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DRAFT Public Health Engineering Guideline: Risk Triggers for Residual Disinfection

1. Introduction

Under the current British Columbia (BC) Drinking Water Protection Act and Regulation, primary disinfection of all surface water and groundwater "at risk of containing pathogens" is mandatory, but disinfection of secure groundwater sources remains optional. There is no mention of secondary or residual disinfection in the legislation. The value of a disinfectant residual has long been recognised in BC public policy, if not in law (BCMoH, 1982; Health Canada, 2003). BC's current policy guide for drinking water gives statutory decision makers complete discretion over "whether, and at what levels, disinfectant residuals are to be present in the distribution system" (BCDWLC, 2007).

The main benefits of residual disinfection in the distribution system include biofilm (regrowth) control, contamination protection, and monitoring sentinel (Haas 1999). Hrudey & Hrudey (2004) conclude that monitoring and maintenance of a disinfectant residual could have prevented or lessened the fatal outbreaks at Walkerton, ON (2000: 7 deaths), Cabool, MO, (1989-90: 4 deaths) and Gideon, MO, (1993: 7 deaths). At the same time, residual disinfection carries costs/risks, including unwanted disinfection by-products (DBPs), reduced monitoring sensitivity, public opposition, and taste and odour complaints. These pros and cons often lead to entrenched positions on either side of the chlorination question.

2. Factors influencing the need for residual disinfection

NRC (2006) defines distribution *system integrity* as comprising physical, hydraulic, and water quality integrity. This guideline adopts the "system integrity" approach, seeks to make it operational, and extends it to include aspects of water system management. Based on the above literature review, **Table 1** proposes nine risk factors as *sufficient* to assess the need for residual disinfection for any water system. Evaluating all nine risk factors would be appropriate for detailed analysis or where administrative fairness requires a decision-maker to take all the particulars into account. For use as a rapid screening tool, it would be advisable to simplify the criteria and focus on the most readily available data, perhaps connections and length of mains, in conjunction with monitoring results, if available.

Table 1. Proposed Water Distribution System Risk Factors.

Risk Factors	***Integrity Category***
1. System documentation 2. Operator vigilance	management system integrity
3. Connections & population 4. Length of distribution mains 5. Age of distribution infrastructure	physical integrity *
6. Hydraulic integrity	hydraulic integrity *
7. Water age 8. Water biostability 9. Monitoring results	water quality integrity *

* NRC (2006)

3. Risk Assessment Scheme

For all but the smallest water systems, the cost of adding a disinfectant residual is minimal. The present document treats (negative) pubic reaction as a constant, making public health risk the primary criterion a statutory decision-maker (DWO) needs to consider.

A standard scheme (**Table 2**) promotes administrative fairness by improving transparency and regional consistency. The triggers suggested below for the nine proposed risk factors are intended to illustrate levels at which a reasonable and prudent practitioner might sensibly consider the need to impose a requirement for maintaining a disinfectant residual in the distribution system.

Table 2. Illustrative Trigger Levels and Risk Weights for Considering Residual Disinfection

Risk Factor	Trigger Level	Weight
1. System documentation	professional judgement of regulator	5
2. Operator vigilance	• no C³ program • no real-time water quality monitoring • operator training inadequate or lapsed for > 2 years • >20% required samples not collected	15
3. Connections & population[a]	• 50 (100) connections[b] without (with) an effective C³ program • 500 persons served	10
4. Length of distribution mains	• >5 km[b] (> 1 km) of dry (submerged) mains	10
5. Age of distribution infrastructure	• average age > 40 years, or • oldest or 90th percentile age (10% older) > 60 years	5
6. Hydraulic integrity	• > 0.2 watermain breaks per year per km • unaccounted water losses > 15% • any non-secure storage reservoir	20
7. Water age	• calculations, modelling or tracer showing age > 7 d • reservoirs: poor (good) circulation: > 3 d (5 d) hydraulic residence time	5
8. Water biostability	• adverse or no biostability test, or • TOC > 5 mg/L	10
9. Monitoring results	• ≥2 adverse results within 72 sampling events (after triggering event), • 90th percentile on proportion of adverse results > 5%	20

[a] Population to be used if connections would not adequately characterise exposure risk.
[b] In Alberta, Canada > 15 connections or > 3 km of distribution mains triggers residual disinfection.

The suggested weights are illustrative and have not been validated against field data. For the scheme shown, there are a total of 100 risk points. Water systems with a low total (say, <10 risk points) may be safe without residual disinfection. Above some threshold (say, > 25 risk points), mandatory residual disinfection could be seriously considered. Alternatively, we might choose to adopt a policy that a significant exceedance of any trigger level prompts added scrutiny and exceedance of two or more triggers creates a presumption that residual disinfection is warranted, while giving the water supplier the opportunity to present counter-evidence or take corrective action. Northern Health should discuss and adopt a procedure that balances the goals of regional consistency, administrative fairness, and evidence-based decision-making, without interfering unduly with the discretion conferred by legislation.

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