

# DRINKING WATER OFFICERS' GUIDE: PART B

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BEST PRACTICES AND TECHNICAL ASSISTANCE



**CONTENTS**

**Determining Appropriate Drinking Water Chemical and Physical Monitoring Guidelines .....4**

- 1. Purpose .....4
- 2. Background .....4
- 3. Process .....5
- 4. Footnotes .....8
- 5. Definitions .....9

**Requests For Investigation Of A Drinking Water Threat Under The Drinking Water Protection Act**

**10**

- 1. Purpose ..... 10
- 2. Application ..... 10

**Request For A Section 29 Investigation Under The Drinking Water Protection Act..... 11**

**Strategies, Tools And Procedures Health Authorities May Use To Find And Regulate Small Systems**

**16**

- 1. Purpose ..... 16
- 2. Background ..... 16
- 3. Strategies to Find Un-permitted Systems ..... 16

**Drinking Water Complaints And Inquiries Process..... 18**

- 1. Purpose ..... 18
- 2. How Do I Make a Complaint or Inquiry?..... 18
- 3. How Will My Concern Be Addressed? ..... 19
  - 3.1 Concerns about Drinking Water Systems ..... 19
  - 3.2 Concerns about Service Provided by Health Authorities ..... 19
  - 3.3 Concerns about Policies or Services Provided by the Health Protection Branch, Ministry of Health 20
- 4. Still Not Satisfied?..... 20
- 5. Ombudsperson ..... 21

**Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British**

**Columbia ..... 22**

- 1. Objective ..... 22
- 2. Background and Regulatory Framework ..... 22
- 3. Purpose and Scope ..... 23
- 4. Treatment Objectives ..... 23
  - 4.1 4-log Inactivation of Viruses ..... 24
  - 4.2 3-log Inactivation of Giardia and Cryptosporidium ..... 26
  - 4.3 Two Methods of Treatment (Dual Treatment) ..... 26
  - 4.4  $\leq 1$  NTU in Turbidity ..... 28
  - 4.5 No Detectable E. Coli, Fecal Coliform and Total Coliform ..... 29
- 5. Conclusion ..... 29

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6. References.....	30
<b>Decision Tree for Responding to a .....</b>	<b>31</b>
<b>Turbidity Event in Unfiltered Drinking Water .....</b>	<b>31</b>
1 Objective.....	31
2 Introduction .....	31
3 Filtration .....	32
4 Communication and decision-making .....	32
5 Definitions.....	33
Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water .....	34
Appendix A: Expanded notes for the decision tree .....	35
Appendix B: Turbidity-related risk factors: considerations for health risk assessment .....	38
<b>Water Systems for Class D &amp; E Slaughter Establishments and Other Unregulated Uses .....</b>	<b>39</b>
1. Purpose .....	39
2. Position.....	39
3. Application .....	39
4. Questions and Answers.....	40
<b>Obligations of the Water Suppliers of Drinking Water Treatment Systems that have Point of Use/Point of Entry Devices .....</b>	<b>41</b>
1. Objective.....	41
2. Background .....	41
3. Water Supplier Obligations.....	42



## DETERMINING APPROPRIATE DRINKING WATER CHEMICAL AND PHYSICAL MONITORING GUIDELINES

### 1. Purpose

To assist in determining Chemical Standards that are applicable to the water in a water supply system and how these should be monitored. This guideline is particularly relevant for sections 3.1.5.2, 3.2.5.2, 3.2.6 and 4.2.1 of the Drinking Water Officer's Guide as these sections deal with decision-making related to permitting, terms and conditions, and monitoring of water systems.

This guideline provides supplemental guidance for drinking water officer (DWO) decisions on monitoring water for various chemical and physical parameters. It also provides a decision flow chart to guide the DWO through a decision-making process to help determine if there is sufficient evidence to support the requirement to test for additional parameters in a specific water source. The approach specified also supports local DWOs in determining which parameters a new or existing water supply system should test for and how often the testing should be conducted.

### 2. Background

Under Section 8(3) of the *Drinking Water Protection Act* (DWPA), a DWO may place terms and conditions on an operating permit respecting monitoring of the drinking water source and the water in the water supply system, as well as standards applicable to the water in the water supply system.

The *Guidelines for Canadian Drinking Water Quality* (GCDWQ) are the water quality objectives that BC's water supply systems should strive to achieve when evaluating potability for chemical constituents. The Maximum Allowable Concentration (MAC) in the GCDWQ generally represents a health-based numerical water quality objective. The drinking water officer will use this and other factors to evaluate the level of risk associated with drinking water.

For most water systems, it would be a significant financial burden to require frequent testing for all the chemical and physical parameters listed in the GCDWQ. This approach would not necessarily improve public health outcomes, especially if data indicates that a parameter consistently meets criteria for the protection of public health. This guideline does not specify a testing frequency for a water supply. Rather, it allows flexibility to ensure testing is focused on site-specific parameters relevant to a particular water source.

Minor exceedances of the guidelines would normally trigger actions such as:

- Increasing monitoring or sampling,
- Source investigation and management,
- Long term planning to meet the water quality objective, and
- Communication of the situation and the mitigation plan.

Where more significant exceedances occur, DWOs will use their discretion, based on available evidence, to determine at what point the level reaches an unacceptable risk and the appropriate public health response.

### 3. Process

Any new water source typically requires comprehensive testing. For example, a typical suite of tests may include something similar to the following:

*For surface water sources (includes ground water that is at risk for containing pathogens):*

Alkalinity	Fluoride	Nitrite (dissolved)
Ammonia	Hardness	Organic Nitrogen
Calcium	Iron	pH
Chloride	Manganese	Sulphate
Colour	Metals Scan <sup>1</sup>	Total Dissolved Solids
Conductivity <sup>2</sup>	Nitrate (dissolved)	Total Organic Carbon
Corrosiveness <sup>3</sup>	Bacterial indicators	
Turbidity	Bromide (for systems using ozone)	

*For ground water sources:*

Alkalinity	Fluoride	Phosphorous
Ammonia	Iron	Sodium
Calcium	Hardness	Sulphate
Chloride	Magnesium	Sulphide
Colour	Manganese	Total Dissolved Solids
Conductivity <sup>4</sup>	Metal Scan <sup>5</sup>	Total Organic Carbon
Corrosiveness <sup>6</sup>	Nitrate	Uranium
	pH	Turbidity

Many analytical labs provide testing packages that cover many of these parameters. Consideration should also be given to appropriateness of testing source water or post-treated water or both.

The DWO may also require additional testing for other parameters should evidence suggest that additional substances of concern exist. DWOs should also consider the type of

<sup>1</sup> Aluminum, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Potassium, Zinc (expand if mineralized to include Mercury)

<sup>2</sup> Conductance/Specific Conductance

<sup>3</sup> Calcium Carbonate saturation/Langelier's index

<sup>4</sup> Conductance/Specific Conductance

<sup>5</sup> Aluminum, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Potassium, Zinc (expand if mineralized to include Mercury)

<sup>6</sup> Calcium Carbonate saturation/Langelier's index

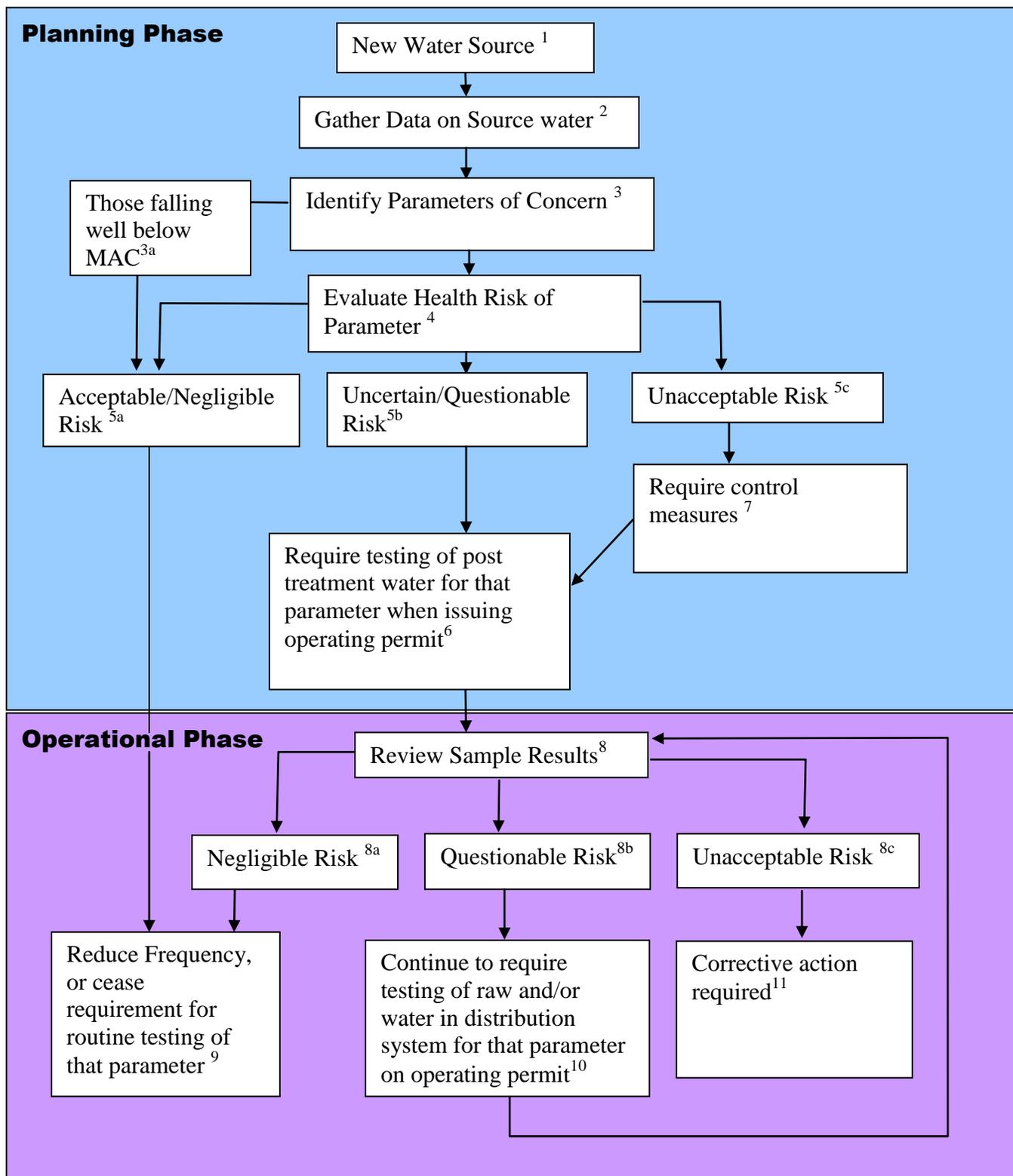
water source, local community history, known contaminant sources, seasonal variation, and local historical water quality reports when deciding on a testing regime. These factors may give clues to what parameters may be likely to be of concern in the future.

Where the results of initial testing indicates that additional chemical parameters are less than the GCDWQ, and local history shows that the parameters are unlikely to vary above the MAC, then further routine testing frequency may be reduced. Another consideration in this decision involves determining whether the water will be consumed by persons on an ongoing or seasonal basis, special vulnerabilities of intended users (e.g., school children), or other such matters.

For chemical or physical parameters that are identified as being near the threshold set out in the GCDWQ, the DWO should review the magnitude of the hazard that may be posed by the parameter falling in this range. If the DWO concludes that there is a health concern, he/she should consider requiring routine testing of the parameter at a defined frequency in the operating permit.

The DWO may wish to re-evaluate the testing requirements based on any new potential risks in situations that impact water quality such as a chemical spill, a new industry with new emission sources, a change in land use, an unusual weather event, or other situation.

Where there is an established history of stable and predictable chemical results, a DWO may amend the operating permit to waive, or reduce the frequency of testing of a parameter. Where a parameter experiences great variability in values over time, risk increases and therefore increased monitoring frequency should be considered.



## 4. Footnotes

1. A new source for a water supply system under the DWPA, or re-evaluation of an existing system after an incident of contamination, or significant system modification.
2. The DWO should ask the supplier to provide the following information for consideration:
  - a. Historical data from nearby water sources
  - b. A suite of chemical and physical testing on the new source for health parameters in GCDWQ
  - c. Activities in the watershed that may contribute to elevated sample results (e.g., local industry, agriculture, historical chemical spills)
  - d. The type of water source (i.e. groundwater vs. surface supply etc.)
  - e. The anticipated effect of proposed treatment on parameters (e.g., formation of disinfection by-products)
  - f. Anticipated seasonal fluctuations in water quality and quantity

The supplier may accomplish this by providing the health authority a health risk assessment of water quality.

3. The DWO will compare data collected to GCDWQ and/or other standards to identify those which may require further consideration. Those that are measured at or near the MAC, or other standards need further consideration. This may include consideration of the anticipated effect of proposed treatment on parameters (e.g., formation of disinfection by-products)
  - a. Subject to consideration given under box 2, those falling well below the MAC or other standards may not require further routine testing.
4. Evaluate the magnitude of the risk for each parameter that is near or exceeding the threshold in the GCDWQ or other standards. The information in Box 2 should be considered in this evaluation.
5. Where the DWO concludes that the risk of a parameter is:
  - a. Acceptable/Negligible: no further routine testing is required; unless there is reason to believe the situation has changed. (Where an event such as a chemical spill, or the introduction of a new industry in the community occurs, the DWO may wish to re-evaluate the testing requirements based on this new information).
  - b. Uncertain/Questionable: Require periodic sampling of the parameter in question on the operating permit (go to box 6)
  - c. Unacceptable – go to box 7
6. The DWO should require periodic sampling and reporting of this parameter on the conditions of the operating permit at source and/or distribution system as appropriate.
7. Where source water is found to be unacceptable, the DWO should require mitigation of the parameter to reduce risk, by:
  - a. Requiring control measures (e.g., water treatment)
  - b. Finding another source

- c. Where water is currently in use, notifying users
- d. Continuing to monitor to verify that control measures are effective (go to box 6)

This may be done through adding or modifying conditions on permit or by an order issued under the DWPA

8. Once a water supply system is in operation, routine sampling will give an indication of whether the risk:
  - a. Is shown to be negligible (e.g., reducing concentration over time)
  - b. Requires further monitoring to ensure that risk does not increase, or
  - c. Increases to an unacceptable level on a temporary or long term basis.
9. With an established history of stable and predictable chemical and/or physical results, a DWO may amend the operating permit to reduce frequency or waive the requirements for testing of a parameter. The DWO may, however take into consideration that if a parameter monitored is part of a suite of measurements offered by a lab, it may not be of any consequence to reduce testing of a particular parameter.
10. Conditions on operating permit should require regular monitoring to ensure that risk does not increase.
11. Where monitoring reveals that the concentration of the parameter increases to an unacceptable level, the DWO should require notification of users. The DWO should evaluate the magnitude of the exceedance of the guideline, as well as whether the condition of the water is of a temporary or long term nature. As most parameters identified in the Guidelines for Canadian Drinking Water Quality are based on lifetime exposure, temporary minor exceedances are usually not a cause for immediate remedial action. However, if there the problem is of a long term nature, the DWO should consider requiring the water supplier to develop a plan for mitigating the problem which includes an established timeline for completion.

## 5. Definitions

### Acceptable/Negligible Risk

- The parameter is below the MAC in the GCDWQ or other prescribed standards

### Uncertain/Questionable Risk:

- The parameter is near or exceeds the MAC in the GCDWQ or other prescribed standards, or;
- There is inadequate data to determine if levels are consistently below MAC.

### Unacceptable:

- Exceeds the MAC in the GCDWQ, or other prescribed standards or,
- Where no standard exists, the DWO has assessed the risk and determined that a drinking water health hazard exists.



## REQUESTS FOR INVESTIGATION OF A DRINKING WATER THREAT UNDER THE DRINKING WATER PROTECTION ACT

### 1. Purpose

Under section 29 of the *Drinking Water Protection Act*, if a person considers that there is a threat to their drinking water, the person may request the drinking water officer (DWO) to investigate the matter. This document contains a sample template questionnaire form for such investigations.

### 2. Application

#### INFORMATION FOR THOSE REQUESTING AN INVESTIGATION UNDER SECTION 29

Requests for investigation can be made by any person that believes that there is a threat to their own drinking water supply. Section 29 requires requests to be in writing.

A request for investigation should include the information contained in the form below. The questionnaire will assist in documenting the specific facts related to the drinking water threat and provide health authority staff with relevant information that can be reviewed in an expeditious manner to determine if an investigation is warranted.

This form should provide the local DWO with enough information as to determine whether an investigation should be initiated under section 29, however the DWO may ask for further information depending on the specifics of the case. Consequently, it is recommended that persons making these requests contact the DWO beforehand.

If the DWO decides not to conduct an investigation, he or she should provide a written explanation as to why the decision was made.

If an investigation is conducted, the DWO must advise of the results of the investigation. When doing so, the DWO should specify his or her findings regarding whether any threat was found, and what, if any, follow-up action will be taken. DWO's should also provide this information in writing.

## REQUEST FOR A SECTION 29 INVESTIGATION UNDER THE DRINKING WATER PROTECTION ACT

**Name:**

**Date:**

**Mailing address:**

**Phone Numbers:**

**Address of well property:**

**1. Is your water supply or residence located on federal or First Nation Lands**    Yes    No  
Unsure

**2. Source of Water**

Private Well

Private Surface Water (Provide Name of Stream or Lake) \_\_\_\_\_

Permitted Community Water System (Provide Name) \_\_\_\_\_ (if municipal option applicable please proceed to question 24)

**3. Describe the location of your drinking water supply (i.e. well) on your property. (ex. 20 m from north boundary and 60 m from east boundary of property)**

**Well Information (If Applicable)**

**4. Is your well:**    Drilled    Excavated (dug)    Driven (sand point)    Unsure

**5. What year was your well drilled?** \_\_\_\_\_    Unsure

**6. Name of well driller** \_\_\_\_\_    Unsure

**7. Do you have a copy of the well Drillers log (Please attach copy if available)**

Yes    No    Unsure

**8. How deep is the well?** \_\_\_\_\_(meters)    Unsure

**9. How deep is the water table below the ground?** \_\_\_\_\_(meters)    Unsure

**10. Does the well draw water from:**    Sand and/or gravel aquifer    Fractured bedrock    Unsure

**11. During well construction were there any layers of clay, silt, till or hardpan encountered above the well screen or well intake?**    Yes    No    Unsure

12. Does the well have a secure well cap?  Yes  No  Unsure

13. Does the well have a surface seal?  Yes  No  Unsure

14. Is the well located in an area where there is known flooding or where water can pond?

Yes  No  Unsure

15. Are there any structures, buildings, material storage, or animals near your well-head? (Please describe)

16. Is your well-head protected by a covered structure?

17. Has your well been disinfected in the past? (please describe)

18. Any other relevant information about your well? (Please describe)

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19. Have there been any ground water assessments of your well water supply conducted by a professional hydrogeologist? (Please provide a copy of the report)

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20. Is water stored at your home stored prior to use in a:

- Pressure tank
- Holding tank
- Other \_\_\_\_\_
- No water storage

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21. What type of material is used for the water distribution pipes?

In your home \_\_\_\_\_

From your well to your home \_\_\_\_\_

From street to your home \_\_\_\_\_

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22. Do you currently treat your drinking water supply?  No  Yes,

If yes, please specify method used:  Chlorine  UV  Osmosis  Boiling

Filtration (specify type) \_\_\_\_\_  Other \_\_\_\_\_

**23. Are any of the following located close to your water well or surface water intake? If so, please describe and include approximate distance:**

a. Chemical storage (household or agricultural, including pesticides) Distance: \_\_\_\_\_ meters

b. Fuel storage (above ground or underground) Distance: \_\_\_\_\_ meters

c. Manure storage or application Distance: \_\_\_\_\_ meters

d. Livestock Distance: \_\_\_\_\_ meters

e. Wildlife Distance: \_\_\_\_\_ meters

f. Other wells including abandoned well(s) Distance: \_\_\_\_\_ meters

g. Septic systems, (including your own or those on nearby properties) Distance: \_\_\_\_\_ meters

h. Major roads, highways, railways, pipelines, drainage ditches Distance: \_\_\_\_\_ meters

i. Lake, stream, river, pond or ocean Distance: \_\_\_\_\_ meters

j. Landfill, refuse storage, contaminated sites Distance: \_\_\_\_\_ meters

k. Other (Specify)

24. Have you noticed any taste, odour and/or appearance changes (colour, cloudiness) to your drinking water? If so, when did you first notice the change? (Please provide details)

25. Has anyone become ill as a result of drinking the tap water from your home? (*Please provide supporting documentation if possible, including water test reports, medical testing results and/ or doctor's report.*)

26. Have there been any water quality tests performed on your drinking water supply (Chemical, Bacteriological, other)? (*Please attach copies of lab reports*)

27. Are you aware if your municipal water supplier has issued a boil water notice or drinking water advisory? If so, what was the nature of the advisory?

28. Have you contacted your municipal water supplier about your concerns? If so, what was their response?

29. If applicable, please provide municipal contact person you have interacted with on this issue

30. Other evidence which supports your concern about the safety of your drinking water? (*Please provide specific details and attach any relevant supporting documents.*)

31. What initiated your complaint?

32. How do you expect your complaint to be resolved?

\_\_\_\_\_  
Name of person requesting an Investigation  
(Please Print)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date



## STRATEGIES, TOOLS AND PROCEDURES HEALTH AUTHORITIES MAY USE TO FIND AND REGULATE SMALL SYSTEMS

### 1. Purpose

The Document outlines strategies that health authorities may use find small water systems that have not been permitted as required by the *Drinking Water Protection Act*.

### 2. Background

There are likely many (possibly thousands) systems that meet the definition of a Water Supply System under the *Drinking Water Protection Act* that are unknown to the health authorities. Many of the operators of these systems either do not know that they are subject to the *Drinking Water Protection Act*, or would prefer not to be regulated.

Should health authorities have the resources to systematically find systems that have not been permitted, there are tools such as databases held by the Ministry of Environment that health authorities could utilize. This document identifies these tools and provides basic procedures on how they may be used. The document also outlines other strategies that may assist in preventing new systems from falling outside of the regulatory process.

### 3. Strategies to Find Un-permitted Systems

- i. **Use the Ministry of Environment's WLIS Water Licence Web Query, to find licences for water extraction.**

All surface water intakes should have a license from the Ministry of Environment, and information on such systems is found under the Water License Information System. Health Authorities can use this database to search for systems that hold licences.

Example procedure to find water supply systems that were issued water works licences since the beginning of 2009:

- a) Go to [http://a100.gov.bc.ca/pub/wtrwhse/water\\_licences.input](http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input)
- b) Under **Purpose**, from the dropdown menu choose **Waterworks - other**.
- c) Under **New Licences or Applications from this date forward**; enter the January 1, 2009 date like this: **20090101**
- d) Click the **Submit** button

This will produce a list of the new applications and licences for this purpose.

This procedure can be done for other **purposes** or **dates**, and/or refined to include only specific geographical areas by selecting the **watershed** or **water district** drop down boxes.

For a list of purposes involving water distribution systems for human consumption; see the highlighted purposes on the **Water Use Purpose Definitions**.

[http://www.env.gov.bc.ca/wsd/a-z\\_index.html](http://www.env.gov.bc.ca/wsd/a-z_index.html)

**ii. Use the Ministry of Environment's "WELLS Database, Report 6" to search for groundwater drinking water supply systems.**

The Ministry of Environment has a well database that contains information submitted on a voluntary basis by well drillers. Health Authorities can use this database to search for systems that have been registered.

Example Procedure to find wells that were drilled as drinking water supply systems in a given year:

- a) Go to <http://a100.gov.bc.ca/pub/wells/public/common/wellsreport6.jsp>
- b) Under "**Well Use**", choose "**drinking water supply system**",
- c) Under **Date Started**, input "**%2009%**",
- d) Select any other fields you wish to be displayed, i.e., **Street Name, Area, Water Supply System Name, Water Utility** (to see if it is a large system)
- e) Click the "Search" button

This will produce a list of those wells drilled in a given year that are a drinking water supply system, and allows the user to then pull up the well construction report for each well.

This procedure can be repeated for other dates or for other well uses such as "domestic", "community water supply", "Municipal", or "water utility", and can be further refined by land district if desired.

Please note:

- The WELLS database doesn't distinguish between large or small drinking water supply systems. The best way to determine if it is a large system is to select the water utility field – this will at least tell you if you are dealing with a water utility.
- Only surface water is licensed by the Ministry of Environment, but groundwater is not, therefore groundwater reports on WELLS are submitted to this database on a voluntary basis, and it may not represent all wells that may exist.
- The WELLS database may have gaps in owner contact information.



## DRINKING WATER COMPLAINTS AND INQUIRIES PROCESS

### 1. Purpose

The Health Protection Branch in the Ministry of Health is contacted from time to time by the public about concerns pertaining to drinking water, including:

- Complaints regarding a specific public health concern in a community (e.g. drinking water threat).
- Complaints regarding service provided by a health authority, or a policy a health authority has adopted.
- Complaints regarding a policy or service of the Ministry of Health's Health Protection Branch.

The purpose of this document is to provide guidance to the public and health protection staff on how to file concerns, and what to expect once they are filed.

### 2. How Do I Make a Complaint or Inquiry?

There are a number of ways you can contact the Ministry of Health to make a drinking water complaint or inquiry. It is most efficient if you phone, email or send a letter to the Health Protection Branch:

#### **Health Protection Branch**

Population and Public Health Division  
Ministry of Health

4th Floor, 1515 Blanshard Street

Victoria, BC, V8W 3C8

phone: 250 952-1469, fax: 250 952-1713

email: [HP-PHW@gov.bc.ca](mailto:HP-PHW@gov.bc.ca)

Hours of operation: 8:30 a.m. to 4:00 p.m., Monday to Friday, excluding holidays

When contacting us, please provide us with as much information as possible, including:

- Your name and contact information.
- The location of your concern.
- The nature of your concern.
- Names of individuals or businesses, or organizations related to your concerns and, where possible, contact information.

### 3. How Will My Concern Be Addressed?

#### 3.1 Concerns about Drinking Water Systems

Many concerns received by Health Protection Branch staff are about a particular drinking water system, incident, event or situation occurring in the person's community.

Most of these issues fall under the jurisdiction of local health authorities, and are best addressed by their staff. Please contact health authorities directly. Health authority contact information is found on [this page](#).

If you are unable to reach the correct person at the health authority, the Health Protection Branch will be happy to assist by:

- Recording the name, contact information, and location of the complainant.
- Recording any pertinent details provided by the complainant.
- Referring the complainant to the relevant person in the health authority for follow up, and/or providing the complainant with contact information, and sources of further information.

Formal requests for investigations under section 29 of the *Drinking Water Protection Act* must be made **directly to your local health authority in writing**. If you are wishing to request an investigation under this section, Health Protection Branch staff can guide you to the appropriate contact person within your local health authority.

#### 3.2 Concerns about Service Provided by Health Authorities

The Health Protection Branch from time to time receives concerns about service provided by health authorities. The health authority staff do not have a direct reporting relationship with the Ministry of Health. The Branch's initial response will be to help people find the right person in the health authority to follow up on their complaints, usually beginning with the supervisor.

Requests for **reconsideration** of a decision as per Part 6 of the *Drinking Water Protection Act* will be referred to health authorities.

Requests for **review** of decisions as per Part 6 of the *Drinking Water Protection Act* will be referred to the office of the Provincial Health Officer.

If, after following this approach, the complainants are not satisfied with the service they have received from the health authority, concerns can be brought to the Health Protection Branch. For these types of concerns, Health Protection Branch staff will:

- Record the name, contact information, and location of the complainant
- Record any pertinent details provided by the complainant, including:
  - The name of the organization about which the complainant is concerned.
  - Names of the people with whom the complainant has dealt.
  - The nature of the concern.
  - The measures the complainant has already taken to try to resolve the concern.
- Refer the concern to the relevant person in the health authorities for follow up, and provide the complainant with the contact information.

For more information, see the [Drinking Water Health Authority Contacts website](#).

For a link to other public health agency contact information, see [this page](#).

### 3.3 Concerns about Policies or Services Provided by the Health Protection Branch, Ministry of Health

If you have views about the Ministry of Health's drinking water policies, its services or the way they are provided, or other inquiries, we would like to hear from you. Our staff value ensuring that all enquiries are treated properly and promptly. Let us know if you have an inquiry that needs answering, or if you are unhappy about:

- A decision we have made.
- Any aspect of our work.
- A member of our staff providing incorrect information or treating you unprofessionally.

When contacted, Health Protection Branch staff will:

- Record the name, contact information, and location of the complainant.
- Record any pertinent details provided by the complainant, including:
  - The name of the organization about which you are concerned.
  - Names and or titles of the people with whom you have dealt.
  - The nature of your concern.

Once we have received this information, we will either direct you to the right person or take a note of your complaint or inquiry, and pass it to him or her. We will usually do this within 24 hours, but please allow up to 20 working days for an initial response. If you do not have all the information above, we will work with you try to determine the best person to address your concern.

If your concern falls outside of the ministry's range of responsibilities we will inform you of this and forward your complaint to the right service agency as quickly as possible.

As a learning organization, we value your feedback. Please let us know if your complaints or inquiries have been satisfactorily resolved and what steps we can undertake to improve our responses. We would also like feedback if you are satisfied with our response.

## 4. Still Not Satisfied?

If you have already contacted the Health Protection Branch and are still not satisfied, you can contact the Deputy Minister or Minister of Health for further consideration of your matter. Please put your concerns in writing and send them to the Minister of Health. A reply will be provided within 20 working days. Your complaint will be logged and tracked to ensure it is resolved.

**Office of the Deputy Minister  
Minister of Health**  
1515 Blanshard Street  
Victoria, BC, V8W 3C8  
Phone: 250 952-1911  
Fax: 250 952-1909

**Office of the Minister of Health**

Phone: 250 953-3547

Fax: 250 356-9587

E-mail: [hlth.minister@gov.bc.ca](mailto:hlth.minister@gov.bc.ca)

If you are unhappy with the minister's response, you can also send a written complaint to the Office of the Premier.

## 5. Ombudsperson

If you are not able to reach a resolution and you feel that you have been treated unfairly by the Ministry of Health, you can refer your complaint to the Office of the Ombudsperson. The Ombudsperson can:

- Provide information about what steps to take in dealing with a public agency.
- Try to settle complaints through consultation.
- Investigate complaints about administrative unfairness by a public agency.
- Make recommendations to a public agency to resolve an unfair situation.
- Report to the provincial legislature.
- Issue public reports.

### **Ombudsperson**

Local phone: (250) 387-5855 (Greater Victoria area)

Toll-free phone: 1-800-567-3247 (all of B.C.)

In Person: 947 Fort Street – 2<sup>nd</sup> floor, Victoria, B.C., Canada

Hours: 8:30 a.m. to 4:30 p/m/. Monday to Friday

By mail: PO Box 9039 STN PROV GOVT, Victoria, B.C., V8W 9A5, Canada

Fax: (250) 387-0198

Website: [www.ombudsman.bc.ca](http://www.ombudsman.bc.ca)



# DRINKING WATER TREATMENT OBJECTIVES (MICROBIOLOGICAL) FOR SURFACE WATER SUPPLIES IN BRITISH COLUMBIA

Version 1.1 / November 2012

## 1. Objective

To provide a general overview of microbiological drinking water treatment objectives for surface water supplies in British Columbia.

## 2. Background and Regulatory Framework

There are three main types of microorganisms (pathogens) that pose risks to human health in drinking water: viruses, bacteria and protozoa. The B.C. [Drinking Water Protection Act](#) (DWPA) (2001) and [Drinking Water Protection Regulation](#) (DWPR) (2003) specify water quality standards, monitoring schedules, applicability and recommended treatment aimed at reducing the risks from these pathogens.

Schedule A of the DWPR specifies bacteriological water quality standards for potable water<sup>7</sup> for the protection of human health. These standards represent partial drinking water treatment goals and are consistent with the [Guidelines for Canadian Drinking Water Quality: Guideline Technical Document — \*Escherichia coli\*](#) and total coliform (Health Canada, 2006).

Schedule B of the DWPR outlines the monitoring schedule and its applicability based on population served. Section 5 of the regulation requires that surface water sources must, as a minimum, receive disinfection. Reducing risks from virus and protozoa through disinfection of drinking water are dealt with through the application of best management principles as outlined in this document and detailed in the [Guidelines for Canadian Drinking Water Quality \(GCDWQ\)](#). As no one type of treatment system is effective in treating all hazards, a multi-barrier approach is usually required to adequately address all risks, which typically includes two or more forms of treatment.

The DWPA and the DWPR give drinking water officers (DWOs) the flexibility and discretion to address public health risks through treatment requirements in operating permits to deal with pathogenic risks. Discretion of the drinking water officer also includes, but is not limited to, understanding the source water characterization, effectiveness of system-specific treatment technologies, operational management issues and reasonable time frames to achieve incremental improvements to existing

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<sup>7</sup> Potable water is defined under the *Drinking Water Protection Act* as water provided by a domestic water system that (a) meets the standards prescribed by regulation, and (b) is safe to drink and fit for domestic purposes without further treatment.

systems. With respect to water quality analyses, the issuing official should ensure that he/she has adequate data to determine that the proposed treatment is adequate to address public health risks in relation to relevant microbiological and chemical/physical parameters.

Existing water supply systems may have some appreciable risk for certain parameters without treatment in place. In such cases, it is acceptable from a public health perspective for water supply systems to present drinking water officers with a continuous improvement plan that addresses implementing treatment for these parameters within a reasonable time period.

### 3. Purpose and Scope

Under the DWPA, water suppliers have the responsibility to provide potable water to all users of their systems. Drinking water treatment requirements are site specific, risk based and dependent on a number of factors, including source water quality and efficacy of treatment technology.

This document provides the basic minimum framework towards goals for drinking water treatment for pathogens in surface water supply systems in British Columbia. It may also be used as a general reference for assessing progress towards updating or improving existing water supply systems. This document does not address the treatment of groundwater or disinfection of distribution systems.

These objectives rely on the [Guidelines for Canadian Drinking Water Quality](#) (Health Canada, 2012) as a primary reference for potability. However, given site-specific conditions of water systems in various regions of B.C., it is necessary to apply these guidelines in consideration of a risk assessment of individual cases. In all cases, the drinking water officer must be contacted to confirm the necessary treatment objectives for microbiological parameters when planning or upgrading water supply systems.

### 4. Treatment Objectives

These objectives provide treatment requirements that address the following microbiological parameters: enteric viruses, pathogenic bacteria, *Giardia* cysts and *Cryptosporidium* oocysts. The general objectives are as follows and described in more detail below:

- 4-log reduction or inactivation of viruses.
- 3-log reduction or inactivation of *Giardia* and *Cryptosporidium*.
- Two treatment processes for surface water.
- Less than or equal to ( $\leq$ ) one nephelometric turbidity unit (NTU) of turbidity.
- No detectable *E. Coli*, fecal coliform and total coliform.

These drinking water treatment objectives provide a minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Depending on specific situations, the actual amount of treatment required will depend on the risks identified and may require greater levels of treatment. Water treatment is only one part of the multi-barrier approach to providing safe drinking water. Choosing an appropriate water source, protecting that source and reducing distribution system risks can be essential complementary steps to providing treatment when dealing with microbiological risks.

While there are numerous precautionary treatment steps available to reduce the risk of microbiological contamination of drinking water supplies, no system is fail-safe. Risk management is based on applying

scientific evidence that documents the quality and variability of the water source and the efficacy of management measures selected to achieve acceptable public health outcomes.

#### 4.1 4-log Inactivation of Viruses

Viruses are micro-organisms that are incapable of replicating outside a host cell. In general, viruses are host specific, which means that viruses that infect animals or plants do not usually infect humans, although a small number of enteric viruses have been detected in both humans and animals (Health Canada, 2010). Viruses are ubiquitous and often species-specific. Viruses of concern in drinking water are those that cause human illness or are capable of cross-species transfer. The role of nonhuman viruses as facilitators of pathogens or in transmitting genetic material that could be pathogenic is not clearly understood; hence, overall reductions of viruses in source water are preferred.

#### Health Risk Management Outcomes for Enteric Viruses

The level of risk deemed tolerable or acceptable by Health Canada for enteric viruses has been adopted from the World Health Organization's (WHO) *Guidelines for Drinking-Water Quality* (WHO, 2004; cited in Health Canada, 2010) based on the Disability Adjusted Life Year (DALY) as a unit of measure for risk.

The basic principle of the DALY is to calculate a value that considers both the probability of experiencing an illness or injury and the impact of the associated health effects (Murray and Lopez, 1996a; Havelaar and Melse, 2003; cited from Health Canada, 2010). The WHO (2004) guidelines adopt  $10^{-6}$  DALY/person per year as a health risk management target. Table 1 describes the relationship between viruses in source water and the level of treatment necessary to achieve this health risk management goal.

**Table 1: Overall treatment requirements for virus log reduction as a function of approximate source water concentration to meet a level of risk of  $1 \times 10^{-6}$  DALY/person per year (Cited in Health Canada, 2010.)**

Source water virus concentration (no./100 L)	Overall required treatment reduction for viruses ( $\log_{10}$ )
1	4
10	5
100	6
1000	7

#### Treatment Objectives for Enteric Virus

A minimum 4-log reduction of enteric viruses is recommended for all surface water sources. Depending on the surface water source, especially those subject to human fecal contamination, a greater than 4-log reduction may be necessary (See Table 1).

Reductions can be achieved through physical removal processes, such as filtration, and/or through inactivation processes, such as disinfection (Health Canada, 2010). Disinfection of water systems is recommended as a means to provide safeguards to the water system. Enteric viruses are readily inactivated by the use of chemical disinfection such as chlorine.

Ultraviolet (UV) light disinfection systems may be used to reduce viruses in water, but the effectiveness of UV varies significantly among different types of viruses. Double-stranded DNA viruses, such as adenoviruses, are more resistant to UV radiation than single-stranded RNA viruses, such as HAV (Meng and Gerba, 1996; cited in Health Canada, 2010).

Because of their high level of resistance to UV treatment and because some adenoviruses can cause illness, particularly in children and immunocompromised adults, adenoviruses have been used by the U.S. EPA as the indicator pathogen for establishing UV light inactivation requirements for enteric viruses in the *Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)* (U.S. EPA, 2006). Accordingly, the LT2ESWTR requires a UV dose of 186 mJ/cm<sup>2</sup> to achieve 4-log inactivation of viruses (U.S. EPA, 2006).

For water supply systems in Canada, UV disinfection is commonly applied, most often in combination with chlorine disinfection or other physical removal barriers such as filtration (Health Canada, 2010). A UV dose of 40 mJ/cm<sup>2</sup> is considered to be protective of human health as most enteric viruses are inactivated at this dosage; however, this dosage would provide only a 0.5-log inactivation of adenovirus. Additional log removal credits may be obtained through the addition of free chlorine.

For drinking water sources considered to be less vulnerable to human fecal contamination, the drinking water officer may accept an enteric virus such as rotavirus as the target pathogen to determine the UV dose required for 4-log inactivation of viruses. Where a system relies solely on UV disinfection for pathogen control and the source water is known or suspected to be contaminated with human sewage<sup>8</sup>, either a higher UV dose such as that stated in the LT2ESWTR or a multi-barrier treatment strategy should be adopted.

The physical removal of viruses can be partially achieved by clarification and filtration processes. Clarification is generally followed by the filtration process. Some filtration systems, however, are used without clarification (direct filtration). Many treatment processes are interdependent and rely on optimal conditions upstream in the treatment process for efficient operation of subsequent treatment steps.

Drinking water treatment plants that meet the turbidity limits established in the [Guidelines for Canadian Drinking Water Quality: Supporting Documentation — Turbidity](#) (Health Canada, 2003) can apply the estimated physical removal credits for enteric viruses. For example, for conventional filtration, the virus credit is 2-log and for direct filtration the virus credit is 1-log.

Alternatively, log removal rates can be established on the basis of demonstrated performance or pilot studies. The physical log removal credits can be combined with the disinfection credits to meet overall treatment goals. In all cases, the drinking water officers must be consulted when planning treatment for a water supply system.

**It is recommended that** water supply systems should provide, as a minimum, 4-log reduction of viruses for all surface water systems.

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<sup>8</sup> The Ministry of Health is awaiting further clarification from Health Canada as to what constitutes as *human fecal contamination*. In lieu of clarification, it is best to use as much available information as possible to make an informed decision on a case-by-case basis.

## 4.2 3-log Inactivation of *Giardia* and *Cryptosporidium*

Protozoa such as *Giardia* and *Cryptosporidium* are relatively large pathogenic microorganisms that multiply only in the gastrointestinal tract of humans and other animals. They cannot multiply in the environment, but their cysts/oocysts can survive in water longer than intestinal bacteria, and they are more infectious and resistant to disinfection than most other microorganisms (Health Canada, 2004).

### Health Risk Management Outcomes for *Giardia* and *Cryptosporidium*

While *Giardia* and *Cryptosporidium* can be responsible for severe and, in some cases, fatal gastrointestinal illness, the *Guidelines for Canadian Drinking Water* have not established maximum acceptable concentrations for these protozoa in drinking water. Routine methods available for the detection of cysts and oocysts have low recovery rates and do not provide any information on their viability or human infectivity. Until better monitoring data and information on the viability and infectivity of cysts and oocysts present in drinking water are available, measures should be implemented to reduce the risk of illness as much as possible.

### Treatment Objectives for *Giardia* and *Cryptosporidium*

The goal of surface water treatment is to reduce the presence of disease-causing organisms and associated health risks to an acceptable safe level.

Treatment of drinking water is another integral part of the multi-barrier approach. In addition to disinfection, where warranted by source water conditions, physical treatment of surface supplies should be included. Because *Giardia* and *Cryptosporidium* are ubiquitous in surface waters in Canada and more resistant to disinfection than most other infectious organisms, it is desirable that treatment achieves at least a 99.9% (3-log) reduction of *Giardia* and *Cryptosporidium* (Health Canada, 2004).

*Giardia* may be partially inactivated by large doses of free chlorine, ozone or chlorine dioxide. Filtration can be effective in removing *Giardia* cysts and *Cryptosporidium* oocysts, but the performance is significantly dependant on the methods of filtration and operational performance. *Giardia* and *Cryptosporidium* may also be inactivated using UV disinfection. Many commercially available UV systems have undergone testing to verify that the dosage provided under design operating conditions achieves the 3-log inactivation required.

**It is recommended that** water supply systems should provide, as a minimum, 3-log reduction of *Giardia* and *Cryptosporidium* for systems that have a water source considered to have low risk of these parasites and have not had an outbreak of the disease. A higher level of reduction may be required if the situation justifies it.

## 4.3 Two Methods of Treatment (Dual Treatment)

### Health Risk Management Outcomes for Dual Treatment of Drinking Water

Some microbiological agents of concern are more resistant to certain forms of treatment than others. Ultimately, the best approach to ensure complete disinfection of water intended for human use is a multi-barrier one, which begins with collecting water from the cleanest source possible.

As most disinfection systems require clear water to ensure maximum efficiency, it may be necessary to combine multiple specific treatment technologies. To provide the most effective protection, the

*Guidelines for Canadian Drinking Water* recommend that filtration and one form of disinfection be used to meet the treatment objectives.

Alternatively, two forms of disinfection (for example, chlorination and UV disinfection) may be considered if certain criteria are met.

A water supply system may be permitted to operate without filtration if the following conditions for exclusion of filtration are met, or a timetable to implement filtration has been agreed to by the drinking water officer:

1. Overall inactivation is met using a minimum of two disinfections, providing 4-log reduction of viruses and 3-log reduction of *Cryptosporidium* and *Giardia*.
2. The number of *E. coli* in raw water does not exceed 20/100 mL (or if *E. coli* data are not available less than 100/100 mL of total coliform) in at least 90% of the weekly samples from the previous six months. Treatment target for all water systems is to contain no detectable *E. coli* or fecal coliform per 100 ml. Total coliform objectives are also zero based on one sample in a 30-day period. For more than one sample in a 30-day period, at least 90% of the samples should have no detectable total coliform bacteria per 100 ml and no sample should have more than 10 total coliform bacteria per 100 ml.
3. Average daily turbidity levels measured at equal intervals (at least every four hours) immediately before the disinfectant is applied are around 1 NTU, but do not exceed 5 NTU for more than two days in a 12-month period.
4. A watershed control program is maintained that minimizes the potential for fecal contamination in the source water. (Health Canada, 2003)

Applying the exclusion of filtration criteria does not mean filtration will never be needed in the future. A consistent supply of good source water quality is critical to the approach, but source quality can change. Therefore, the exclusion of filtration must be supported by continuous assessment of water supply conditions.

Changing source water quality can occur with changes in watershed conditions. Increased threats identified through ongoing assessment and monitoring may necessitate filtration. Maintaining the exclusion condition relies on known current and historic source water conditions, and provides some level of assurance to water suppliers that a filtration system may not be necessary unless the risk of adverse source water quality increases.

**It is recommended that** dual water treatment should be applied to all surface water.

#### 4.4 $\leq 1$ NTU in Turbidity

Events such as sedimentation from road surfaces, higher surface runoff peak flows, landslides and debris flows increase a condition commonly referred to as “turbidity.” Turbidity in water is caused by suspended organic and colloidal matter, such as clay, silt, finely divided organic and inorganic matter, bacteria, protozoa and other microscopic organisms. It is measured in nephelometric turbidity units (NTU) and is generally acceptable when less than 1 NTU, as per the exclusion criteria in section 4.3, and becomes visible when above 5 NTU.

#### Health Risk Management Outcomes for Turbidity

Turbidity is an indicator of the potential presence of human pathogens such as bacteria and protozoa. Furthermore, a greater concentration of organic and/or microbiological matter in source water has the potential to disrupt or overload drinking water disinfection processes, such as UV light and chlorination, to the point that they may no longer effectively control pathogens in the water. In addition, organic matter in the water can react with disinfectants such as chlorine to create byproducts that may cause adverse health effects (Health Canada, 2003).

#### Treatment Objectives for Turbidity

In general, turbidity is caused by particles in water and can be effectively reduced by filtration. Depending on the filtration technologies applied to the water, filtered water from well operated filtration systems could have turbidity ranges from 0.1 to 1.0 NTU. The Canadian Guideline on turbidity applies to filtered surface water and is categorized by the type of filtration technology: conventional and direct filtration, slow sand or diatomaceous earth filtration, and membrane filtration. To comply with the Canadian Guideline, continuous monitoring of turbidity is required.

Turbidity is effectively reduced through filtration, using one of a number of common technologies. The goal of treating water for turbidity is to reduce its level to as low as possible and minimize fluctuation. For this reason, when filtration technology is employed, the system should strive to achieve a treated water turbidity target from individual filters or units of less than 0.1 NTU at all times. Where this is not achievable, the treated water from filters or units should be less than or equal to 0.3 NTU for conventional and direct filtration; less than or equal to 1.0 NTU for slow sand or diatomaceous earth filtration; and less than or equal to 0.1 NTU for filtration systems that use membrane filtration. Inability to achieve these objectives in filtered systems indicates a breakdown of the treatment train and potential health impacts to users.

For nonfiltered surface water to be acceptable as a drinking water source supply, average daily turbidity levels should be established through sampling at equal intervals (at least every four hours) immediately before the disinfectant is applied. Turbidity levels of around 1.0 NTU but not exceeding 5.0 NTU for more than two days in a 12-month period should be demonstrated in the absence of filtration. In addition, source water turbidity also should not show evidence of harbouring microbiological contaminants in excess of the exemption criteria under section 4.3 of this document.

**It is recommended that** turbidity of treated surface water should be maintained at less than 1 NTU. Where filtration is part of the treatment process, the turbidity levels should comply with the Canadian guideline on turbidity, entitled [\*Guidelines for Canadian Drinking Water Quality: Guideline Technical Document — Turbidity\*](#) (Health Canada, 2003) (expected turbidity reduction depends on the filtration methods). Continuous monitoring of turbidity should be required for water systems with filtration to

verify compliance with system performance objectives. Systems that meet the criteria for exclusion from the requirement for filtration should be monitored to verify that the system continues to meet the exclusion criteria.

#### 4.5 No Detectable *E. Coli*, Fecal Coliform and Total Coliform

*E. coli* and other fecal coliforms are members of the total coliform group of bacteria, but *E. coli* is the only member found exclusively in the feces of humans and other animals. Other members of the total coliform group (including fecal coliforms) are found naturally in water, soil, and vegetation, as well as in feces. The presence of *E. coli* and other fecal coliforms in water indicates not only recent fecal contamination, but also the possible presence of intestinal disease-causing bacteria, viruses, and protozoa.

#### Health Risk Management Outcome for *E. Coli* and Total Coliform

The absence of *E. coli*, *fecal coliform* and total coliform is used as an indicator that treated water is free from intestinal disease-causing bacteria. Their presence in drinking water distributed from a treatment plant indicates a serious failure and that corrective action is necessary. The presence of total coliform bacteria in the water distribution system indicates that the system may be vulnerable to contamination or experiencing bacterial regrowth.

#### Treatment Objectives for *E. coli*, Fecal Coliform and Total Coliform

*E. coli*, fecal coliform and total coliform are easily controlled with disinfection processes such as chlorine or UV light and can also be reduced by filtration. The DWPR calls for water suppliers to provide water with nondetectable *E. coli*, fecal coliform and total coliform based on sampling frequency established by the DWPR or through agreement with the drinking water officer.

**In summary**, according to Schedule A of the DWPR (updated 2008), the treatment target for all water systems is to contain no detectable *E. coli* or fecal coliform per 100 ml. Total coliform objectives are also zero based on one sample in a 30-day period. For more than one sample in a 30-day period, at least 90% of the samples should have no detectable total coliform bacteria per 100 ml and no sample should have more than 10 total coliform bacteria per 100 ml.

## 5. Conclusion

These objectives are intended to provide general requirements for surface water supply treatment systems in B.C. and rely on the [Guidelines for Canadian Drinking Water Quality](#) (Health Canada, 2012) as a primary reference for potability and treatment. However, given site-specific physical, chemical and biological conditions of water supplies throughout various regions in B.C., it may be necessary to apply these guidelines based on risk assessment of individual cases.

In all cases, the treatment objectives for microbiological parameters in specific water supply systems must be developed in consultation with a drinking water officer when planning or upgrading drinking water supply systems in the province.

## 6. References

B.C. Ministry of Healthy Living and Sport. 2010. *Comprehensive Drinking Water Source-to-Tap Assessment Guideline*.

<http://www.health.gov.bc.ca/protect/source.html>

B.C. *Drinking Water Protection Act*.

[http://www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/00\\_01009\\_01](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_01009_01)

B.C. *Drinking Water Protection Regulation*.

[http://www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/10\\_200\\_2003](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_200_2003)

Drinking Water Leadership Council (B.C. Ministry of Health website). 2007. *Drinking Water Officers' Guide*. [http://www.health.gov.bc.ca/protect/dwoguide\\_updated\\_approved%202007.pdf](http://www.health.gov.bc.ca/protect/dwoguide_updated_approved%202007.pdf)

Health Canada, 2012. *Guidelines for Canadian Drinking Water Quality (Summary Table)*.

[http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2012-sum\\_guide-res\\_recom/index-eng.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2012-sum_guide-res_recom/index-eng.php)

Health Canada, 2010. Draft for Public Comment. *Guidelines for Canadian Drinking Water Quality: Supporting Documentation — Enteric Viruses*.

<http://www.hc-sc.gc.ca/ewh-semt/consult/2010/enteric-enteriques/draft-ebauche-eng.php>

Health Canada, 2006. *Guidelines for Canadian Drinking Water Quality: Guideline Technical Document — Escherichia coli*.

[http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/escherichia\\_coli/index-eng.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/escherichia_coli/index-eng.php)

Health Canada, 2004. *Guidelines for Canadian Drinking Water Quality: Supporting Documentation — Protozoa: Giardia and Cryptosporidium*.

<http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/protozoa/index-eng.php>

Health Canada, 2003. *Guidelines for Canadian Drinking Water Quality: Supporting Documentation — Turbidity*.

<http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/turbidity/index-eng.php>

Health Canada, 2008. *Water Treatment Devices for Disinfection of Drinking Water*. <http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/disinfect-desinfection-eng.php>

U.S. EPA, 2006. *National Primary Drinking Water Regulations: Long Term 2 Enhanced Surface Water Treatment Rule*. <http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/index.cfm>



## DECISION TREE FOR RESPONDING TO A TURBIDITY EVENT IN UNFILTERED DRINKING WATER

April 2013

### 1 Objective

The *Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water* (decision tree) is intended to provide water supply system operators and health authority drinking water officers (DWOs) with a tool to help:

- Plan for future turbidity events in unfiltered drinking water from systems meeting the filtration exemption criteria.
- Provide quick response to acute turbidity events.

This tool will help decision makers take proactive measures to mitigate potential health risks from pathogens **before** there is a threat to public health. The decision tree applies to unfiltered<sup>9</sup> surface water and ground water at risk of containing pathogens and should be incorporated into a water supply system's standard operating procedure.

The decision tree is not intended to provide guidance for determining if a drinking water system is in compliance with provincial treatment objectives or to be used as an alternative to providing appropriate treatment.

### 2 Introduction

Turbidity is caused by suspended organic and colloidal matter - such as: clay, silt, finely divided organic and inorganic matter, bacteria, protozoa, and other microscopic organisms. Turbidity can increase following events, such as, landslides, higher surface runoff, peak flows, debris flows, or road sedimentation due to construction. Turbidity does not necessarily pose a threat to human health, but it can be an indicator of the potential presence of human pathogens. It also has the potential to disrupt or overload drinking water disinfection processes, such as ultraviolet (UV) light and chlorination, to the point that they no longer effectively deactivate pathogens.

The decision tree outlines the steps for evaluating the health risks associated with the turbidity event and the appropriate course of action. Appendix A contains expanded explanations for each step within

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<sup>9</sup> For information about what to do in the case of a turbidity event related to filtered water, please speak to the local Drinking Water Officer immediately.

the decision tree. Appendix B contains turbidity-related risk factors that should be considered when determining the appropriate course of action.

### 3 Filtration

Under section 6 of the *Drinking Water Protection Act*, water supply systems must provide potable water to all users. This is an important responsibility. The Ministry of Health developed the following documents to set out minimum performance targets for treating surface water and ground water at risk of containing pathogens (GARP) which are considered to pose increased risk to human health:

- [Drinking Water Treatment Objectives \(Microbiological\) for Surface Water Supplies in British Columbia](#) (Version 1.1, November 2012).
- [Guidance Document for Determining Ground Water at Risk of Containing Pathogens \(GARP\) including Ground Water Under Direct Influence of Surface Water \(GWUDI\)](#) (Version 1, April 2012).
- *Drinking Water Treatment Objectives (Microbiological) for Ground Water Supplies in British Columbia* (under development).

These documents endorse the recommendations from the [Guidelines for Canadian Drinking Water Quality](#) which state that systems using surface water or GARP sources should use filtration and one form of disinfection. A second form of disinfection may be considered in lieu of filtration if certain criteria are met.<sup>10</sup> The filtration exclusion criteria can be found in the *Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia*. Should a water system qualify for an exemption, it is important to remember that these criteria need to be reassessed on an on-going basis to confirm continued validity. It should not be considered a permanent exemption as source water quality can change with alterations in watershed conditions.

If turbidity is an on-going issue for a water system, the filtration exemption should be re-evaluated. The decision tree is only to be used for isolated incidents.

### 4 Communication and decision-making

Under section 10 of the *Drinking Water Protection Act*, water suppliers must have a written emergency response and contingency plan that includes a strategy for communication with users of the system. Response to a turbidity event should be part of this plan.

It is important for water system operators and DWOs to maintain open dialogue during any emergency situation. The two parties should reach agreement regarding the degree of potential health risk associated with a turbidity event and its related considerations (set out in Appendix B). There should be agreement on the appropriate public communication and/or water quality monitoring strategy. In circumstances where there is no agreement, the DWO has the authority to request or order the water system operator to comply.

When a notice regarding turbidity is issued, the risk event(s) underlying the turbidity should be communicated to the public, as well as the scientific evidence. For example, if a Boil Water Notice (BWN) is issued, the notice should specify if sampling evidence indicates the presence of potential indicator organisms or if the BWN is based on other available (or lack of available) evidence or

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<sup>10</sup> If a system does not use filtration and does not meet the filtration exclusion criteria, it is not in compliance with the *Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia*. In this situation, system operators should consult with the local DWO about the steps that need to be taken in order to be compliant.

information. The situation may change over the course of an event, and further testing and new data may allow the water supplier to rescind the BWN. It is the responsibility of the water supplier to provide the scientific evidence that the drinking water is safe for human consumption. A DWO has the authority to order the issuance of a BWN should there be a failure on the part of the water supplier to provide the information that is needed to assess the health risk posed by the turbid drinking water.

## 5 Definitions

**Boil Water Notice (BWN)** – Notice provided to water users to boil their water before any use that may involve ingestion of the water. A BWN infers that an adverse microbiological health risk exists if the water is ingested. A BWN is issued by the system operator at their own discretion or on request or order by the DWO. Consultative agreement between the operator and the DWO is the preferred approach. The DWO should verify that the BWN has been issued to users of the system.

**Drinking Water Officer (DWO)** – The DWO is responsible for enforcing drinking water legislation, ensuring water systems are operating within the parameters of their permits and providing advice/orders during events that have potential to adversely affect public health. The local medical health officer is appointed as the DWO. The medical health officer has the authority to designate the duties of a DWO to environmental health officers. Generally, it is these designated environmental health officers that perform the front-line DWO duties.

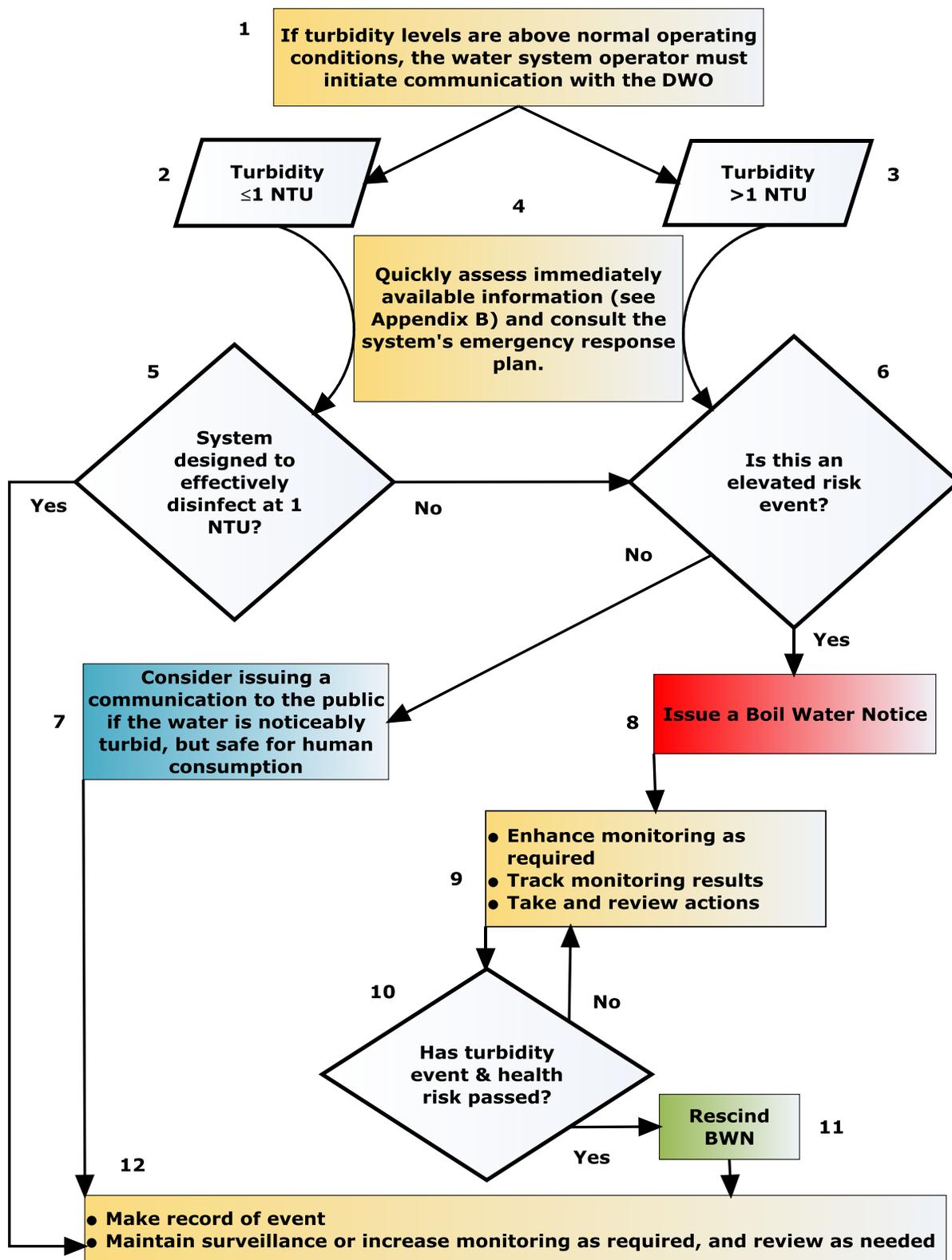
**Filtration** – A treatment process for the removal of particulate matter that has been approved by the issuing official (a person authorized under the Drinking Water Protection Regulations to issue a construction permit, operating permit or other permit required under the *Drinking Water Protection Act*). The filtration system has been granted removal credits for pathogens and is operating as expected.

**GARP** – Ground water at risk of containing pathogens – For more information, please see the Ministry of Health document: *Guidance Document for Determining Ground Water at Risk of Containing Pathogens (GARP) including Ground Water Under Direct Influence of Surface Water (GWUDI) (Version 1, April 2012)*.

**Medical Health Officer (MHO)** – A physician appointed under the *Public Health Act* to advise and report on local public health issues within a health authority. The MHO is responsible for fulfilling the role of a DWO unless the MHO delegates this responsibility to another qualified individual.

**Nephelometric Turbidity Unit (NTU)** – This is the unit of measurement that is used for evaluating the level of turbidity (suspended and colloidal particles and/or microscopic organisms) in water.

Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water



## Appendix A: Expanded notes for the decision tree

The following notes provide an expanded explanation for each box in the decision tree. The numbering below corresponds to the numbering in the decision tree boxes.

**Box 1.** In the case that a system operator identifies a turbidity spike above normal operating conditions, that system operator should first determine if it is possible to remove the source of the turbidity from the system (e.g., switch to an alternate source). The system operator must notify the DWO of a turbidity event immediately. The level of the measured turbidity will determine which box the system operator, with consultation from the DWO, should proceed to from this point:

- Less than or equal to 1 Nephelometric Turbidity Units (NTU), move to box 2.
- Greater than 1 NTU, move to box 3.

**Box 2.** This box applies when the turbidity level is  $\leq 1$  NTU. Generally, cases of turbidity that measure  $\leq 1$  NTU are not associated with adverse health effects when treatment by disinfection is provided. There are, however, some circumstances in which this condition may not apply. For example, if the water system is designed to operate at an extremely low NTU (e.g., 0.25) than it may become overwhelmed at a measurement above that level even if it is still below 1 NTU (e.g., 0.99 NTU). It is important to investigate all turbidity spikes regardless if the measurement is  $\leq 1$  NTU. From here, investigators should proceed to box 4.

**Box 3.** This box applies when turbidity levels are  $>1$  NTU. Turbidity spikes above this threshold should be investigated because turbidity levels  $>1$  NTU are associated with a greater probability of adverse health effects. The actual health risk may depend on a number of factors that include the parameters under which the system is designed to operate. Other factors to consider include identifying the source of the turbidity to assess the potential for pathogens harmful to human health (e.g., organic vs. inorganic material) and whether harmful pathogens have been identified through bacteriological water monitoring during previous similar turbidity events. From here, investigators should proceed to box 4.

**Box 4. Assessment:** Each of boxes 2 and 3 moves through box 4. This is the stage in which stakeholders quickly assess the situation for the purpose of decision-making. Decision makers may consult with the system's emergency response plan for prescribed actions. Monitoring and water testing takes time – to wait for results before taking action could put the public at risk for adverse health effects. Only evidence that is immediately available should be considered in this step. Appendix B contains potential risk factors that should be considered during the assessment. Once assessment information is gathered, continue on to box 5 for measurements of  $\leq 1$  NTU or box 6 for measurements  $>1$  NTU to make decisions about the safety of the water and corresponding actions.

**Box 5. Decision: *Disinfection sufficient?*** - If the water system is designed to provide disinfection up to 1 NTU, adjust disinfection and maintain surveillance or increase monitoring as required. Proceed to box 12 and review as needed. Documented evidence must be available to demonstrate that disinfection at this level of turbidity is effective. If historical evidence demonstrates disinfection could be insufficient at this level, or no data is available, continue to box 6 for further investigation.

**Box 6. Decision: *Is this an elevated risk event?*** – This box applies to a turbidity event when the level is >1 NTU or if there is evidence indicating that disinfection is insufficient for turbidity spikes  $\leq$ 1 NTU. The information assessed in box 4 is used to determine the risk level of the turbidity event. The DWO has the discretion to default to a determination of elevated risk should the water system operator not provide compelling evidence to the contrary (as per Appendix B).

Proceed to box 8 and issue a BWN if:

- The emergency response plan prescribes this action in this circumstance;
- Risk factors of concern demonstrate an adverse risk to human health;
- Historical evidence indicates a relationship between adverse health effects and similar turbidity events; or
- There is no strong documented evidence (current or historical) of a low level of risk.

In some circumstances, a BWN may not be necessary. For example, the treatment system is designed to effectively disinfect at the measured turbidity level (e.g., measured at 3.0 NTU and designed to effectively disinfect up to 3.5 NTU), or there is documented evidence of an acceptable low level of risk (e.g., historically, similar turbidity events have not been related to adverse health effects). It is the responsibility of the water supplier to provide solid evidence to the DWO that either of these situations applies. Under these circumstances, decision makers can increase disinfection processes as required and continue to box 7.

**Box 7. Issue a communication to the public:** A public communication may be issued to notify users that the water is turbid, but there is a low risk of adverse health effects. This communication should explain the reason (e.g., water line flushing, harmless algae bloom, etc.) for the turbidity as well as provide contact information should they have any further questions. The decision to issue a communication (as well as the form of communication – informal notice or formal advisory) should be jointly agreed upon by the water system operator and the DWO. This is not a requirement, but something to consider for mitigating concerns in consumers. Proceed to box 12.

**Box 8. Issue Boil Water Notice:** Issue a BWN with the guidance of the water system operator's emergency response and contingency plan. A BWN is issued by the system operator and the DWO should verify that the users of the system have received the notice. Proceed to box 9.

**Box 9. Evaluation:** When a BWN is issued, it is important to increase/enhance monitoring as required and track the results of monitoring. This may include bacteriological or other water tests. This is done to determine when the event of concern has passed. If possible, the water supplier should undertake actions that can mitigate the turbidity. It is also important to review decisions on an ongoing basis to ensure that the water system operator has taken appropriate action. Continue to box 10.

**Box 10. Decision:** This box provides two options:

- If monitoring demonstrates continuing elevated risk, stay on the BWN and continue monitoring (proceed back to box 9).
- If monitoring demonstrates that the turbidity event and elevated health risk has passed, rescind the BWN (proceed to box 11).

**Box 11. *Rescind BWN*:** When conditions have returned to normal (i.e., the health risk is no longer elevated), the BWN may be rescinded. The DWO should provide oversight to the process of rescinding the BWN by the water system operator to ensure that users of the system are notified. Proceed to box 12.

**Box 12.** Record turbidity events, causes, and actions taken so they can be reviewed in case of a future similar event. At this stage, the system should be back to normal operating conditions; although, there may be increased monitoring during and after the turbidity event (e.g., post-treatment bacteriological testing, distribution system bacteriological testing, operational parameters, disinfectant residuals, illness among users and possibly other parameters).

## Appendix B: Turbidity-related risk factors: considerations for health risk assessment <sup>11</sup>

### Source Water

1. Has there been contamination or a spill in which there is likely to be human pathogens? For example:
  - Sewage.
  - Animal waste.
  - Any substance likely to contain fecal material (e.g., agricultural run-off).
2. Are there recent changes in the hydrological characteristics of the watershed due to factors such as ground disturbances (e.g., mining, road work or other development projects) or vegetative cover disruptions (e.g., mountain pine beetle or planting/harvesting)?
3. Has precipitation been abnormally intense and/or have there been anomalies in weather (e.g., the amount and timing of rain, snow or snowmelt)?

### Treatment System

1. Has the turbidity level exceeded the level for which the system has been designed or validated (e.g., system designed to operate effectively for turbidity levels  $\leq 3.5$  NTU but the current turbidity level is 4 NTU)?
2. Have there been failures in the treatment train? For example:
  - Power outage.
  - Existing treatment outcomes from chemical disinfection cannot be maintained (e.g., loss of chlorine residual).
  - Decrease in UV dose or lamp failure.
  - Decrease in UV transmittance (the amount of light passing through the water).

### Other Considerations

1. Is there evidence of indicator organisms in the distribution system?
2. Is there evidence of illness related to the current event?
3. Has there been a history of health concerns under similar turbidity conditions? Or, is there lack of evidence to the contrary? There should be documented historical evidence demonstrating a lack of elevated health risk; otherwise, all involved parties should consider a precautionary approach and issue a BWN.

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<sup>11</sup> There is the possibility that some of these questions may not be applicable to all systems. Additionally, this is not an exhaustive list of risk factors. Should the answer to any of these questions be 'yes,' it is possible that the water is not safe for human consumption.



## WATER SYSTEMS FOR CLASS D & E SLAUGHTER ESTABLISHMENTS AND OTHER UNREGULATED USES

### 1. Purpose

To clarify the circumstances when a domestic water system serving one single family dwelling and used for other purposes is not regulated as a water supply system under the *Drinking Water Protection Act* (DWPA).

### 2. Position

The use of water supplied by a domestic water system to one single family dwelling, for a purpose that does not come within the definition of “domestic purposes”, as defined in the DWPA, does not require the system to be regulated as a water supply system under the DWPA.

### 3. Application

There are many uses to which water supplied by a domestic water system to one single family dwelling may be put which will not change the status of the water system and require it to meet the requirements under the DWPA. One of these is the use of water in the slaughtering process by the holders of Class D or E licenses issued under the Meat Inspection Regulation. Water used in Class D and E slaughter facilities is regulated under the *Food Safety Act* (FSA), Meat Inspection Regulation, which requires that it be potable. In determining whether or not the water is potable, an Environmental Health Officer may rely upon those water quality standards which are in common use in the field of public health protection.

Other uses of water which are not domestic in nature could include:

- watering animals;
- irrigating crops;
- washing buildings or machinery;
- cooling machinery; and
- industrial uses.

Examples of uses which could change the status of a water system so that it is to be regulated as a water supply system are:

- supplying water to a second dwelling; or
- supplying water to a food service establishment where food was being prepared and the water is likely consumed directly by the public

#### 4. Questions and Answers

- Q. Is a slaughter establishment a food establishment, as defined in the FSA?
- A. Yes, a slaughter establishment is a food establishment for the purposes of the FSA, with the result that inspectors appointed under the FSA are authorized to inspect and take action with respect to slaughter establishments.
- Q. Does the fact that slaughter establishments are food establishments for the purposes of the FSA mean that the Public Health Act Food Premises Regulation applies to them?
- A. No. The Public Health Act Food Premises Regulation applies to food premises, as defined in the Food Premises Regulation. The FSA and the Meat Inspection Regulation apply to slaughter establishments.
- Q. Must the water for a Class D or E slaughter establishment come from a water supply system for which the water supplier holds a valid operating permit issued in accordance with the DWPA?
- A. No. The only requirement for water used during slaughter in a Class D or E slaughter establishment is that the water must be potable.
- Q. If a Class D or E slaughter establishment is supplied with water by a domestic water system that serves only one single family residence, and the slaughter establishment has a separate sink and toilet for the use of the people working in the slaughter establishment, does this change the status of the water system into a water supply system regulated under the DWPA?
- A. An argument could be made that the existence of a separate toilet and sink for sanitation purposes would attract the application of the DWPA. The Health Protection Branch suggests that the Drinking Water Officers assess this situation in the same way they do those where separate sanitation facilities are provided in out buildings on agricultural property, which is supplied by a domestic water system serving one single family residence. A similar situation would be an auto body shop with a separate toilet and sink, where the water for the shop is supplied by a single domestic dwelling; this would not be considered a water system under the DWPA.
- Q. Must the water used in the slaughtering process be potable?
- A. Yes. This refers to the water actually used in the process, not the source water from which it is drawn. Secondary treatment of water that is used (with bleach for example) may be all that is required if there are ongoing concerns with the source water.
- Q. Could the standards set out in Schedule A to the Drinking Water Protection Regulation be used as the standard for measuring the potability of water used in the slaughtering process?
- A. Yes, as could the standards set out in the Meat Inspection Regulation Class D and E Licensing Policy and Procedures Manual.



## OBLIGATIONS OF THE WATER SUPPLIERS OF DRINKING WATER TREATMENT SYSTEMS THAT HAVE POINT OF USE/POINT OF ENTRY DEVICES

### 1. Objective

To clarify the obligation of water suppliers operating decentralized drinking water treatment systems.

### 2. Background

The [Drinking Water Protection Act](#) (DWPA) contains requirements for drinking water suppliers to ensure the water supplied to their users is potable and meets any additional requirements established by the [Drinking Water Protection Regulation](#) (DWPR) and the water supply system's operating permit. The DWPR sets out requirements for drinking water quality — including treatment, construction and operation of water systems, monitoring, reporting, and public notification should health hazards arise.

The DWPR includes options for small water systems (systems serving under 500 people in a 24 hour period) to provide potable water via a decentralized system that utilizes Point-of-Use (POU) or Point-of-Entry (POE) devices.<sup>12</sup>

Section 3.1(a) of the DWPR contains the specific amendment pertaining to POU/POE devices:

*The following are exempt from section 6 of the [Drinking Water Protection] Act :*

*(a) a small water system, if:*

*(i) each recipient of the water from the small system has a point of entry or point of use treatment system that makes the water potable.*

*(ii) the water supplier ensures that the location of non-potable water discharge and non-potable water piping are identified by markings that are permanent, distinct and easily recognized.<sup>13</sup>*

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<sup>12</sup> POE provides each service user with a device that treats all the water entering the property, house or building (ensures that all of the water entering the service user's system is treated). POU provides a device for individual locations within the building where potable water is required (e.g., a single outlet or faucet such as a kitchen sink).

<sup>13</sup> Section 6 (DWPA):

*Subject to the regulations, a water supplier must provide, to the users served by its water supply system, drinking water from the water supply system that*

*(a) is potable water, and*

*(b) meets any additional requirements established by the regulations or by its operating permit.*

### 3. Water Supplier Obligations

Section 3.1(a)(i) of the DWPR exempts small systems with POU/POE devices from section 6 of the DWPA, but it does not exempt suppliers from providing potable water to end users. This provision provides an alternative to the construction and operation of a centralized treatment facility by permitting decentralized treatment for individual homes. The effect is to shift the requirement to provide potable water from one section of the DWPA to another section under the DWPR.

The shifting of the requirement to provide potable water does not exempt the water supplier from other obligations under the DWPA or DWPR. The provision of potable water to the end user is not a one-time obligation. The provision of potable water is an on-going obligation that water suppliers are expected to meet by monitoring water quality, maintaining systems and dealing with operational failures. There is nothing in the DWPA or DWPR to suggest that a water supplier is absolved of these on-going responsibilities.

Section 4(1) of the DWPR provides that all water supply systems are prescribed for the purposes of sections 7, 8, 10, 11, and 22(1)(b) of the DWPA. These sections outline obligations with respect to Construction Permits, Operating Permits, Emergency Response and Contingency Plans, Water Monitoring Requirements and Assessment Response Plans. In the case of water supply systems using POU/POE devices, the water monitoring requirements under section 11(1) of the DWPA are limited to water that has been treated by the POU/POE device.

POU/POE devices are not excluded from definition of a domestic water system due to section 3(c) of the DWPR, which refers to "building system." The definition of a "building system" refers to systems to which the BC Plumbing Code applies that receive water from a water supply system operating under a valid permit under the DWPA. The BC Plumbing code (now contained within the BC Building Code as Book II (Plumbing Systems)) makes no provision for POU/POE systems; rather, it sets out the requirements for plumbing for distributing potable water within homes (e.g., pipes, taps and toilets). POU/POE systems are considered to be part of the water supply system and requirements for their construction and operation are regulated by the provisions of the DWPA and DWPR.

The exemption from section 6(b) of the DWPA does not apply to the regulations made under the DWPA or to all of the requirements on the operating permit of a water supplier. The only effect of section 3.1(a)(i) of the DWPR is to exempt the water in the distribution system from the source up to the point of connection with a POU/POE device from meeting the requirement of being potable and meeting any additional requirements established by the regulations or by the system's operating permit related to water quality. This exemption no longer applies once the water enters the treatment device as section 3.1(a)(i) states specifically that the exemption is contingent on there being a POU/POE device that "makes the water potable."