THE THREE E'S OF OPERATIONAL PERFORMANCE MONITORING (OPM) – EFFICIENCY, EFFECTIVENESS AND EVALUATION

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ABSTRACT

Operational performance monitoring (OPM) is defined as a planned sequence of measurements and observations throughout the water supply system to ensure and confirm performance of preventative measures and barriers to contamination (NHMRC, 2011). This is an integral aspect of drinking water quality risk management, as suboptimal conditions that may pose a risk to drinking water safety, are identified early, acted upon and managed in a timely manner to minimise or preferably avoid impacting upon consumers.

With the *Safe Drinking Water Regulations 2005* (Vic) due to sunset in July 2015 the Victorian Department of Health is considering the inclusion of OPM in the new regulations and adopting more of a barrier performance approach to safe drinking water assessment. Given this, the OPM practices undertaken by Victorian water businesses will be required to demonstrate that the preventative measures in place and barrier performance is adequate to manage the water quality hazards and risks posed. Crucial to achieving this will be efficient, effective and evaluated OPM practices that support an informed operational decision making process

1.0 INTRODUCTION

The last revision of the Australian Drinking Water Guidelines (ADWG) included a rewrite of the monitoring chapters nine and ten to expand guidance for effective operational monitoring of water supply systems. The purpose was to 'achieve closer alignment with the 'Framework for Management of Drinking Water Quality' ('the framework') (NHMRC, 2011). This was a shift in guidance, from relying upon end-point water quality monitoring at customer taps to determine drinking water safety, to that of a barrier performance approach that supports the framework's preventative risk management strategy. It is an approach that the Victorian Department of Health (DoH) is considering adopting as it reviews the *Safe Drinking Water Regulations 2005* (Vic) that are due to sunset in July 2015.

Central to the barrier performance approach to drinking water safety assessment is the establishment of robust operational performance monitoring (OPM) practices. OPM is defined as a planned sequence of measurements and observations throughout the water supply system to ensure and confirm the performance of preventative measures and barriers to contamination (NHMRC, 2011). This is an integral aspect of drinking water quality risk management, as suboptimal conditions that may pose a risk to drinking water safety, are identified early, acted upon and managed in a timely manner to minimise or preferably avoid impacting upon consumers.

The Victorian DoH view the inclusion of OPM in the next set of regulations as an opportunity to increase the focus on operational performance and consider it necessary to protect public health (Department of Health, 2013). Given this, the OPM practices undertaken by Victorian water businesses will be required to demonstrate that the preventative measures in place and the barrier performance is adequate to manage water quality hazards and the risks posed. Crucial to achieving this will be efficient, effective and evaluated OPM practices that support an informed operational decision making process.

2.0 EFFICIENT OPM

Drinking water quality management publications occasionally refer to the term efficient when describing OPM practices. However, at the business end of drinking water quality risk management efficient is often a key directive from the boardroom. What defines efficient OPM practices? Essentially it is a set of practices that are working productively with no waste of resources, for example, financial or time resources. This relies primarily upon a thorough understanding of the water quality hazards that are known to exist or are likely to exist within the water supply system and the risk that they pose. Each water supply system will have a substantial number of water quality hazards and to monitor each and every one would be unproductive and inefficient.

When implementing efficient OPM practices, resource allocation should be channelled toward water quality hazards that pose significant risk, with priority assigned to those with the highest risk rating. Efficiency is further gained by understanding the nature of the risk posed by each water quality hazard. For many water quality hazards the risk posed is dynamic, that is, it will change from season to season, between alternative source waters, during abnormal operating conditions and in response to climatic conditions. Through understanding the changing risk dynamic this will allow the implementation of flexible OPM practices that are preventative in nature, targeted and adaptive to varying water quality risk.

Some key elements of efficient OPM practices are:

- A robust set of baseline OPM practices that targets the significant water quality risks of the water supply system during normal operational conditions; and;
- A series of planned "event" OPM practices to respond rapidly to indicators of a changing water quality risk profile e.g. wet weather, raw water basin supply, the onset of nitrification, elevated natural organic matter (NOM) or blue green algae levels.

3.0 EFFECTIVE OPM

Throughout drinking water management publications effective is probably the term most frequently used to describe operational performance. In the context of drinking water quality management, effective OPM demonstrates that the drinking water ***to be*** supplied is safe for public consumption. Chapter nine of the ADWG states the following, to be effective, operational monitoring is needed at those points within the water supply system, including critical control points such that if an adverse result is obtained, corrective action can be triggered to ensure that unsafe water does not reach the consumer (NHMRC, 2011).

This highlights that effective OPM should be preventative providing early identification of suboptimal operating conditions that may pose a risk to drinking water safety and that prompt action is initiated to manage any water quality risks in a timely manner to ensure that public health is protected. This relies upon a thorough understanding of the preventative measures and barriers in place to remove, inactivate or reduce the water quality hazards and their performance during a variety of operating conditions e.g. normal, periods of challenge, such as high flow and during periods of elevated source water quality risk. The aim of effective OPM is to provide early identification of when barrier performance is such that drinking water safety is not assured.

Some key elements of an effective OPM are:

- Identified critical control points (CCPs) within a water supply system particularly at water treatment plants;
- CCP sampling and monitoring points are situated in strategic locations to ensure representative information is generated in a timely manner;
- Use of instrumentation that is applicable to the application and is maintained in a manner to ensure accurate and reliable data is obtained;
- Barrier performance criteria that is known to adequately control/manage the identified water quality risks;
- A set of triggers that provide early warning of suboptimal barrier performance or operating conditions; and;
- Development of clear operational response plans detailing appropriate corrective actions to address suboptimal barrier performance or operational conditions.

4.0 EVALUATED OPM

Evaluate, evaluated or evaluation are terms that appear frequently throughout drinking water publications and research articles. Evaluation features in the ADWG framework Elements 11 & 12 and is discussed further in chapter 10 (NHMRC, 2011). It is a term used to state that some type of process has occurred to interpret or assess OPM information/data against a set objective(s) that can then be used in an evidence based approach to decision making. The ADWG Chapter 10 describes both short term and long-term evaluation. With short term evaluation to assess safety e.g. did individual monitoring results meet ADWG values, CCP criteria or contractual obligations and long term evaluation to assess performance e.g. assessing filtered water turbidity values to determine if the process performed adequately over the past twelve months to manage water quality risks i.e. what was the filtered water turbidity twelve month average, maximum and minimum and how did these compare to performance targets e.g. ADWG states filtered water turbidity leaving individual filters should be <0.2NTU, and should not exceed 0.5NTU at any time?

Evaluation is critical aspect of understanding the water supply system overall and the strategies in place to manage water quality risks (WHO, 2011). Water treatment operators play a central role in the evaluation process while undertaking day to day duties. Operators are constantly assessing the data and information generated at a water treatment plant and will often hold the knowledge concerning long term performance of each of the process units. Operators are encouraged to communicate this information in a format that clearly articulates the drinking water safety risk. This information provides the evidence required by water quality managers, senior and executive management to determine if drinking water objectives have been achieved in an efficient and effective manner and if there is a requirement for improvement projects.

Tools to assist with evaluation are commonly the SCADA system with alarms, trending of operational data and conditions, custom designed water quality databases and Microsoft Excel tools. However, progress has been made over the past few years in the water industry to implement more sophisticated operational databases or data warehouses. Catherine Huf presented Wannon Water's use of Aquantify at the Bendigo Water Industry Operators Conference in 2013. This paper was recently published in Water Works along with a similar program (WIMS) implemented at South Gippsland Water (Chatler, 2014; Huf, 2014). The use of tools such as these to evaluate OPM data and information is invaluable for evaluating and optimising barrier performance in an evidence based approach to operational decision making.

5.0 CASE STUDY

A short case study applying the principles of efficient, effective and evaluated OPM practices is presented below using a water quality event extracted from the Victorian DoH publication 'The future of Victoria's Safe Drinking Water Regulations technical report – background to proposed regulations'.

Water from an unprotected catchment was being passed through a water treatment plant that had filtration and disinfection processes. An underestimated rain event caused a very significant increase in the raw water turbidity, which impacted on filtration performance. The filters were not able to cope, but water production was continued due to the potential for the town to run out of water. The result was undertreated and potentially contaminated water entering the drinking water supply system. Effective filtration control is a control measure for bacteria and protozoa; while no reports of illness were received, potentially unsafe drinking water was delivered to customers (Department of Health, 2013).

It is noted that this example is a simplified summary of a water quality event and details regarding any OPM practices undertaken have not been provided to critique, however, the following questions could be raised in terms of efficient, effective and evaluated.

Efficient – Did the OPM practices adequately target the significant water quality risks present in this unprotected catchment particularly in terms of understanding the dynamic or variable risk of key water quality hazards? Were additional OPM practices initiated in a timely manner i.e. a rain event program to gain an understanding of the potential and actual impact of this event upon the production of safe drinking water? A rain event OPM program may include additional catchment water quality monitoring, inspection / review of the filters and other process units e.g. coagulation to determine if operational settings required adjustment or if the production rate could be managed to allow the filters to cope better with a change to source water quality and risk.

Effective – Was the performance of the filtration barrier adequately understood, particularly during periods of challenge and elevated source water risk? Was the filtration process identified as a CCP and monitored accordingly to provide representative, accurate and reliable data? Was corrective action initiated in a timely manner to minimise the impact of this event or even avoid it occurring in the first instance?

Evaluated – Had the performance of the filters been evaluated in the recent past to gain an understanding regarding how they may cope with a significant source water change i.e. were the filters able to meet water quality criteria across a range of source water conditions or were periods of elevated / spiked turbidity identified in the past? Were there tools available to evaluate the performance of the filters e.g. a water quality database or easily accessible SCADA data?

While these questions seems relatively simple, they are quite often asked in hindsight following a water quality incident, rather than asked proactively as a critique of existing OPM practices. Collectively the information and data obtained from efficient, effective and evaluated OPM practices can significantly reduce or even avoid the impact upon customers of a water quality event as described above.

The figure below illustrates efficient, effective and evaluated OPM practices as a cycle each contributing to the other in the production of safe drinking water.

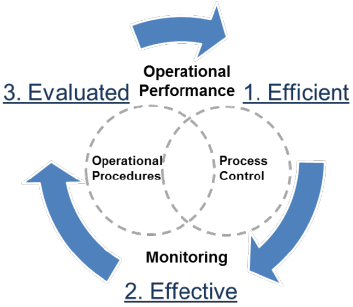

Figure 1: ***Efficient, Effective and Evaluated OPM practices***

6.0 CONCLUSION

Evaluation of efficient and effective OPM practices offers a valuable and powerful safeguard in the provision of safe drinking water. This model may be useful to water businesses in the review of existing OPM practices. A worthwhile and timely exercise given the impending Victorian regulatory changes and the possibility of a fourth OPM "E" - Enforcement.

7.0 REFERENCES

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