source.

In Queensland, Australia, a similar approach has recently been adopted by the Department of Environment and Resource Management (DERM) through the requirements of preparing Drinking Water Quality Management Plans (DWQMPs).

This paper will compare and contrast the two Risk Management approaches adopted by the MOH and DERM and give an insight into the Best Practice for each approach.

KEYWORDS

Drinking Water, Risk Assessment, Public Health Risk Management Plans

1.0 INTRODUCTION

Providing safe drinking water to all communities is one of the Millennium Development Goals by United Nations. From a recent article published by the International Water Association, it was estimated that approximately 86% of global population has access to potable water. However, the article also stated that the aspect of "safe" drinking water is not easily quantifiable. This is because whilst it is relatively easy to measure the percentage of people connected to public water supplies, it is difficult to collate and assess water monitoring data and then determine whether they are safe, particularly in the developing countries.

2.0 CASE STUDIES OF INADEQUATE ATTENTION TO DRINKING WATER QUALITY

Historical Cases

The importance of removing potential contaminating sources from drinking water was not given attention until a major cholera outbreak in London in 1854. John Snow, a physican identified that the primary cause of this outbreak was due to contamination of groundwater bore by sewage. He prompted the local authorities to discontinue the use of the bore pump which eventually ended the outbreak.

Similarly in 1892, a massive cholera outbreak hit Hamburg, which took 8600 lives. Similar to the previous case in London, it was believed that the massive cholera outbreak was caused by contamination of potable water source by sewage discharge.

Modern Times

Water treatment technologies have since evolved significantly; Coagulation, filtration and disinfection are widely practised to remove key contaminants such as cryptosporidium and E coli in the drinking water. As a result, the society has been better protected against from water-borne diseases.

Nevertheless, there have been severe public health incidents associated with the supply of contaminated potable water. A number of these examples are summarised in Table 1 below.

Table 1 Recent Drinking Water Incidents in Developed Countries (Reference: DERM, 2011)

Cities	Year	Public Health Effects
Milawukee (USA)	1993	400,000 people struck with illness and 100 deaths as a result of heavy rain causing sewage overflows into raw water intake catchment. This was compounded by failure of coagulation and filtration units at the WTP at the time.
Gideon (USA)	1993	500 people struck with illness and 7 deaths as a result of pigeons nesting in an unsealed water reservoir. Treated water was contaminated with Salmonella.
Walkerton (Canada)	2000	2300 people struck with illbness and 7 deaths as a result of heavy rain washing cow manure into groundwater wells. Contaminated water was undetected and the chlorination system was having operational issues at the time.
Queensland (Australia)	2005	8 people struck with illness as a result of contaminated rainwater tanks in an aged care facility.
Melbourne (Australia)	2007	Recycled water/service water was incorrectly connected to the potable water supply network at Melbourne Eastern Water Treatment Plant, resulting 12 people struck with illness.

As illustrated from above, the integrity of water supply systems are susceptible to both design and operational issues.

As a result, various regulatory authorities have implemented drinking water quality standards and risk assessment based management plans to ensure safe and good quality drinking water arrives at the customer taps.

3.0 DRINKING WATER MANAGMENT IN NEW ZEALAND AND AUSTRALIA

3.1 New Zealand

Public water suppliers are required to comply with the Drinking Water Standards for New Zealand 2005 (Revised 2008). In 2009, a revised timetable was set by the Ministry of Health requiring all potable water supply schemes to comply with the DWSNZ.

Table 2 Drinking Water Standard Compliance Timetable

Size of Water Suppliers	Compliance Date
Large Supplies (>10000)	1st July 2012
Medium Supplies (5000 to 10000)	1st July 2013
Minor (500 to 5000)	1st July 2014
Small Supplies (100-500 people)	1st July 2015
Rural Agricultural Drinking Water Supplies	1st July 2016

It is mandatory for the public water suppliers to have a Public Health Risk Management Plan (PHRMP) in place for any scheme serving more than 500 people. These PHRMPs identify the public health risks as well as stipulate the barriers and control measures addressing these risks.

The DWSNZ consists of three elements:

- Water Quality Standards and Maximum Acceptable Values (MAVs)
- Compliance Criteria and Reporting Requirements
- Remedial Actions

Water quality standards and MAVs set the water quality standards that all drinking water supplies must comply.

The parameters are then classified as:

- Priority 1 Determinands (E coli and Protozoa);
- Priority 2 Determinands (chemical and radiological compounds);
- and less important Priority 3 and 4 Determinands.

The DWSNZ specifies various Priority 1 compliance criteria applicable based on the nature of the water source (e.g. confined aquifer, unprotected surface water), plant configuration (e.g. direct filtration versus conventional treatment process) and monitoring practice.

A drinking water assessor from Ministry of Health will develop the necessary risk profile relating to water source, water treatment and distribution system. The risk profile (e.g. log credit required for Protozoa compliance) will enable the public water suppliers to augment their facilities to address the associated risks and comply with DWSNZ.

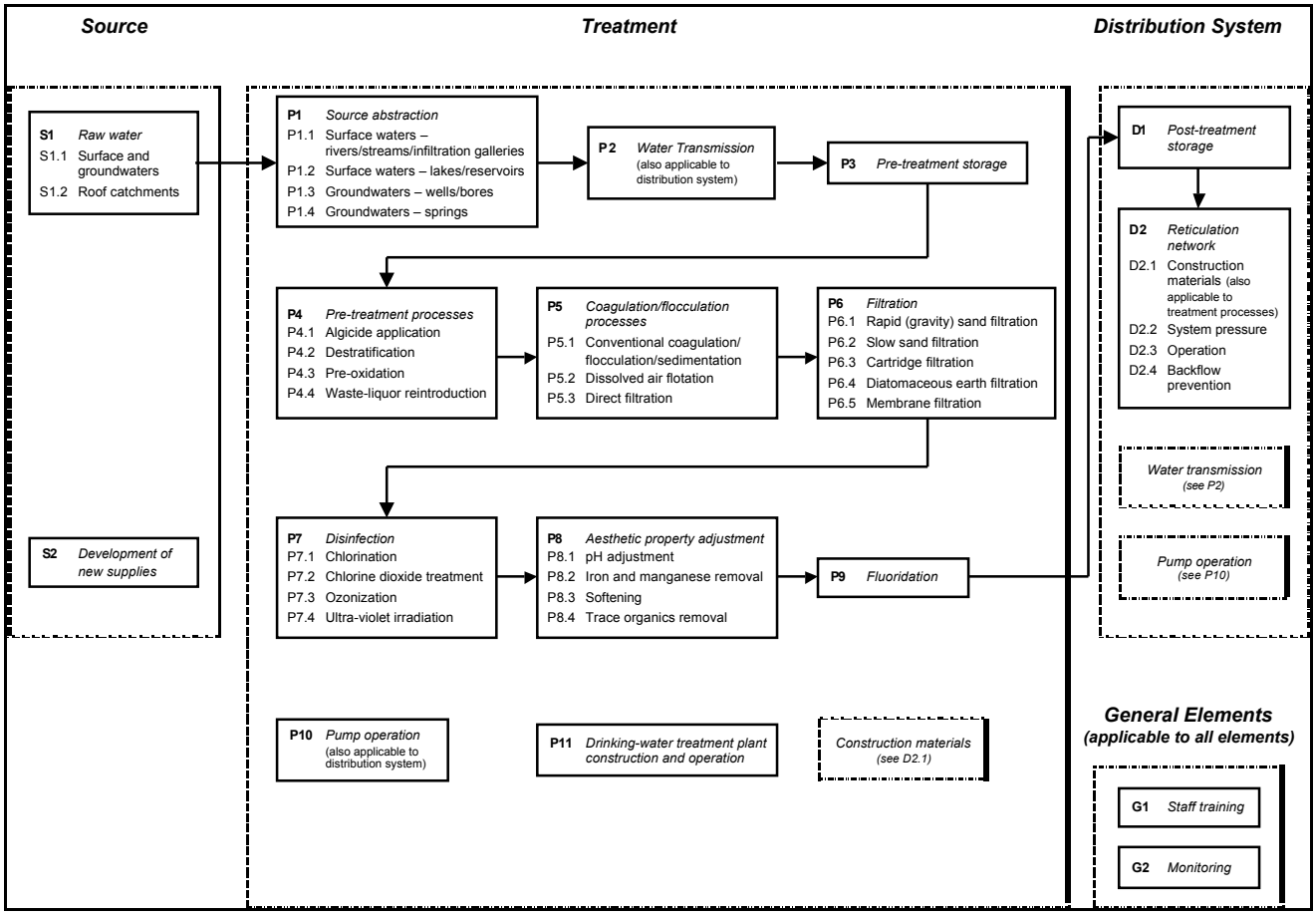
3.2 Public Health Risk Management Plan (PHRMP)

The PHRMP is intended for the public water suppliers to robustly examine their water sources, existing barriers (including treatment process), responses to various events through a risk management perspective. This would involve a series of risk identification, evaluation and development of mitigation measures or system or procedural improvements.

As part of the PHRMP development, various improvement works will be identified. These improvement works may include physical upgrades, such as additional plant equipment or online instrumentation; or development of operational management plans including Contingency Plans.

The figure below presents the approximate boundary of the PHRMP and the relevant guides. Ministry of Health has published these guides to assist the Public Water Suppliers to undertake risk assessment on their water supply systems.

Figure 1: PHRMP Guides from sources to distribution



4.0 AUSTRALIA DRINKING WATER MANAGEMENT

4.1 Australia Drinking Water Guidelines (ADWG)

Australian Drinking Water Guidelines 2011 is the current drinking water quality guideline applicable to public water supplies in Australia. It should be noted that the guideline itself is not a mandatory requirement, however the state legislations requires the public water suppliers to achieve compliance with the ADWG.

There are twelve elements of the ADWG, and they are listed below.

1. Commitment to Drinking Water Management
2. Assessment of Drinking Water Supply System
3. Preventive Measures of Drinking Water Quality Management
4. Operational Procedures and Process Control
5. Verification of Drinking Water Quality
6. Management of Incidents and Emergencies
7. Employee Awareness and Training
8. Community Involvement and Awareness
9. Research and Development
10. Documentation and Reporting
11. Evaluation and Audit
12. Review and Continual Improvement

Similar to the DWSNZ, the ADWG also emphasises preventive measures, multiple barriers as well as stipulating drinking water quality requirements. Identification of critical control points is essential in terms of developing and refining process control, operational procedures and verification monitoring.

Compliance with the ADWG is demonstrated by regular verification monitoring of final water at the water treatment plant outlet and at the water distribution network.

4.2 Queensland Drinking Water Quality Management Plan (DWQMP)

The Queensland Government has passed the Water Supply (Safety and Reliability) Act 2008 in July 2008. The primary purpose of this act is to ensure safe and reliable drinking water for the Queensland State. The Department of Environment Resource and Management (DERM) is Regulator under the Act.

The Queensland Government has rolled out a programme for all public water suppliers to prepare a Drinking Water Quality Management Plan by July 2013. The format of Drinking Water Quality Management Plan is similar to PHRMP of New Zealand.

When a scheme involves recycled water to be introduced to the drinking water supply, both the DWQMP and Recycle Water Management Plan must be in place

before the recycle water is connected to the drinking water supply network. The Recycle Water Management Plan will be separately prepared if the recycle water supplier is a separate entity to the potable water supplier.

The preparation of DWQMP is consisted of the following phases:

1. Data Collation and Information Gathering
2. Water System Analysis including Compliance and Procedures Review
3. Hazards Identification
4. Hazards and Risks Evaluation (a Risk Workshop is typically held)
5. Risk Management Measures including identification of critical control points and the respective critical limits which trigger responses or remedial actions
6. Identification of improvements including physical works, procedures (operation, maintenance and monitoring)
7. Review of incident reporting and response procedures

5.0 COMPARING THE TWO APPROACHES

Similarities

The similarities between the PHRMP and the DWQMP are as follows:

- Public potable water suppliers are responsible for developing the scheme specific management plans.
- Both approaches cover from raw water (catchment), treatment process to the usage points (customers).
- Both approaches adopt qualitative risk management principles (Risk = Likelihood x Consequences).
- Improvement schedules/programmes are important deliverables resulted from the Risk Assessment.
- PHRMPs and DWQMPs are living documents and will be reviewed accordingly.

Differences

Nevertheless, there are some differences between the PHRMP and the DWQMP:

- As there is no specific priority of determinands in the ADWG, the public potable water suppliers are required to identify the at-risk contaminants through the development of the DWQMPs.
- There is no log credit criteria assessment in ADWG/DWQMP, thus the public potable water suppliers are required to develop appropriate operational and verification monitoring programme to ensure compliance with the ADWG.
- In addition, the public potable water suppliers are required to develop specific critical control points and the associated corrective actions.
- Unlike PHRMP, Contingency Plans are separately prepared outside DWQMP.
- An independent auditor will be appointed to audit the DWQMPs.

As highlighted above, both PHRMPs and DWQMPs have a robust approach in terms of identifying the risks and the appropriate mitigations to ensure safe drinking water is being delivered to the customers.

We believe that the DWSNZ and PHRMPs have an advantage over the ADWG and DWQMPs as the priority levels of determinands and establishment of protozoal-compliance log credit criteria helps the public potable water suppliers to streamline the plant operation and monitoring programmes.

The critical control points and the associated corrective actions which are presented in DWQMPs allow the operators to develop and refine their O&M procedures accordingly.

6.0 CONCLUDING REMARKS

The Public has placed a huge amount of trust on the public water suppliers (usually the local councils) to deliver safe drinking water. Any incidents or negative feedback from the communities as a result of poor drinking water quality will significantly damage this trust; This will take the public water suppliers an extended period to regain that confidence.

Risk management approach such as PHRMP and DWQMP allows the public water suppliers to systematically analyse their system, resources, performance and procedures. The continual review of the risk management plans provides a driving force for the public water suppliers to continuously seek pathways to lift their games while delivering safe drinking water quality to the communities.

7.0 REFERENCES

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